

No. 321

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MODEL ENGINEERS' WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS NOVEMBER 2022 ISSUE 321 WWW.MODEL-ENGINEER.CO.UK

THE ARTFUL DODGER

A new series for beginners in the hobby showcases John Smith's remarkable engineering skills



STEVENSON TROPHY ENTRIES

A great selection of workshop tooling, get ready to cast your vote!

MINI LATHE MODIFICATIONS

Converting a popular machine to direct belt drive plus a fistful of handy accessories

INSIDE THIS ISSUE

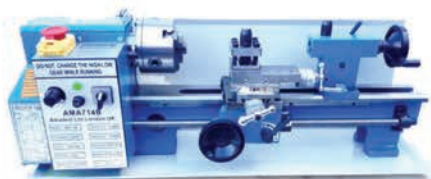
- A VINTAGE REFURB - BRINGING A CHURCHILL LATHE BACK TO WORK
- GET A GRIP! - MAKE BETTER KNOBS FOR YOUR MACHINE TOOLS
- HAND FITTING SKILLS, HOW TO SIZE WASHERS AND PISTON RINGS
- DRUMMOND UPGRADE - MAKING A BIGGER CAPACITY TAILSTOCK
- INDEXING ER25 COLLET HOLDER FOR A TOOL AND CUTTER GRINDER
- A MOBILE WORKSHOP CRANE TO TACKLE THOSE HEAVY JOBS

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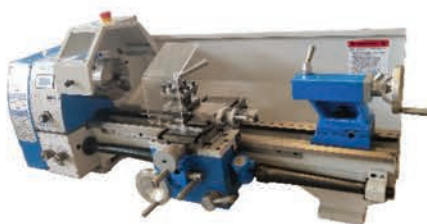


AMA714B Mini lathe
Brushless Motor

SPECIFICATION:

Distance between centers: 350mm
Taper of spindle bore: MT3
Spindle bore: 20mm
Number of spindle speeds: Variable
Range of spindle speeds: 100-2250rpm
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: 700x180mm
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: 840x210mm
T-slot size: 14mm
Weight: 240Kg

Price: £1,962.00

W AXIS POWERFEED - Price: £2,081

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EDITORIAL

Editor: Neil Wyatt

Designer: Andy Tompkins

Publisher: Steve O'Hara

By post: Model Engineers' Workshop,
Mortons Media Group, Media Centre,
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This issue was published on June 17, 2022.

The next will be on sale on July 22, 2022.

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On the Editor's Bench

John Smith, the Artful Dodger

Longer standing readers may remember past articles by John Smith, showcasing his exceptional skill and patience as a metalworker. One example detailed four attempts at making rounded corners for the bunker of a model locomotive tender and sharing the successful technique he used in the end. Some time ago John submitted the first dozen or so instalments of a series of hints and tips for those new to our hobby. Originally the series was planned to have over twenty parts. Sadly John's health declined, and we lost contact.

Following the change of publisher earlier this year, I was reviewing my stock of submitted articles and found the parts John had finished and was struck again by the quality of his writing and exceptionally good workshop photography. I was able to contact his wife, Lizzie Smith, who told me the sad news that John had passed on after a long illness. However, it was good to hear stories of John's past achievements and generosity. We both agreed it would be a fitting memorial to John to run his series 'The Artful Dodger', not least as he would be delighted to know that his experience would be available to inspire and encourage new people to improve their skills and try some more advanced techniques. I'm sure his articles will also prove useful to many more experienced readers as well.



Workshop Photography

On the subject of workshop photography, as an editor one of the greatest bugbears I have is that the typical subject of photographs for our articles is a grey lump of metal fixed to a grey or muted green piece of machinery, taken in a working machine shop, rather than a well-lit studio. With such a starting point, it's not surprising that sometimes taken during the production of practical devices, are more a matter of record than perfectly composed and presented photographs. But it is possible to avoid the worst pitfalls, such as cluttered backgrounds with a little effort, and the really skilled can make the most mundane of unfettled castings look interesting!

As well as John Smith's immaculate photographs of delicate machining operations, I'll highlight Geoff Andrews' clear images with well-cropped backgrounds in his article on mini-lathe modifications, but I think our other contributors have all done well this month. In our next issue, we'll have an article with advice on taking workshop photographs with suggestions and advice to help improve your images, whether you are using a professional camera or just your phone.

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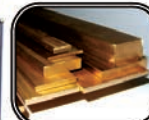
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Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

A majority of locomotives enjoyed long service with the final "Jinty" withdrawn in 1967, right at the end of the steam era. The locomotives were always painted in un-lined black livery. Before nationalisation in 1948 LMS initials were carried on the tank sides. In BR service either lion crest was carried according to period.

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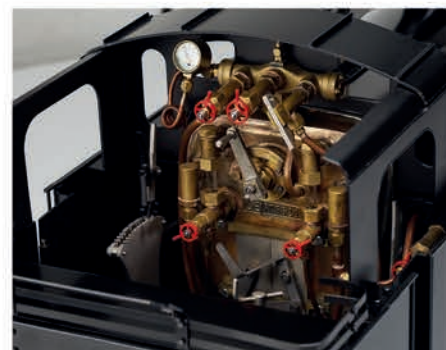
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Contents

9 Upgrading a vintage Drummond lathe

David George decided to upgrade the tailstock of his Drummond to take tooling with a larger MT2 taper fitting.

