No. 322

HIGH RATIO BEVELS:

Tweaking shop made gears for performance.

FREE INSIDE RAIL BOOKAZINE

MODEL ENGINEERS' WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS DECEMBER 2022 ISSUE 322 WWW.MODEL-ENGINEER.CO.UK

MMEX 2022

We visit the Midlands Model Engineering Exhibition, the first major event for the hobby since Covid

WORKSHOP PHOTOGRAPHY

DLSR or phone? Either way our tips will help you take better pictures

A VERSATILE VICE

How to make your angle vice even more capable

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DEC. 22
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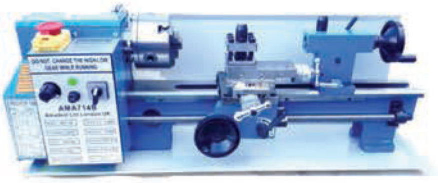
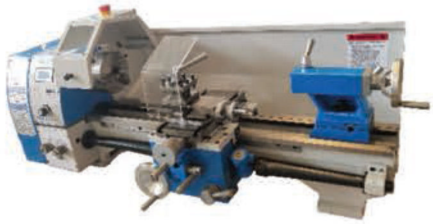


AMA714B Mini lathe
Brushless Motor

SPECIFICATION:
Distance between centers: 350mm
Taper of spindle bore: MT3
Spindle bore: 20mm
Number of spindle speeds: Variable
Range of spindle speeds: 100-2250mm
Weight: 43Kg

Price: £694



AMABL250Fx750

SPECIFICATION:
Distance between centers: 750mm
Taper of spindle bore: MT4
Spindle bore: 26mm
Number of spindle speeds: Variable
Range of spindle speeds: 50~2500rpm
Weight: 140Kg

Price: £1,904
W 2 Axis DRO - Price: £2,280

AMABL290VF Bench Lathe (11x27) - power cross feed - BRUSHLESS MOTOR

SPECIFICATION:

Distance between centers: 700mm
Taper of spindle bore: MT5
Taper of tailstock quill: MT3
Motor: 1.5kw
Weight: 230Kg

Price: £2,395
W 2 Axis DRO – Price: £2,787

AMAVM25LV

SPECIFICATION:
Model No: AMAVM25LV (MT3) / (R8)
Max. face milling capacity: 63mm
Table size: 700×180mm
T-slot size: 12mm
Weight: 120Kg

Price: £1,360.00
W AXIS POWERFEED - Price: £1,659
W DRO – Price: £1,730
W DRO + PF - Price: £2,045

E3 Mill R8 Metric Brushless Motor

Direct drive spindle.
No gears. No belt

SPECIFICATION:
Max. drilling capacity: 32mm
Max. end milling capacity: 20 mm
Max. face milling capacity: 76mm
Motor: Input- 1.5KW
Packing size: 1050x740x1150mm
Net weight: 240kg

Price: £2,560.00

AMAVM32LV

SPECIFICATION:
Model No: AMAVM32LV (MT3) / (R8)
Max. face milling capacity: 76mm
Table size: 840×210mm
T-slot size: 14mm
Weight: 240Kg

Price: £1,962.00
W AXIS POWERFEED - Price: £2,081
W DRO – Price: £2,363
W DRO + PF - Price: £2,856

See website for more details of these machines and many other products including a large range of accessories that we stock

MODEL ENGINEERS' WORKSHOP

EDITORIAL
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This issue was published on November 18, 2022.
The next will be on sale on December 23, 2022.

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On the Editor's Bench

In this issue you will find my report from the Midlands Model Engineering Exhibition. I'm now based in South Wales, and it was a reasonable prospect to travel to and from the exhibition on the day, fortunately in a very fuel-efficient car. As well as seeing the exhibition, I had another important task to complete on the day, meeting up with Ian Johnson, the previous winner of the Stevenson Trophy. I hadn't met Ian before as the complications of 'covid travel' got in the way, but fortunately the winner before Ian, Michael Cox, coincidentally lives fairly close to Ian and had been able to make the handover. Chatting to Ian I found out that the focus of his hobby is not so much on models as on full size items. A recent task was making a large batch of brass oilers for the steam Tug Danny. The Daniel Adamson was originally a canal tug that operated between the potteries and the Wirral, towing barges. In 2004 this historic vessel was facing the scrapyard, but following campaigning and fundraising, including a National Lottery grant of £3.8M was saved and restored to working order. As you might expect keeping Danny afloat and working depends on Ian and many other dedicated volunteers. Visit **www.thedanny.co.uk** to find out more.

Don't forget to vote in the Stevenson Trophy Competition!

The Stevenson Trophy is the competition for workshop made equipment decided by our readers and forum members! There are plenty of votes in for this year's Trophy – but some of those scores are very close so every vote counts!

Voting will close at the end of November so don't delay - vote today! You can use this link: **www.model-engineer.co.uk/stevenson**

Or point the camera of your smartphone at this QR code and be magically transported to the voting page – isn't technology wonderful?

The pages has descriptions and pictures of all the entries, but more details were in MEW issue 321. Voting is a simple tick-box at the bottom of the page, you don't need to enter any other details.

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Coming up...

in our next issue

Brett Meacle describes his rear spindle steady for making it safer to turn long workpieces.

Regulars

ON THE COVER

The cover of this issue shows Tom Jacob's original prototype for his gear hobbing machine design on the SMEE stand at the recent Midlands Model Engineering Exhibition. The machine has been restored and is t work cutting a gear. Many people have successfully made their own versions using casting sets, but the original is fabricated. See page 39 for our report on the show.

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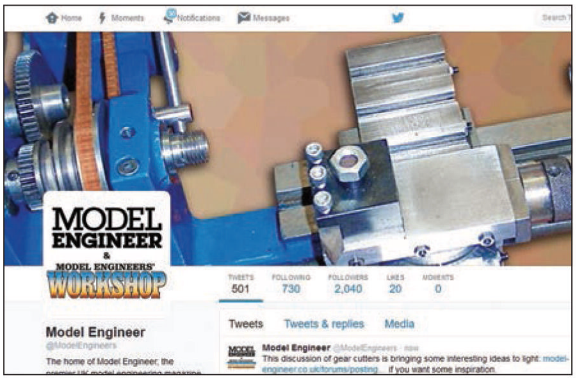

THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

Visit our website to vote in the Stevenson Trophy Competition.
www.model-engineer.co.uk/stevenson

Other hot topics on the forum include:

How to fix a thread that is too loose?
Ways of solving a common problem by Sebastian Kowal.

Colouring technical illustrations
An interesting question with some interesting answers! By Michael Gilligan.

Duplex steam feed pump
Various designs discussed in this thread started by John Rutzen.

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

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WLTA Mobile Transport Forklift Pallet Stacker 900mm 200kg

Technical Specification	
Lifting capacity	200kg
Minimum lifting height	55mm
Maximum lifting height	900mm
Wheel size	Ø250 x 50mm
Platform dimension	500 x 500mm
Dimensions	830 x 730 x 1240mm
Weight	47kg

PRICE INC VAT: £552.00

WLTB Mobile Transport Forklift Pallet Stacker 900mm 200kg

Technical Specification	
Capacity	200kg
Minimum lifting height	55mm
Maximum lifting height	900mm
Forks length	575mm
Forks width	660mm
Total height	650 x 580mm
Wheel size	Ø250 x 50mm
Dimensions	830 x 730 x 1240mm
Weight	40kg

PRICE INC VAT: £545.00

WLTC Mobile Transport Forklift Pallet Stacker 900mm 200kg

Technical Specification	
Capacity	200kg
Minimum lifting height	55mm
Maximum lifting height	900mm
Forks length	575mm
Forks width	660mm
Total height	650 x 580mm
Wheel size	Ø250 x 50mm
Dimensions	830 x 730 x 1240mm
Weight	46kg

PRICE INC VAT: £595.00

Easy to manoeuvre stacker with a compact design that facilitates the lifting and handling of pallets up to 200kg. Also great for transport purposes and for outbound work.

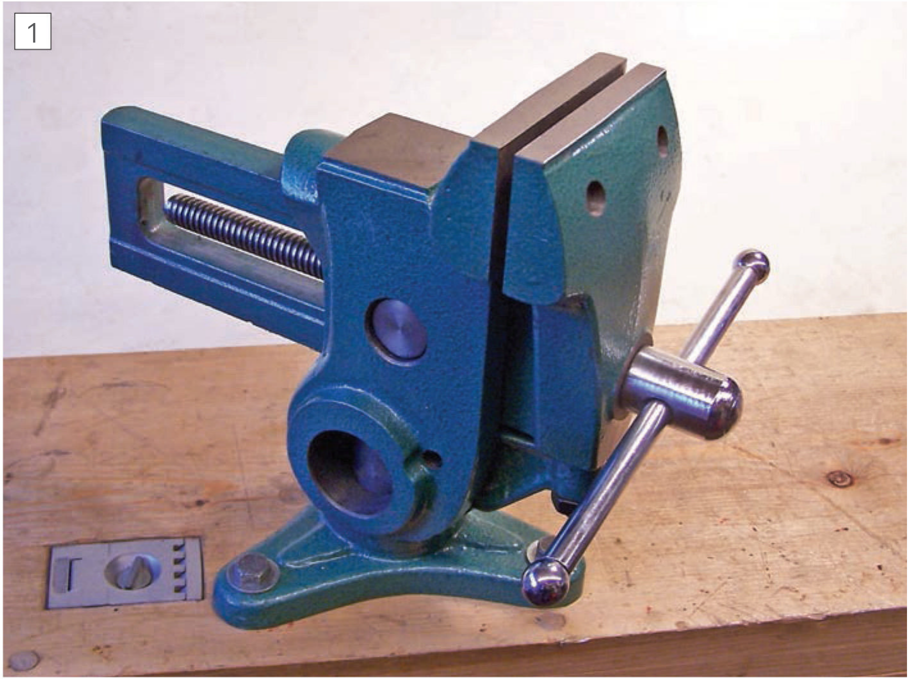
- The rubber grips in the jack allow you to transport goods safely.
- Regulation of forks height in range 55-900 mm by ergonomic foot pump
- Additional polyurethane rollers mounted at the bottom of the jack support stable transport of goods
- Quick and trouble-free fork width regulation.
- Load capacity up to 200 kg
- Specialist hydraulic pump
- Specialized hydraulic pump allows for stepless lowering of the forks
- Very strong construction of the transport jack
- Wheels and rollers suitable for uneven surfaces: polyurethane at the drawbar

Extending the versatility of a 'Parrot Vice'

R. Finch adds some extras to his 'universal' vice.

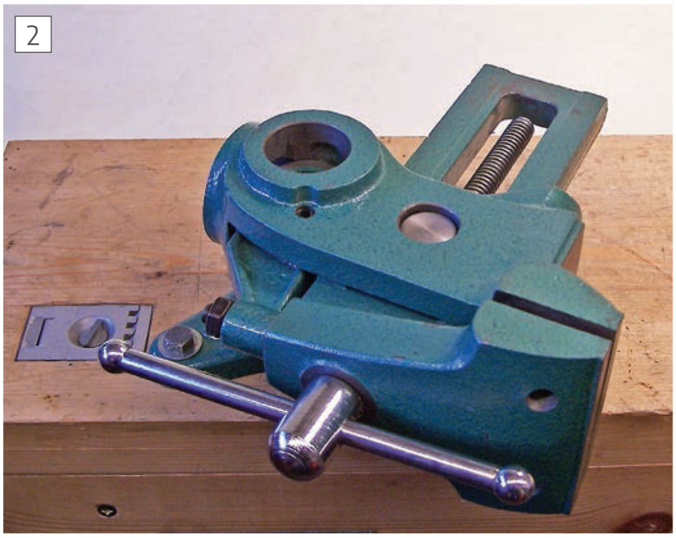
The one thing that separates this type of vice from others is that when the handle is, the jaws close first to grip the work, but the body of the vice does not tighten up completely on the base spigot, allowing it to be rotated without losing the grip between the jaws. When in the correct position, it can be fully tightened to lock the vice in position. It is a very ingenious idea. There is a screw with a locknut for adjusting the vice grip before the rotation is locked.

The 'Parrot' vice is only one particular make of this style of vice - there are others, such as the 'Versa Vise', the original design made by Garrett Wade); the 'Ultimate Versatile Vise', an updated Garret Wade vice); the 'Universal Vice'; and the Shop Fox D3125 - to name but a few. I am not suggesting that any particular make of this type is better than any other - these extras are based on the one that I bought from Axminster Tools, usual disclaimer. This type of vice is commonly used by luthiers, wood-carvers and pattern makers, **photo 1**. It is very useful for holding any wooden items, such as patterns for castings, in different orientations to allow work to be done on shaping the wood. It can also be used to hold items for welding at various angles so can be set to avoid some positional welding.

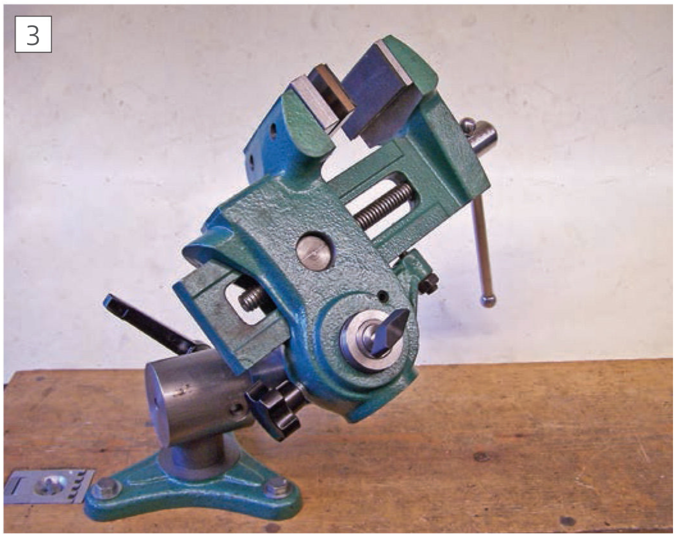


The 'Parrot' Vice as supplied.

However, the original vice can only be used in the vertical and horizontal positions, **photo 2**, but is able to rotate 360 degrees about its axis in whichever position it is mounted. I found that it was not quite as versatile as I had hoped when I purchased it and so, as usual, I set about making accessories for it. Whilst the accessories I describe are specifically for my own vice, I would check your own vice dimensions before making these accessories. The vice mounted on its accessories is shown in **photo 3**.



The 'Parrot' Vice on its side for vertical use.



The 'Parrot' vice mounted on its new accessory arms.

The mounting holes in the bench and the steel plugs.

The offset arm.

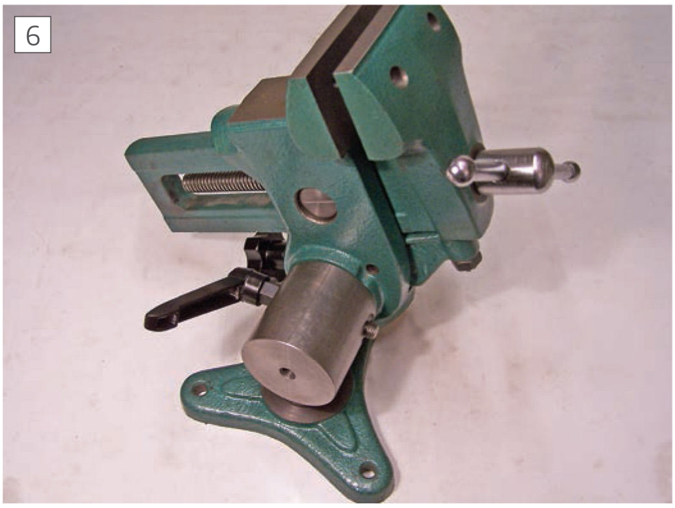
Mounting the vice on the bench

As my woodworking bench is quite small, I decided that I would make the vice easily demountable so I fitted a 6mm thick steel plate, with three M8 tapped holes on a 138mm diameter pitch circle, under the bench top. Using M8 x 65 long bolts allows the mounting spigot to be tightened onto the bench yet be easily removable. I made the holes in the bench top 10.5mm diameter and made three 10mm diameter steel plugs to put into the holes when the vice was removed, **photo 4**. This ensures that sawdust and other bits and pieces do not accidentally fall down the holes and be difficult to retrieve. The plugs are 1mm shorter that the bench top thickness, so that they do not protrude above the bench top and gouge pieces out of my woodworking plane or chisels. When I want to use the vice, I can lift the plugs out easily using a magnet. Naturally, I placed the mounting spigot so that it was as close to the edge as practical and would allow long lengths of material to be held vertically in front of the bench.

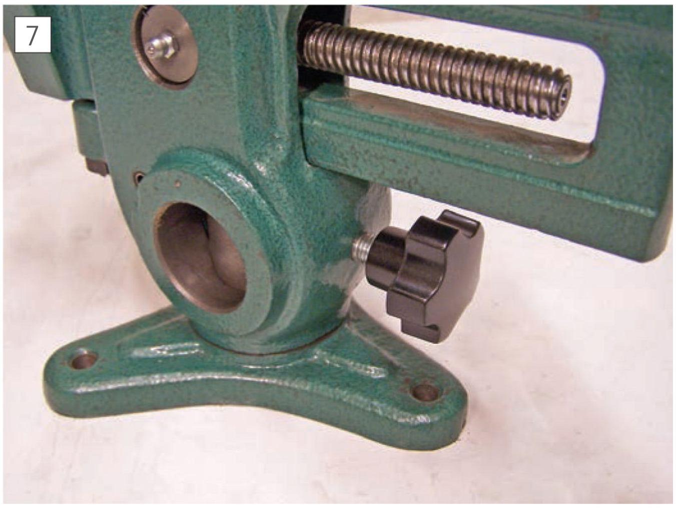
The Offset Arm

The suppliers of the original vice, Garrett Wade in the USA, ref 1) - can provide an “offset arm” for full axis positioning. As the vice that I bought did not have this available as an extra, I decided to make one for myself. This is shown in **photo 5**. It is shown with the vice mounted on it in **photo 6** - note that the vice has been tilted backwards so that the faces of the vice jaws are no longer vertical. This offset arm now allows the vice to be rotated 360° around the vertical axis and allows it to rock backwards and forwards to allow the jaws to be positioned in a non-vertical direction to allow the tool being used to be presented horizontally to the workpiece, which is a position in which it more natural to work.

This is a simple accessory to make and is well worth the effort. Garret Wade have now provided a hole in the rear of the vice drilled and tapped M10 to take a star knob to allow locking of the vice on the offset arm. I do not know whether other manufacturers of similar vices have also provided this tapped hole. I decided to make this modification to my own vice as shown in photo 7. My initial thought was to use the drilling machine, but I soon found that there was inadequate distance between the chuck and the table to mount the whole vice for drilling. I ended up just holding it in the ordinary bench vice and using a pistol drill held as vertically as I could manage. Having opened up the hole to 8.5mm, I then tapped the hole M10. Later I discovered how to dismantle the vice so that just the body could be mounted on the bench drilling machine as in **photo 8**. I would recommend dismantling the vice and drilling this hole exactly on the vice body centre-line so that the vice can be fitted to the additional support arm, to be described later, either way round. The vice can be dismantled easily by unscrewing the main vice screw using the handle until the vice is fully open. By continuing



The vice mounted on the offset arm.

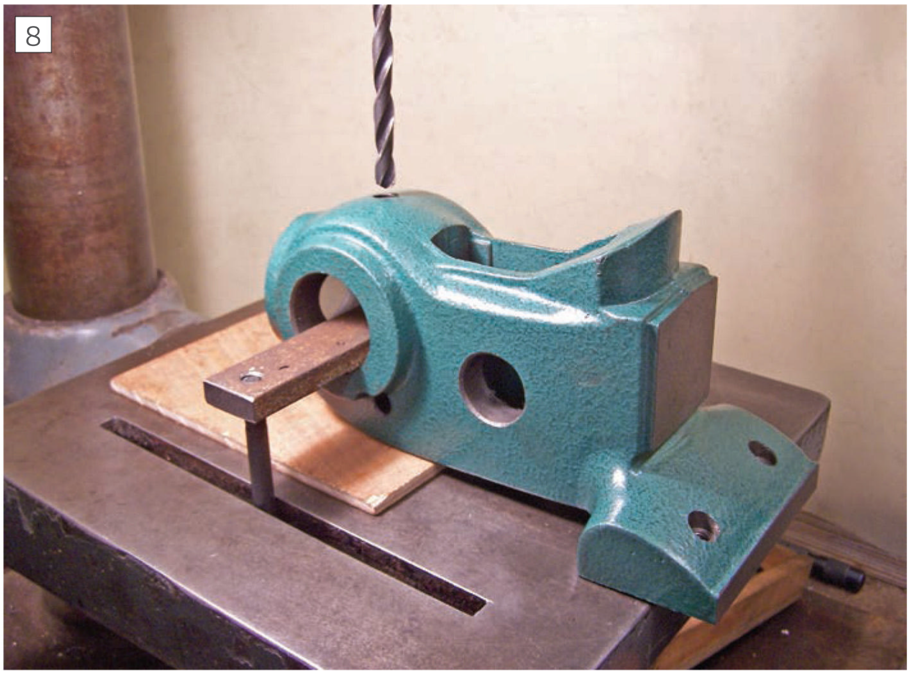


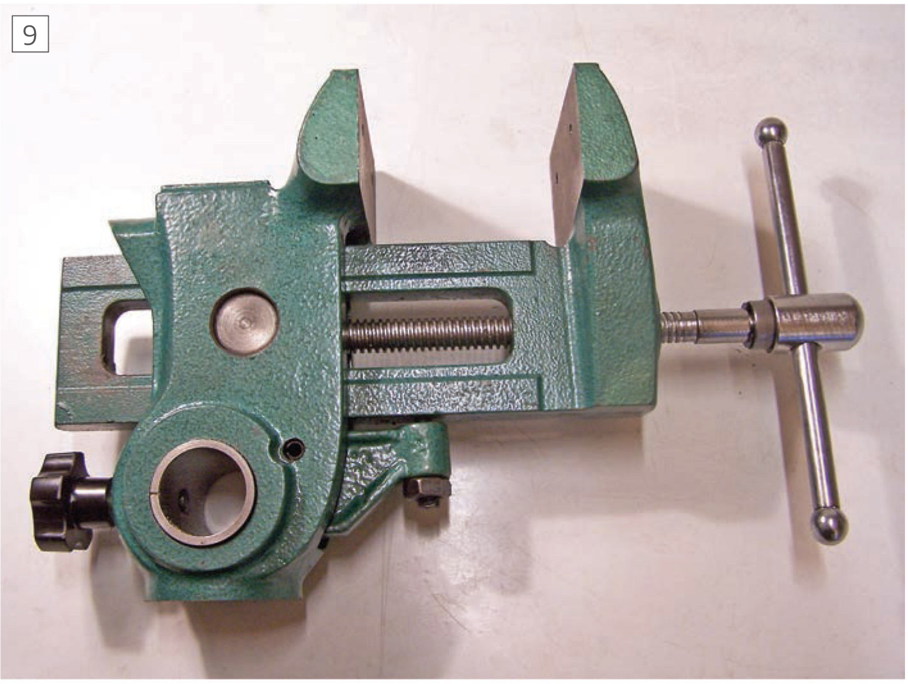
The rear clamp screw with star knob.

to unscrew the handle, which can be a bit stiff at this point, it jacks out the retaining thick spacer from the moving jaw as in **photo 9**. Then the roll pin, used for the pivot for locking the vice to the base spigot, needs driving out using a small punch. I made one from a $2\frac{1}{2}$" length of $\frac{5}{16}$" diameter silver steel turned down to $\frac{3}{16}$" diameter for $\frac{3}{16}$". I didn't bother hardening it as hopefully I was only going to use it once. I was not sure whether the roll pin was imperial or metric - the hole into which it was driven seemed to be a little large for a $\frac{5}{16}$" pin as the $\frac{5}{16}$" silver steel passed through the hole easily - indicative of an 8mm x 50mm pin, rather than a $\frac{5}{16}$" x 2" pin. It seems that the vice is "impetric" as it has $\frac{3}{16}$" holes in the jaws on 2 inch centres $\frac{3}{4}$ inches down from the top; a 14 x 3 trapezoidal metric thread on the main screw, not an Acme thread!); and an 8mm roll pin! When driving out the roll pin, it is important to locate the punch at the end of the roll pin which is not chamfered and drive it out that way. When re-inserting the pin, it has the chamfered end inserted into the vice first with the punch again driving the plain end.

Whilst I had the vice dismantled, I drilled and tapped the vice nut with an M6 thread to fit a grease nipple to be able to lubricate the vice nut, **photo 10**. It appears from the Internet that on some makes of vices, the main nut can be subject to wear and therefore have a short life. Hopefully the addition of the grease nipple will reduce the likelihood of this happening. As 14 x 3 trapezoidal taps are extremely expensive, at £114 it is more than twice the price of the vice!) I thought that fitting the grease nipple might be worthwhile. I also added a light saw-cut across the nut parallel to the threaded hole, so that it easier to orientate the nut when re-assembling the vice, visible in photo 3. Re-assembly is the reverse of the dismantling procedure - which sounds rather like a well-known series of car maintenance manuals - but make sure that you put the locking arm back the correct way round. I took a photograph before I took it apart to make sure I got it correct.

I originally bought a male M10 star wheel screw but found that, at 50mm in diameter, it was a bit too large and it left little clearance from both the bench spigot and the rear of the moving jaw. The male screw also had a rather rough end due to the thread being rolled as in **photo 11**. I thought that this might score or damage the spigot or offset arm. I subsequently found a female M10 star knob which was only 40mm in diameter and I used a 45mm length of M10 studding for a male thread which I secured in the knob with epoxy adhesive and a good tightening. This allowed a much smoother end to be machined on the studding so as not to damage the mounting spigot, **photo 12**. The star knob came from WDS Components with their part number being WDS 8148-215, ref. 2.


Mounting the vice body on the drilling machine.

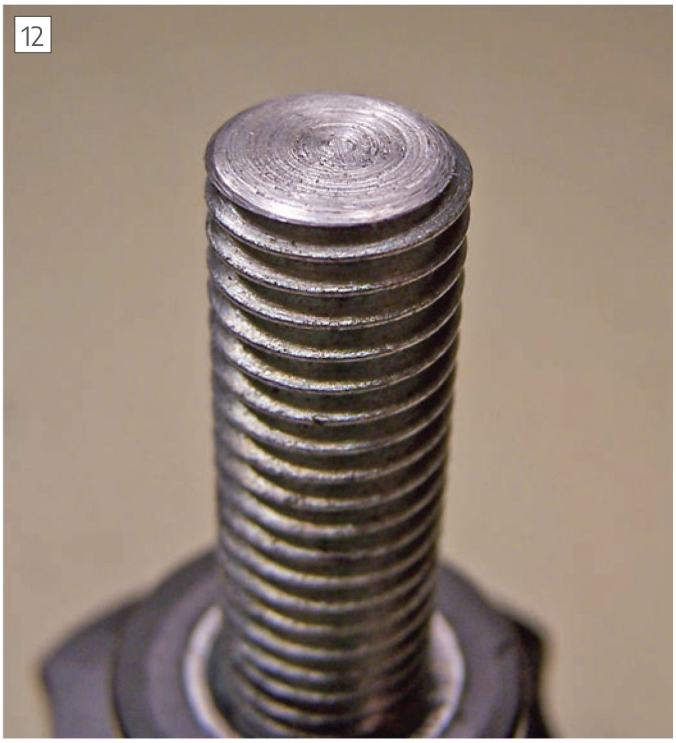

The vice screw having jacked out the spacer on the moving jaw.


The grease nipple in the vice nut.

11

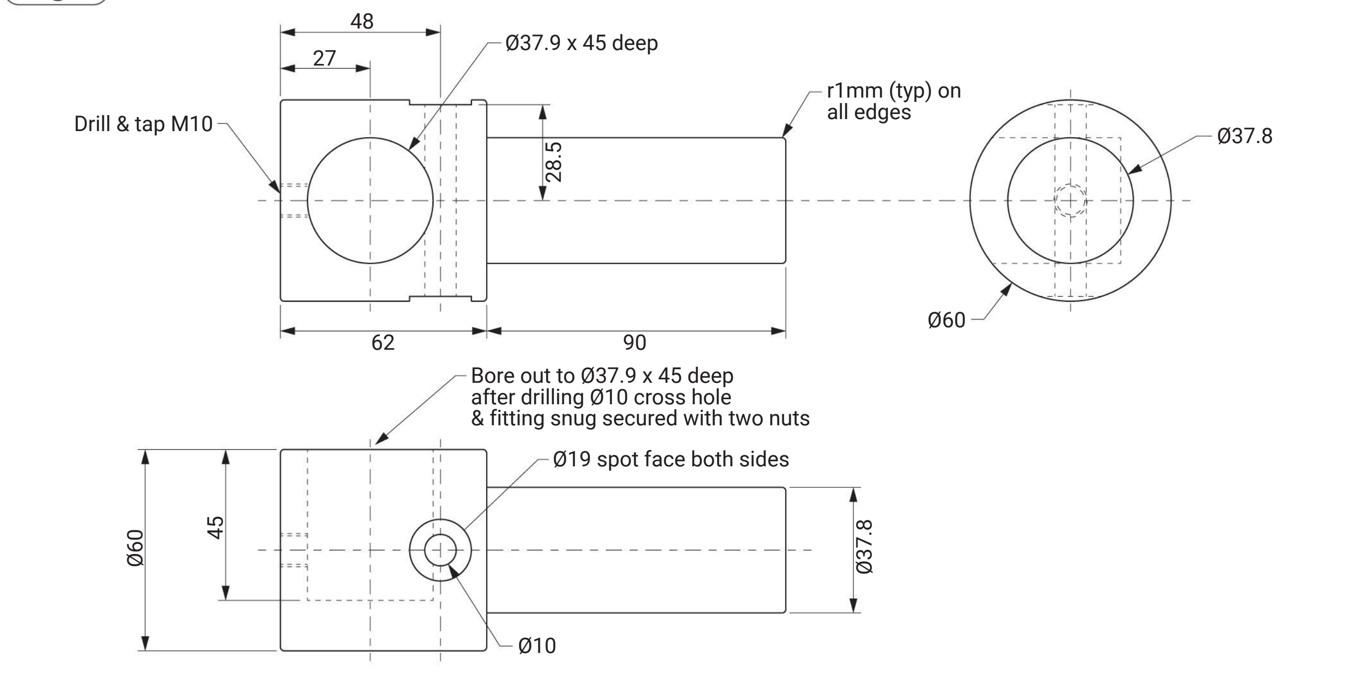
The rather uneven end to the male thread of the star knob.

12



A slightly smoother end.

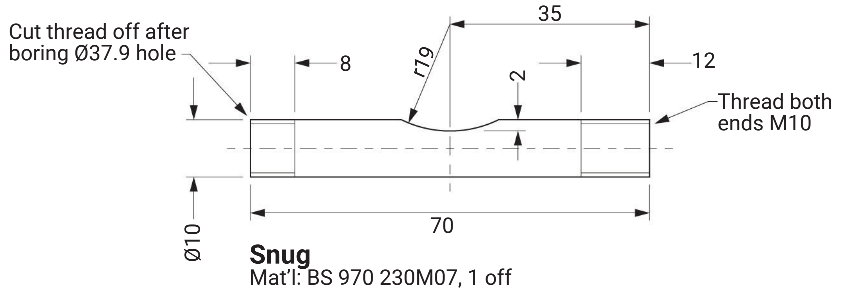
Fig.1



Machining the offset arm was rather a long task. If I were going to make more than one, I would have made a wooden pattern and had the arm cast in iron as it would have saved a lot of machining. I used bright mild steel bar 60mm in diameter and since the spigot on which the vice is mounted is only 38mm diameter, there was a lot of swarf produced. I estimated the diameter of the larger diameter at 60mm by scaling from the photograph that appeared on the Garret Wade website, and I may have made it just a bit too large - maybe 50mm diameter would have been better. I used mild steel to BS970 grade 230M07 (EN1A), but any steel could be used as it is not critical. Also required are two M10 nuts to hold the snug whilst boring the 37.9mm diameter hole.