19 Making an ER25 collet holder for a Worden Grinder

Laurie Leonard takes us through his approach to making a flexible tool holder for a tool and cutter grinder.

20 Modifying my mini lathe

Geoff Andrews explains how to convert a brushless motor powered mini lathe to direct belt drive, as well as sharing some useful spindle accessories.

26 Overhauling a Vintage Churchill Lathe

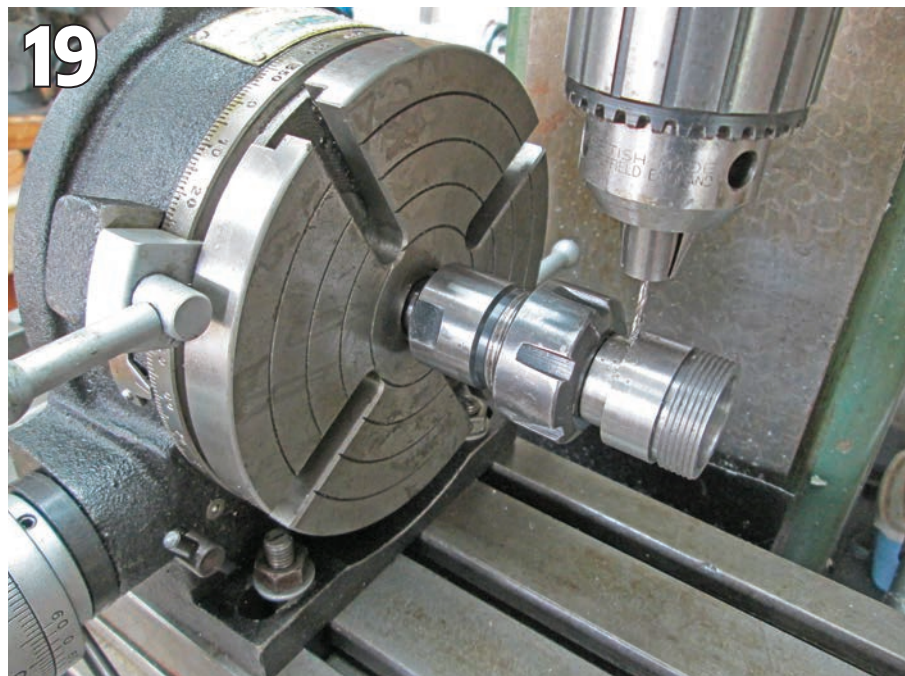
Brian Wood bought a 1947 Churchill-Redman Cub lathe as a restoration and overhaul project, he didn't realise the problems he would have to tackle to get it working.

32 The 2022 Stevenson Trophy

We show case the entries for this year's competition. Head over to www.model-engineer.co.uk/stevenson to vote for your favourite.

40 Artful Dodges

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



43 Readers' Photos

The first winner in our new competition.

47 Replacing a Vintage Thumbscrew

Brett Meacle uses an unusual technique to make a 'reliced' thumbscrew for a vintage tool.

52 Beginners' Workshop

Geometer looks at techniques for hand fitting washers and piston rings.

56 A Mobile Workshop Crane

Des Bromilow shows us how to combine a palette jack and an engine crane to create a new, extra mobile lifting device.

63 Making four-lobed knobs in the home workshop

A nice how-to article by Ed Hanson looking at making more easily gripped control knobs and handles for machine tools.



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Coming up...

in our next issue

Howard Lewis explains how to make a ball centre for taper turning.



Regulars

3 On the Editor's Bench

What content would you like to see in your magazine?

14 Readers' Tips

At last – a way to reduce waste from lateral flow tests!

44 Scribe A Line

Your thoughts and ideas on MEW's content. Neil Wyatt, is always keen to hear from readers, just drop an email to meweditor@mortons.co.uk.

53 On the Wire

3D printed buildings and more!

66 Readers' Classifieds

Another fine selection of our readers' sale and wanted ads.

ON THE COVER



The cover of this issue shows delicate milling operation carefully set up and clamped in place by the late John Smith, see page 40 for details

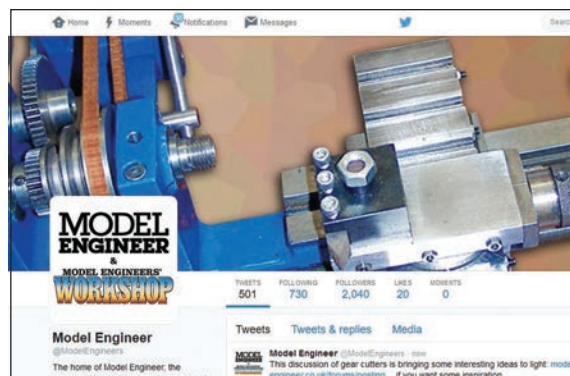


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THIS MONTH'S BONUS CONTENT

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Visit our website to vote in the Stevenson Trophy Competition.

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Other hot topics on the forum include:

Edgar Westbury Wallaby ignition

Interesting adventures to get a classic model running by Andy Cameron.

Unknown taper on lathe centre

Investigating a mystery fitting by Vic Newey.

2022 Midlands Model Engineering Exhibition, 13th to 16th October

The latest information on tickets by Meridienne Exhibitions.

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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Manufacturer	Cormak
Model	HK25L VARIO
Condition	New
Max Drilling Capacity	25mm
Max Slot/End Milling Capacity	16mm
Max Face Milling	63mm
Spindle Taper	MT3
Draw Bar Thread	12mm
Spindle Feed	50mm
Head Tilt	+/-90°
Number of Spindle Speeds	Variable Speed Control
Spindle Speed Range	50-2250 rpm
Table Surface	500x180 mm
Maximum Longitudinal Table Travel	480mm
Maximum Transverse Table Travel	175mm
Maximum Vertical Travel	380mm
T-Slots	3
T-slots Dimensions	10mm
Motor Power	750 W, 230V
Weight	110kg



Manufacturer	Cormak
Model	TYTAN 500
Condition	New
Swing over bed	200mm
Swing over cross slide	140mm
Centre width	500mm
Bed width	100mm
Spindle bore	21mm
Spindle tip	MT3
Spindle speed	100-2500 rpm
Metric thread	(14) 0.3-3 mm/turn
Inch thread	(10) 10-44 Gg/1"
Tool holder	4- slots
Maximum cross support travel	55mm
Maximum transverse support travel	100mm
Maximum longitudinal support travel	376mm
Tailstock spindle travel	60mm
Tailstock quill taper	MT2
Motor power	500 W / 230V
Dimensions (without base)	900x390x340 mm
Dimensions (with base)	900x390x1160 mm
Weight	95kg

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Upgrading a vintage

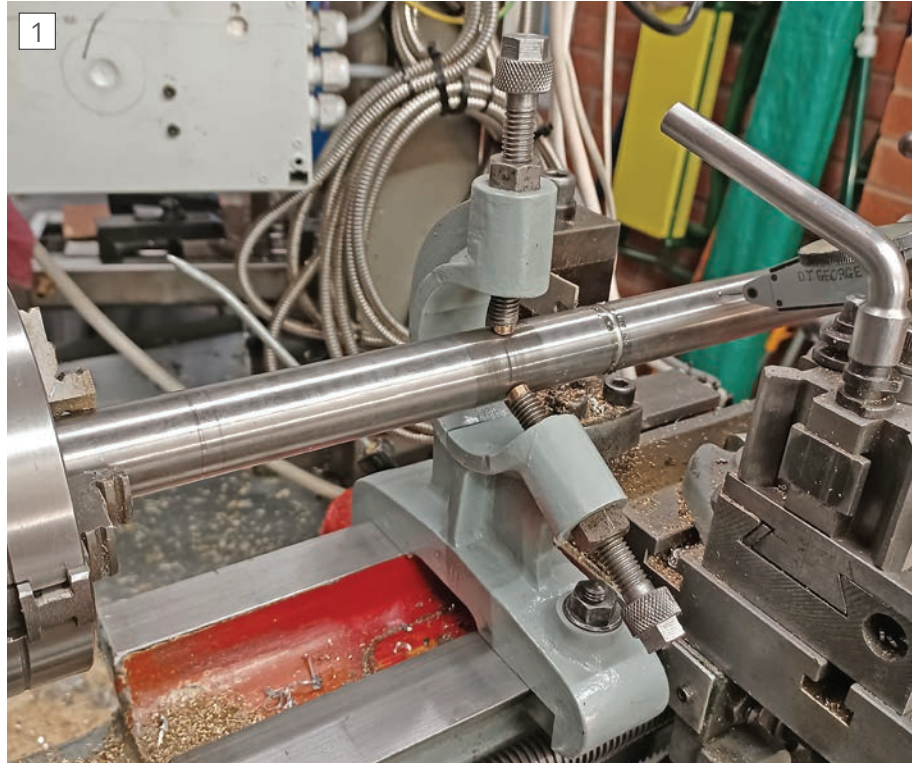
Drummond lathe

David George wondered for quite a while if he could get a MT2 taper into the quill on his Drummond M-Type Lathe, it turned out it was possible – with a fair amount of work.