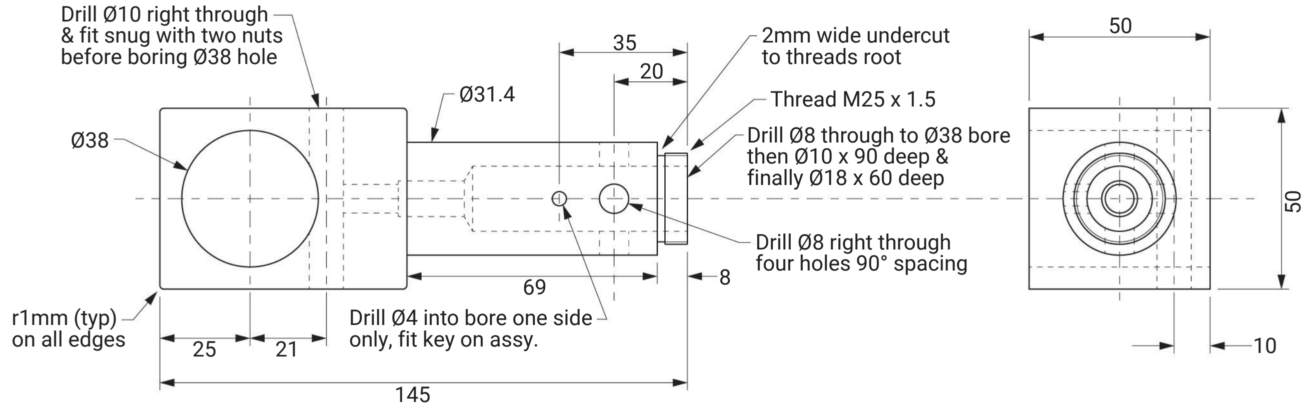
The hole which fits onto the bench mounted spigot is also a nominal 38mm diameter and is a blind hole. This is so that the arm does not sit too close to the mounting spigot which would inhibit the range of movement of the vice. I made this hole 45mm deep to make sure that the hole did not break through. The original Offset Arm has just a hole at the end to take a star knob screw for locking. I duly drilled and tapped such a hole, visible in photo 6, so that I could use a star knob if I wanted to. If you do this, you will need a 30mm length of M10 studding to fit into the star knob - the choice is yours. Having drilled and tapped this hole, I decided that I would prefer a snug key as this was less likely to cause damage to the cast iron spigot of the mounting foot. This is visible in photo 5. The drawing of the body shown in **fig 1** is pretty self-explanatory and is a simple drilling and boring the hole for the spigot and then turning down the rest to fit the vice. I made the snug without the 19mm radius first, **fig 2**, and fitted two M10 nuts and washers to hold it securely before boring the hole for the spigot and the radius on the snug at the same time. The spot-face for the star knob or 'Bristol' locking lever securing the snug is on both sides. This allows the arm to be used on the opposite side of the vice spigot, so left-handed users may want to assemble it the opposite way to that shown in the photograph. I used an M10 female threaded 'Bristol' locking lever, from Axminster Tools, their code 953467, ref 3, to lock the snug in place on assembly. If you use a star knob, you may need to make a thick washer as the base of the star knob may be too large to fit onto the spot faces on the arm.

Fig.2



Snug
Mat'l: BS 970 230M07, 1 off

Fig.3



Main Body
Mat'l: BS 970 230M07 or 070M20, 1 off

I did find that the two bores of the vice I had were not identical and both were a rather easy fit on to the spigot on the bench mount. Consequently I ended up with a 'rattling good fit' in one plane of the vice on the spigot. Precision machining is not critical here, as the locking screw takes up any slack and since the vice is adjustable, any slight movement of the arm when tightening the locking screw can be allowed for by adjusting the vice.

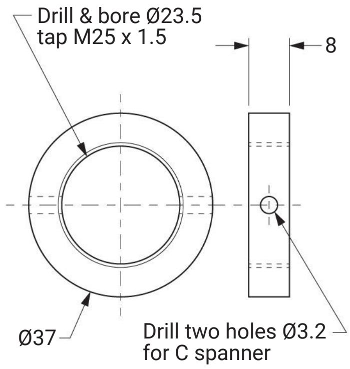
The Additional Support Arm

Whilst the offset arm allows the vice to be far more versatile, the tops of the jaws are always parallel to the bench: the vice can be rocked forwards and backwards as in photo 6. It does not, however, allow the vice jaws to be rocked from side to side. If a second arm were to be added, it would allow the vice jaws to be positioned at virtually any angle desired to allow work on any weirdly shaped items. I spent a little while on working out how this might be accomplished, and this is the result.

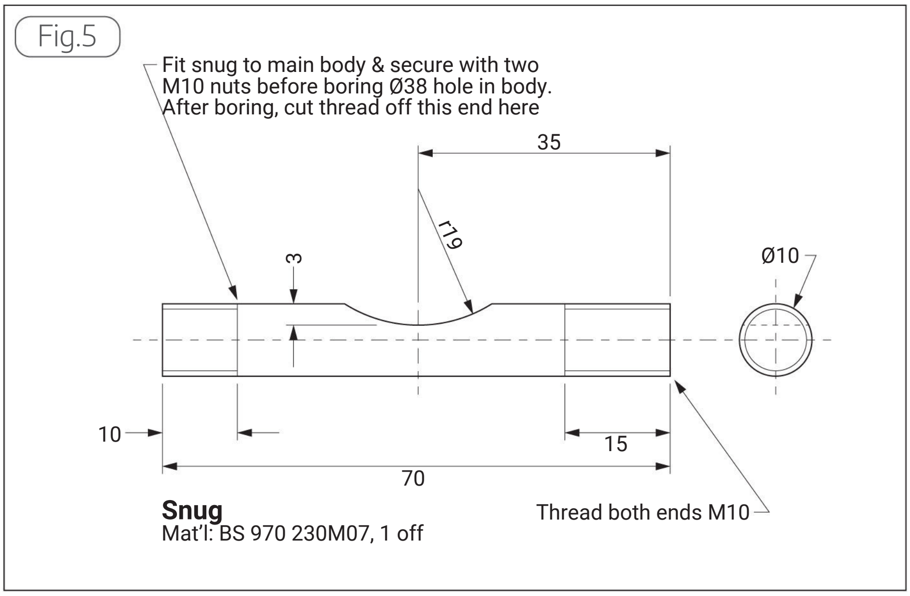
As the vice can now be positioned in all three planes, it might be difficult to lock it in the required position unless separate locking was available in all three planes. This might require three hands - one to hold the vice and one for each locking screw. I decided to make it possible to lock the vice onto the Additional Support Arm by using just one clamp screw. I also decided to make each movement separately lockable to make sure that it was possible to adjust the vice position in one plane without upsetting or losing the position in the second plane.

The drawing for the main body is in **fig 3** and there are a few points to note when making it. The way that I made it is not in the most straightforward manner, as some parts have to be made before others to ensure that they fit together properly. I started with the retaining ring, **fig 4**. I made mine from a 40mm length of 8mm x 40mm flat bar, drilling and boring the hole on the lathe

Fig.4



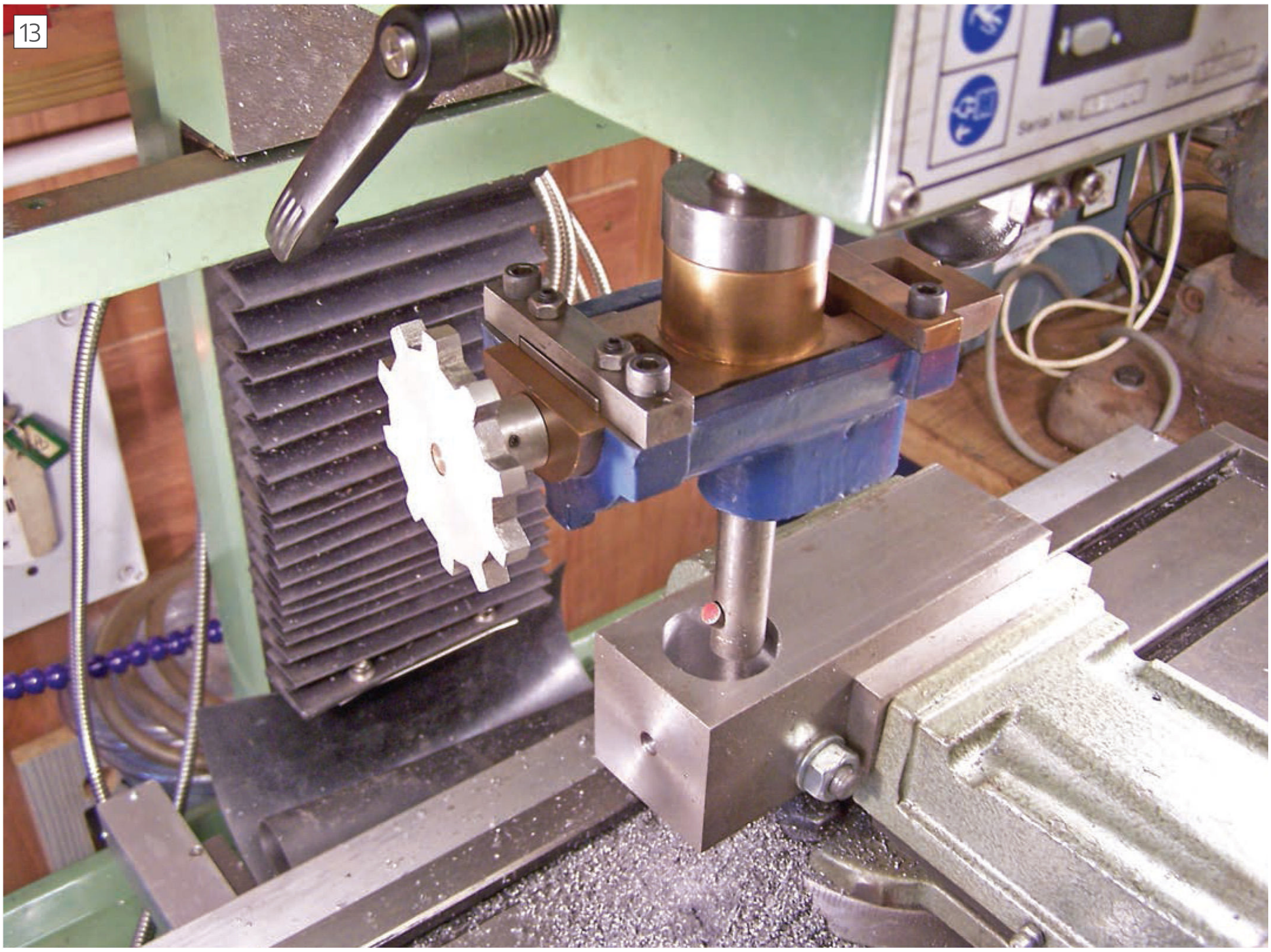
Retaining Ring
Mat'l: BS 970 230M07, 1 off



before tapping it using a standard M25 x 1.5 electrical conduit tap. I just sawed the rough corners off as it can be finished in situ later. The snug to act as the clamp is machined next, noting that both ends are threaded M10, but the radius is not machined in at this point, **fig 5**.

Next the main body is machined, fig 3. I drilled the cross hole for the snug first and fitted the snug with a washer and nut both ends to hold it firmly. The bar was mounted in the milling machine vice and the 38mm diameter hole was drilled in stages finishing with the largest drill that I had. I was quite surprised that my milling machine was able to drill a hole of 25mm diameter when its stated maximum drilling size is half this. The secret was to use the correct speed and feed the drill in very slowly with lots of neat cutting oil. When the largest drilled hole was finished, I changed to using a 'Dore' boring head to complete the hole, **photo 13**. Note that I had to remove the guard to provide enough room for the boring head to rotate, so great care was required to ensure that I kept away from the rotating head. The hole was bored to fit both the spigot of the vice mounting base and the offset arm. Note that the hole has to fit both of these and since the manufacturing tolerance on the original vice left a little to be desired, make sure that both parts will fit before removing the body from the milling machine.

●To be continued

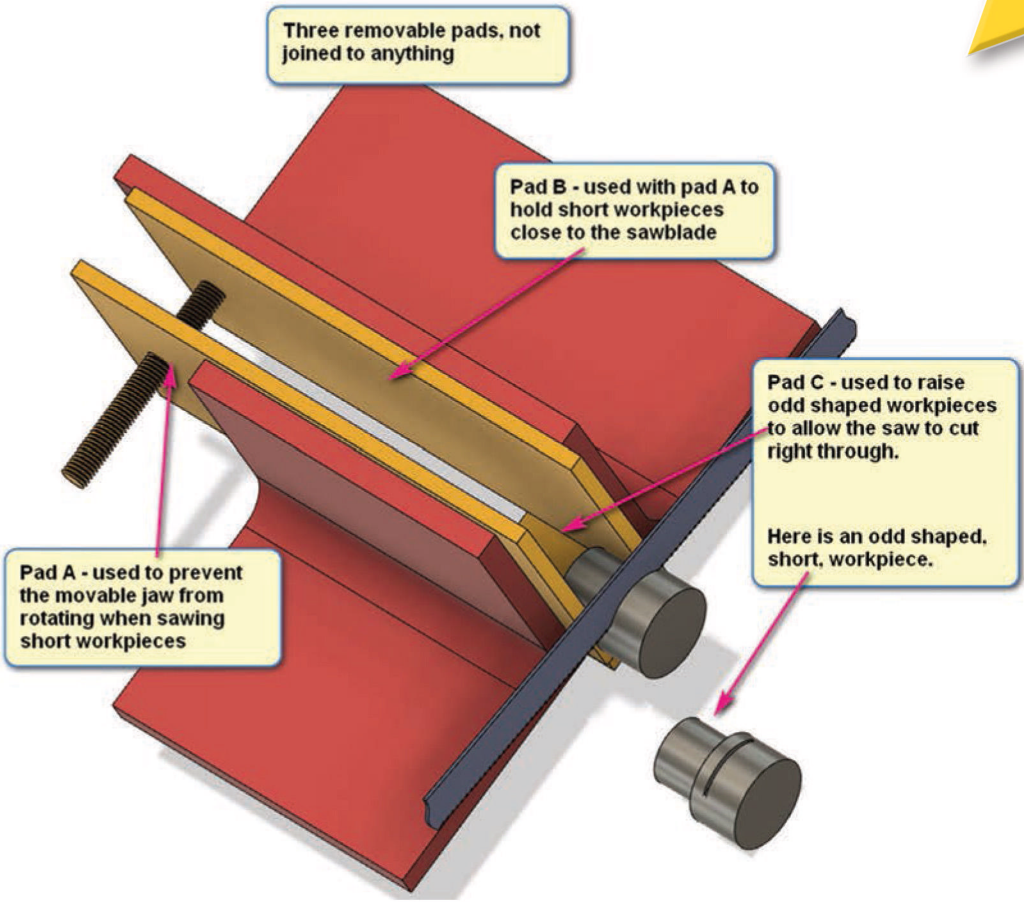


Boring out the hole in the Main Body.

Readers' Tips

A Bandsaw Jaw Modification

TIP OF THE MONTH WINNER!



This month's winner is Gary Wooding from Coventry, with a tip that is a nice complement to the bandsaw article elsewhere in this issue.

Many users of the ubiquitous 4x6 bandsaw have discovered that the movable vice jaw tends to rotate when trying to hold short length workpieces. This tip completely solves this problem and requires no changes to any part of the bandsaw at all. It's just a metal plate the same size as the fixed vice jaw, about 6mm thick. I used some aluminium sheet. A hole is drilled and tapped near one end to accept a suitable length of threaded rod that is used as a jack. I used M10. That's it.

The plate is positioned against the moveable jaw and, with the workpiece clamped tightly near the pivot point of the moveable jaw, the jack can be adjusted to meet the other jaw. The vice is released to allow the workpiece to be positioned properly and then clamped firmly. The jack stops the movable jaw from rotating.

If another plate is made but without the threaded hole, the two plates can be used together to hold short items very close to the saw blade.

A third plate of appropriate thickness can be used to lift odd-shaped workpieces to allow the saw to cut right though. The diagram illustrates all three ideas.

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to **meweditor@mortons.co.uk** 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.

Six By Four Metal Cutting Band Saw Modifications

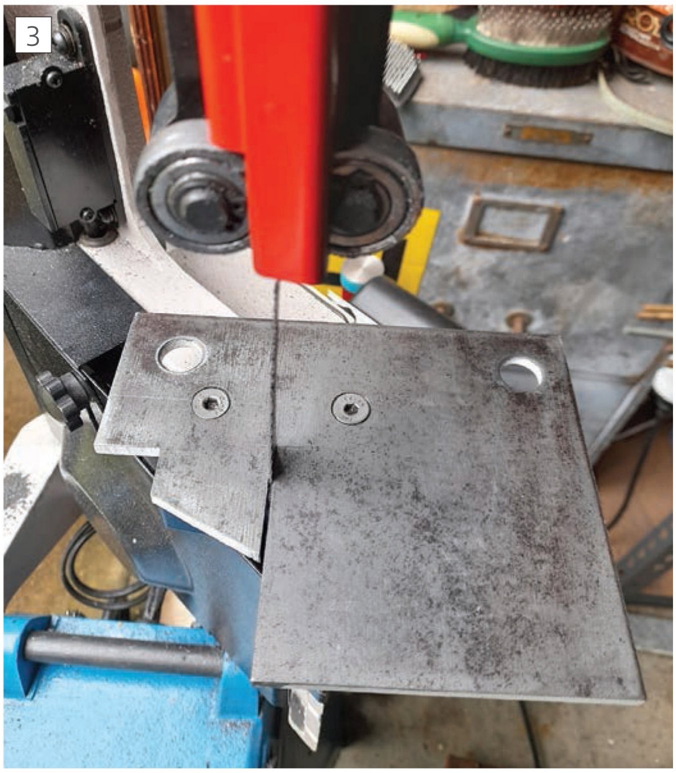
Robert Walker purchased one of the ubiquitous Chinese 6 x 4" metal cutting band saws, and soon set about making a number of modifications to improve its usability.

I first got interested in one of these bandsaws, **photo 1**, after seeing it advertised on the inside cover of Model Engineer from March 1996, a gift from my dad that I was reading a couple of months ago. Like many others I have made a few modifications to the machine to make it a bit more comfortable to use. Most of the ideas are not mine but I thought it worthwhile compiling them in one document.

The screw that holds the blade guard closed has now been replaced with a knob so that a screwdriver is not

6 by 4 Bandsaw.

Knob for blade guard.



Screw replacement on upper blade guide.

New smaller plate for vertical operation.

New smaller plate still attached in the horizontal postilion.

Hand wheel to lock vice jaw and repositioned bracket for tension operating shaft.

Crank handle for vice replacement.

Cast iron wheel.

New operating shaft and bearing block.

The jaw of the vice that can be rotated to allow angles to be cut is locked in place by a nut and bolt.

required for operation, **photo 2**.

The blade guides must be removed to replace the blade and they are held in place by Phillips head screws. These screws for the upper blade guide are easy to remove but quite fiddly to replace so they have been swapped out for cap head screws which stay on the end of an Allen key nicely for insertion into a confined space, **photo 3**. The screws for the lower blade guide have been replaced too as it is a bit difficult to get at them with a screwdriver because of the proximity of the blade. These screws also hold the plate that is used for vertical operation in place, **photo 4**.

The table that attaches to facilitate use in the vertical position has been replaced with a smaller one so that it

External modifications from a distance.

can stay attached when the machine is used horizontally, **photo 5**. An acknowledgement, I got the idea for this shaped plate from a channel on YouTube called Woods Creek Workshop.

The jaw of the vice that can be rotated to allow angles to be cut is locked in place by a nut and bolt. The nut is accessed by reaching under the main casting with a spanner which I found to be a bit awkward. The solution was to replace the nut with a threaded adaptor attached to a hand wheel. The wheel protrudes past the main casting a bit to allow for easy operation, **photo 6**.

The crank handle that opens and closes the vice works okay but is not balanced. I replaced this with a heavier balanced symmetrical handle which when flicked will execute several turns making for very quick operation compared to the original. It is also easier to exert firm pressure with one hand, **photo 7**.

I have heard several reviews or the machine state that the tension system that controls the rate of cut is next to useless. After a bit of operation, I observed that the bracket that supports the eye bolt that in turn attaches the spring to the operating shaft was installed 180 degrees about face. In this position you have to take up more than half of the thread on the eye bolt before any tension is put on the spring and then the thread runs out before there is any meaningful change in tension. To resolve this, I removed the bracket and turned it around, photo 6. This effectively added a bit over another 25mm to the adjustment travel. While it was apart, I also cut another 10mm of thread on the eye bolt. Now I get the complete range of feed rate available from full weight to point of balance. Point of balance is handy for lining up work with the blade using only two hands.

I also found the small diameter of the plastic handle on the shaft a bit tedious to use. I replaced this with a much larger cast iron wheel, **photo 8**, and while I was at it made a new operating shaft out of 16mm galvanized pipe. The rear support bracket was removed and in its place is a bearing made from a block of aluminium. The hole in the bearing was done with a boring bar and is a close fit so holds oil well. This set up is much easier and comfortable to use.

Although not a modification but more of a discovery I found that the blade guide adjustment has a greater range than may have been expected. I have

> I have heard several reviews of the machine state that the tension system that controls the rate of cut is next to useless.

heard complaint that particularly in the vertical mode the blade guide is too far from the work allowing the blade to flex excessively. When I inadvertently loosened the knob that locks the adjustable upper blade guide in postilion to the extent that it came right out the guide dropped away revealing another threaded hole about 60 mm away from the original. Utilizing this hole pretty much halves the distance of the guide to the work, **photo 9**.

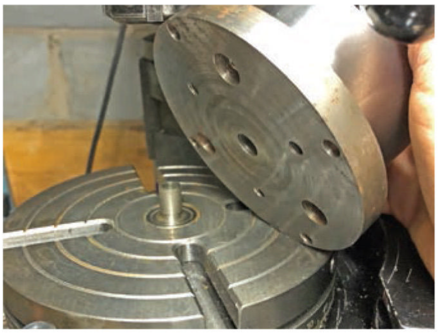
The final photo shows all of the external modifications from a distance, **photo 10**. ■

In our Next Issue

Coming up in issue 323
On Sale 23rd December 2022

Content may be subject to change

Look out for your copy of MEW 323, the January 2023 issue:



Malcolm Tierney explains how to centre a rotary table.

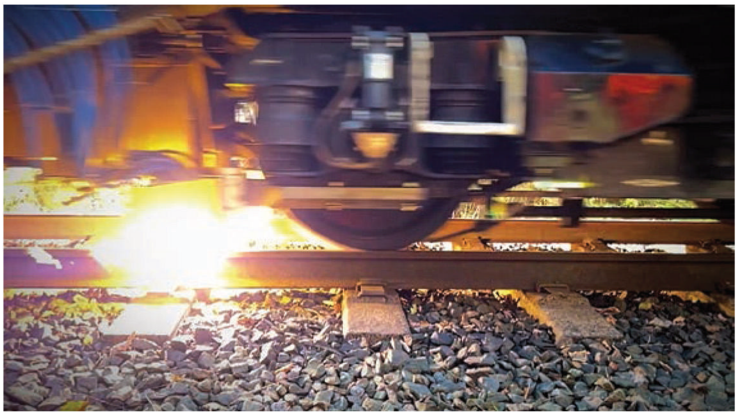
Brett Meacle describes making a rear spindle steady.

Will Doggett tackles making rotary rivet heads to fit his chain alteration machine.

DON'T MISS THIS GREAT ISSUE - SEE PAGE 54 FOR OUR LATEST SUBSCRIPTION OFFER

On the Wire NEWS from the World of Hobby Engineering

Laser and plasma train trials zap autumn leaves off the line



Lasers and plasma jets are being trialled as a more sustainable way to vaporise autumn leaves from railway lines and minimise passenger delays in the future. Throughout October, Network Rail has been carrying out comprehensive testing using its multi-purpose vehicles (MPVs) on heritage lines at the East Lancashire Railway.

Engineers have been testing if autumn treatment trains fitted with the laser beams and superheated plasma jets are as effective at cleaning rails as the current method using high pressure water systems. During autumn train wheels compress leaves onto rails and form a black residue which makes it harder for trains to brake or accelerate.

Currently a fleet of leaf-blasting trains with high-pressure water jets clear Britain's 20,000-mile railway network in the autumn. This technology could potentially reduce the need for 200 million litres of water, and the fuel needed to transport it around the country, benefiting both the environment and costing the taxpayer less.

If the tests find lasers or plasma can clean the rails effectively, further development work will be needed to see if it would work on the complexities of the live railway network.

Airfix celebrates 70 years by offering once-in-a-lifetime experience flight in Britain's iconic Spitfire

Airfix, one of the world's oldest and most well-known manufacturers of model kits, is giving the chance for one lucky person to experience an incredible once-in-a-lifetime flight in Britain's iconic Spitfire aircraft.

Anyone who purchases an Airfix Gift Set or Starter Set through the Airfix website, will automatically have the opportunity to win the flight, which will take place in an authentic Spitfire in Summer 2023.

Dale Luckhurst, Head of Brand at Airfix, says:

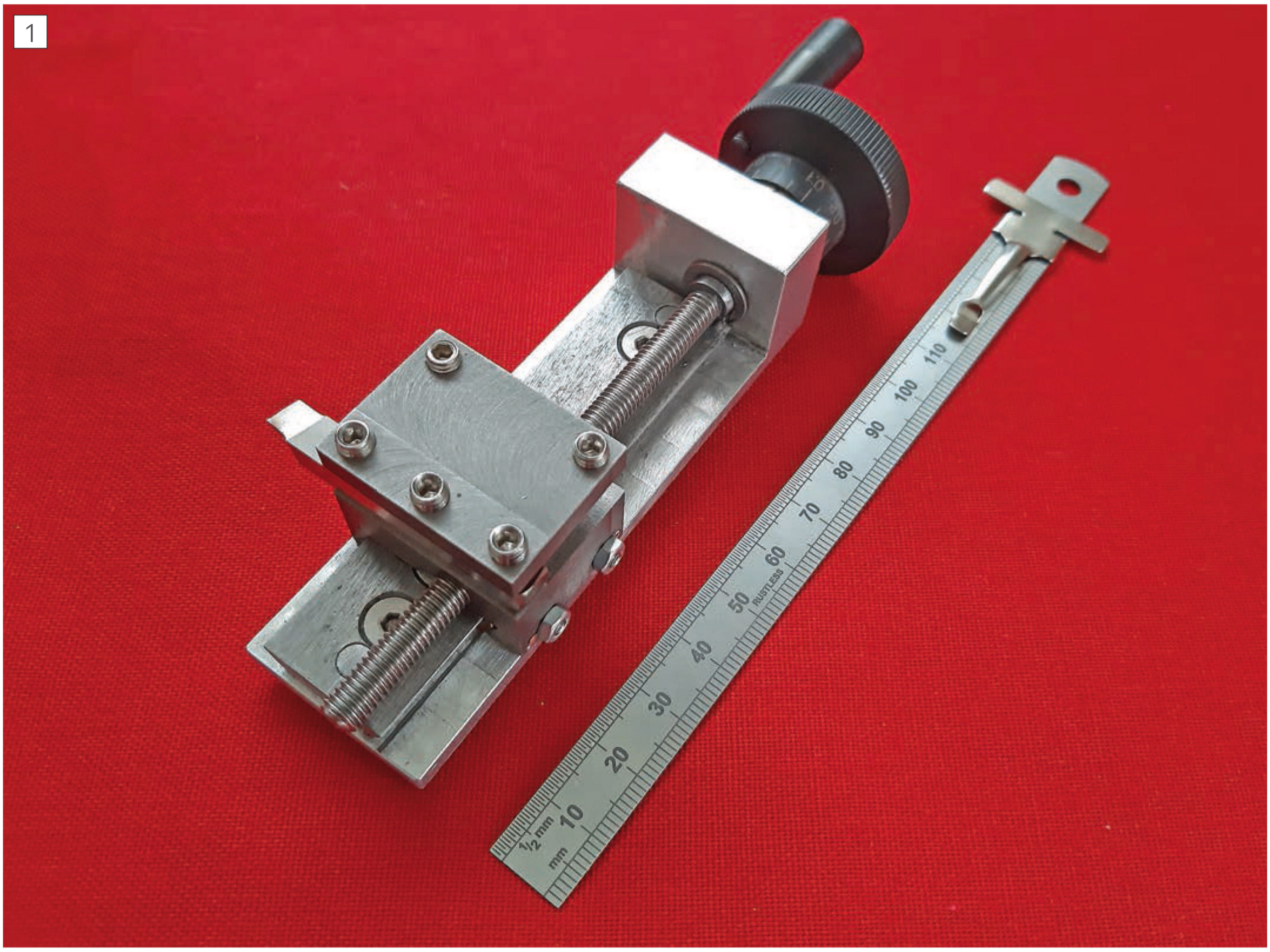
"The winner of the Airfix prize draw will be able to fly a Spitfire TR9 over the English Channel. Enroute they'll enjoy the sight of the Spitfire's famous elliptical wing passing over Britain's green and pleasant land, and if they elect to try some aerobatics they'll marvel at the power, manoeuvrability and grace of this aircraft that is over 75 years old. They will also have the opportunity to touch the controls and fly the aircraft themselves, so it really is an incredible prize."

Dale concluded: "While the flight must be taken by those over 18 years old, and health conditions apply, we hope that customers of all ages will purchase a starter kit. Whether it's a gift for a eight-year-old or a new hobby for those aged over 75, like our Spitfire, the joy of model building is that everyone can get involved."

Entries to the prize draw will be applicable for Airfix Starter Set or Gift Set purchases (from £11.99) made on the Airfix website between 1st October 2022 and 31st January 2023. Terms and conditions apply, visit **uk.airfix.com/community/win-flight-spitfire** for details.

A Compound Slide for a Sherline lathe

Geoff Walker describes how he made a robust slide for taper turning on his Sherline lathe.



The assembled slide.

Sherline lathes offer two solutions for short taper turning, one of which is their taper turning compound slide and the other by offsetting the headstock. I have doubts about their slide, I really don't like the way the tool is inverted and therefore cuts are made on the upturn of the workpiece. As for offsetting the headstock, again not for me as once set for accurate parallel turning I prefer to leave it that way.

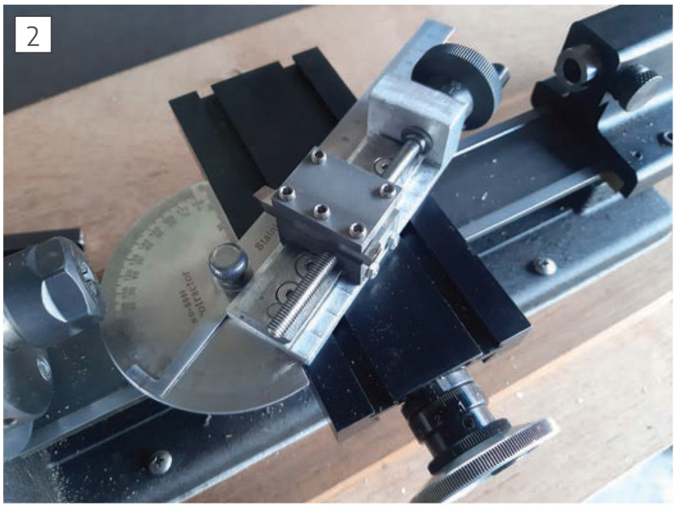
The slide shown in **photo 1** was inspired by the Unimat 3 compound slide and a similar far east design for the Sieg mini lathe. I thought about buying the latter and modifying to fit my lathe, but the build quality looked suspect and dimensionally I could not be sure modification was possible.

A few brief details about the slide shown in photo 1:

1. The base and tee nut are made from aluminium alloy.
2. The base vee slide is made from 5mm thick ground gauge plate and the tool post is made from cast iron.
3. The feed screw is a length of 6mm x 1mm stainless steel left-hand studding which is modified at the bridge end with a mild steel extension piece.
4. The bush in the bridge is made from brass and the handwheel is from a Sieg mini lathe.
5. The slide has a conventional arrangement, a slim brass gib strip is adjusted with grub screws and is supported at each end with dowel pegs.
6. It has no angular scale. Accurate setting is achieved with an adjustable protractor as shown in **photo 2**.

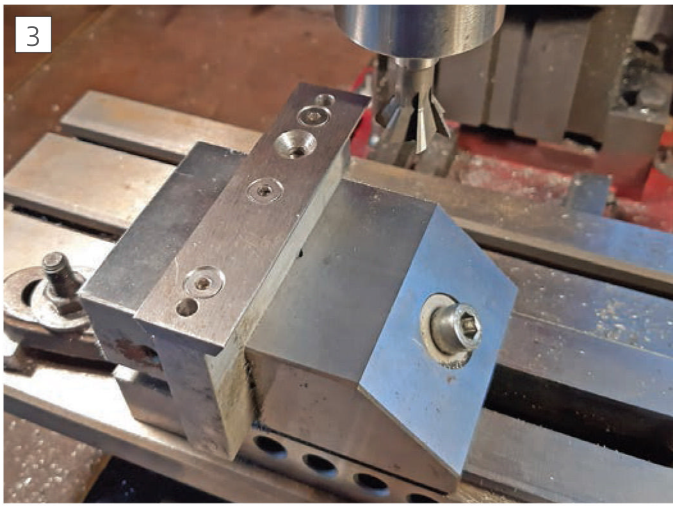
Procedure

Figure 1 shows A, B and C elevations that have the overall sizes needed to make the slide with a scale provided for less important ones. **Figure 2** has more detailed sizes for the tool block. Both drawings should be read in conjunction with the text and photographs.



2

Precise angular setting.



3

Milling the vee slide.

View A shows in plan the position of the vee slide on the base. The hole positions are all on the same centre line which is in the centre of the base but not the centre of the vee slide. There are three countersunk holes for 4mm csk. head screws, one countersunk hole for a 5mm countersunk head tee nut screw and two dowel holes for 4mm dowel pegs. The vee slide should be fixed as shown ensuring that the two datum edges are parallel. Align them carefully and drill/ream for the dowel pegs before drilling and tapping the base for the 4mm screws. The gap at the bridge end is to accommodate a slim 6mm thrust washer which can be seen in photo 1.

Photograph 3 shows a set up for machining the angular sides of the vee slide using a 60-degree milling cutter. Don't cut the angle leaving a sharp corner, finish with a small flat approximately 0.5mm wide.

View B is a part sectional side elevation. The section through the bridge shows the brass bush for the feed screw. The boss is 9.5mm diameter and the flange 22mm diameter. The hole can be either 6mm or a ¼". The overall length is 15.5mm, the flange is 2mm thick and 0.5mm protrudes on the inside face of the bridge.

The section shows the feed screw in two parts. The studding is turned down to 4.5mm diameter for a length of 10mm. The extension piece is made from 8mm diameter M.S. and is drilled 4.5mm diameter at one end and centre drilled at the other end. The two are bonded together and assembled in the lathe as shown in **photo 4**. The collet is a ¼" diameter and there is a thin shim collar wrapped around the studding. When the adhesive is set the extension can be turned to size. If using the Sieg handwheel the threaded portion would be a 5mm thread. **Photograph 5** shows the feed screw and extension piece after turning and threading.

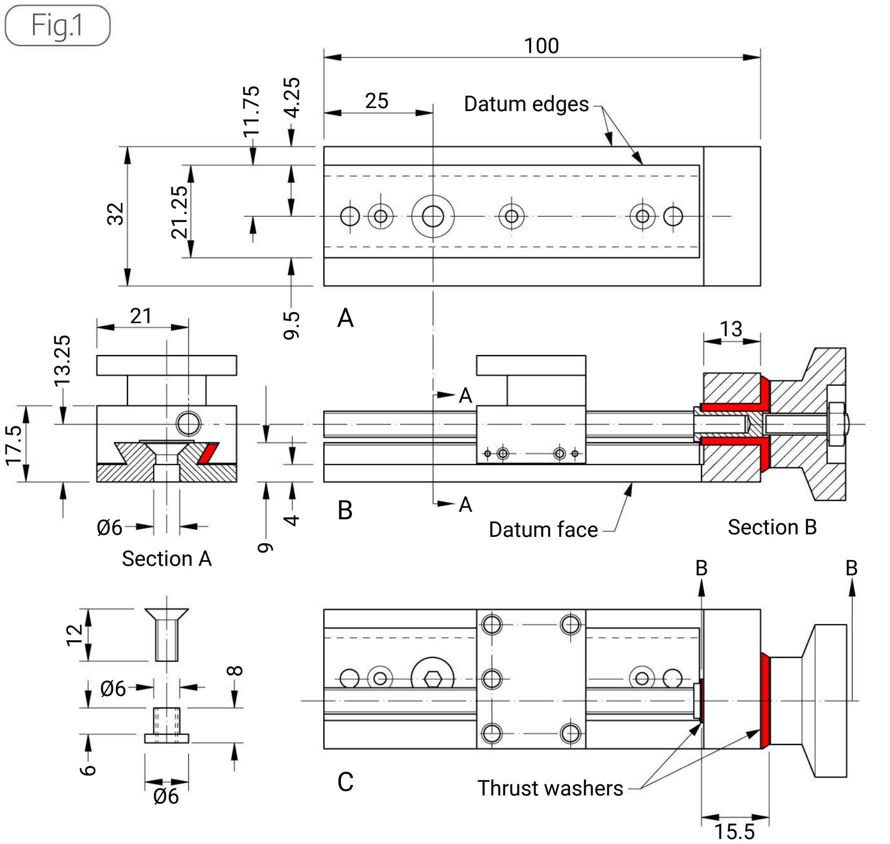


Fig.1 Sherline Lathe, Compound Slide General Arrangement
Please refer to Fig.2, text & photographs for more information

The sectional end view has sizes which are set from the datum edge and datum face of the base. The feed screw holes through the bridge and tool block are drilled with the set up shown in **photo 6**. The base is set vertical to the datum face when clamped to the angle plate and the datum edge is set vertical with a set square. The drill head is then positioned accurately using the two coordinates. The tool post is locked in place with the grub adjustment screws and an extra clamp. The hole in the bridge and the hole in the tool post are now both drilled at this setting, drilling initially straight through both with a 5.1mm tapping size drill for a 6mm left hand thread tap. The bridge hole can be enlarged to 9.5mm but before dismantling tap the hole in the tool post as shown. The tap used is a left hand

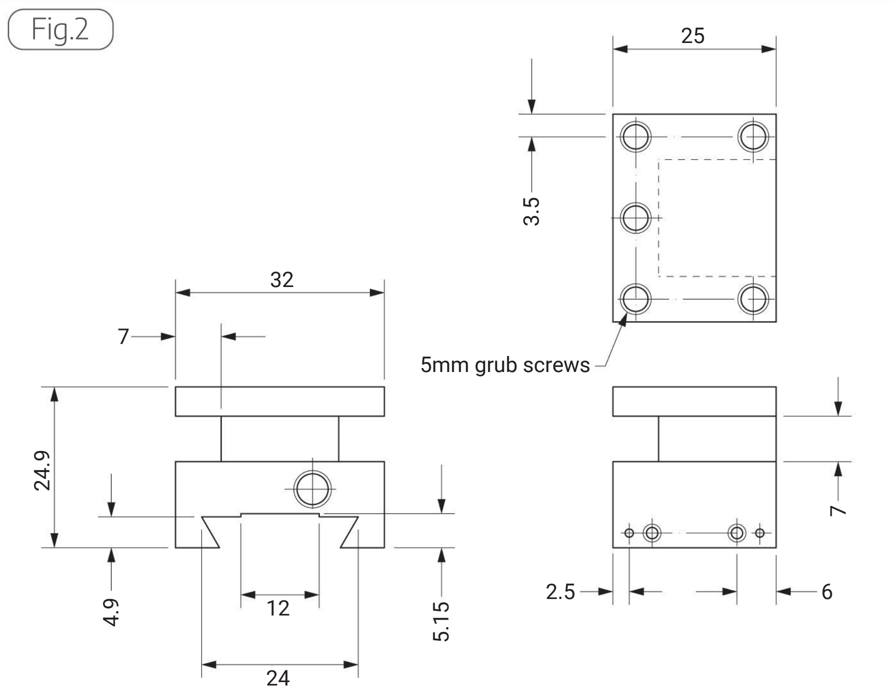
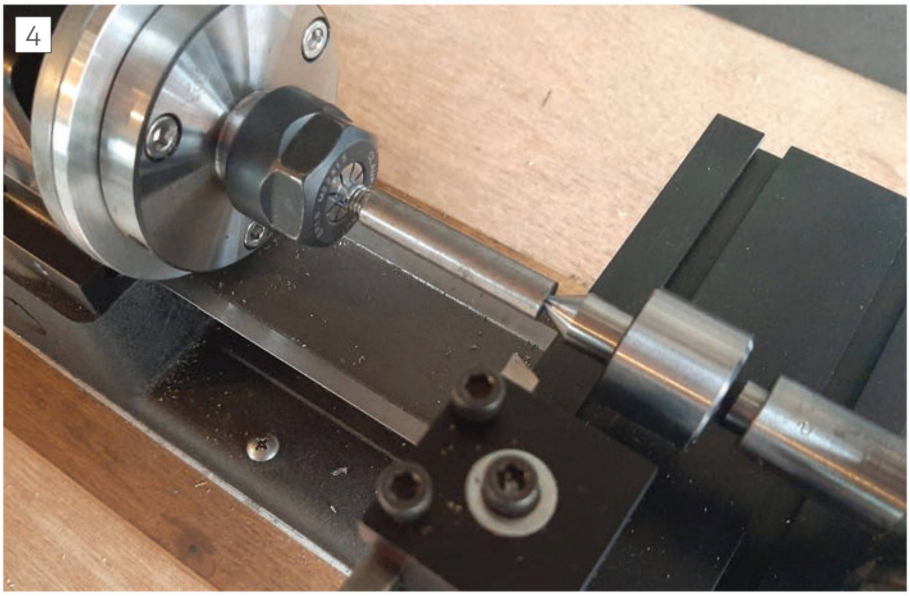


Fig.2. Toolpost



The feed screw and extension piece.

second tap supplied by Tracey tools. There was just enough full threads and waist length on the tap to thread the full 25mm length of the tool post.

The height shown from the datum face to the tool shelf is the same as on the standard Sherline tool holder 17.5mm or 11/16”. The centre height of a Sherline lathe above the cross slide is 15/16” or 23.8mm, therefore if standard unground ¼” square HSS (high speed steel) tooling is used it would theoretically be set on the centre height of the lathe.

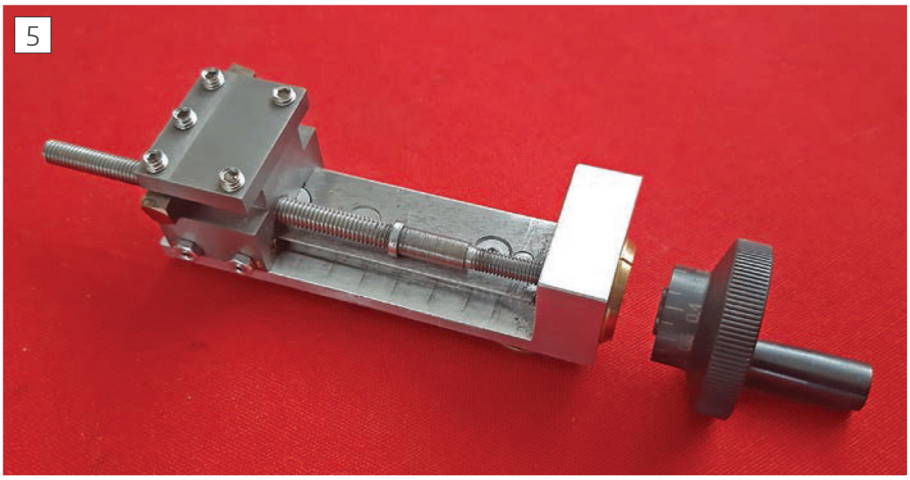
In view C the feed screw is shown offset thus giving access for a tee wrench to the countersunk head tee nut screw. The chamfer on the bush flange tapers from 22mm to 20mm diameter and the flange can have an index line engraved as shown in photo 5. The tee nut is made from 10mm square aluminium alloy.

Figure 2 gives more details for the tool post. The 4.9mm depth for the vee slot leaves a small clearance between the post and base. If the vee is machined to the width shown, 24mm, then a gib strip of 2mm thickness will fit neatly in the space created. The strip will have to be chamfered top and bottom to slide into the space. The gib screws are 3mm diameter and the support/guide pins 1.5mm or 1/16”. To drill the holes through the gib use the set up shown in **photo 7**. Tighten the gib screws and using a stubby drill, ground flat on the end, slowly “peck” at the gib to create a flat surface in the angled side. A standard drill can then be used to complete the hole. Make the pegs so they are a “sticky fit” in the gib hole and sliding fit in the tool post. The pegs, just visible in photo 5, are made from 1/16” copper cable. No need for grub screw dimples in the gib, the pegs prevent any up/down or lateral movement.

The other sizes for the vee slide are straightforward. The relief area in the centre 12mm wide and 0.25mm deep will be positioned when milling away the centre portion of the vee. This would be a central slot 12mm wide and 5.15mm deep, creating space for the shank of a 60-degree milling cutter.

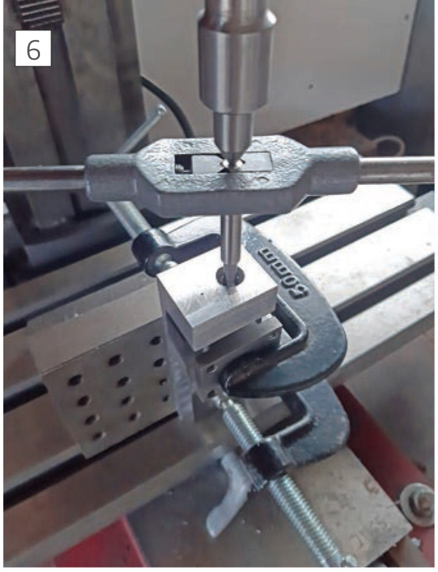
Assembly and Summary

Assembly and adjustment of the slide is straightforward. Prior to adjusting the gib screws the gib strip could be lapped up to the vee slide with a fine lapping paste and plenty of oil. There are two thin steel thrust washers which



The machined feed screw extension.

6



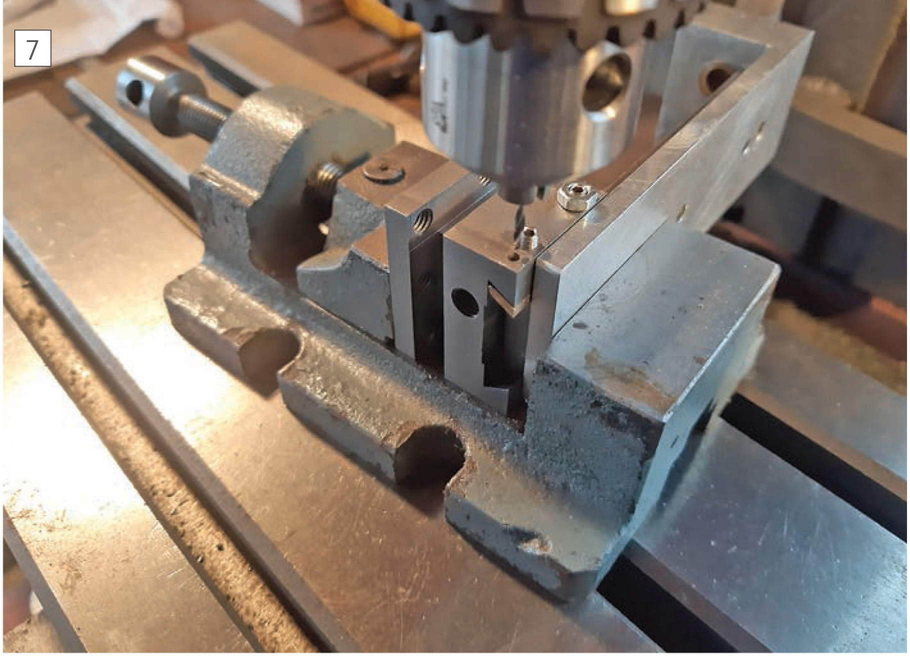
Tapping the tool post.

are indicated in view C. These should be lightly greased on assembly. At the bridge any end float of the feed screw can be minimised by a screwed adjustment of the hand wheel. The wheel and the nut can then be locked together to retain that position.

The base and nut are made from a softer aluminium alloy and are the only parts which contact the cross slide. The gauge plate vee slide gives rigidity to the base and with its ground face is a good match of materials with the cast iron tool post.

The slide functions well, I was pleasantly surprised by its efficiency. The design principles are clearly sound and attention to detail in the assembly and adjustments results in a smooth effortless cutting action. There is some inevitable backlash in the feed screw, approximately 0.1mm.

7



Drilling the gib strip.

The Sieg hand wheel is indexed with 10 marked divisions each of which are 0.1mm, perfectly matching the 6mm x 1mm pitch feed screw. There are a 20 further sub-divisions of 0.05mm.

Photograph 8 shows a short 0 morse taper being turned in silver steel. The maximum travel of the slide is around 60mm so a 1 morse taper could be accommodated if desired. There are of course limits to depth of cut, rate of feed but you get what you would expect from an accessory for this size of lathe.

Using the angular setting method in photo 2 it is possible to set accurately any external angle through 0 to 90 degrees. For the larger angles the slide operates over the end of the cross slide. A key tee wrench is a very useful tool to have when setting the angle.

The left-handed studding is available from suppliers on the internet. Right-handed studding could be used but then of course any movement of the tool post in relation to the rotation of the hand wheel will be contrary to the accepted norm.

Suppliers for the hand wheel and a 6mm left hand tap are listed below. ■

Suppliers:

Arc eurotrade www.arceurotrade.co.uk

Tracy tools www.tracytools.co.uk

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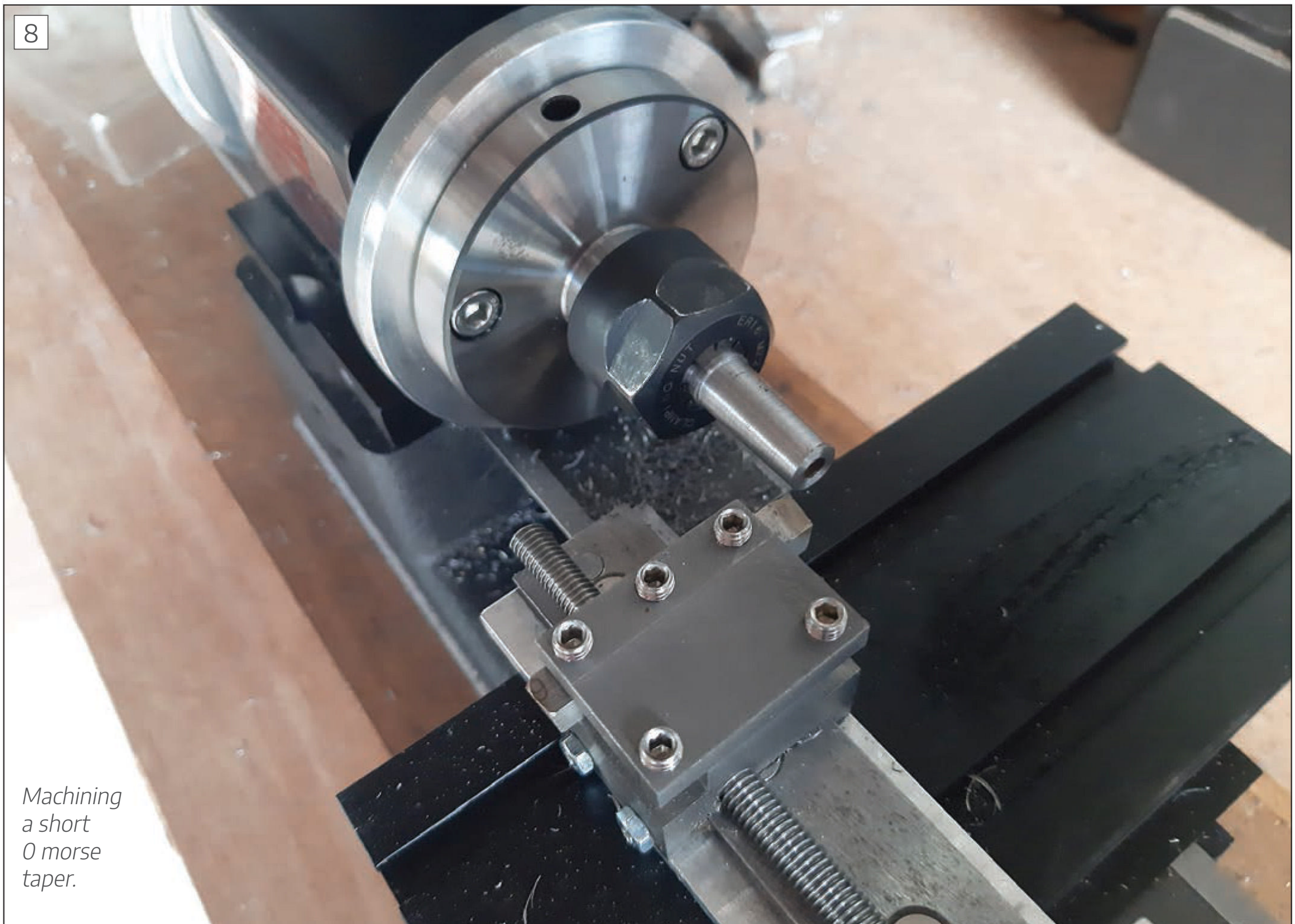


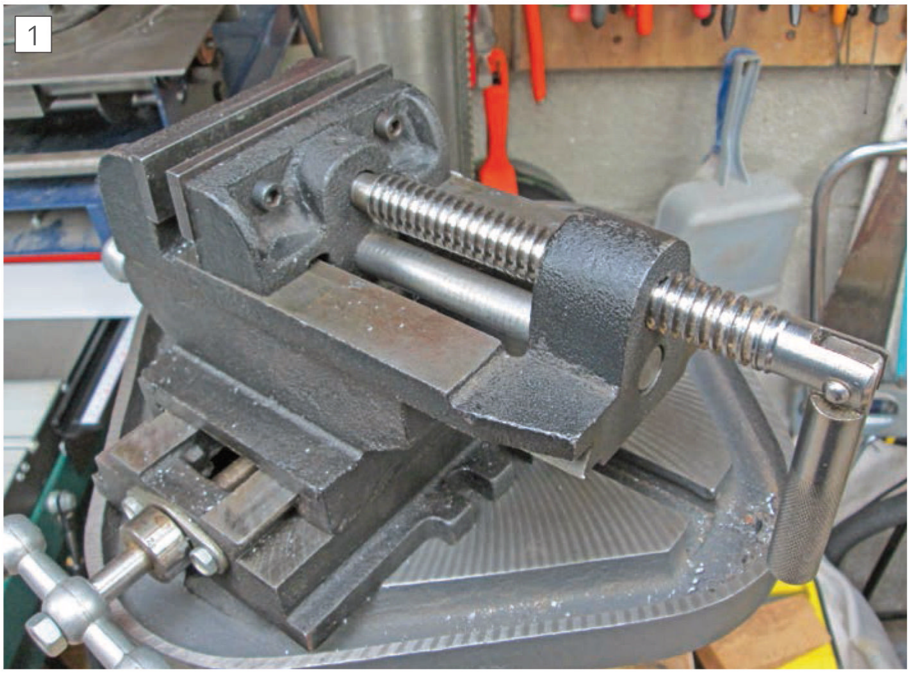
Machining a short 0 morse taper.

Modifications to a Cross Vice

Many years ago Laurie Leonard decided that the accuracy of drilled holes using a pillar drill could be better with more flexible workholding. He purchased a budget cross vice that could be bolted to the pillar drill table but found that there was room to improve its performance.

The main advantages that I saw were the fixed nature of the work holding and the ability to adjust the intended drill position via the vice slide screws. The vice in position on the pillar drill table is shown in photo1. At the time of purchase I was making electronic printed circuit boards (PCBs) when the standard circuit components had pins at a 0.1 inch pitch, so I made new screws that made moving the work by the required 0.1 inch an easy operation. Both ¾ Whit and ¾ UNC have 10 TPI (threads per inch) so utilising either would make the move one revolution of the screw.

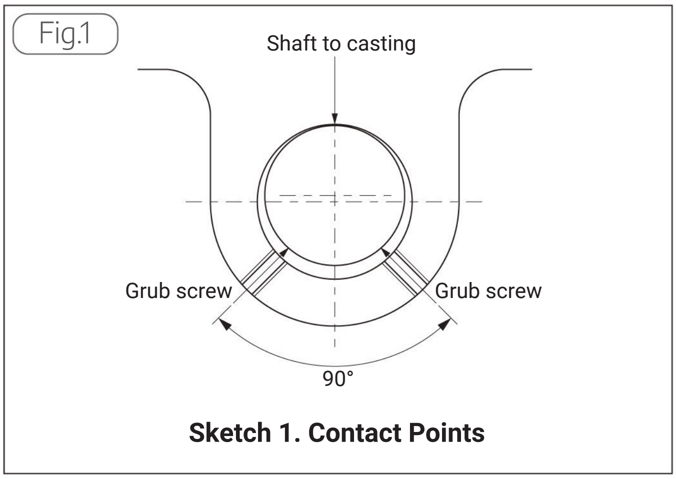
Next came the requirement for an even more accurately placed hole as I found that the sliding jaw was lifting on tightening causing the job to move out of square. Could the vice be modified to overcome this problem?

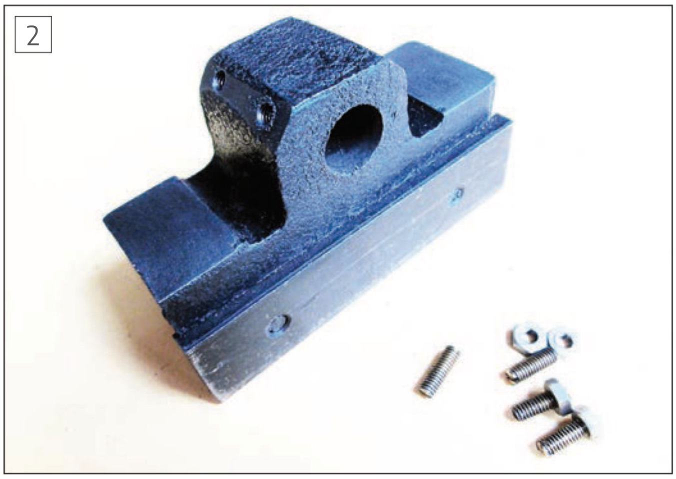


Cross vice in position on the pillar drill table.

Improving the alignment of the sliding jaw

As can be seen in **photo 1** the sliding jaw is bolted to a casting that is carried on a round rod/shaft guide. The play was found to be in the hole in the casting in relation to the size of the rod guide. To overcome this, four grub screws were added. Ideally three equidistant points of contact around the circle are desirable but due to the nature of the casting I settled for the angles and locations as shown in **fig. 1**. The relevant faces of the casting were skimmed to make landings for the grub screw locking nuts and to facilitate drilling. Two pairs of holes were drilled and tapped in the casting, **photo 2**. Brass grub screws made as in **fig. 2** are also shown in the photograph. Two





Holes drilled and tapped in the sliding jaw casting.

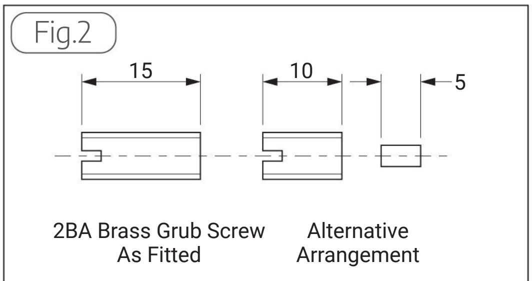
Modified sliding jaw casting showing adjustment screws.

holes were drilled so that any play along the guide axis should be reduced. Ideally steel grub screws should have been used with a brass wear slug as when it is time to take up the wear on the brass grub screw it will have a curve worn on the end making adjustment less definite and future wear quicker. I am living with this at the moment. At the time it was done there was a need for the increased accuracy, but I had some doubt as to whether the modification would actually be of value. The modified sliding jaw adjustment, viewed from below is shown in **photos 3** and **4**.

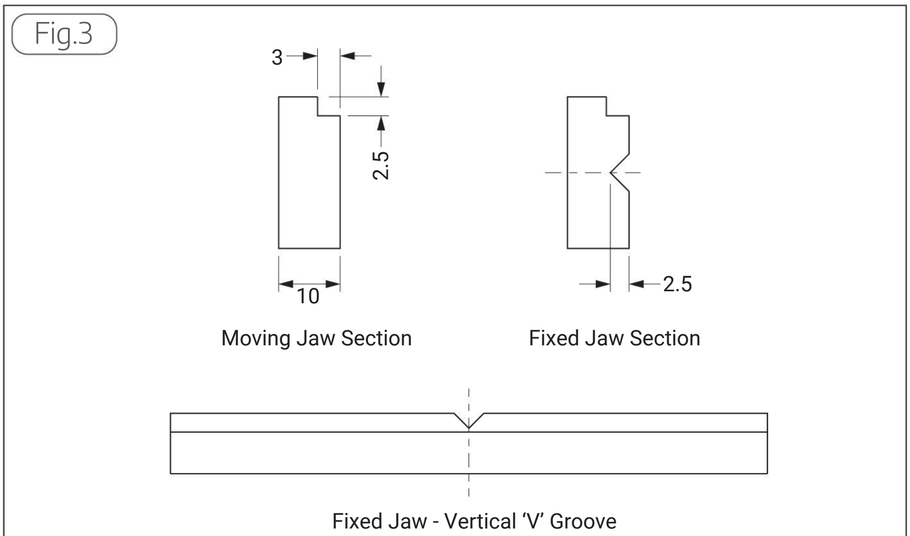
Modifications to the Jaws

A lot of the operations carried out in the vice do not require a high level of accuracy, but simplicity of the drilling operation is key. If it is required to drill a hole in fairly thin stock coupled with the desire not to drill into the vice itself, then some method of holding the work clear of vice base is needed. A suitable piece of wood resting in the vice that is narrower than the stock will perform this operation but at the same time it is desirable that the job is near the top of the vice for access and, with failing eye sight, within easy viewing. Specific jobs also have a requirement for the drilled piece to be horizontal when being drilled to get a vertical hole. To achieve this some vices on the market have a slight ledge machined into the top of the vice jaws to cater for this need. Vices may also have "V" grooves for gripping round rod in both the vertical and horizontal planes.