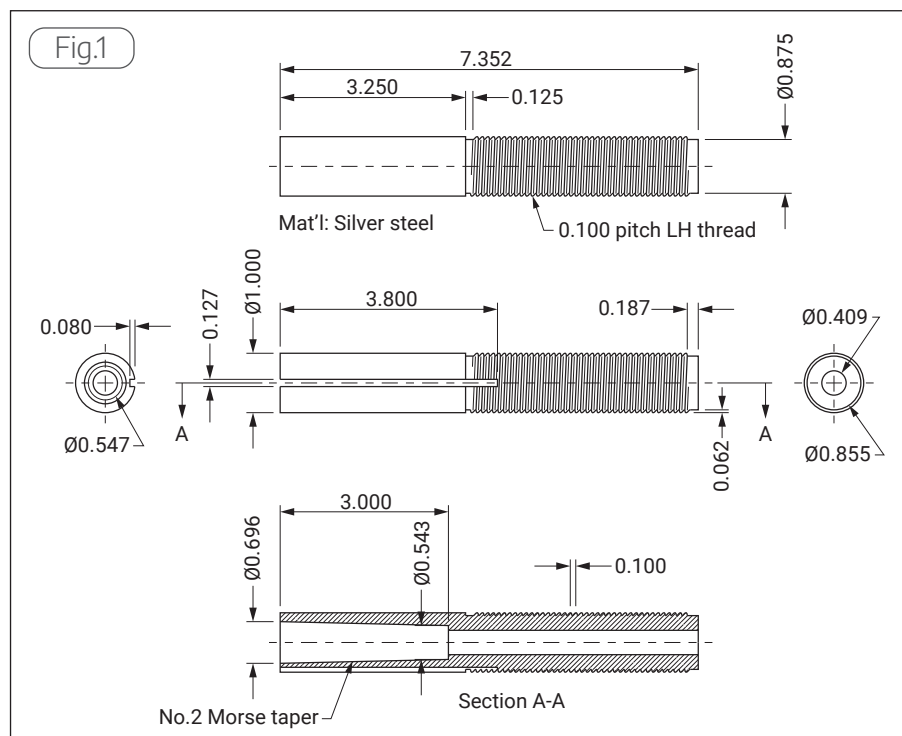
I thought about the modification for some time, and after investigating I found that only by increasing the quill diameter it is possible as the Morse taper would cut into the location slot on the outside diameter. **Figure 1** is a drawing for the new quill.

I drew up a one-inch variation and found that it is possible and so carried on with that configuration as I would only have to bore $\frac{1}{8}$ inch from casting. A one-inch piece of silver steel is perfect for this job as it is tough, ground, machinable, straight and stable in its stock state. I had to hold it in my chuck and using a fixed steady to support it I parted it to length, **photo 1**, and drilled through from both ends, **photo 2**. Then having set the top slide to the correct angle bored the morse taper, **photo 3**. Turning it around I then cut the undercut for the start of the thread in the middle screw cut the thread in an outward direction, as the thread is a left hand one, **photo 4**.

The handwheel was next but as it is a chunk of cast iron it took a while and I made quite a bit of swarf roughing it



Parting off with steady.



out, **photo 5**. I then finished it to size and bored to suit ID of thread which has a bit of clearance on the core of the quill screw thread. I had a boring bar with a 5mm cross hole for a HSS tool and ground a cutter the correct size for the width of the thread but with a few thou clearance on the flank of the thread. I wound the boring bar through the bore wound on a cut and it screw cut again, **photo 6**, going outwards because of the left hand thread, so little chance of crashing into the job. I took it to theoretical depth and tried the quill, **photos 7** and **8**, but I had to take a little more out and then a few spring cuts as the boring bar was only $\frac{1}{2}$ inch diameter.

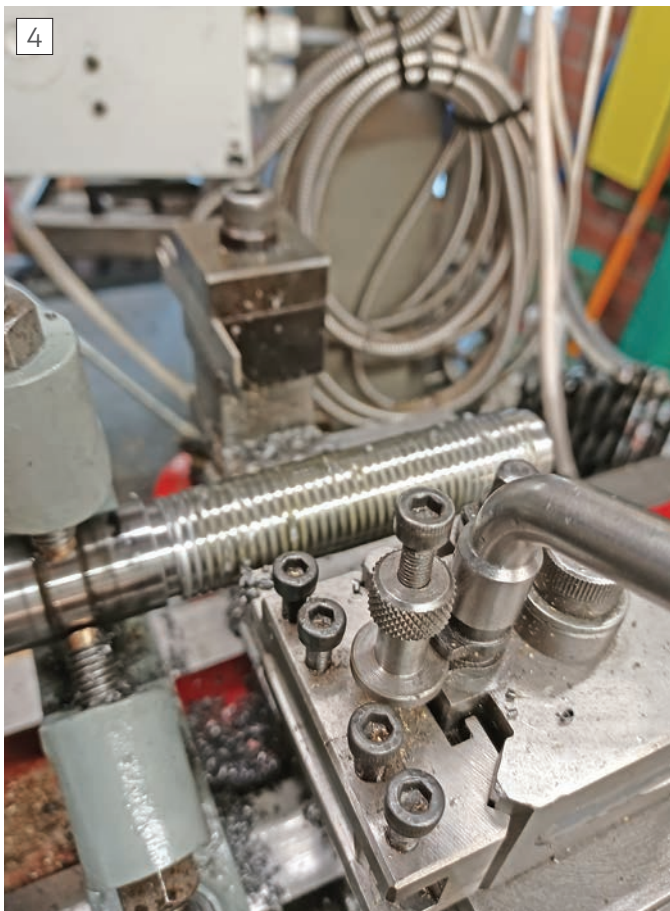
I made the location segments next as they are made from cast iron and keep all the same work together and then just one clean down of the lathe to get rid of the cast iron dust. They are a slide fit in the groove in the handwheel with four holes to hold them in place then I slit it in two, **photo 9**, leaving a small amount



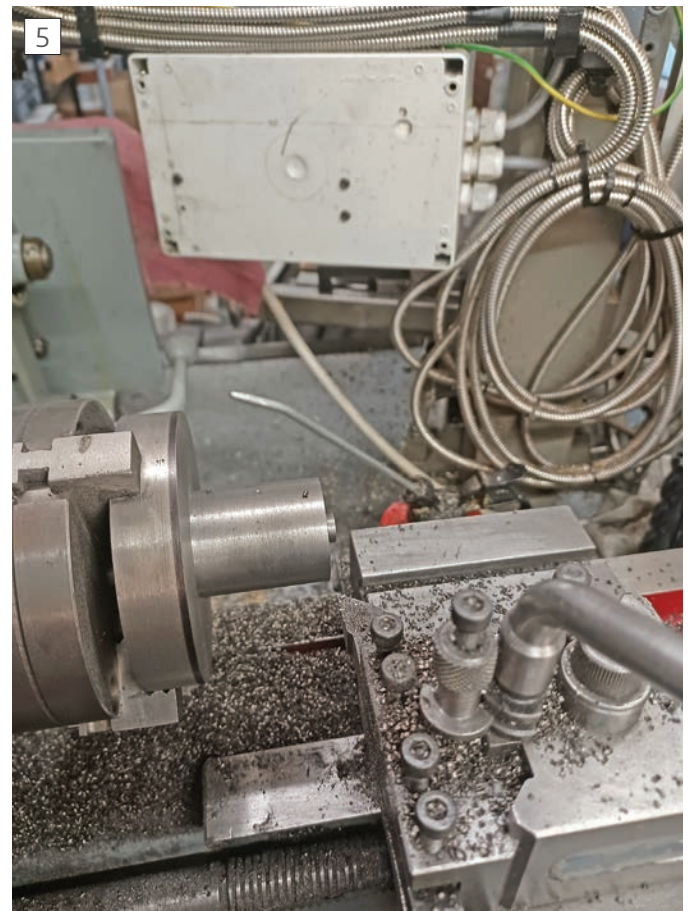
Drilling bar with steady.



Boring the morse taper.



Screw cutting quill thread.



Turning handwheel.



Screwcutting thread.



Fitting quill to handwheel.



Parts turned.



Segment slitting.



Dial turned and stamp jig.



Cutting lines on dividing head.

which I broke in two with the vice and a mallet so they are held against each other when assembled and not rubbing on the handwheel diameter. This is how the originals were made by Drummond but with only two holes.

I decided to have a dial which will give me a depth to which I can drill more accurately when needed, **photo 10**. It is made from aluminium with a small thumb screw to stop it spinning when set. I turned it to size and cut the radial grooves. The dimension lines were cut on my dividing head using an engraving cutter on the mill, **photo 11**. The ten main segments needed stamping and as my hand coordination is a bit off, I made a jig to hold the dial with a slot milled in to guide the stamps square and in the correct depth across, **photo 12**. The stampings were polished on the lathe



Stamping dial.



Dial in place.



Tapping casting.



Milling cotter pin.



First assembly.



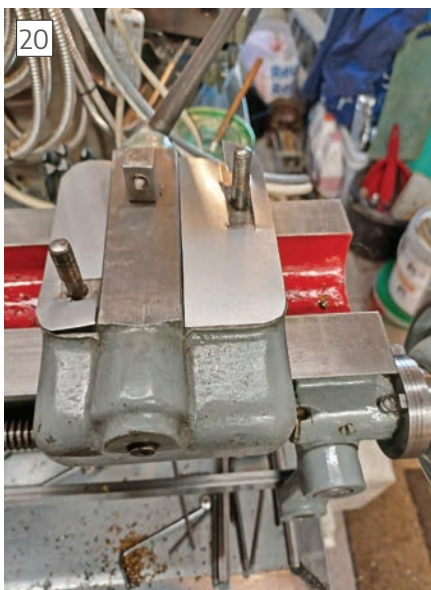
Keyway parts.



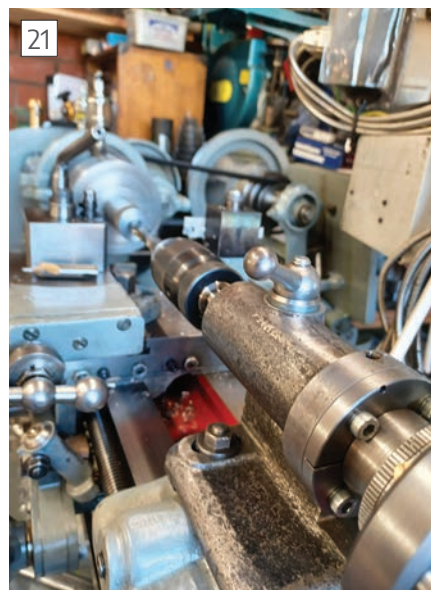
Keyway assembled.



Clocking centre height.



Shim in place.



Drilling steel.

and filled with black paint, **photo 13**.

The handle for the handwheel was made and fitted with a piece rotating round a shoulder screw, and a clearance hole was cut to access the screw for the handwheel line piece. The dial piece was made and screwed to one of the location segments with a single screw.

The casting was bored next with the casting sat on the handwheel face and clamped to an angle plate, **photo 14**. The four holes were then drilled and tapped on the handwheel face just clamped to the angle plate.

The quill clamp is just a steel cotter with a round form to match the diameter of the quill so as I have some high tensile bar, I turned a new one because I don't know what steel the original one is made from and I would be removing a $\frac{1}{16}$ inch from its thickness. I turned



Quill from front before painting.

it up and threaded it then bolted it to the angle plate with a nut and washer where I bored the scallop to match the 1inch diameter of the quill, **photo 15**.