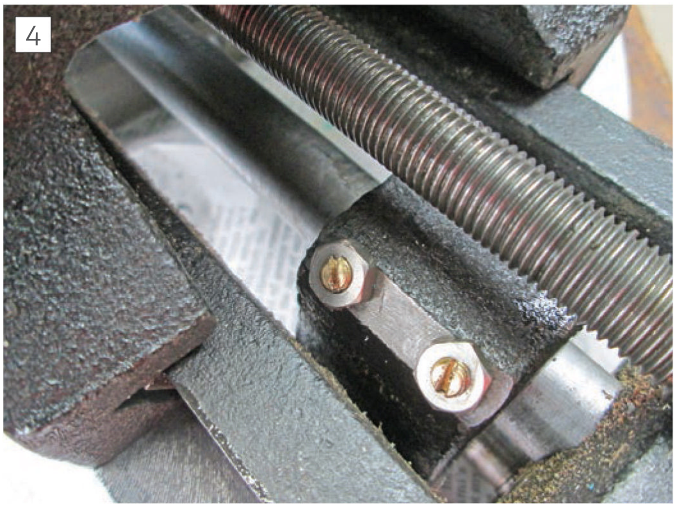
It was decided to make new jaws with these attributes. It was concluded that the existing jaws were just too thin to take the modification so new jaws were made from 10 mm thick stock. As vice dimensions vary with make, I just show the size of the ledges and "V" slot approximate dimensions in **fig. 3**. The ledges need to be able to support stock and enable it to be gripped as do the "V" slots. If the latter were too large then they would not be able to



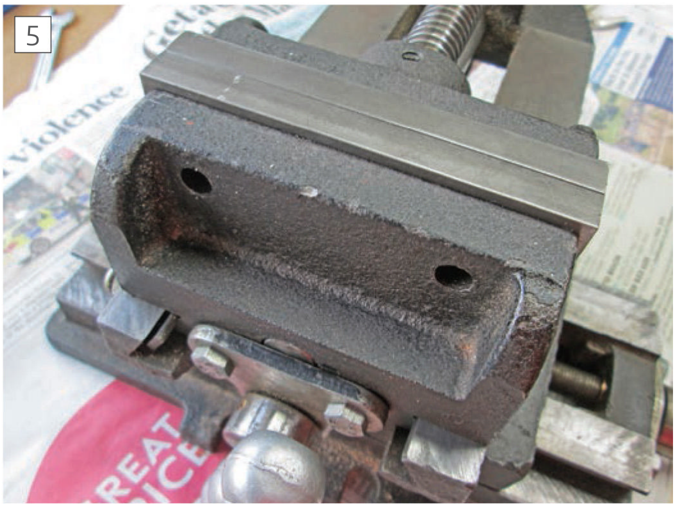
Sketch 2. Grub Screws



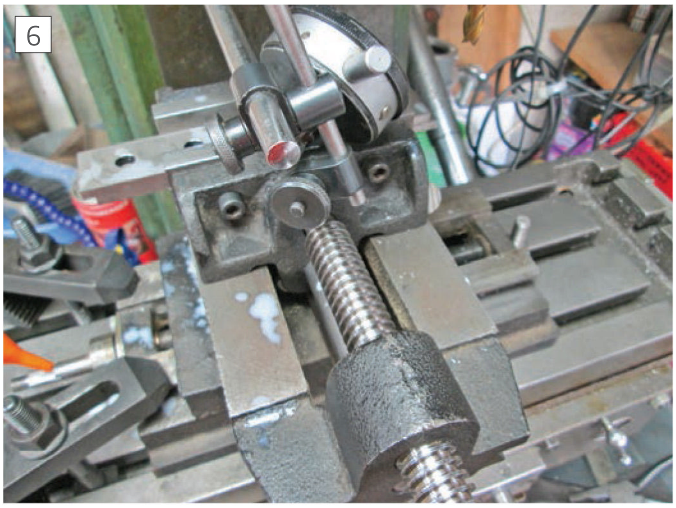
Sketch 3. Ledges And 'V' Grooves In Jaws
Note: Dimensions indicative



Another view of the modified jaw.

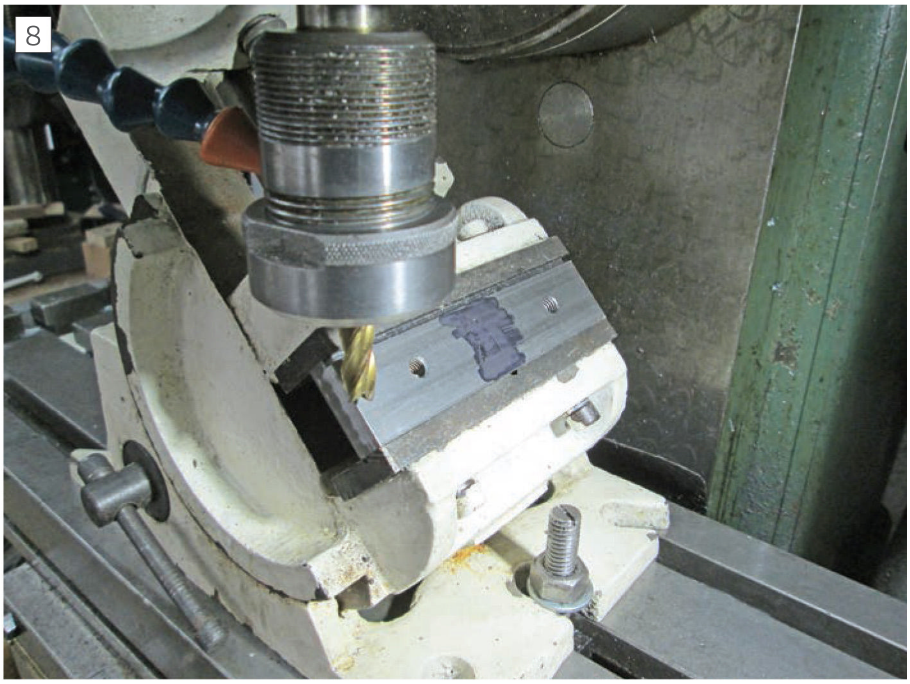


New jaw blanks ready for marking fixing screw holes.



Vice clamping arrangement on the mill table.

Use of parallels to rigidly clamp jaw blanks for machining.



Use of tilting vice to cut "V" slot.

Setting jaw at 45 degrees for machining "V" slot.

grip small stock but the smaller they are the less robust the location of large diameter stock. I came up with the measurements shown which are on the lean side as they could be enlarged if found to be too small in practice. The new blanks are shown in **photo 5** ready for the holding screw tapped holes to be marked.

It was intended to carry out the machining on my Tom Senior M1 mill. As all work on the pillar drill carried out using the vice would be done with the vice resting on the drill table it was concluded that the machining of the ledges should take place with the vice on the mill table and the jaws in position. The vice was clamped onto the mill table, **photo 6**, and aligned to the mill table axis using a clock gauge. This was the second set up as the most obvious set up was with the vice at 90 degrees to the illustration to utilise two opposite mounting lugs on the vice base but after it was nicely aligned, I found I could not get the required travel hence the use of clamps on one end. The other end utilised a lug on the vice base.

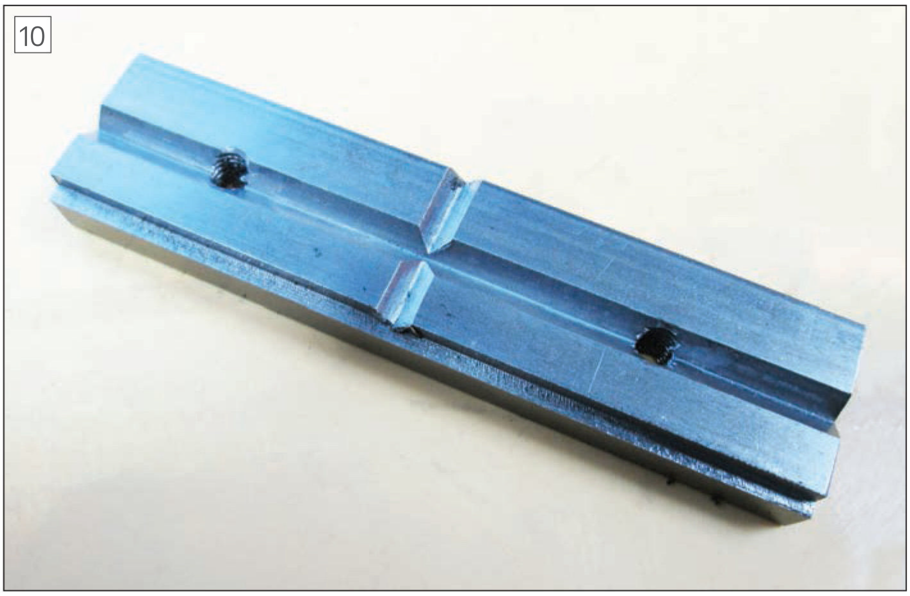
The ledge could have been milled on both jaws simultaneously with the right width of cutter, but I decided to cut each one separately although I wanted to ensure that the cuts were parallel. This was achieved by trapping a pair of parallels, one above the other for rigidly, between the jaws and tightening up solidly, **photo 7**. The ledge was then milled on each jaw.

Whilst the two "v" slots could have been machined in both jaws their relative positions would have to be nearly spot on for reasonable accuracy in use, so it was decided to machine the "V" slots in the fixed jaw only. The "V" slot parallel to the vice jaw was machined utilising a tilting vice, **photo 8**. The centre line of the jaw was marked, and the edge of the cutter was aligned to this. Equal amounts were then milled off in the vertical and horizontal planes.

I played with my tilting vice to get a set up to mill the vertical groove in the jaw but failed to get a satisfactory one so resorted to the machine vice and set the job in the vertical plane using an angle box gauge, zeroing it on the table before setting the angle of 45 degrees, **photo 9**.

The machined fixed jaw is shown in **photo 10** and the new jaws installed on the vice in **photo 11**. Although the work looks as if it has been blued it has not been, and the colour is the result of my photography. I have installed LED light panels and I think that this is the source of the colour.

10



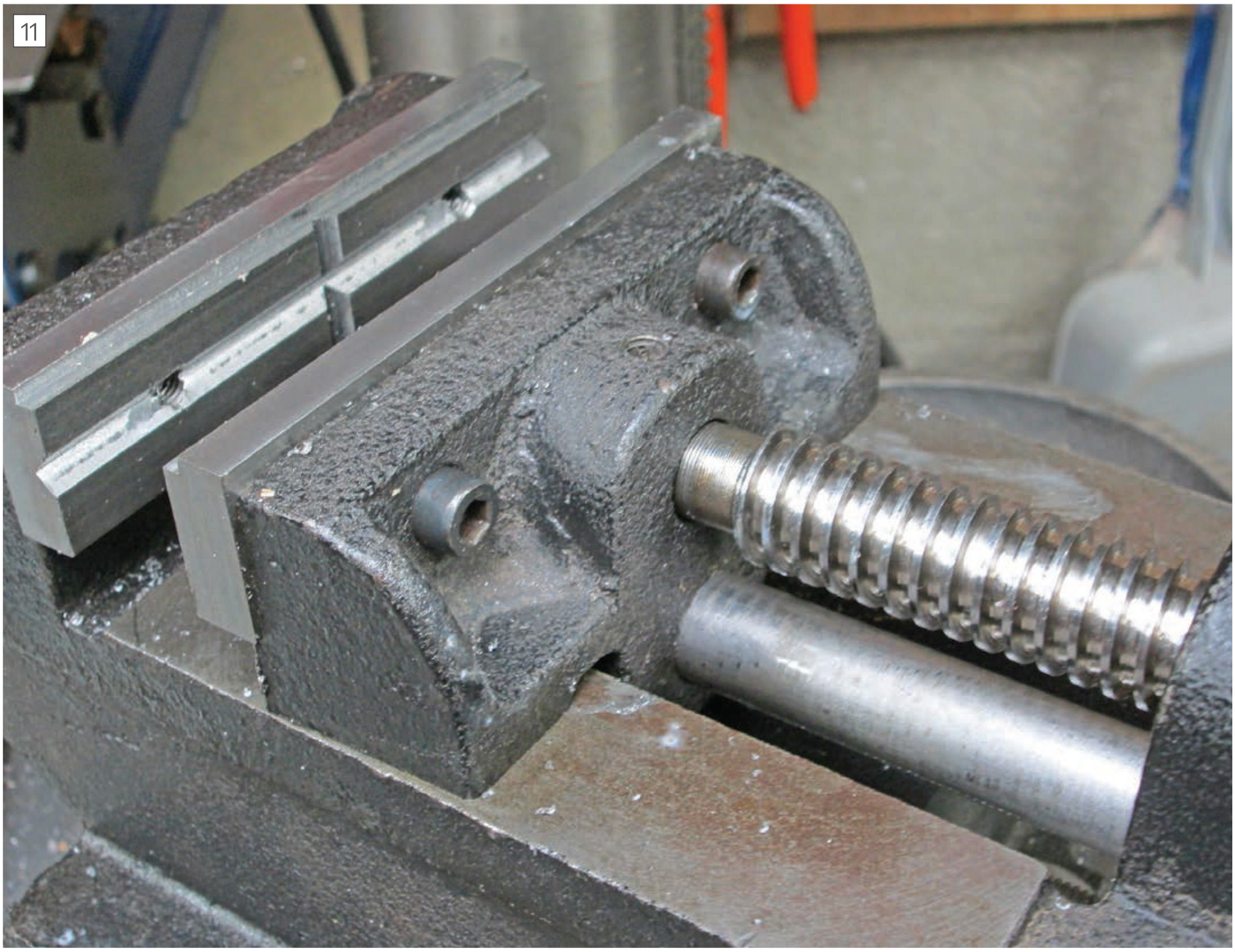
Machined fixed jaw.

Conclusion

The modification to improve the alignment was carried out many years ago and did provide some improvement in accuracy although grub screw adjustment is required from time to time. If there is a requirement for high accuracy, then work is carried out held in the machine vice on the mill table.

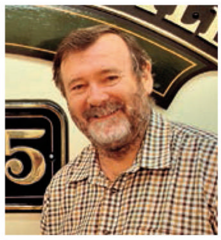
It is still early days for the jaw modification but current indications are that it will meet the requirements.

11



New jaws in place on the cross vice.

Artful Dodge #2 – Always have a plan



Essential reading for beginners and valuable to old hands, this series by the late John Smith shares some of his wealth of skill and experience from over half a century in hobby engineering.

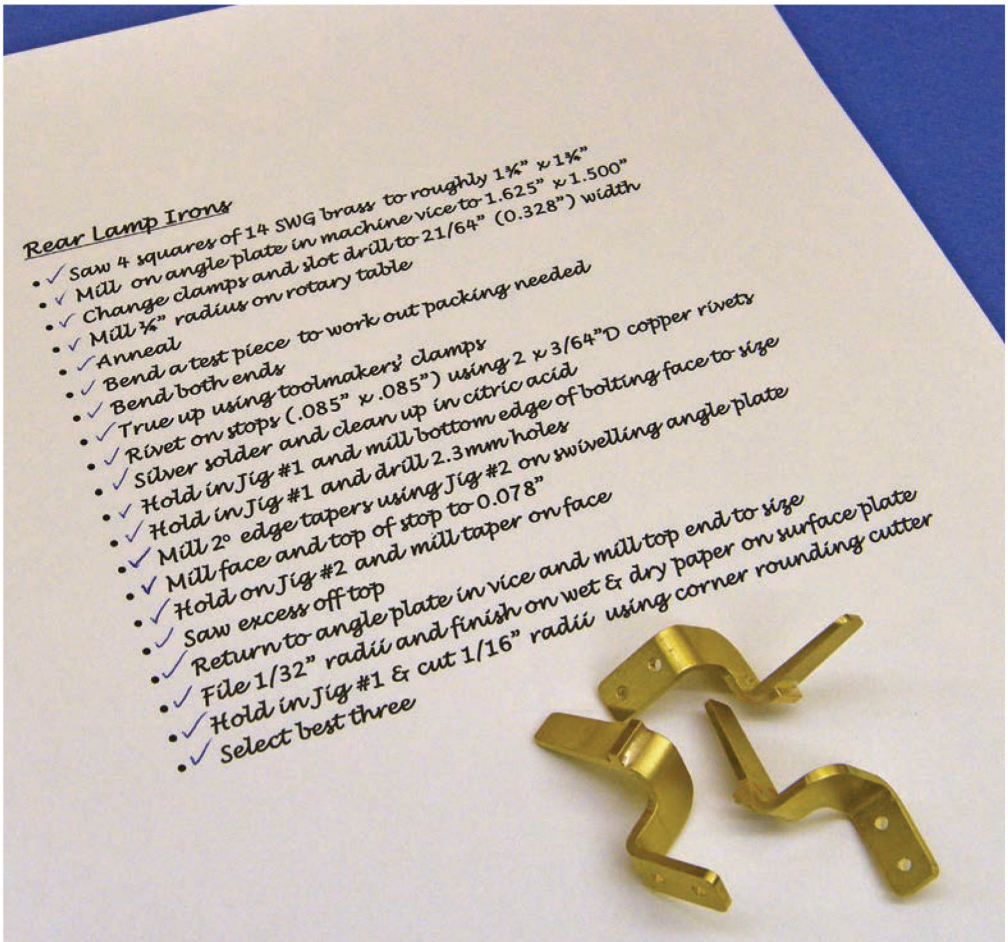
I'd like to start with a book recommendation for those who are starting out in our hobby. The Amateur's Lathe by L H Sparey is still one of the best books covering lathe work, despite it being written in 1948. You'll find it hard to find the recommended lard oil or whale oil today, and there is no mention of tools with replaceable carbide tips, but the book does cover the basics of turning very well.

I remember from many years ago that when Martin Evans started a new locomotive construction series, several readers would do their best to keep up with Martin, so that when the last article in the series was published, they were very close to finishing their models. They clearly did not work or have a family! This is not what I mean by a plan. We all have enough stress in the workplace; we don't need the pressure of meeting tight timescales when unwinding in the workshop!

No, what I mean by a plan is a simple list showing a logical sequence of parts to make. Here is a scrap of mine, which is on a notice board in the workshop:

Valve chest, valves, end covers, shackles and rods
Cylinders
Motion plate
Cylinder front covers
Cylinder rear covers and glands
Pistons and rings
Piston rods
Crossheads
Slide-bars
Connecting rods
Big end bearings and straps etc

Tick them off as you go. Then, when you are ready to make each part, sit down and make a note of each step needed to make it. In the IT business, this process is called "step-wise refinement" and it works; it's very useful for writing articles and books too. Some days you will only be able to complete a couple of steps, but it's satisfying to tick them off as you go, **photo 1**.



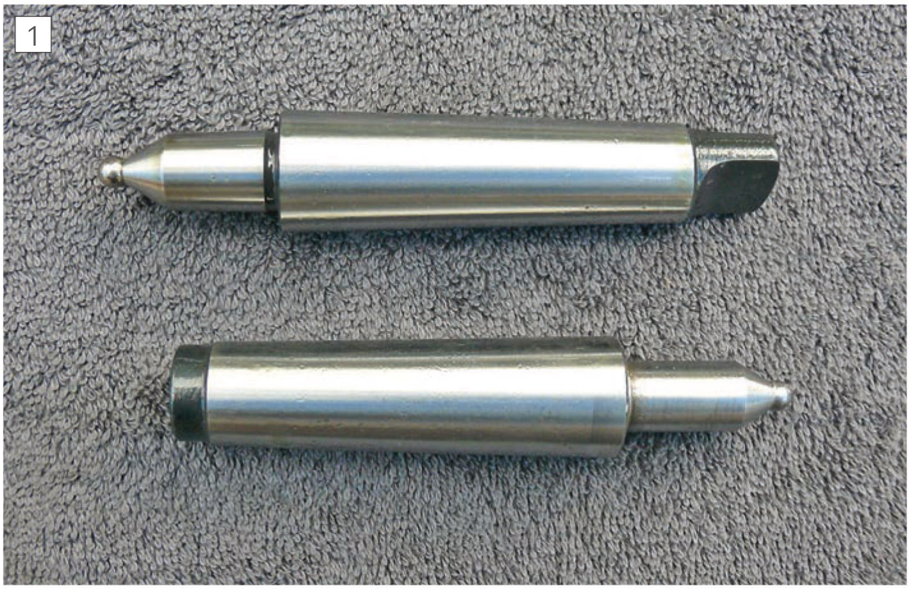
An example list for locomotive lamp irons.

For most parts, there will be ten to twenty steps. For complex assemblies (like the bunker of a tank engine) there could be a hundred or more steps. Why bother? Because it will help you to avoid mistakes; it forces you to consider the best sequence of machining operations and how you are going to hold the workpiece for each one; and, during the planning, you will often think of a quicker, easier or more accurate way to make the part.

It also helps you to work out the best sequence for riveting parts together to ensure that you can get to both ends of each rivet to close it. Also, a visitor will ask you how you made something and, without the list of steps, you won't have a clue. ∎

A Different Angle on Taper Turning

Ball centres provide a simple and effective way to support the work when turning tapers in the lathe. In this article Howard Lewis explains his approach to making various sizes of ball centre.



¼" diameter ball Centres on 3MT Arbors

Over the years, our daughter has given me many older copies of Model Engineer. Needing space, they were earmarked to be sent to a new home. Before passing them on to someone else, I read through them, looking for articles that might be of interest. Among the articles was one by the late Peter Spenlove-Spenlove, on turning steep tapers between centres.

He had converted normal centres to take a ball bearing, which would allow a greater angular offset for turning steep tapers, on short workpieces, between centres. These are used instead of typical taper-tipped centres, running in holes drilled with centre drills and with plenty of lubrication and are much more tolerant of the required 'misalignment' of headstock and tailstock. Since it seemed a Good Idea at the time, I decided to make some, **photo 1** shows two of my ball centres.

The original method had been to grind back hardened centres, and drill them to take a ball bearing on a short parallel bar, but, as usual I chose to take a slightly different route, and used a blank Arbor as raw material.

Rather than waste a lot of material modifying ordinary blank arbors, Drill chuck arbors were chosen. Jacobs JT1 arbors were used to minimise the amount of metal to be turned away. Some were chosen with a Tang, and others with a thread for a drawbar, to cover likely eventualities.

Each was cleaned and placed in a Morse taper in the mandrel of the lathe. The JT1 tapers were hardened, so a carbide tip was used to face off the original centre, so that a new centre drilling could be made in unhardened material, which would be bright steel. The outside of the JT1 taper was then turned down to give a parallel diameter.

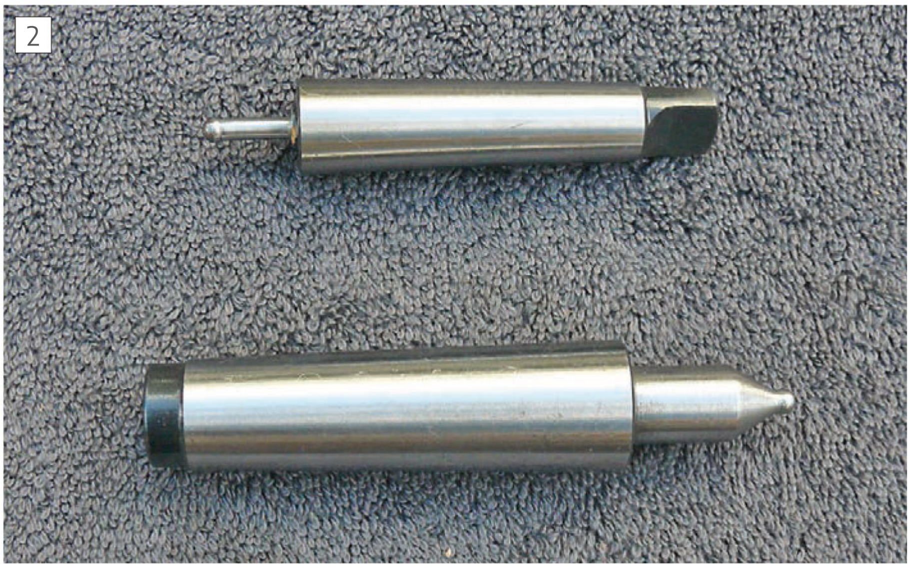
Thread Modification

The reason for the parallel section is allow the arbor to be gripped in the 3-jaw chuck, to modify the internal drawbar thread. The arbors were tapped M12, whilst all my other Morse taper arbors are tapped ⅜ BSW. The wall between the crest of a ⅜ BSW external thread and the crest of a M12 internal thread is very small, so the material needed to be supported whilst it was drilled and tapped ⅜ BSW.

The method used was to cut some M12 studding to a little over length when screwed fully home in the arbor, before being glued into each arbor with high strength retainer. When the anaerobic had cured, the arbor was gripped on the parallel diameter so that the end of the M12 studding could be faced flat, centre drilled, drilled and tapped ⅜ BSW.

Once this had been done, the arbor was replaced in the Morse taper in the mandrel and turned down behind the behind the seating for the ball, to provide clearance. There were 3⁄16" and ¼" balls available, so arbors were made up for ¼" and 3⁄16" balls for the BL12-24, and 3⁄16" for the mini lathe, **photo 2**.

For the larger lathe, 3MT arbors could be used in both headstock and tailstock, but while the mini lathe headstock was 3 MT, the tailstock was 2 MT, so this arbor was left as parallel, but a slightly smaller diameter than the outside diameter

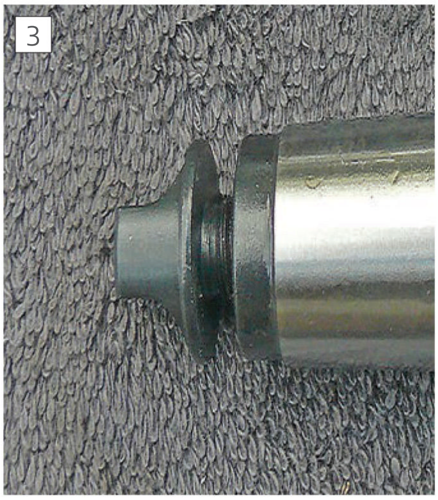


3⁄16" diameter ball centres 3 MT and 2 MT Arbors, suitable for a mini lathe of the ball. If, for any reason, it was necessary to use two arbors with a tang, a threaded arbor could be used with a screw in tang, **photo 3**.

Fixing The Ball

Once machining had been completed, it was time to fix the balls in place. It was decided to soft solder the balls into place, so that the lower temperatures would minimise the risk of softening the balls. If, in use, temperatures became so high that the soft solder were to melt, something would be wrong!

Each arbor was wrapped in rag and gripped, by the tang, in the vice. A short length of solder was cut and dropped into the centre drilling, before the ball was placed on top. A heat gun was used rather than a flame, since it was thought that the heat would be a little less concentrated, to melt the solder. If there was any sign of the ball floating on the molten solder, a light touch with a small hammer forced out excess solder.


3

Screw in Tang fitted to a ball centre.

Once the ball had been fixed in place and the arbor was cold, it was put into the lathe and any marks and excess solder gently polished off with fine emery and a green scouring pad. Each new ball centre was oiled, to protect against rusting, and placed in its original plastic box, ready for use as required.

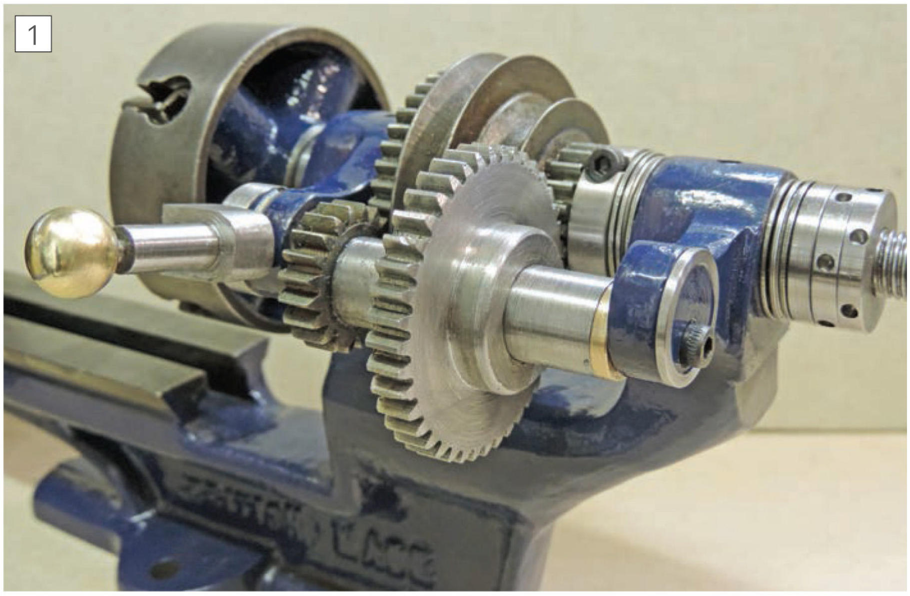
For taper turning, ball centres need to be used in pairs, one in the headstock and one in the tailstock, which is offset to achieve the required angle. A driving dog is needed to keep the work from slipping at the headstock end. They must run in lubricated centre drilled holes, adjusting the pressure from the tailstock to allow shake free support without excessive friction. Keep speed and depth of cut modest. ■

Workshop Photography *Part 1*

We can't all be professional photographers or even access the most sophisticated of photographic equipment, but there are many simple things we can do to improve the quality of our workshop images.

We must be honest, the sort of photographs that accompany articles in Model Engineers' Workshop are often more a matter of practical record than great works of artistry. Their function is usually to illustrating some machining operation, a feature of a machine or give an idea of the function and layout of a tool.

In this short series of articles, my ambition isn't to transform every photograph submitted for publication into a work of art. Nor is it to claim to be a master photographer and parade my finest images for readers to appreciate! Quite the opposite, as many of the images I will be using are to show where I have gone wrong, or at least where I could have done better. In fact, I will have to be telling the designer to go easy on correcting some of the issues with the pictures to make sure that their faults remain obvious. Modern image processing tools are remarkable in their ability to make a silk purses out of sow's ear, well at least artificial silk ones. Though I will be sharing a few tips on rescuing sub-par images, my main aim is to help you take clear, usable and more interesting photographs. Hopefully, the exercise of putting a little more thought into workshop photography can help bring more interest to your hobby and give you future pleasure when you look back at a more engaging record of your workshop activities.

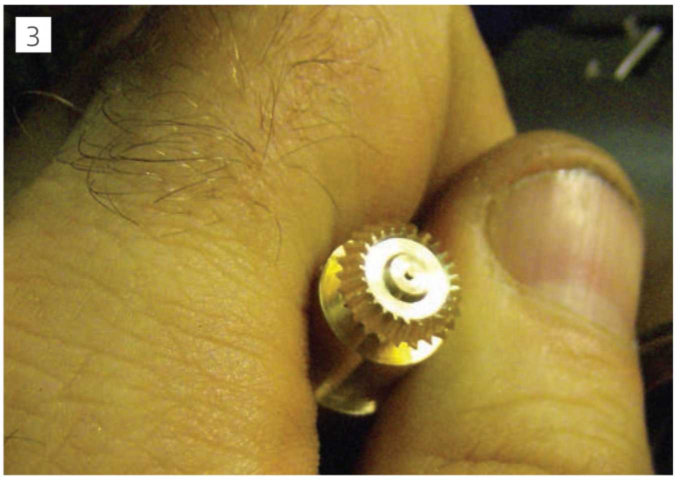

1

Taken with an advanced bridge camera, this image has good exposure and colour as well as considerable depth of field.