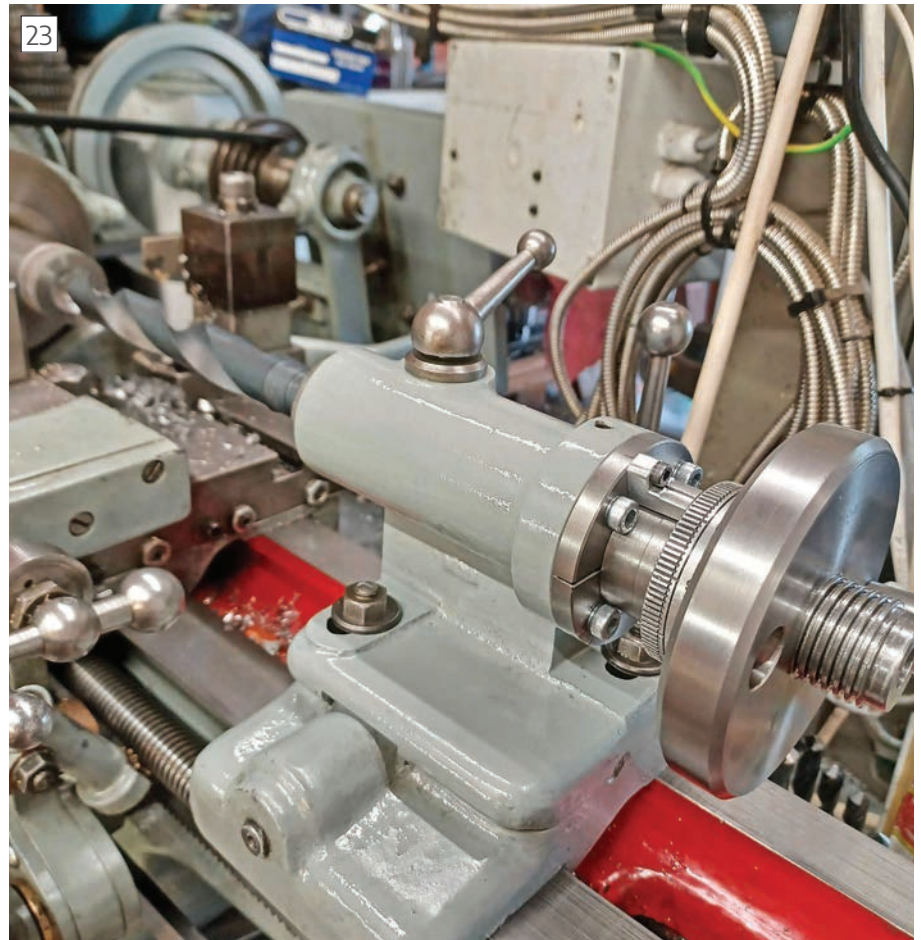
I finally got to assemble the main parts and it went well, **photo 16**, except for the clamp stud wanted a bit of fettling to make it fit the radius of the quill and slide. I then needed to cut the location slot down the length of the quill and make the key which fits into the hole on the rear of the casting.

The keyway went very well, and the key made from phosphor bronze has a tapped hole in the top to remove it as it is a tap fit in the casting, **photos 17 and 18**.

The assembly was done again with all parts and no problem except for needing a cut down Allen key for the screws that hold the segments in place and the screws were very close to the diameter of the handwheel which I removed a local band area to give a bit more clearance to the side of the screw heads.

It was time to remove the original casting from the lathe and fit the new one. The casting fitted ok but there was a little more clearance on the guide part. When fitted the bore was clocked up from the chuck, **photo 19**, and there was a 0.006 inch reading difference which needed shimming, **photo 20**. I cut a 0.006 inch pair of shims and when checked it had the opposite reading. Like an idiot I had made an error and had to remake but with 0.003 inch shim half the error! Rechecked and all's well on centre height and set across set as well, no problem.

I put a piece of mild steel in the 3-jaw chuck which I centred and then using a 13mm drill in the tailstock chuck drilled a good hole with no problems, **photo**



Finished job.

21. All I had to do is strip, **photo 22**, and paint the casting and all done, and I think a very worthwhile modification, **photos 23 and 24**.

I found that machining the handwheel from a piece of solid cast bar was a bit onerous so in hindsight have decided to have a casting made available and I have made a pattern, **photo 25**, I took it to my local foundry for him to quote and

he said it would be £18.00 to cast it plus postage to you if you want to take up the offer to have one. I can be contacted via the Model Engineer Forum. He is casting one for me in the next few weeks so I can have a look at the real McCoy. The drawings for this mod will be free to all.

Image 27 pattern for casting.

I would like to thank Geoff Walker for kindly giving me the casting of the tailstock top body to allow me to do this modification. ■



Another view of the finished tailstock.



Readers' Tips



Lateral Flow Lubing

TIP OF
THE MONTH
WINNER!



This month's winner is Frances Coakley, with a tip that makes use of a small object most of us are now all too familiar with!

Re-use the small test tubes that were part of a covid lateral flow test - they make excellent small oil or for me cutting fluid dispensers. The repluggable top allows drop by drop dispensing by compressing the flexible tube and they will stand upright in a simple frame or a hole cut in small tray that also holds MT2 arbours.

I use one for cutting fluid when threading - a second one currently has plus-gas in it as easier to drip it where needed than with the spray can. If I get a third (having a couple more as yet unused test kits as freely supplied by IoM a year ago) I would use one for WD-40 when milling aluminium.

The size is convenient as most things I make are small scale and they don't drip when put down on their side, the small hole means any evaporation is slow.

Frances Coakley

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.chestershobbystore.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.



1

Making an ER25 collet holder for a Worden Grinder

Worden tool holder with index block mounted ready to receive the new chuck

Laurie Leonard explains his approach to making Giles Parkes' ER25 collet holder for drill sharpening the Worden, to complement last month's article by Howard Lewis which focused on the sharpening process.

In MEW issue 293, which appeared at the start of the virus lockdown, the Editor re-published an article on twist drill sharpening by the four-facet method utilising the Worden Tool and Cutter Grinder, "Twist drill Sharpening by the Four Facet Method" by Giles Parkes. I ashamed to admit that I still fail to get good results

sharpening twist drills with my grinder so re-read the article with interest. It covers utilising an ER20 collet to hold the drills in the grinder tool holder. Having a set of ER25 collets I looked into utilising these in a similar manner. I then recalled Roderick Jenkins' similar article, MEW 198, "An ER25 Chuck for a Worden Tool and Cutter Grinder", that

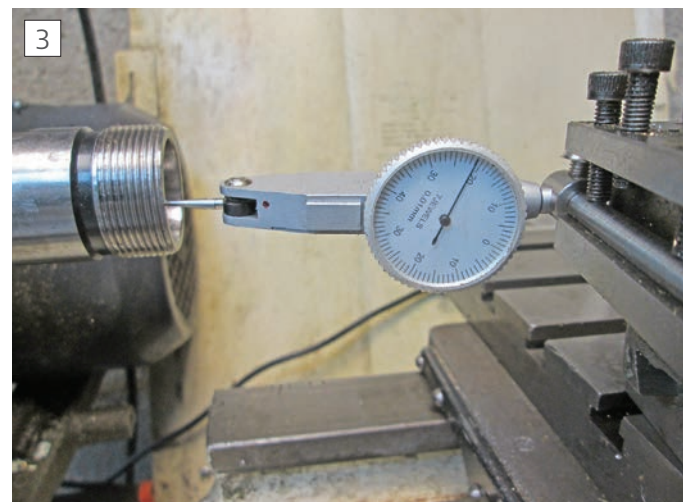
made a mount to carry the E25 collets in the Worden tool holder so I got this out and started to cut metal utilising this article as the basis.

Departures from the MEW 198 Article

Like many readers I tend to use what material I have to hand when making



Setting the clock sensor on the lathe centre line



Clock set up to follow the ER25 chuck bore

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things from an article so my finished items usually differ from the design because of this. My version of the completed chuck is shown in **photo 1** together with the indexing block mounted on the Worden tool holder. I made the main body of the ER25 as in the drawing in the article but set up to bore the ER25 taper in a different manor.

I set the top slide over to the taper angle as best I could and mounted a clock gauge in the tool post. As taught in school for lathe tools, I set the sensor of the clock gauge to centre height by sighting a centre mounted in the tailstock, **photo 2**. With the clock sensor resting in the bore of my Morse taper 2 ER25 collet chuck mounted in the headstock (drawn home using a drawbar), **photo 3**, the top slide was traversed and clock deflection noted. Minor adjustments to the top slide angle were carried out until zero deflection was obtained.

The work was then mounted in the collet chuck. I had purchased a spare chuck nut ready to make an ER25 chuck for direct mounting on the Myford