The better images I will be using, at least I hope readers think they are better, will not be perfect, but they will illustrate some useful point. There will be some that illustrate good practice really well but fail in another department. I plan only to use my own images, not because they are superior, but because I don't think it's fair on to criticise others' images that may be perfectly suitable for their intended purpose even if there are ways they might have been made more appealing. Let's start by thinking about what makes a good workshop photograph, bearing in mind that every rule is made

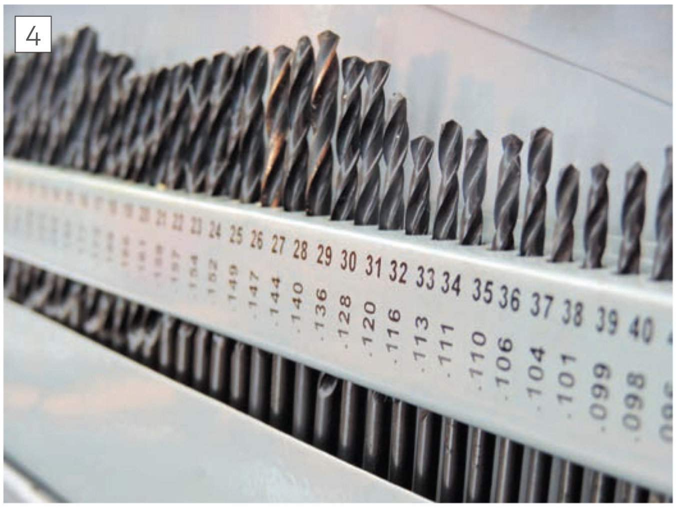
2

The eye goes straight to the important parts of this bore micrometer, ignoring the out of focus handle.



3

Lots of faults here, but the main one is that the workpiece is out of focus.



4

An otherwise boring image, spiced up by using a narrow depth of field.

5

A handy clip for attaching a phone to a camera tripod, also a good example of how a simple subject can be improved by angling the item to give a more interesting perspective.

to be broken! Look on the internet and you will find lists of anywhere between three and ten qualities of a good photograph. Here are the broad areas I will be exploring.

1. **Technical qualities** – were the right camera settings used and does the image meet the basic requirements for publication.
2. **Composition** – How does the image illustrate the points it is supposed to highlight? Is it an interesting attractive image in its own right?
3. **Lighting** – Has thought gone into how the subject has been lit?
4. **Colour** – Does the image make creative use of colour?
5. **Textures** – has the photograph managed to capture interesting textures.
6. **Telling a story** – does the image suggest motion, progress or some other change?

Now is a good point to mention the choice of camera, with the irony being that this is, to a large extent, unimportant. In recent years many MEW images, including covers, have been taken on mobile phones or very basic digital cameras. All the points we cover below apply equally to camera phones, point and shoot and basic digital cameras, bridge cameras (advanced digital cameras with a permanently attached zoom lens) and fully featured DSLRs. If you are unsure of your cameras capabilities, then simply setting it in a basic 'auto' or 'program' mode is the best starting point. Whatever I use for photos, I always start off using an automatic mode for all its settings, but I always preview the image to check it, and if necessary, I will use a manual setting if this can improve the image. I strongly recommend 'playing' with the features of your camera to try out the different features and modes, so you have an idea what works and what is just a waste of time. For example, you will almost certainly discover that your manual focusing abilities are rapidly put to shame by its auto focus!

Photograph 1 shows the headstock of my much-modified Super Adept lathe. The image has good depth of field - that is nearly all the subject is in focus. The exposure is good with detail in both the shadows and highlights. The composition is deliberately chosen to concentrate on the headstock arrangement with other parts of the lathe cropped out, a higher angle may have shown more features of the gearing, but it is an interesting image. The very simple background highlights the complexity of the machine. The lighting is from multiple sources, softening the shadows without eliminating them. The colour balance is natural looking, and the cobalt blue colour is quite striking against the contrasting but subdued background. The different metals, especially the brass knob add colour interest. The textures of the paint and machined surfaces, as well as the gear teeth and drilled holes reinforce the idea

A 3D printed skull, underexposure can often be corrected to some extent (right hand side).

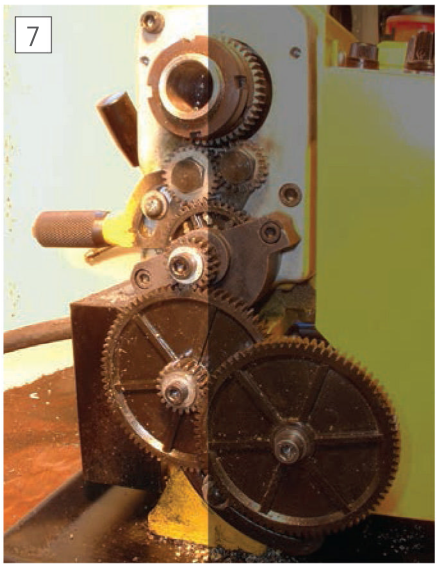
of a machine where some parts are solid and fixed and others capable of complex motions. On its own it doesn't tell a story, but in the context of a wider article on modifying the lathe it would clearly show major changes that were made. That's a fairly pretentious summary of a relatively simple photograph, but hopefully it illustrates how what could be a very simple image can be quite interesting.

Technical Qualities

Let's look at the basic technical aspects of taking a photograph, because if, for example, if you are busily working through a project, you may just want to record a setup or machining operation and don't want to worry about clever composition or inspiring use of colour. But you will want your image to be sharp, well exposed and to have a good colour balance.

Sharp primarily means the main elements are in focus, and the picture is without shake, **photo 2** has the important elements of the bore micrometer in focus. Many images are spoilt because the camera has inadvertently focused on some area away from the main point of interest, **photo 3** is a typical example with the hairs in focus and a blurred workpiece. That doesn't mean every part of an image must be pin-sharp, **photo 4** takes what could be a boring image of a row of drill bits and adds interest as the row of bits and numbers passes through the plane of focus. This is most easily achieved on cameras with manual aperture control.

With auto focus, you may need to ensure the subject is at the centre of the image to make sure it is sharp. Most cameras allow you to 'lock' the focus at this point by partially depressing the shutter button, so you can change the framing. With many phone cameras, you can tap a spot on the image and it will focus and set the exposure for that spot.



This image was overexposed causing 'blown out' highlights. Unlike the underexposed image, it was not possible to correct it easily.

Sometimes light levels may be low, leading to long exposures and difficulty in keeping the camera steady. If your phone or camera has an 'anti-vibration' setting, then use it! If not, consider using a tripod, **photograph 5** shows a handy little spring clamp device that fits on a normal tripod and firmly grips a phone. Incidentally it also shows a ceramic tile providing a nice, neutral background. Using a 'shutter delay' setting with any tripod, so that pressing the shutter release doesn't cause vibration.

Well exposed pictures capture the full range of shadows, mid-tones and highlights in an image. **Photograph 6** shows an underexposed image of a 3D print, in this case there was little detail in the shadows, and a simple 'auto adjustment' brightened up the skull and even restored some texture to the background. As a rule of thumb, it's generally easier to 'rescue' an underexposed picture than an over-exposed one. In **photo 7**, simply darkening the image has just made the highlights an unnatural grey and made the whole image look 'flat'.

Professional photographers shoot 'RAW' images with 14 or more bits of colour depth, making it easy to recover details in bright or dark parts of the image through processing. Most of us will have cameras that save the output at a JPEG file which is only 8-bit colour depth, however they will still use an imaging chip with a greater range. If your camera or phone as a feature such as 'HDR mode' or 'D-lighting' as Nikon call it, it will automatically compensate to improve the shadows and highlights. This is a real boon for workshop photos which often have deep shadows or harsh highlights due to having to use lighting installed with the purpose of brightly illuminating a workpiece.

Colour balance is often poorly understood. The light under a natural sky is often very rich in blue, while that under old fashioned incandescent lighting is strongly yellow. By adjusting he 'colour temperature' setting on a camera you can compensate for this, however for all but a tiny minority of subjects you will find that using auto colour balance, you will get a much better result. This is especially true under fluorescent lighting and for most types of LED lighting. Using auto colour balance also avoid the awful results of using the wrong setting as in **photo 8**, taken using a 'sunlight' setting under incandescent light. Even using colour balancing in post processing (the right hand side of the image) has failed to correct it.

In summary, don't be afraid to trust the automatic settings of your phone or camera to get the technical aspects of your images right. In the next part of this short series, we'll move on to composition. ■

There are lots of things wrong with this picture, but the most obvious is that it has been taken with an outdoor colour temperature setting under incandescent lighting. Adjustment of the right had section has made a marginal improvement.

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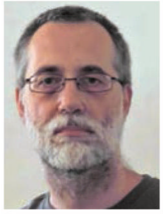
INST/SERV	HUGHES	320	9	P	A	ELEVATING A HORIZONTAL BANDSAW
INST/SERV	LANE	315	31	C	A	MYFORD IMPROVED TAILSTOCK 1
INST/SERV	LANE	316	31	C	A	MYFORD IMPROVED TAILSTOCK 2
INST/SERV	LANE	317	56	C	A	MYFORD IMPROVED TAILSTOCK 3
INST/SERV	LEONARD	313	18	C	A	MYFORD BEARING MODIFICATION
INST/SERV	LEWIS	310	9	P	A	RECOMMISSIONING A MYFORD ML4
INST/SERV	MAUREL	319	47	C	A	BANDSAW BLADE TENSION METER
INST/SERV	MAUREL	320	23	P	L	BANDSAW TENSION METER
INST/SERV	MILLER	314	41	P	A	LATHE TOP-SLIDE DIGITAL CALLIPER
INST/SERV	NESBITT	314	38	M	A	RESTORING A CENTEC 2A MILL
INST/SERV	PHILPOTTS	320	56	C	A	PILLAR DRILL COUNTERWEIGHT
INST/SERV	PURDY	313	38	C	A	MILLING MACHINE DEPTH STOP
INST/SERV	REVILL	312	48	C	A	SIEG SX3 DRO INSTALL
INST/SERV	SPEDDINGS	317	19	P	A	PROPER HANDLE
INST/SERV	TRETHEWEY	311	25	P	A	MYFORD 254V PLUS LATHE DRO FIT
INST/SERV	TOWERS	317	64	M	A	PEATOL SADDLE HAND WHEEL
INST/SERV	WOOD	315	19	P	A	RESTORING A SLIPPING DRIVE
LUBRICATION	PEPPER	317	14	C	A	CUTTING FLUID DRIP FEED
MARKING	BRAY	318	19	C	A	HOME MADE PRECISION OPTICS
MEASURING	LEWIS	314	48	P	A	MAKING A COMPARATOR
MEASURING	MACPHERSON	319	31	M	L	CALIPER SUBSTITUTE
MEASURING	RUSSELL	309	63	C	A	FINGER PLATE
MEASURING	TOWERS	320	33	P	A	TALE OF TWO INDICATORS
MEASURING	WOODING	309	37	C	A	MAKING AN ELEPHANT FOOT
MILLING	EVERETT	319	22	P	A	CHANGING A SHELL MILL ARBOR
MILLING	GORIN	310	59	C	A	X-Y DUAL AXIS WORKTABLE 1
MILLING	GORIN	311	31	C	A	X-Y DUAL AXIS WORKTABLE 1
MILLING	GORIN	312	31	C	A	X-Y DUAL AXIS WORKTABLE 3
MILLING	LEWIS	316	48	P	A	TANGENTIAL FLYCUTTER
MILLING	MAUREL	310	25	C	A	CARBIDE TIPPED MILLING CUTTERS
MILLING	WYATT	310	44	M	A	MILLING IN THE LATHE
MISC	BEAUMONT	318	27	P	A	THRUST MEASUREMENT RIG
MISC	CHEVALIER	320	22	C	L	SHORTENING SCREWS AND BOLTS
MISC	CUCKSON	309	9	P	A	TAILSTOCK TAIL
MISC	DEAN	316	39	M	L	CHESTER DB10 LATHE STOP
MISC	DINNING	310	16	M	L	MAKING LEGO WHEELS
MISC	DODDS	314	43	M	A	LOAD OF ABALONE
MISC	FARR	309	13	M	A	3D IMAGES OF WORKSHOP TOOLS
MISC	GEOMETER	315	18	M	A	JOINTS AND WASHERS
MISC	GEOMETER	316	29	P	A	CUTTING AND FITTING GASKETS
MISC	GEOMETER	319	21	M	A	SCRAPERS AND HOW TO USE THEM
MISC	GEOMETER	320	15	P	A	HAND FITTING METHODS
MISC	GEORGE	320	53	M	A	DRUMMOND TYPE M LATHE CASTINGS
MISC	HALL	311	61	P	A	CENTRE FINDING ON A SCREEN
MISC	HARTMANN	315	25	M	A	NO MORE BELLOWS
MISC	JOLIFFE	309	21	M	A	SUPPLEMENTARY WORK SURFACE
MISC	MANDREL	313	54	M	A	MACHINING CASTINGS
MISC	MANDREL	315	26	M	A	MAKING YOUR OWN TOOLS
MISC	MANDREL	318	32	M	A	JOINING METALS
MISC	MISSING	313	29	M	A	SIMPLE NUT STARTER
MISC	NESBITT	318	46	C	A	RIDE ON WALKER
MISC	STARGAZER	320	27	P	A	MAKING EYEPIECES 1
MISC	THEASBY	309	64	M	A	TUNING RADIO CONTROL
MISC	THEASBY	318	38	M	A	DIY FIXED STEADY
MISC	TRETHEWEY	314	9	P	A	MILL AUTO FEED UNIT
MISC	WOOD	320	32	P	L	EASY EXTRACTION OF SHAFT KEYS
MISC	WYATT	317	38	M	A	THE JOHN STEVENSON TROPHY
MISC	WYATT	318	18	M	A	STAN BRAY 1925 - 2022
MISC	WYATT	319	40	M	A	CUSTOMISING VEHICLES
MISC	WYATT	319	52	M	A	UPCYCLING USING METALLIC SPRAY

INDEX BY AUTHOR, SUBJECT, ISSUE AND PAGE NUMBER

Credits

This index is compiled by Barry Chamberlain. Supplies of Barry's computerised version CAHW are now sold out. For information on David Frith's computer searchable indexes please visit: **www.model-engineer.co.uk** and search for 'index'.

The Midlands Model Engineering Exhibition



October 2022 finally saw the return of a large scale model and hobby engineering exhibition after two long years of covid lockdowns and cancellations. Editor Neil Wyatt went along on the Friday to seek out interesting examples of workshop tooling.

MMEX is organised by Meridienne Exhibitions, and for them this was something of a bittersweet event due to the relatively recent passing of Chris Deith, the originator of the exhibition. His contribution to the hobby was marked by a new trophy, The Chris Deith Memorial Trophy, awarded to the best overall entry in the competition classes. The trophy was award to Mike Tull for his ¼ scale Working Model of Bristol Mercury MK8 9 Cylinder Supercharged Radial Engine. Mike actually made two of these engines, and **photo 1** shows the 'exploded' version which came third in the class in which his trophy winning example came first.

Stepping back for a moment, on arriving at the Warwickshire Event Centre, it was clear the show had attracted a good audience by the crowded car park, **photo 2**. This was borne out when I went inside with the halls already buzzing and continuing to get busier during the day, **photo 3**. There was a good attendance by sellers of smaller tooling, accessories and materials as well as sellers of castings kits and other kits and parts from small accessories to working railway engine models., **photo 4**.

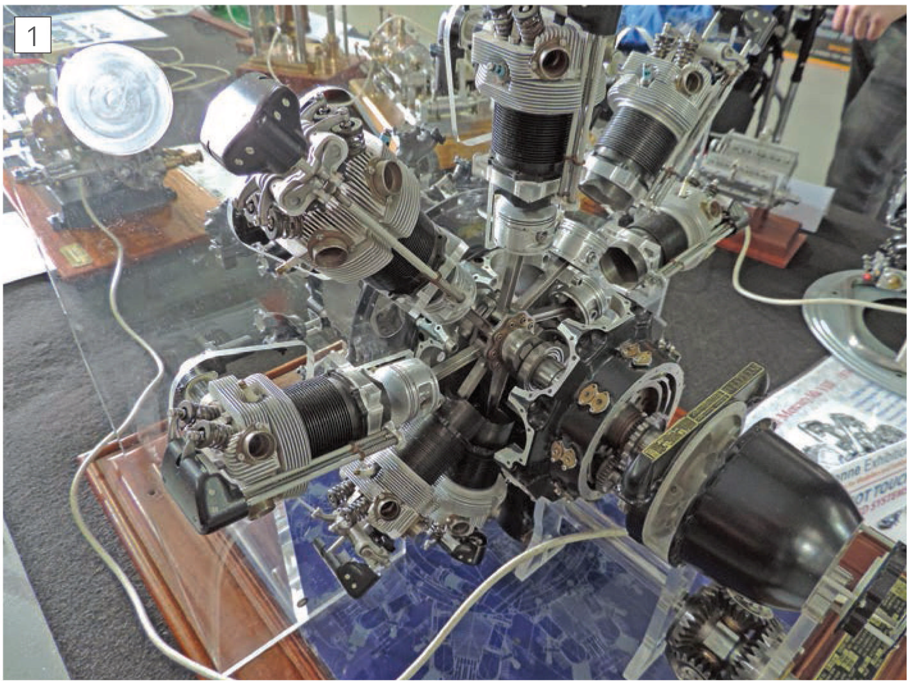
There were relatively few manufacturers or importers of large machine tools present, a trend which was already evident before covid struck. Exceptions to this were Proxxon, **photo 5** and Myford, who are now offering modest numbers of new machines, including a 'small bore' Myford Super 7, **photo 6**.

Naturally there were many club stands in evidence including several local clubs and some of the national societies such as the National 2½" Gauge Association, **photo 7**. Outside there was some live steam in evidence,

Outside the main halls there was an area set aside for live steam demonstrations, with a few traction engines running at all times, **photo 8**. An unusual example of tooling the sat between a model and a working item was the circular saw, **photo 9**, driven from the flywheel of a model traction engine.

Of course, my main mission was to find some examples of shop-made tooling. One of the first examples to catch my eye was a fine example of the Colyer-Casey tool and cutter grinder by David Arnold on the Coventry Model Engineering Society stand. Less often encountered than grinders made to the Quorn and Worden designs, this is a relatively compact design, **photo 10**. David explained several modifications he made to the machine, including longer

1



Mike Tull's 'Exploded' Bristol Mercury, I omitted to photograph the complete version which won best in show.

2

The car park was filling nicely when I arrived.

Inside the trade stands were attracting plenty of interest.

There was an excellent selection of small tooling and accessories to be found across Hall One.

Proxxon were exhibiting some of the beautifully made small power tools. Expect exciting new CNC options in 2023!

A brand new Myford Super 7, it's remarkable that these machines are still being produced after nearly seventy years!

bars for extended travel and the use of larger bracket to allow a 'Kennet' spindle that would take ER32 collets.

It's always nice to see things featured in the magazine 'in the flesh' so to speak and exhibited on the Coventry stand was Gary Wooding's bandsaw tension meter, described in MEW 319, **photo 11**.

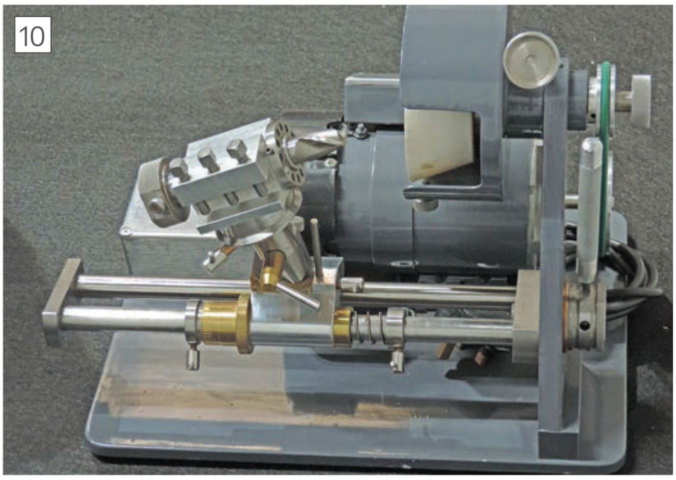
Dave Oliver from the Melton Mowbray and District MES exhibited a collection of jigs and fixtures made to assist with the manufacture of steam injectors, **photo 12**. Injectors are notoriously tricky devices to make requiring many tapered nozzles of exact sizes all fitted in careful alignment and spacing. The grinding fixture in **photo 13** is used to put precision angles on tiny reamers.

The Hereford Society of Model Engineers work hard to encourage and support young people in entering the hobby. **Photograph 14** shows and example work journal made by one of the youngsters and **photo 15** features

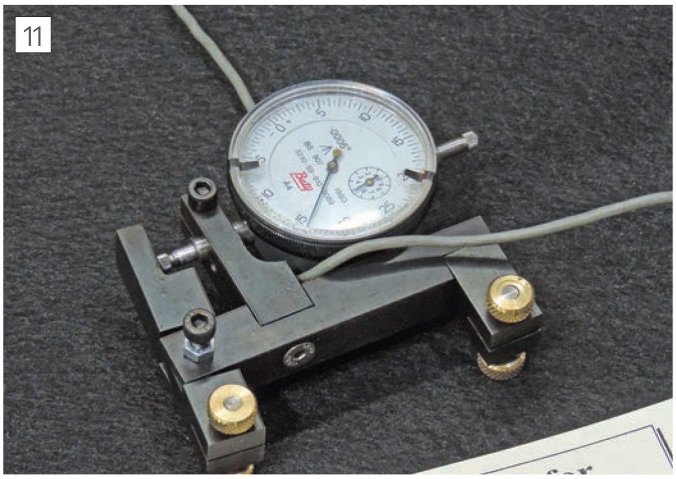
One of many national societies exhibiting, the National 2 ½" Gauge Association.

Outside was hot food and even hotter traction engines.

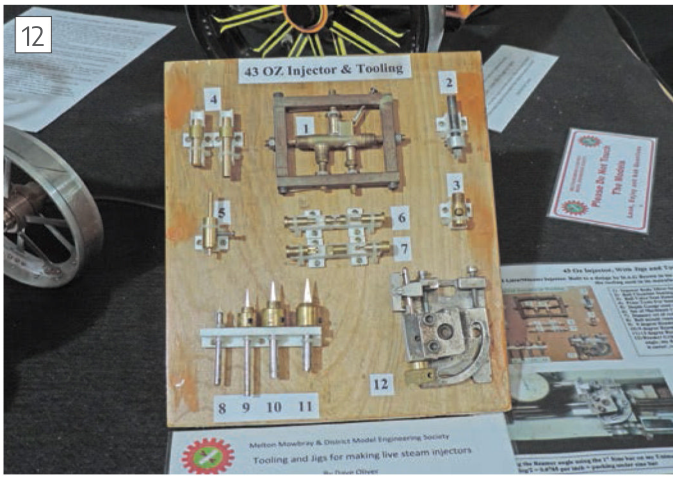
This demonstration of steam sawing attracted a lot of attention.



The Colyer-Casey design of cutter grinder deserves to be built more often.



Gary Wooding's bandsaw tension meter based on Jaques Maurel's design and featured in a recent MEW.

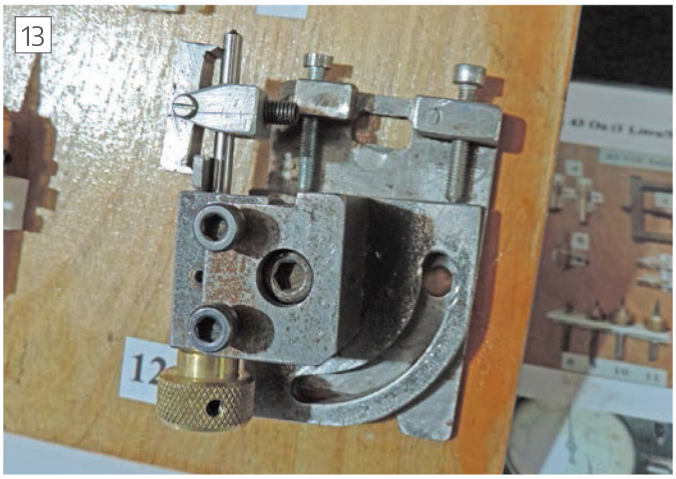


Dave Oliver's jigs and fixtures for making injectors.

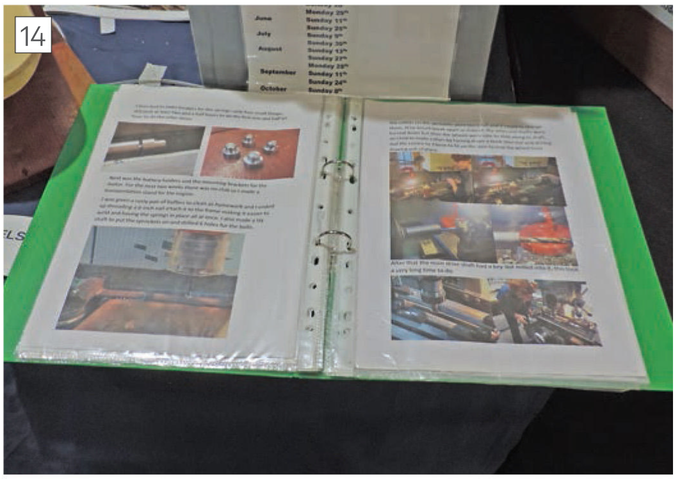
a selection of some of the tooling they have made to help with their projects.

One stand which always attracts a lot of interest at any exhibition it appears in is that of the Society of Model and Experimental Engineers (SMEE), **photo 16**. The SMEE is a remarkable organisation that shares its anniversary with Model Engineer magazine (the two are inextricably linked!) and there will be much more to say about both institutions next year, their 25th anniversary.

There was one very special exhibit on the SMEE stand, it was Tom Jacob's original gear hobbing machine, **photo 17**. Based on this prototype, castings have been available for a long time and MEW has featured many articles on the making and using of the Jacobs Gear Hobbing Machine. It's interesting to see how Tom Jacobs essentially built his version from his scrapbox, look at the stiffening bars in **photo 18** to beef up



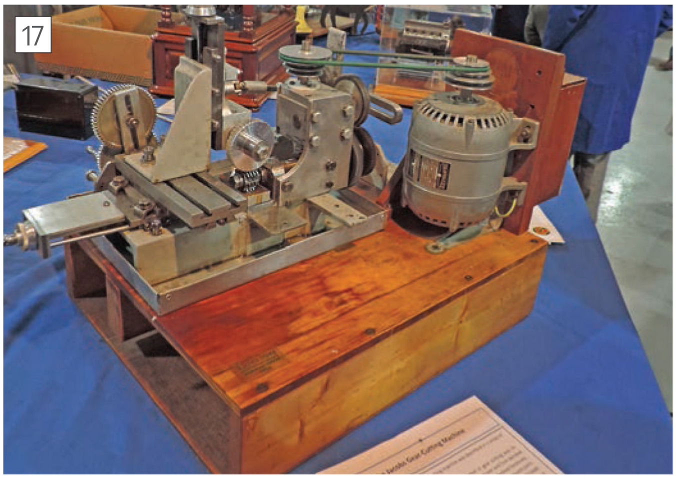
A closeup of the grinding fixture.



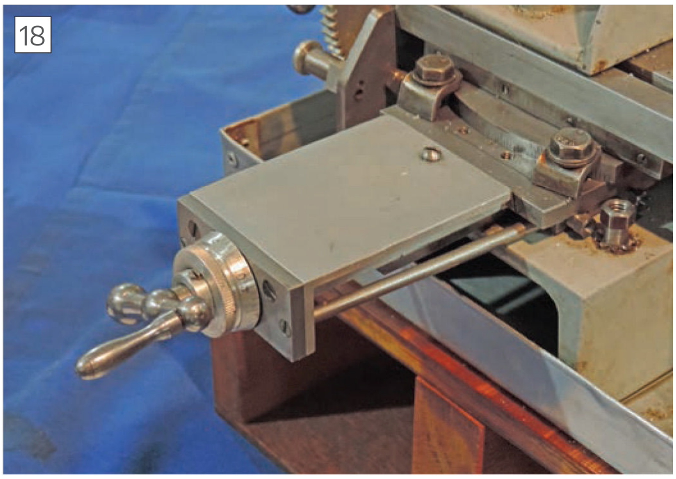
Young model engineers are encouraged to make a log to record their achievements by the Hereford SME.

Examples of tooling made by the young model engineers.

The Society of Model and Experimental Engineers' stand is always full of interesting things.



Tom Jacobs' original prototype gear hobber.

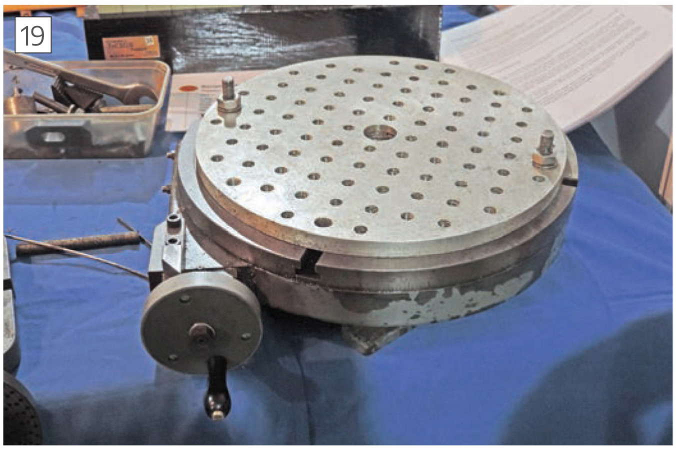


A close up of the restored machine shows economical design.

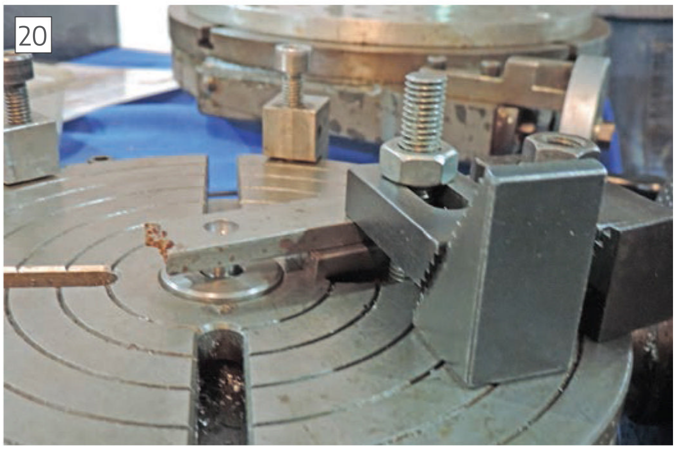
a too-light extension piece. The original has been in the care of SMEE for many decades, last being exhibited in the 1980s. It has been carefully restored by society members and was in action cutting a gear wheel when I saw it.

On the SMEE stand another interesting exhibit by John Florentin featured two large rotary tables. One of these **photo 19**, features a large aluminium adapter plate with many holes, most of which are tapped but others can be tapped in needed in the future. This plate offers far greater flexibility for clamping, using lengths of studding to secure the clamps. The plate also functions as a flexible face plate for John's lathe. The second small, but useful, piece of tooling was a simple jig that fits in the centre of another rotary table. Interchangeable centre pieces allow it to be use to locate workpieces for rounding their ends under the mill, **photo 20**. This table is also fitted with two moveable stops, visible at the rear, to simplify moving the work through exact angles.

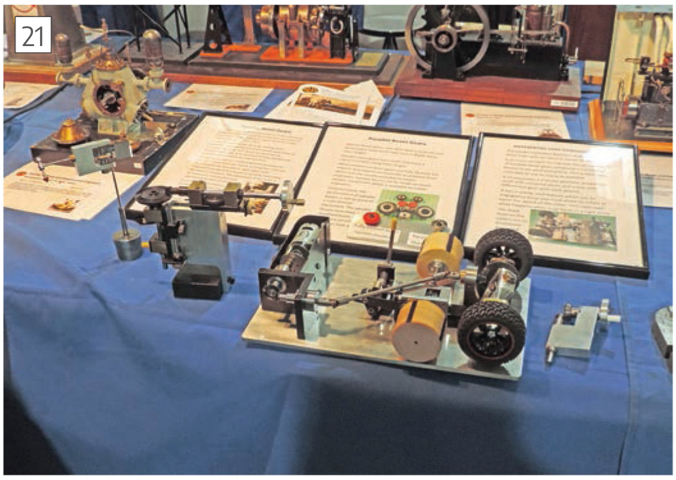
I also encountered Bob Reeve on the SMEE stand, he was demonstrating some of the setups used to test his bevels as featured in the 'Bob's Better Bevels' series. **Photograph 21** also shows demonstrator for differential



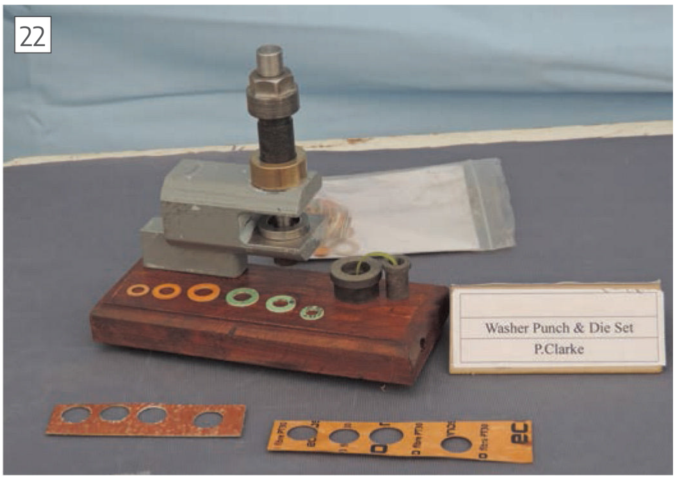
A flexible adaptor plate on a large rotary table.



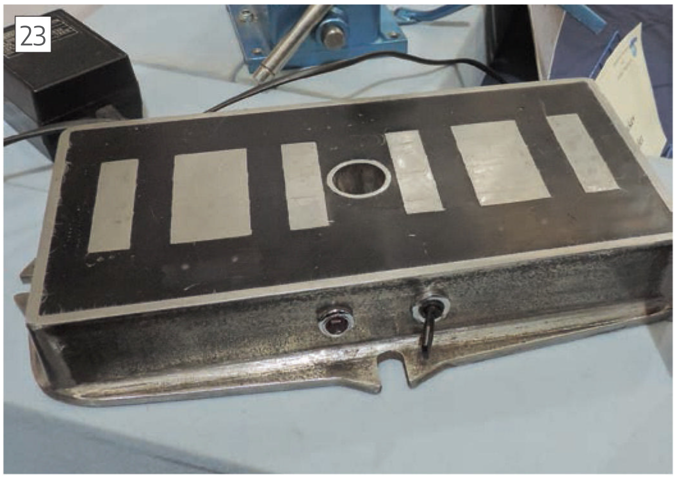
A simple device for centring work using interchangeable pegs.



Bob Reeves bevel gear test rigs and differential demonstrator.



A washer punch and die set by P. Clarke of the Erewash club.



An ambitious magnetic vice by Wally Sykes.

Four highly commended pieces of shop made tooling on the Birmingham club stand.

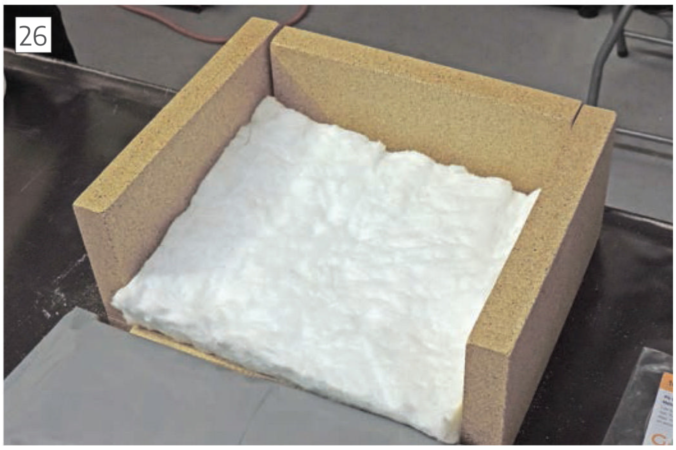
gears that shows how the two 'wheels' connected by the differential axle can rotate at different rates.

There were only four entries in the Machine Tools and Workshop Equipment competition, a shame as I saw several other items that might have done well, **photos 22** and **23**. All highly commended and on the Birmingham Society stand these were a Hemingway Sensitive Knurling Tool, a Reeves Sensitive Drilling Machine and a Hemingway Graduating Tool by Stephen Harrison, and a Simple Dividing Head by Keith Bloor, **photo 24**.

Just to finish, I'd like to highlight two rather nice things I saw on the CuP Alloys stand, one was a small oxy-gas set that could find a home in any workshop, no matter how small, **photo 25** and a really neat and simple hearth made from a few pieces of insulation board and a layer of glass cloth, **photo 26**. I have got the bits ready to make one of these, I really must finish it!

All in all, a very enjoyable day out and an opportunity to meet some old friends and to put faces to a few that I have only met online before! Let's hope MMEX continues its success and that we see other shows joining it again in the future. ■

Oxy-Turbo torch set on the CuP Alloys stand.



A simple brazing hearth.

Scribe a line

YOUR CHANCE TO TALK TO US!

Readers! We want to hear from you! Drop us a line sharing your advice, questions or opinions. Why not send us a picture of your latest workshop creation, or that strange tool you found in a boot sale? Email your contributions to **meweditor@mortons.co.uk**.

Rust

Dear Neil, the article on rust and rust removal (MEW 320) is something everyone should know. I have salvaged tools and machine parts from watchmaker size to really big using either malt vinegar or, latterly, proprietary lime-scale remover (less smelly) to remove rust.

Your article warns that de-rusted parts should be dried well and oiled to prevent re-rusting but one of the causes of this is that the de-rust solution is acid and, especially with organic acids which may leave a solid residue even when dried, it advisable to neutralise the acid used by giving a bath in washing soda or bicarbonate of soda solution (one teaspoon per litre) after rinsing, then dry in an oven.

Incidentally, I have frequently used brickwork cleaner (20% hydrochloric acid) to remove zinc plate from nuts and bolts which these days are more likely to be thus finished. When the effervescence finishes, wash, neutralise and dry well; then you can oil-blacken the fastenings for a nice finish.

Alan Moore, Leeds

2D CAD Packages

Dear Neil, my old computer has come to the end of its life, and Windows 8.1 will cease to be supported in January. My son-in-law Marc has given me his old computer which is light years ahead of my old one. Unfortunately this new one cannot be convinced it is a 32 bit computer so that I can run my AutoCad LT.

I therefore need to look around for another package. I know there are some free downloads to be had but I know I will struggle to learn a new system. I don't want to learn something new only to find out I have to buy the package at a later date. I would much rather buy it first.

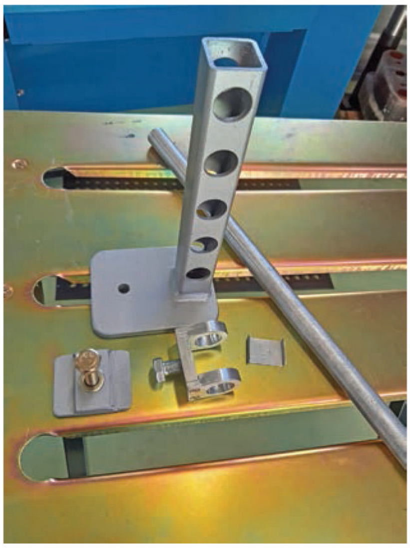
Can readers help and possibly advise me what is out there in the 2D world which does not warrant a small mortgage?

Graham Meek, Gloucestershire

Welding Steady

Many years ago I used to be a confident TIG welder but due to a slight career change I didn't do any TIG welding for more than 40 years. Now that I am retired, I had a job that required TIG welding so I purchased a TIG machine and whilst the brain remembered all the tech stuff my hands failed me due to the shakes, not as steady now. Surfing the net I discovered a rest that could be used to steady your hands during welding. Straight away the brain kicked in and I went about putting my own spin on one and this is the end result. I have used a 30 x 30mm box section for the upright and a 20mm diameter aluminium rod for the support that you rest your arm/hands on. Currently it bolts down via the slots in my table but there are plenty of other options to securing the base e.g. magnet etc.

The finished product works really well, alleviating the shakes. It can be adjusted in height to suit the job in hand as well as the length.



Rex Goadby, Australia

Mystery Tool

Dear Neil, is it possible that anyone can help me identify this tool and explain how does it work?

I will appreciate any help greatly.

Hawk Gripen, South Africa

Tangential Flycutter

Dear Neil, I was interested to see the article on the tangential flycutter by Howard Lewis in the June Model Engineers' Workshop when I got it earlier this month.

I had been toying with the idea of trying to make one myself but among the other bits and bobs happening in my life, I hadn't got around to starting.

I was puzzled though, by Howard's orientation of the cutter.

Considering Eccentric Engineering's Diamond lathe tools – the cutting edge is tangential to the piece being worked on, where the direction of action on the tool is close to a tangent of a circle.

As Gary of Eccentric Engineering has said, the whole idea of the Diamond tool is that a too heavy a cut will merely drive the tool bit sliding in the diamond holder, instead of any major crashing. It certainly worked for me when I was a bit too enthusiastic to start, rather than presetting the cutting depth prior to setting the Hafco 1000D into motion.

I've since been thinking of utilizing a Left Hand Diamond tool mounted so that the diamond edge of the tool bit is about 10 degrees to the face of the piece being milled.

The biggest problem, I think, at the moment, is that the whole thing is going to be rather large and heavy, and maybe unbalanced!

With my 16mm Diamond tool holder, with the tool piece tip on the diameter of the cutting circle, I'll need about 75mm square block, milled to give the correct angle and the groove to clamp the tool holder in place. And this has to be attached to a 3MT shank to fit my old, second hand, RF30 mill.

Doug Burchill, Australia

More on Exchange Clocks!

Dear Neil, I read with interest correspondence in Issues 320 and 321 of MEW discussing GPO Telephone exchange master/slave clocks.

I also worked for the GPO in the 1960's although in the postal side of the organisation rather than the Telecoms side, my work being involved with automatic mail sorting and I am familiar with the master/slave clock systems described in the previous correspondence because they were also installed in large post offices.

In addition to providing a 1 minute pulse to rotate the minute hand of the slave clocks, the master clock also provided 60 1 second pulses on the hour and any slave clocks which were not also on the hour, would be automatically advanced by these pulses until the hour was reached at which time a contact in the slave clock would open and prevent further stepping. This ensured that if a slave clock became out of synchronisation, it would be corrected reasonably quickly.

The master clocks were always well looked after and kept correctly adjusted by GPO engineers who invariably took pride in the appearance of both the mechanics and of the polished case and would be a joy to see. The slave clocks in the buildings were usually not nearly as grand and other than an occasional dusting would not receive any attention although clocks in public areas would be of a higher standard. If they gave trouble, they would be replaced and thrown away.

Keith Jeeves, Sydney, Australia

Hi Keith, I think the details of these clocks are fascinating, I can't believe how much interest MEW readers have shown in these clocks. Neil

Exchange Clock Offer

Dear Neil, I have an exchange clock. It was the standby clock from the Monument Exchange in the City of London. Whilst not immaculate it is pretty good and with it I have the Post Office instruction for installation and maintenance.

I have just downsized and would be happy to pass it on, at no charge, to someone who would care for it. First responder has it. He must collect from Reading.

Terry Hunt, Reading

Can anyone interested in this generous offer please email me, meweditor@mortons.co.uk, and I will forward any messages to Terry.

BEGINNERS WORKSHOP

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

Wheel and shaft pullers

TAPERS and light driving or force fits are common ways of securing components firmly to shafts and other parts-yet admitting of dismantling when required. Normally, no problems are encountered in assembling, as there is usually a nut, setscrew, or series of such, by which parts can be pulled together. It is their dismantling which occasions difficulty-or even damage, if the right methods and tools are not employed.

Tools with which dismantling is effected are called pullers, drags, or drawers: and take a variety of forms. Some components can be dismantled with universal tools covering a range of sixes, while others demand special tools for each purpose.

The common type of puller, A, consists of a beam carrying a pressure screw and slotted for a pair of jaws which can be adjusted to fit over components-flywheels? pulleys, sprockets, gears. Adaptations of this puller are those incorporating a three-armed beam with link and screw adjustment for three jaws; and those in which the beam is a circular plate, slotted for *jaw* attachments to three, four, and five stud fittings-these for drawing wheel hubs.

Out-of-the-ordinary pullers

On very heavy commercial pullers, the screw is often of large diameter with a fine thread and incorporates a hydraulic device which provides a very powerful extracting force. On pullers intended for vee-belt pulleys, the jaws, instead of being square, are tapered to fit the vee-groove, thus obviating damage. Such jaws would be incorrect for ordinary use because of a tendency to " ride up " under pressure.

When the component-usually a flywheel, sprocket or gear-has threaded holes for extractor studs, a simple puller can on occasion be used without a pressure screw, as at B, employing the nuts on the studs for tightening, then freeing the component by striking centrally on the bar with hammer and punch.

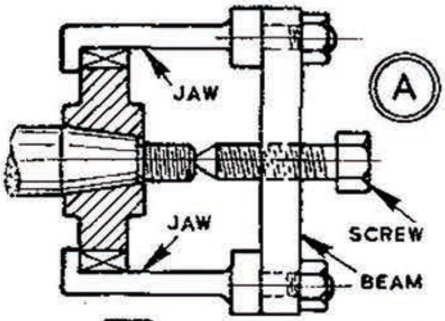
The shock of such a blow is generally sufficient to free the component and the same is true when a pressure screw is fitted-though in all cases it is necessary to consider what may be further along the shaft, so damage is not done by the blow. If possible, levering behind the component before striking is advisable.

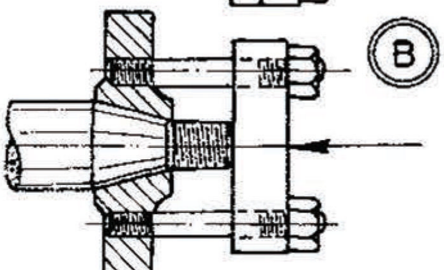
When there are special reasons, such as restriction by adjacent parts, slenderness in a pulley or hub flange, or other inherent weakness against extraction force, the boss of the component is provided with a thread to take a screw on puller, C, a type which is straighforward to use, but which must be screwed up fully-not on just a few threads.

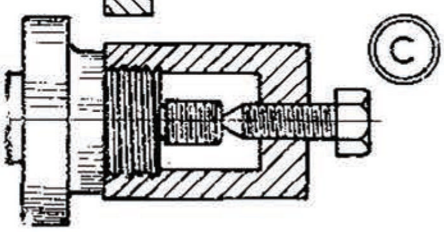
It will be seen the pullers described are fairly straightforward to make from mild steel, using B.S.F. bolts in commercial sizes. Type B is particularly easy, requiring only two holes drilled through the bar, and two studs for attachment. Type C can be made where a lathe is available-and material of sufficient size.

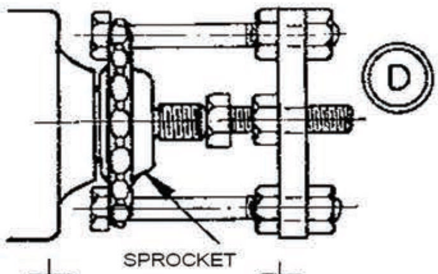
Other equally easy-to-construct pullers appear at ***D, E*** and ***F.*** That at ***D*** is intended particularly for small sprockets and consists simply of three suitable bolts and a bar. The latter is drilled clearance, centrally for the pressure bolt, and at suitable spacing for the bolts acting as jaws to lie holding firmly in the sprocket teeth.

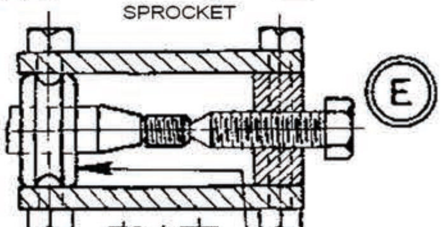
The type at ***E,*** slightly more complicated, can be used with a pressure bolt like the other, or with a tapped hole for a screw as shown. This puller is intended for drawing inner members of ball bearings, and holes are drilled in the top and bottom plates for the two bolts passing through to hug tightly in the semi-circular track of the race member. Two bolts also attach the endplate for the pressure screw or bolt.

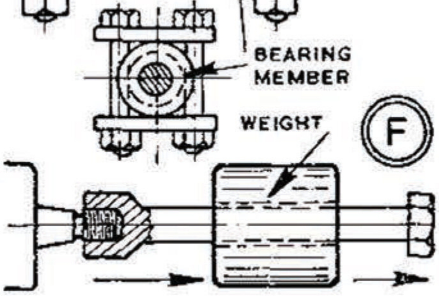












The type at ***F,*** known as an impact puller, is employed for drawing axle shafts and bearings, and differs from the others in functioning by shock instead of pressure. It is threaded at the end to screw on the shaft, and the weight is bumped to the opposite end. ❑

Make a

Hydraulic Press Brake

Paul Lousick needed a sheet metal press to make parts for an engine, he found the most practical solution was this sprung press brake that fits inside a 20-tonne press.

A press brake is a tool for bending sheet metal. It forms predetermined bends by clamping the workpiece between a matching punch and die. The term brake was derived from the Middle English verb breken, which means to break or change the direction of or deflect.

In a mechanical press, energy is added to a flywheel with an electric motor. A clutch engages the flywheel to power a crank mechanism that moves the ram vertically. Accuracy and speed are two advantages of the mechanical press. Hydraulic and pneumatic presses operate by means of cylinders to apply a force. Servo-electric brake presses use a motor to drive a ballscrew or belt drive to exert force on the ram.

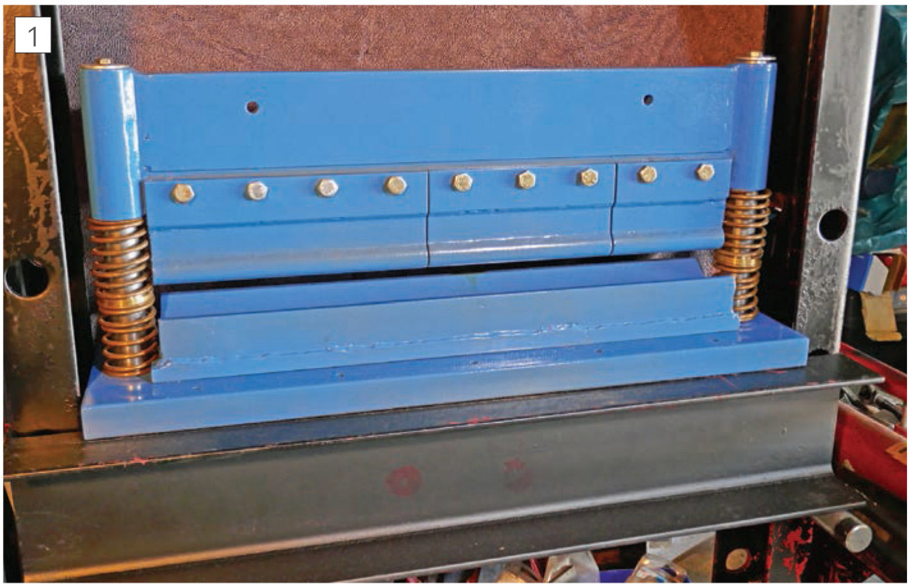
Until the 1950s, mechanical brakes dominated the world market. The advent of better hydraulics and computer controls has led to hydraulic machines being the most popular.

Pneumatic and servo-electric machines are typically used in lower tonnage applications. Hydraulic brakes produce accurate high-quality products, are reliable, use little energy and are safer because unlike flywheel-driven presses, the motion of the ram can be easily stopped at any time in response to a safety device.

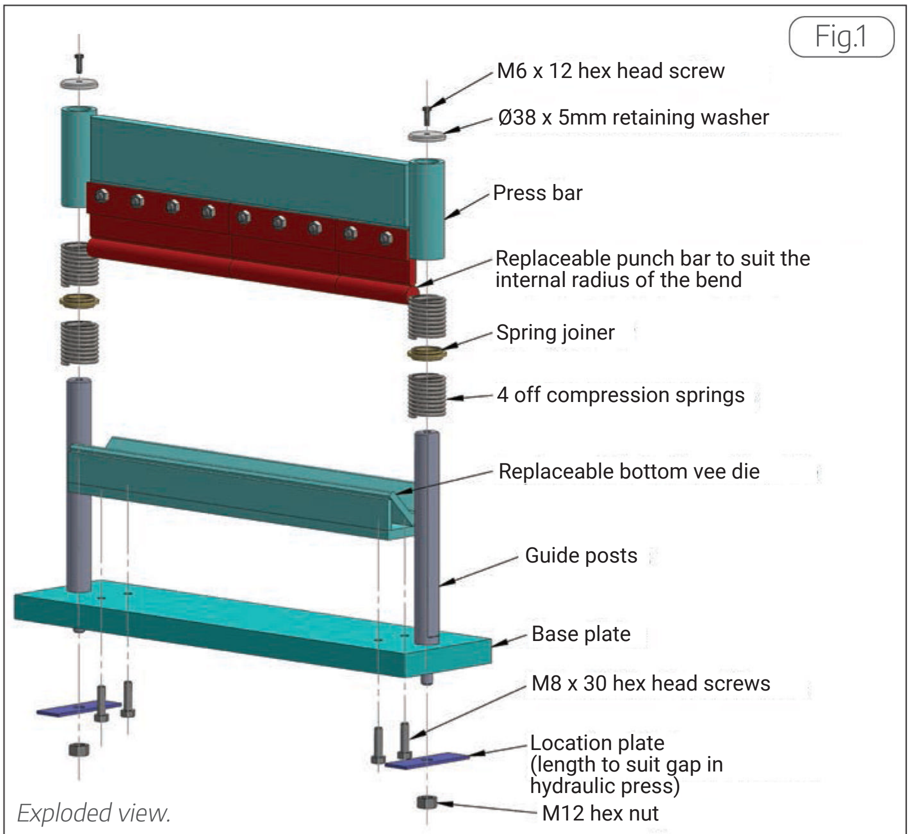
I have a 20 tonne hydraulic press which I purchased as part of the workshop tooling to build a steam traction engine. Commercially available brakes are available to suit the press but do not have some of the bending features that I needed to make parts for an engine, so I made the one shown in **photo 1** and **fig. 1**.

This press brake may be fitted with changeable bottom and top dies for bending plates with different radii and the press blade may be used without a punch bar for bending thin sheet metal with a smaller radius, **fig.2**.

The punch bar, **fig. 3**, must fit inside of parts that already have bent edges

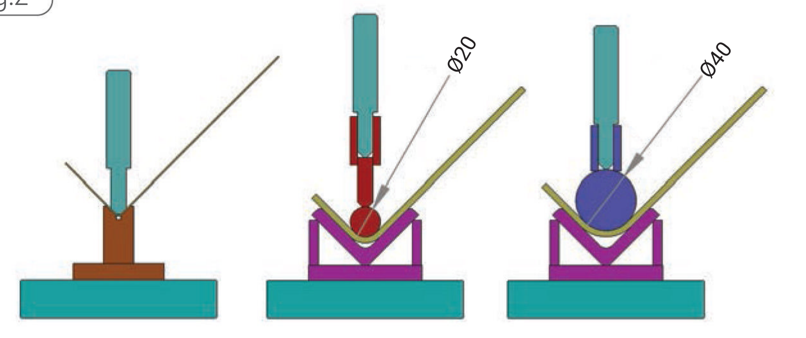


Brake press.



Exploded view.

Fig.2



Changeable punch and dies.

and are therefore made in segments of different lengths. This allows the previously bent sides to clear the punch, **photo 2**. (Dies of different lengths can be used together or made to specific lengths to suit your individual requirements).

Figure 4 is the general arrangement of my design. I will go through the main parts in turn.

Press brake double bend.

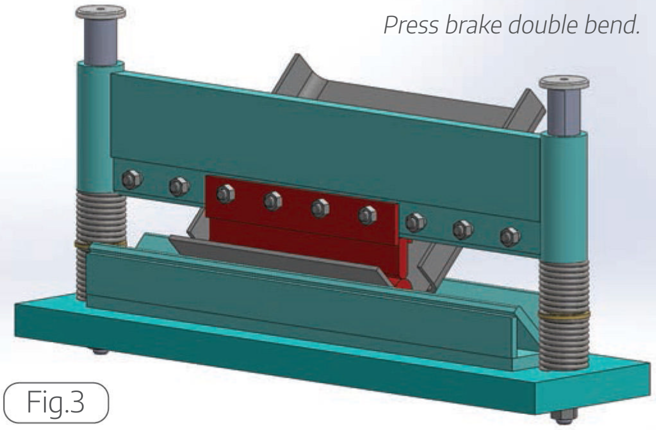


Fig.3

General arrangement.

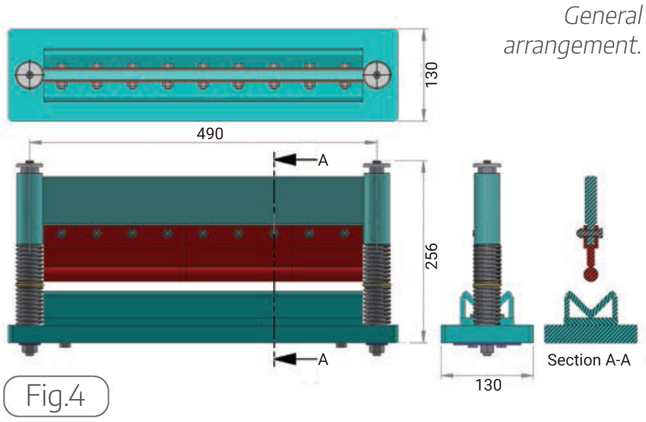


Fig.4

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Bending plate.

Base Plate, fig. 5

Cut plate to length and drill and ream 2 x 20mm dia. holes for the guide bars and 4 x 8.5mm holes for attaching the bottom die.

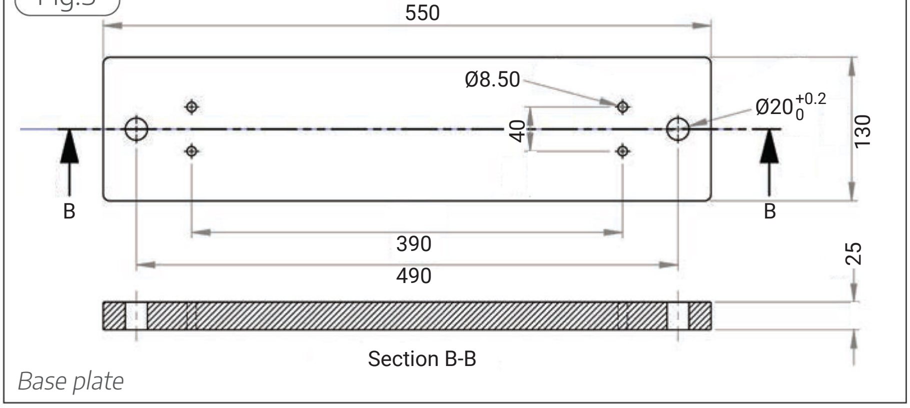
Bottom Die, fig 6

Start by milling a small flat on the bottom corner of the steel, **photo 3**, angle to allow it to sit square and flat on the base plate.

Then clamp the base plate to a rigid structure and weld the parts together in small, alternate steps. (Too much weld and heat in one place will cause distortion).

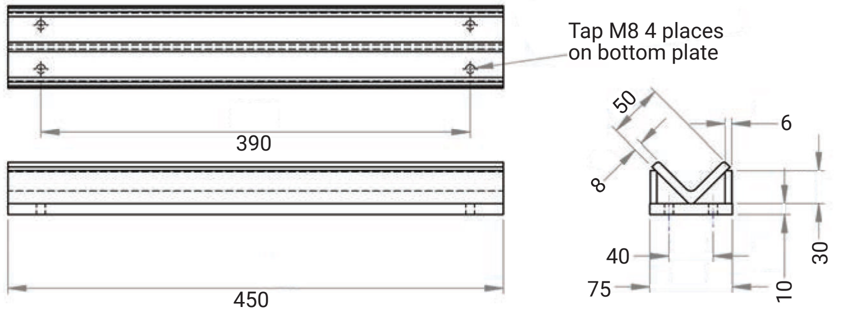
It is important that the mounting holes are equidistant about the centre line of the steel angle as this weldment will be used as a jig for fabricating the punch bars.

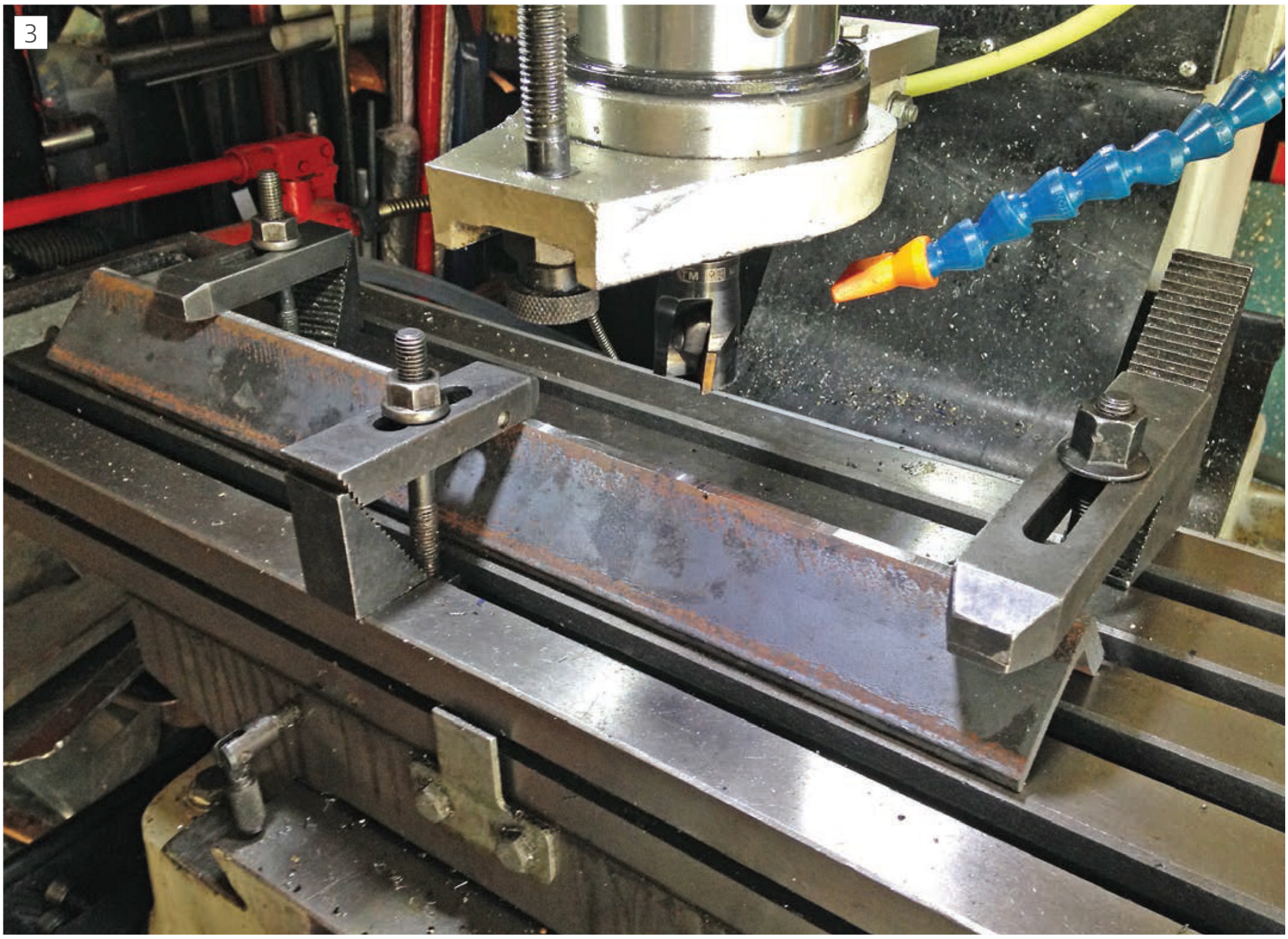
Fig.5



Base plate

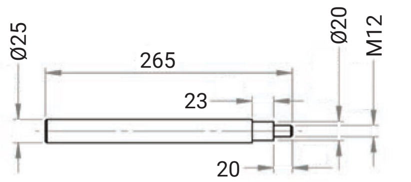
Fig.6 *Bottom die.*





Bottom die machining.

Fig.7 *Guide post.*



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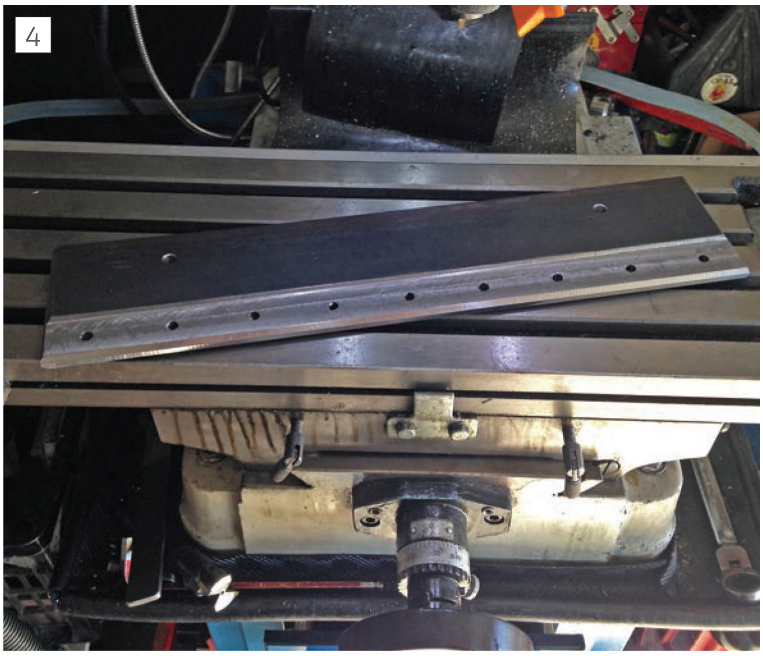


Blade machining.

Guide Post, fig. 7

Turn two posts for a tight fit with the holes in the base plate.

Press Blade, fig. 8

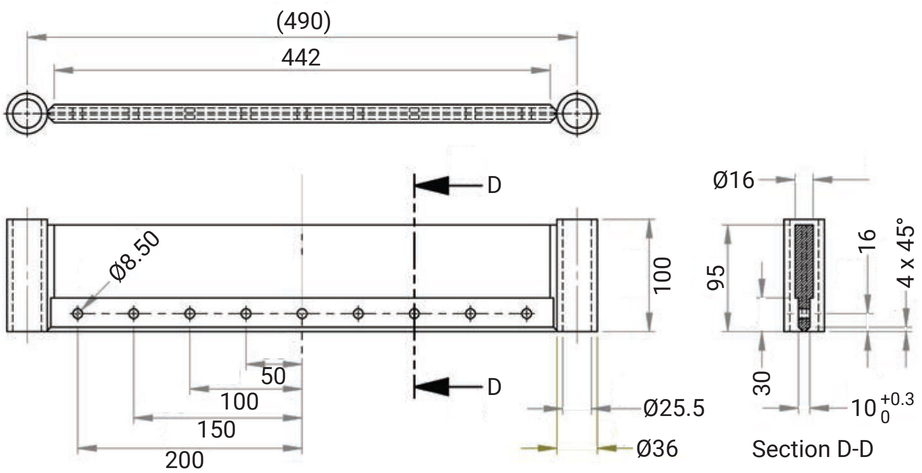
Mill front and rear of blade and a 4 x 45° chamfer on the bottom edge. Drill mounting holes, **photo 4**.

Set-up for welding Press Blade, fig. 9

Assemble base plate and guide posts and bottom die. Use this set-up for aligning the blade with the vee groove in the die and weld the blade to the two pipes.

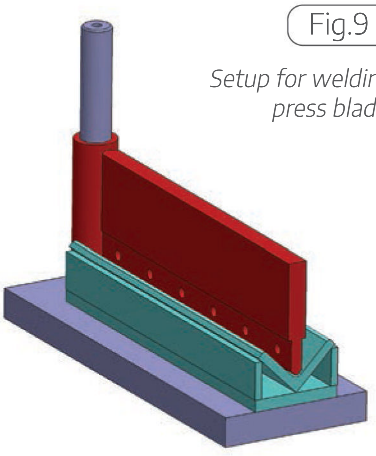
My welding was a bit on the heavy side and needed a bit of tidy-up after fabrication, which I did on the mill, **photo 5**.

Fig.8



Press Blade.

Fig.9 *Setup for welding press blade.*



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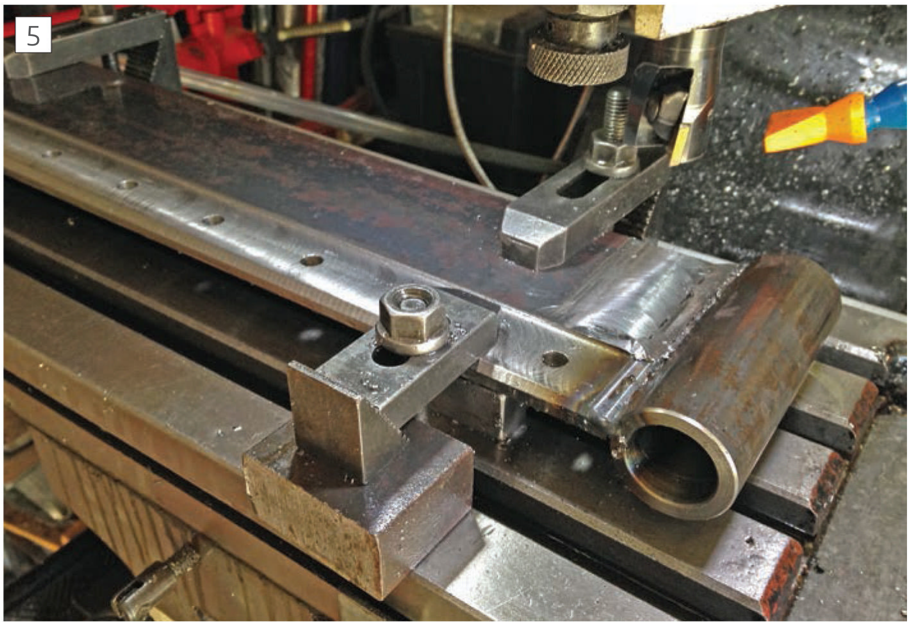
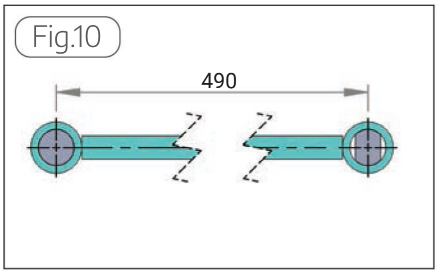
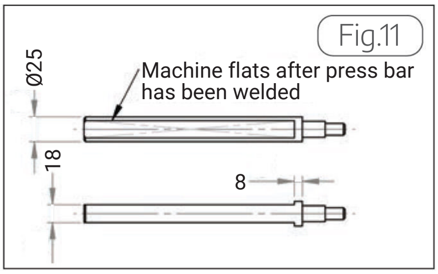


Blade welding.



Guide bar modification 1.

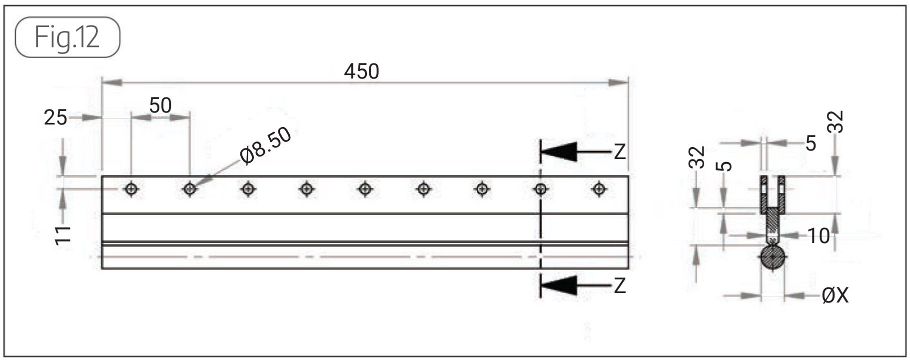


Guide bar modification 2.

Guide Bar Modification, fig. 10

Note: If the Press Bar is not aligned and spaced exactly with both guide posts it will jam and not slide easily.

Milling flats on the side of one of the posts, **fig. 11**, will overcome this problem and compensate for any difference in distance between the two pipes on the press bar while maintaining an accurate alignment with the bottom die.



Punch bar.

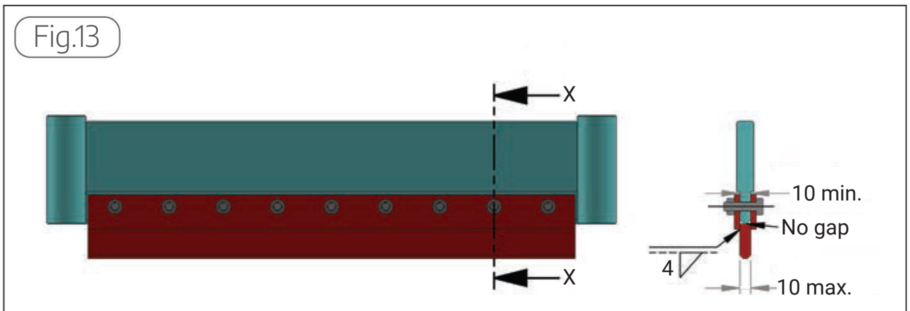
Punch Bar, fig. 12

Use a round bar to suit the inside radius of the bend that you want to make.

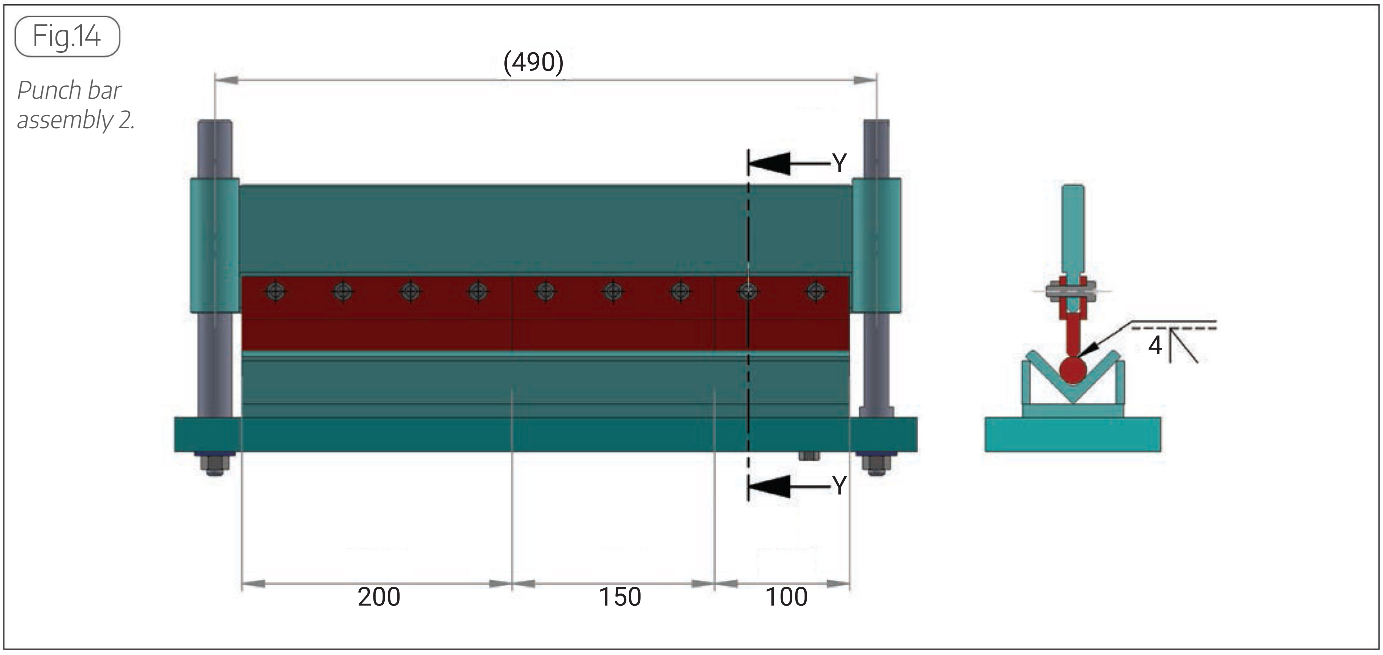
Punch Bar Assembly

Part 1, **fig. 13**

Bolt the 2 outer plates of the punch to the press bar. Then slide the middle plate between them until it butts against the bottom edge of the press bar. This will ensure that there is a tight fit between the bar and die after welding.



Punch bar assembly 1



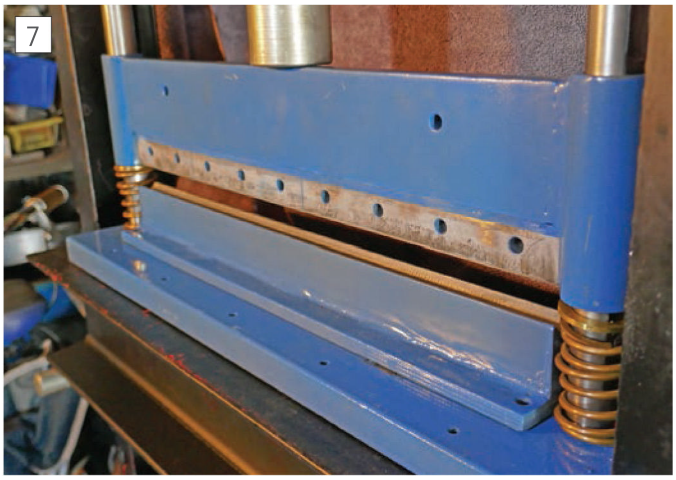
Punch bar assembly 2.

Punch Bar Assembly

Part 2, **fig. 14**

Assemble the press bar and punch in the base assembly and use the vee groove to align the round bar of the punch and weld together.

Cutting punch.



Small radius die.

Individual Punch Bar

Cut punch into lengths to suit requirements, **photo 6**, if required to clear other bends in the work piece (refer to earlier examples).

Set-up for bending a small radius

This arrangement, **photo 7**, is limited to bending steel sheets up to 1.6mm thick by using the bare press bar without a punch and optional bottom die. Remove one of the springs on each side to lower the blade.

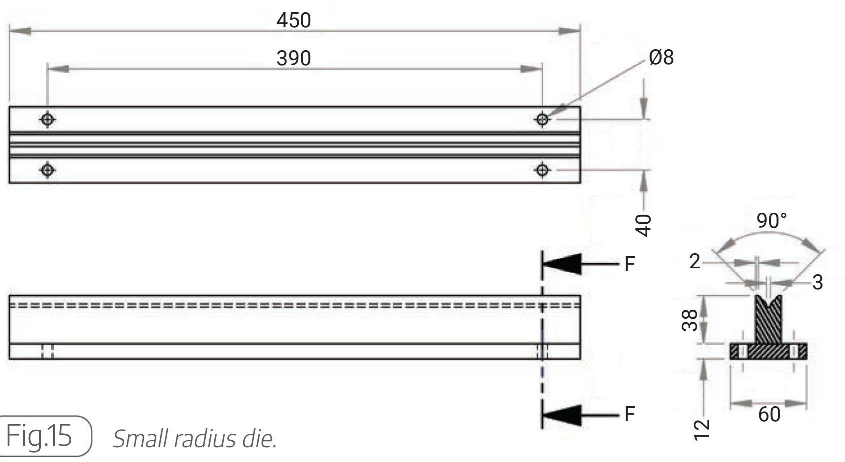


Fig.15 *Small radius die.*

Bottom Die for Small Bend Radius,

fig. 15

Bolt the mounting plate to the press base and lower the blade into the vee slot to align it, then weld parts together.

Bottom Die for Optional Radius Bends

Optional Press bars for forming different bends can be made by selecting a round bar with a diameter to suit the inside radius of the work piece, **photo 8**.

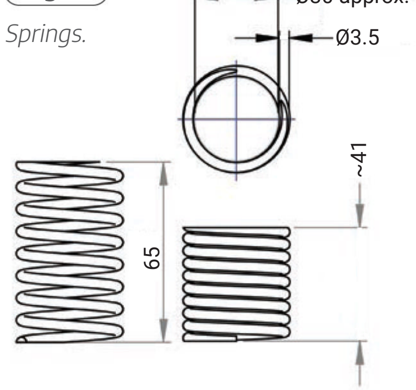


Fig.16 *Springs.*

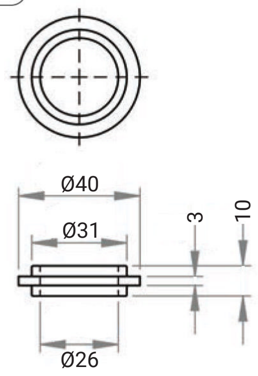
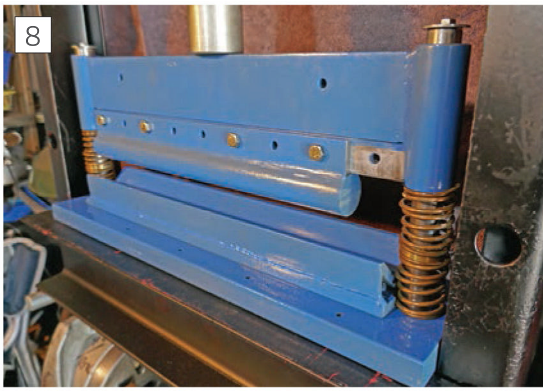


Fig.17 *Spring joiner.*



Large radius punch.

Springs, fig. 16

The selection of compression springs for supporting the punch bar are not critical. Those that I have used are valve springs from a car engine. (Hardware stores sell a range of different sizes). A single, longer spring may be used if the bottom die for small bends is not required but will not compress enough when the press bar is used without a press blade.

Spring Joiner, fig. 17

Make the joiner to suit the springs which you have chosen. It should have a loose, sliding fit with the guide posts. ∎


Jaw Regrinding - Pete Barker

High Ratio Bevels

Bob Reeve continues the development work documented in "Bobs Better Bevels" (Ref 1). The bevel gears in question are the sort of bevels made by Model Engineers and are usually known as parallel bevels because the tooth depth is constant along the length of the tooth, unlike commercial bevels which are usually described as fully formed.

Parallel bevels are attractive to model engineers because they can be made without the large and expensive machines used for their fully formed equivalents. The two types of bevels are shown in **photo 1**, with the larger bevels being fully-formed commercial products. However, parallel bevels are generally inferior in terms of smooth running and backlash. The latter persists even when they are tightly meshed. The revised geometry developed in "Bobs Better Bevels" improves this, but for technical reasons the development was initially on 1:1 bevels and then largely on 2:1 bevels. Bevels having a higher ratio were noticeably more difficult to manufacture and as 2:1 became 3:1 then 4:1, I realised that some revisions in the manufacturing sequence were required. **Photograph 2** shows blanks and finish machined 4:1 parallel bevels. The crown wheel is in cast iron with 60 teeth, Module 0.5. The large number of teeth, increased diameter and shallow angles all contribute to the increased manufacturing difficulties.

The bevels in question were all manufactured on my CNC X3 mill with a 4th axis; **photo 3**. Manual milling should be possible, but is prone to errors because of the large number of precise workpiece movements required. The Holy Grail here was a parallel bevel that came as close as possible to a fully formed precision bevel in terms of smooth running and lack of backlash.

The first problem was concentricity of the arbor flitted to the fourth axis. Initially this was 7mm diameter silver steel held a collet with drawbar. On investigation, using a long ground test bar with a 2MT end, the best I could achieve was just over 40 microns TIR (1000 microns = 1 mm). Probably not too bad for an inexpensive imported rotary table, but not good enough! The question was what to do about it?

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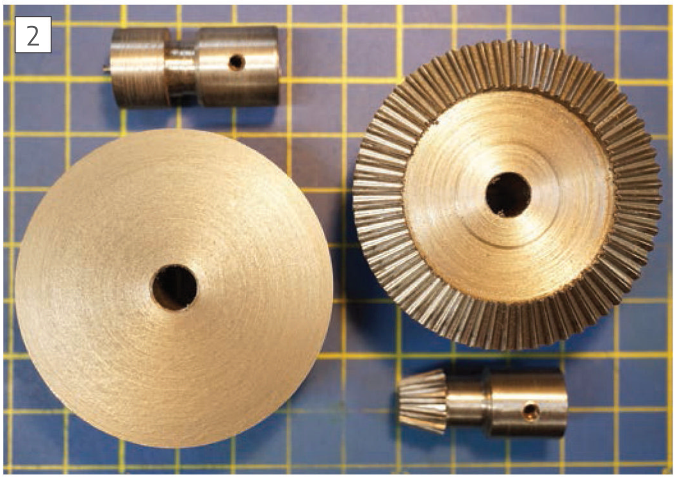

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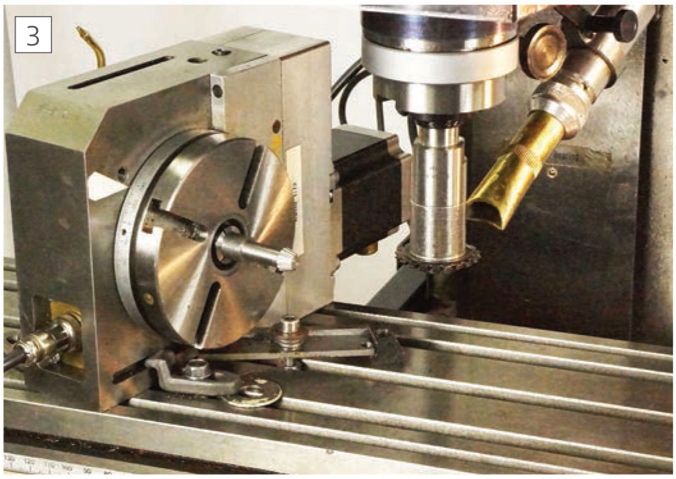

Fellow members of SMEE suggested that I might grind the arbor in the rotary table, which was definitely easier said than done. I started by turning the required shape in silver steel between centres which was to be subsequently hardened and ground all over. **Photograph 4** shows the arbor being quenched in oil straight from the fiery furnace. Tempering was done in a domestic oven at 200°C.

The grinding allowance was problematic, and I settled for 0.025 -0.050 mm on the taper, but the 0.4mm I allowed on the 7mm parallel portion was far too generous.

For the next phase of the machining I need to introduce my Myford. Not quite what you might expect, and **photo 5** shows my MG 12-M cylindrical grinder with internal and external grinding capabilities. The M indicating this is a manual machine without the hydraulics of the more sophisticated versions. The 12 indicates the maximum external diameter in inches. Also needed were the setting bars in **photo 6** ground by my own fair hand. These allow the MG12 to be set up both for the MT2 and the parallel portion of the arbor.

Preliminary grinding of the arbor commenced with the No. 2 Morse taper, **photo 7**, followed by the parallel portion, **photo 8**. Note that, for reasons of accuracy, the centres in a cylindrical grinder are usually kept stationary and the workpiece is rotated by the catch plate.

Photograph 9 shows the rotary table for my X3 which was converted to CNC use and no longer has a manual capability. Note the just visible, red dots on the MT2 socket to ensure the arbor is replaced in the same position each time.

Photograph 10 shows the rotary table mounted on the bed of the MG12 using special angled T-nuts to match the angled T-slot provided. Since the rotary table was only designed to be splash proof it needed some added protection for operating with a flood-coolant supply. That was provided by placing a polythene bag over it. This is not shown in the photo, since it proved impractical to photograph anything meaningful inside the bag. Only the blued portion of the workpiece, poking through a hole in the bag, could be seen.

Grinding was started cautiously, which was perhaps as well, because what happened next was unexpected and too rapid to photograph. The blue was removed in parallel stripes initially 1-2 mm wide, along the length of the parallel portion. This was only transitory, and all the blue was soon removed.

My explanation for this was that the narrow stripes indicated lateral movement of the workpiece caused by the pressure from the worm which

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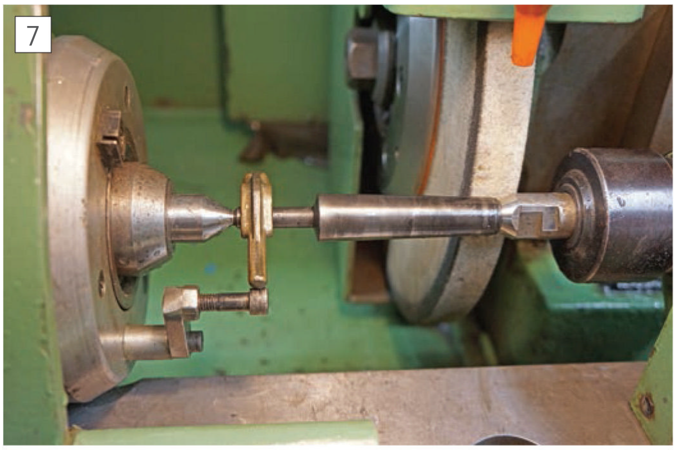
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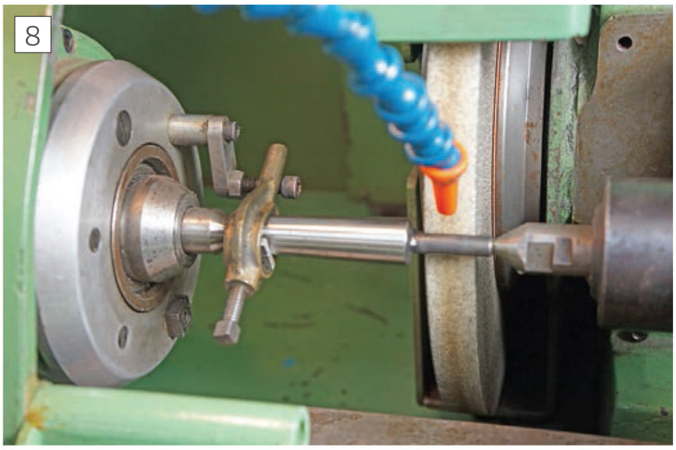
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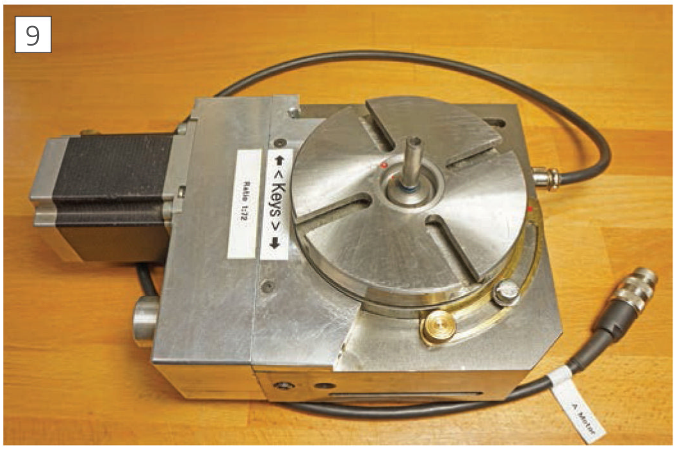
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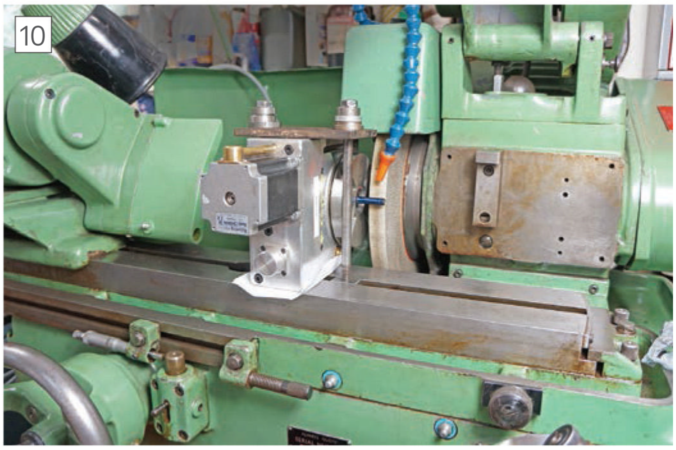
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was rotating slightly eccentrically. Slight slackness in the wormwheel bearings allowed the workpiece to be pushed towards the grinding wheel and so produce a stripe. In addition the stripes were more prominent on one side of the workpiece than the other, this time indicating some eccentricity in the wormwheel itself. Had the stripes been tapered that may have indicated some angular misalignment which was fortunately not the case.

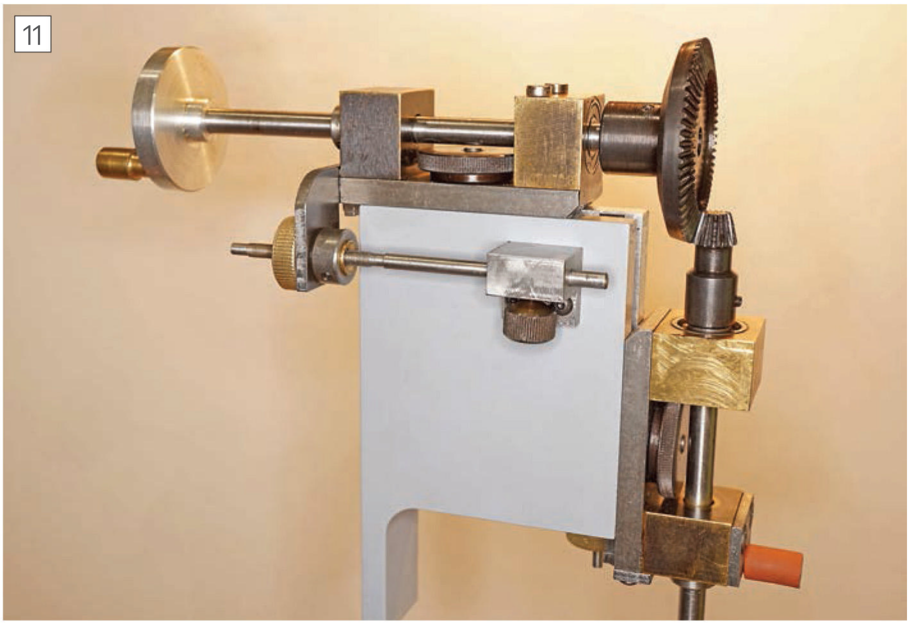
With the new ground arbor in place another pair of 4:1 bevels were machined but not before measuring the runout. This time better than 10 microns TIR – a better result but somewhat flattered by the shorter length of the arbor.

To assess the gears I used the test rig originally introduced in “Bob’s Better Bevels”, but with a few refinements; **photo 11**. Most noticeable is the small hand wheel to rotate the gears, but more significant are the two micrometer-type adjustment to move the gears independently, each along its own axis. Each turn of the thumb wheel moves the gear 0.025”. This time, on a whim, I chemically blacked the gears before mounting them in the test rig.

As expected, they were noticeably better. But the chemical blacking had an unexpected benefit. After a few turns of the handle a bright wear pattern began to appear at the outer ends of the crown wheel teeth. Not easy to photograph and even harder to explain; **photo 12**.

It seemed to me that the most likely cause was that there was a slight error in the pitch cone angle of the crown wheel. Since the gear blanks are turned, the initial accuracy of the angle was dictated by the angular graduations of the top slide on the lathe. Subsequently, this was modified by the angular setting of the 4th axis on the CNC mill which had been set with a protractor. In both cases the graduations were 1 degree. So, at best, with careful interpolation I might have achieved ±0.1°. Clearly not good enough.

One possible improvement was to use a dial gauge to measure the deflection produced by a known movement along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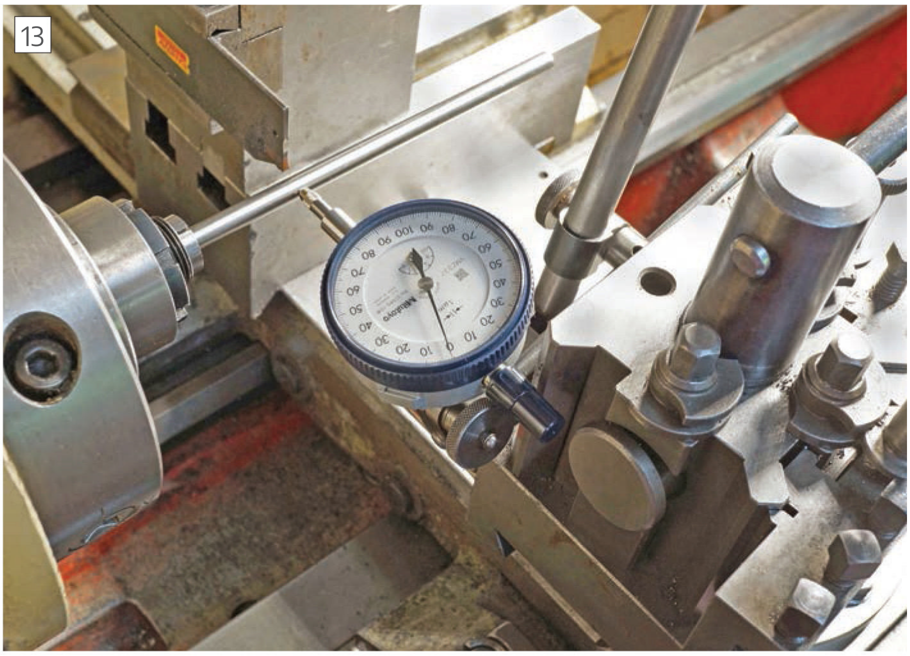
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one axis, then check the angle using a bit of geometry. **Photograph 13** shows the set up for the pinion which used a parallel bar with a dial gauge with a 1 micron sensitivity. The topslide was set over to the pitch cone semi angle.

Because of the limited travel of the dial gauge (1mm), and the shallow angle involved, a slightly different set up was required for the crown wheel; **photo 14**. For setting the rotary table on the mill the arbor was too short to use directly, so after checking that the arbor was square to the rotary table, I used the surface of the rotary table; **photo 15**.

Note the custom clamps used for the rotary table. The Y-travel on the X3 was limited and the clamps were designed to make best use of what limited space was available.

For a 4:1 bevel the pitch cone angle should be ArcTan (1/4) = 14.036° (Ref 1)

The top slide movement for 1mm deflection of the dial gauge required is 1/ Sin 14.036 = 4.123 mm.

To gauge if this was likely to be an improvement, an estimate of the uncertainties was created (When I was at school this would have been an estimate of likely errors, but is now "uncertainties" – that way no one has to admit to an error!).

As a preliminary exercise, it was first necessary to assess what sort of errors might arise and where. There are two distances to be measured, one by the dial gauge and the other by the topslide dial. In both cases the movement is assessed by taking a reading at the beginning and then at the end. There is an error of the same magnitude associated with each. Therefore the maximum error in the distance travelled is twice the individual errors.

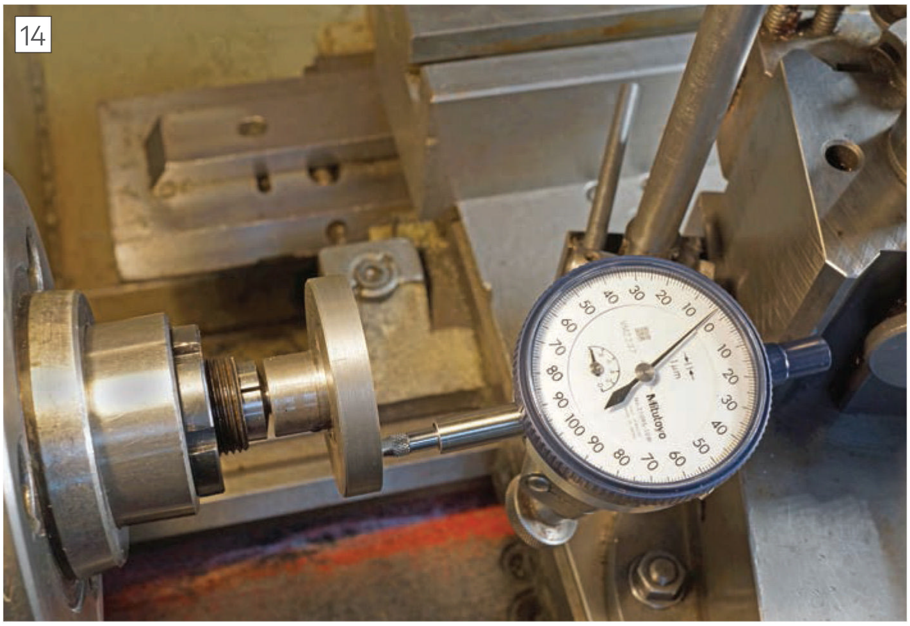
The worst-case scenario assumes the errors are combined so as to give the maximum error. But in reality, the errors will have varied in magnitude and direction, usually in a random way. I used the root mean square (RMS) method as an alternative method of assessment which usually gives a less pessimistic result (hopefully)!

Uncertainty of measurement estimate used to predict accuracy.

- Worst case scenario Dial Gauge readings ±2μ ie 4μ max.
- Worst case topslide dial reading ±0.02mm ie 0.04mm max.
- Worst case angular error ArcSin(1004/4083)= 14.235°
- Calculated bevel angle 14.036°
- Max. Error 14.235 -14.036 = ± 0.199°
- Probable (RMS) error = ± 0.104°

The results were initially somewhat disappointing being almost identical to the figure I had guessed earlier! The implication was that if my initial guess was correct there would be little benefit from my improvements. However, the proof of the pudding etc. etc. So the mill was set up to machine a new pair of 4:1 bevels. About forty minutes and one cup of tea later, the new pinion was complete; **photo 16**. Note that the rotary table has also been modified with a brass quadrant equipped with a fiducial mark which can be rapidly moved to the start point when cutting the teeth.

The new gears were set up on the test rig and, in deference to my observations ›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on the chemically blacked gears, treated to a sparse coat of engineers' blue (the one that does not dry). The results are shown in **Photo 17**.

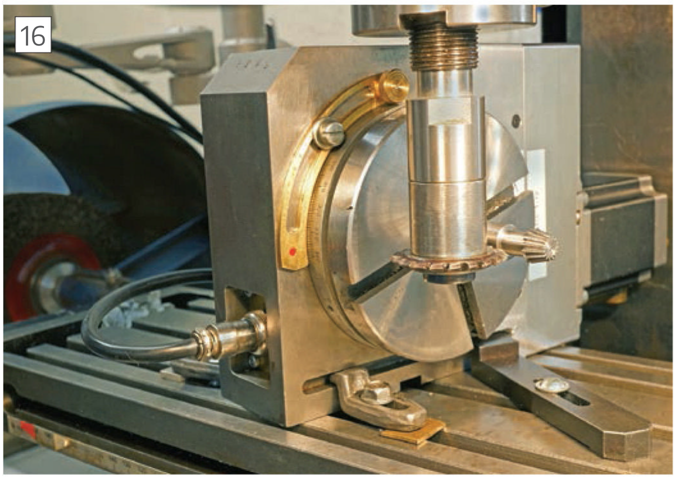
The first observation was that these gears were definitely superior to the previous ones – both in terms of smooth running and lack of backlash. I was forced to conclude that my initial estimate of angular error had been optimistic! But optimum running was only available if the meshing was very carefully controlled, which indicated there might have been scope for further improvement.

There were some further features revealed by the Engineers' Blue which confirmed this and needed explaining:

1. There was no longer a wear pattern restricted to the outer ends of the crown wheel teeth. So there had been a pitch angle error that had now been corrected.
2. The wear track on the crown wheel approximated to a square with rounded corners.
3. The wear track on the pinion was a diagonal line.

The last two were still attributable to eccentricity, but where? After a long search I found some intermittent eccentricity in the 7mm lathe collet and (to my shame!) one shaft in the test rig was slightly bent! Probably due to an unscripted trip from the milling machine table to the floor!

In the meantime, fellow SMEE member, John Fry suggested an even better method of improving the accuracy of the pitch cone angles. **Photograph 18** shows the lathe set up for the pinion. Slightly different set ups were required for the crown wheel and the rotary table



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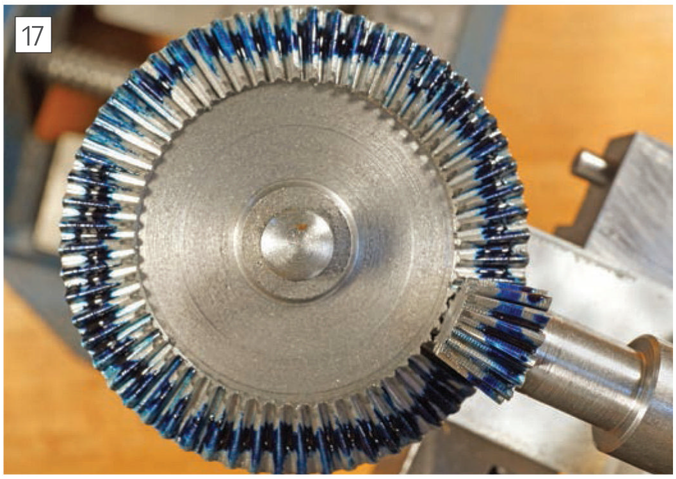

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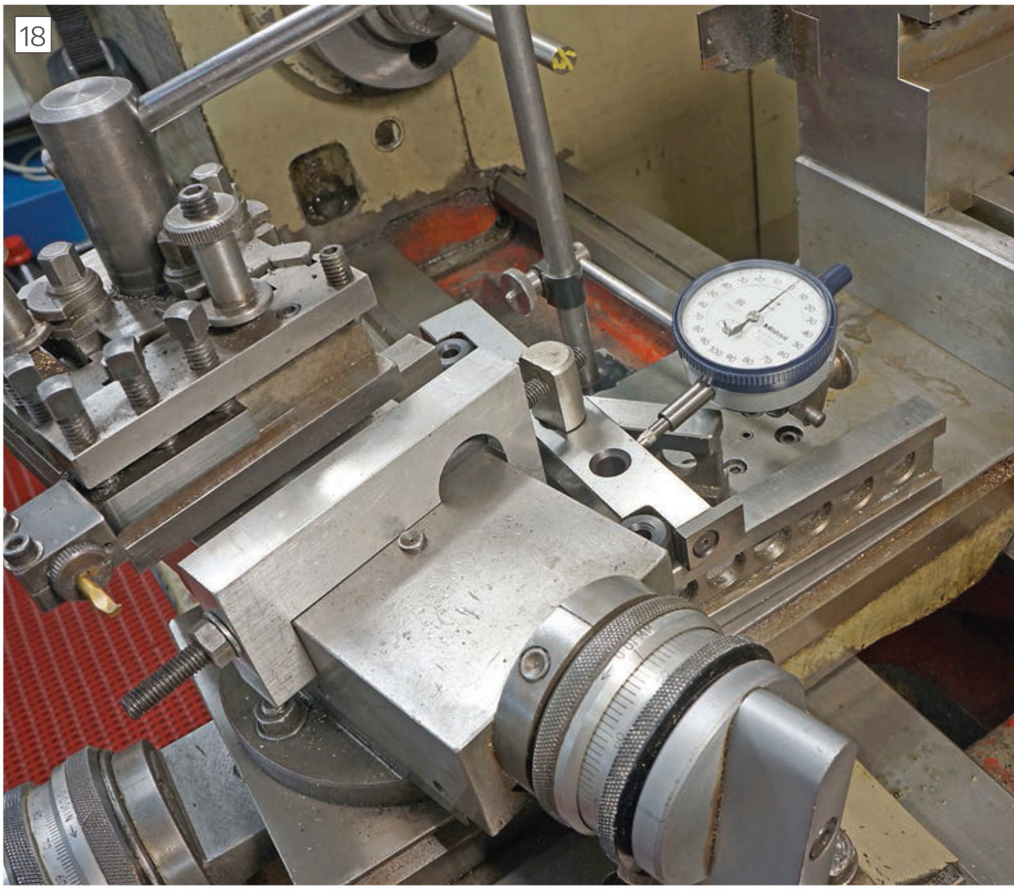
on the mill. The sine bar is lightly clamped to the side of the topslide and the parallels beneath it keep it parallel to the cross slide. Before doing this, it was necessary to check the sides of the topslide were parallel to the dovetails both vertically and horizontally. My estimate of the uncertainties for this arrangement were at least an order of magnitude better ie. RMS error ±0.01°. So that is the way I shall set angles from now on.

Yet another pair of bevels was machined, and these last improvements achieved what I was after: a pair of 4:1 bevels that would run smoothly together with negligible backlash. The best bevels I had made. Probably not quite up to the requirements of instrument standards, but hard to find much difference between the parallel bevels and fully formed equivalents. Disappointingly they appeared to the naked eye much the same as the originals with all the errors!

There was now one last problem to be addressed. I now had a boxful of bevels of varying precision, but what was I going to use them for? ■



References

Ref 1. Bob's Better Bevels MEW No 316

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Biddlecombe Day

Southampton celebrates the life and work of a long-standing member – Nick Feast remembers a very happy occasion.

Molesworth

Roger Backhouse takes a look at a key work of reference well-known amongst all kinds of engineers.

Wagons

Gerald Martyn looks back over his experiences of building 5 inch gauge wagons for the LSWR.

Atkinson Engine

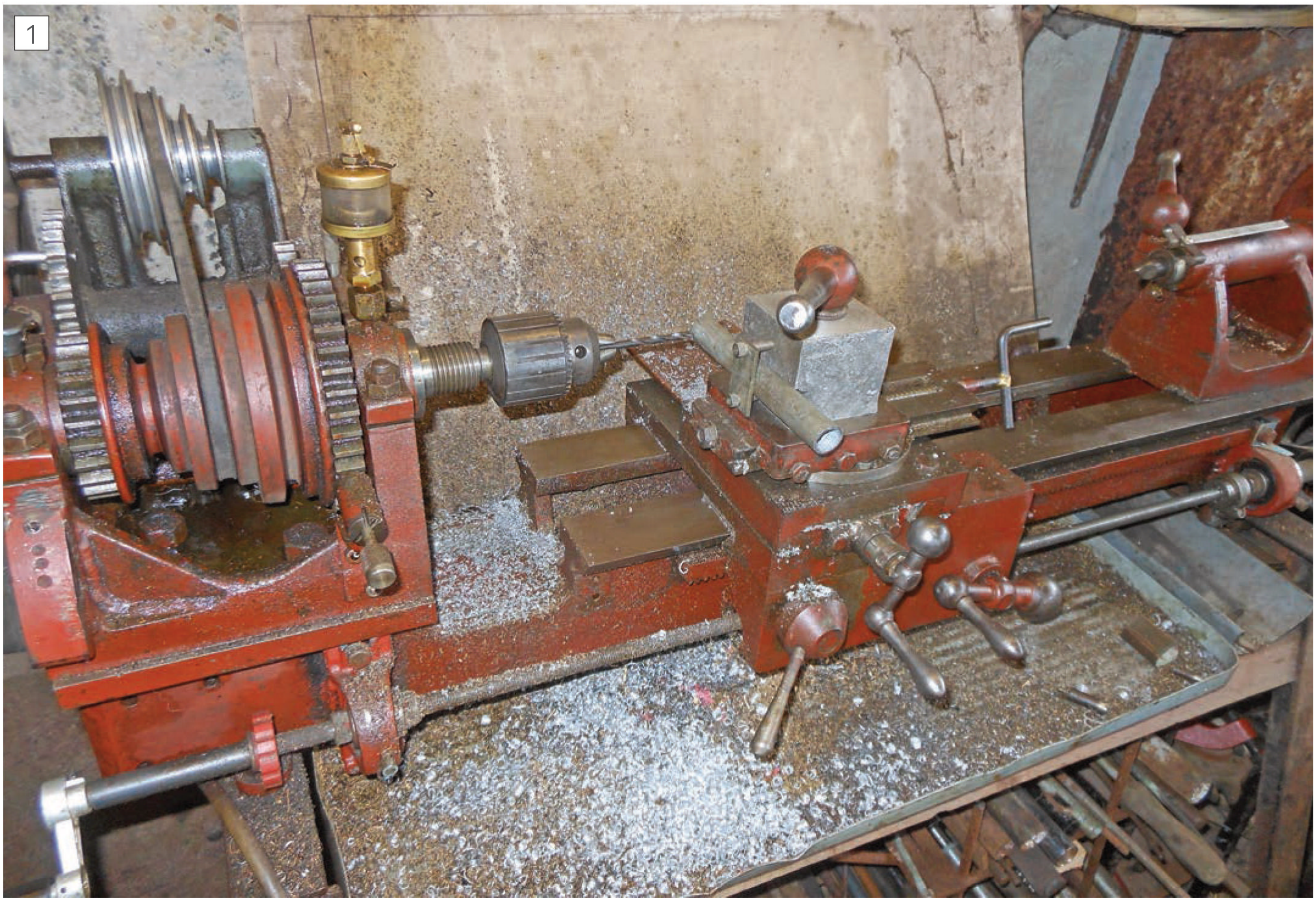
Terry Dowling constructs a model of an Atkinson engine, a novel design which is more common that might be supposed.

Content may be subject to change.

ON SALE 2 DECEMBER 2022

A Speedy Milling and Drilling Lathe Fixture

Paul Tiney describes a project suitable for beginners who 'want to make something useful'.



Finished project in use.

Whilst the production of swarf, whether chips or long spring-like threads, can be treated as satisfying in itself it is far more rewarding if the swarf produced is the product of the making a "something".

The item described is an "attachment" for use on lathes that have a large threaded central stud or bolt to clamp down the tool post or tool holder. Its use is to simplify the holding and drilling holes in rod or tube. No units of measurement are specified, and no accuracy of the "half a gnats" variety is required. In fact not even any dimensions shall be supplied. So you shall also have to supply a certain amount of design, **photo 1**.

What is being made is similar, in use and application, to that of a "V" block and clamp. However in our case instead of a smooth 90 degree "V" we have a number of "steps", the edges of whose "treads", if joined together by a line or straight edge, would form the 90-degree angle.

Tools and Material required

- Lathe
- Variety of different size end mills
- Holder for end mills
- Cube shaped lump of metal of whatever material you have available. (In my case I cast a block of aluminium using the metal supplied from a dead garden strimmer engine. I couldn't melt the lovely wee piston and con-rod, I'm not a complete savage.)
- Short strip of flat steel
- Two Allen screws and taps to suit.

Method

Decide on the size of cube, (design stage!) For ease this can simply be the same size as the four-sided tool holder you have on the lathe or of a size that will sit comfortably on the top of the compound slide.

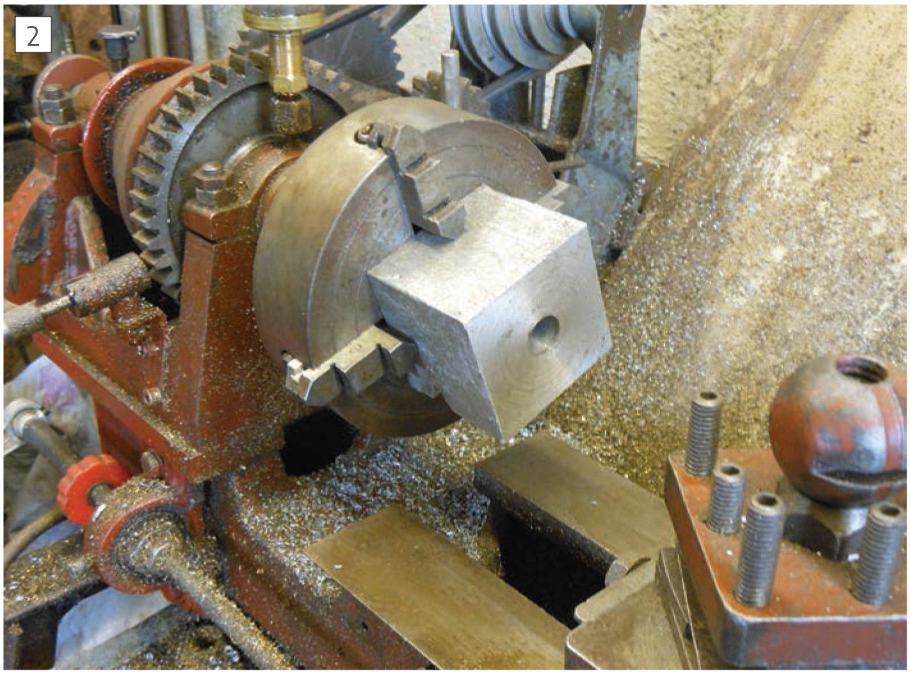
Mount your cube in the four-jaw chuck and skim the face flat. Don't spend an age centring it, it isn't necessary, and at our time of life speed is of the essence, the edge of a rule is close enough.

Reverse cube, place machined face against face of chuck or parallel spacer, clamp up and machine a new face parallel to the first face.

Drill a hole right through the block, a size equal to a clearance size for the tool post clamp bolt/stud, **photo 2**.

Remove the lathe tool holder and replace with your cube. Set cube with one face parallel to the face of the lathe. Your exact method of doing this will depend upon lathe size and clearance etc. but using a square or straight edge is fine, a dial gauge is just showing off.

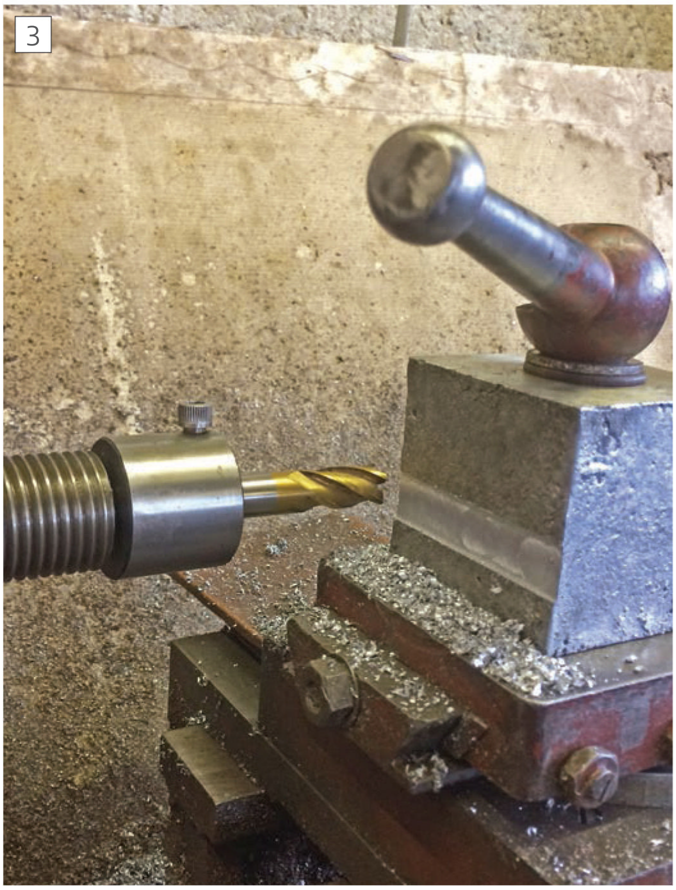
Remove four jaw chuck and replace with end mill holder. If you just "nip 'em up in the three jaw or drill chuck" make sure the Apprentice Supervisor isn't watching because "heads will roll!" if he sees you, as they can't hold an end mill securely.



2 *Block faced and bored*

Digression

At this point in the proceedings we'll pause for a cuppa and a description of Theory and Practice as applied to the work in hand. Referring back to the earlier description of a "V" block formed from a series of steps, to accurately accomplish this will require each depth of cut to be equal to half the incremental difference in size between each cutter used. The points of contact on any round bar or tube placed in a proper "V" block are tangential in nature. This is the Theory, and right and proper it is. However, for us, practice in the real world indicates that a) we have cutters that are a mixture of both Imperial and Metric, and, b) that there are some gaps in their sequence due to past breakages. Be not down hearted! Though not as proscribed by mathematical theory, in practice odd sizes and inaccurate depths of cut have little effect on operational use. The various points of contact on the different diameters of work, though



3 *Making the first milling pass.*

4 *The last milling pass and finished "V".*

Drilling and taping clamp fixings.

Drilling a tube.

Drilling completed.

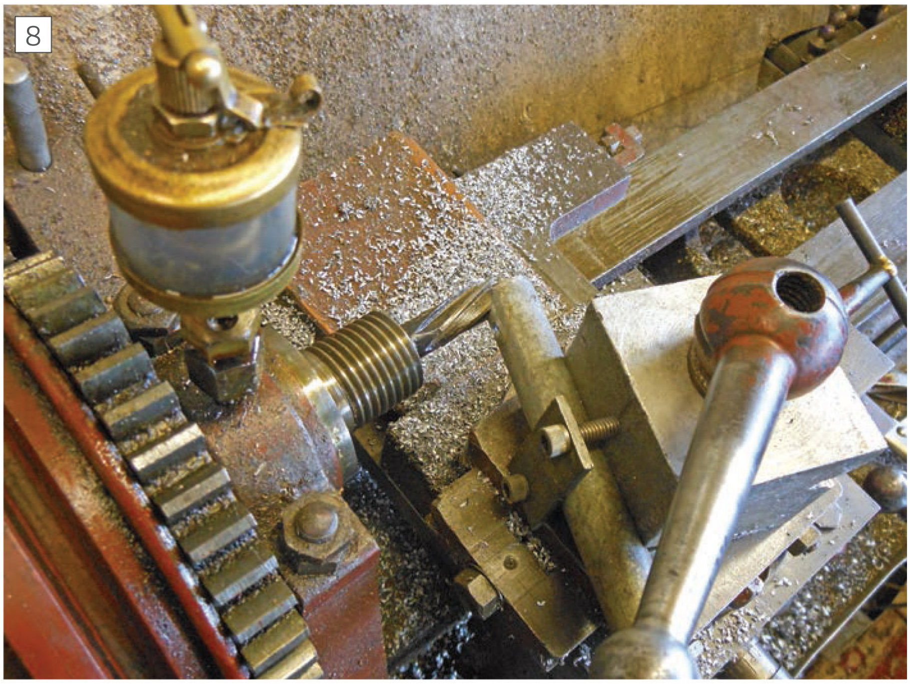
not tangential simply occur at different locations ranged about the 90 degrees of arc that is available. Not ideal perhaps, but effective enough for our purposes. Don't now go and get side tracked drawing it out with paper and pencil, you can do all that when you have finished. Right then, on with the motley!

Beginning with your largest end mill make a couple of passes across the face creating a wide shallow slot. Now fit your next size down end mill and repeat the process. Keep doing this until you reach your smallest mill. You should now have across the face of your cube a valley, the sides of which resemble a series of steps, and which look much like a graving dock when drawn in section, **photos 3** and **4**.

Remove block from lathe and place in vice.

Mark. drill and tap two holes, one each side of the groove to hold the clamp. Your choice of size, (I used quarter whit.) Drill clearance holes in the short steel flat bar the same width apart as the tapped holes, **photo 5**.

Rub off all sharp edges with smoothing file, clean swarf off lathe and oil surfaces.



Milling a mitre.

Small diameter rod mounted for drilling.

In Use

When fitted in place of the tool holder any tube or bar placed across the cube and clamped will have its centre immediately at lathe centre height. A drill mounted in the lathe will put a hole through the centre of the work when the lathe saddle is moved towards the chuck. The work can be traversed across the lathe using the cross slide and, if required. a series of holes in a line can be made. The compound slide can be swivelled to enable a hole to be made at an angle through the work. The drill can be replaced by a milling cutter and a tube can be mitred to any required angle. A shaft can have a key way milled, assuredly, "on centre". All machining carried out will be centred and carried out on centre without the need to measure or mark the centre on the work. There are many possible uses, and you also have three other faces to make use of for perhaps a ready mounted parting tool or knurling rollers, as any good huckster would say, "Gents your only limitation is your imagination." **Photographs 6**, **7**, **8** and **9** show different uses of the block. ■

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Models

- I have several ex-civil service clocks for sale (£20.00 each, see Scribe a Line). All are normally 48 volt dc powered, 30 second steps, but a slightly reduced voltage also will operate. A suitable pulse supply unit is available on e-bay. I would prefer payment on collection, to enable purchaser to select his/her choice, confirm operation, ensure safe delivery. **E. kenmackenzie@live.co.uk. Glasgow**.

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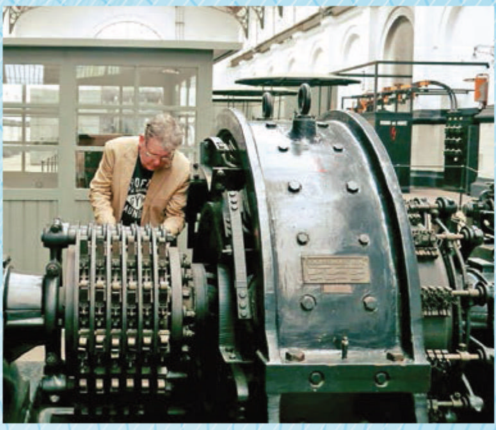

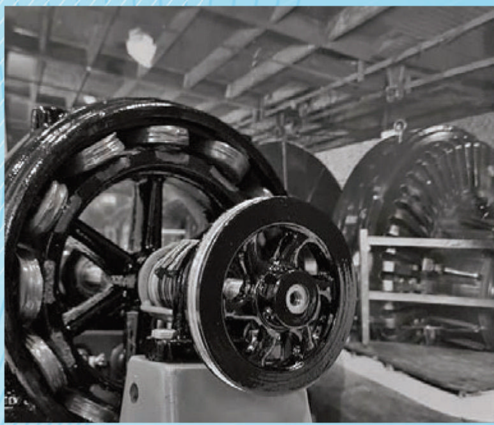

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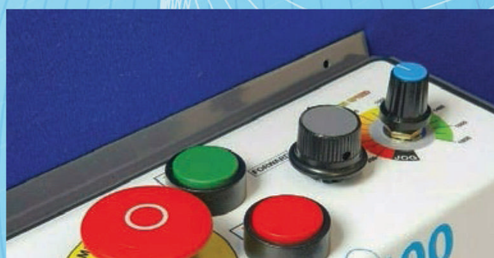

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