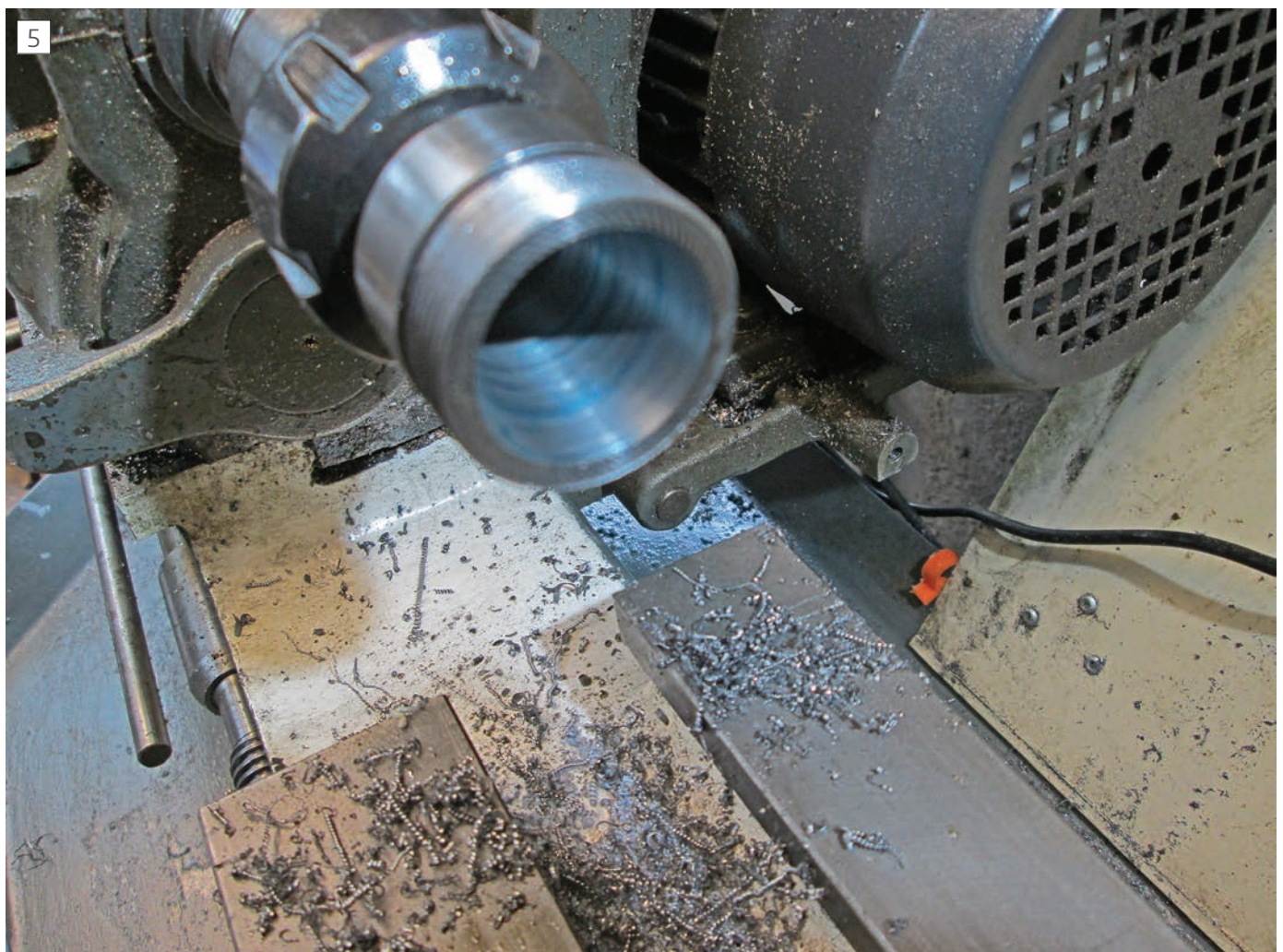
Engineer's blue applied to an ER25 collet

headstock mandrel – still to do – so had one to hand for testing the machining of the threads of the Worden collet

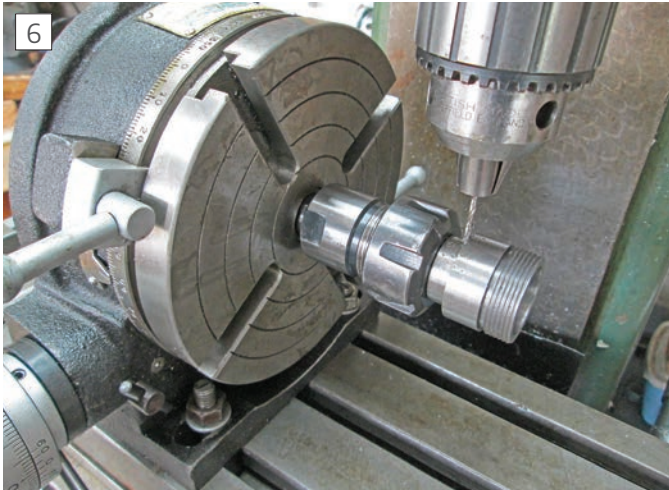
As a check, one of the ER25 collets was coated with engineer's blue and loosely spun in the newly machined taper...

chuck later. The bore was then machined to size. As a check, one of the ER25 collets was coated with engineer's blue, **photo 4** and loosely spun in the newly machined taper giving the witness marks as shown in **photo 5** which I deemed to be acceptable although not a "ground" finish.

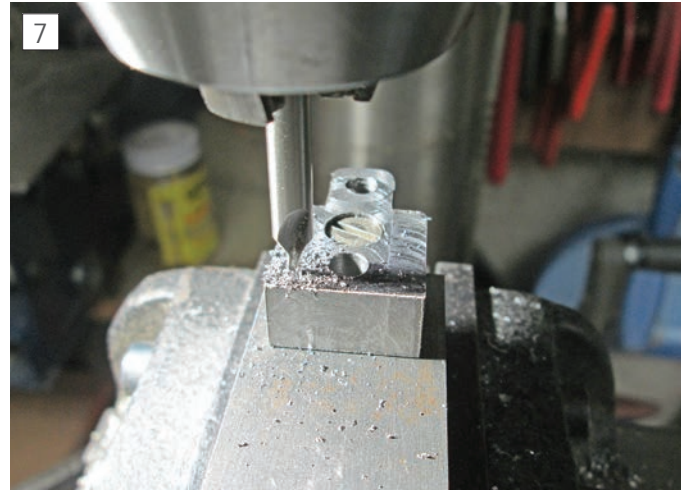
The indexing holes were drilled utilising my Tom Senior M1 milling machine and a rotary table, **photo 6**. The material I had to hand for the indexing block was $\frac{3}{4}$ inch instead of the $\frac{1}{2}$ inch called for, so the indexing



Witness marks on the collet chuck bore from the blued collet



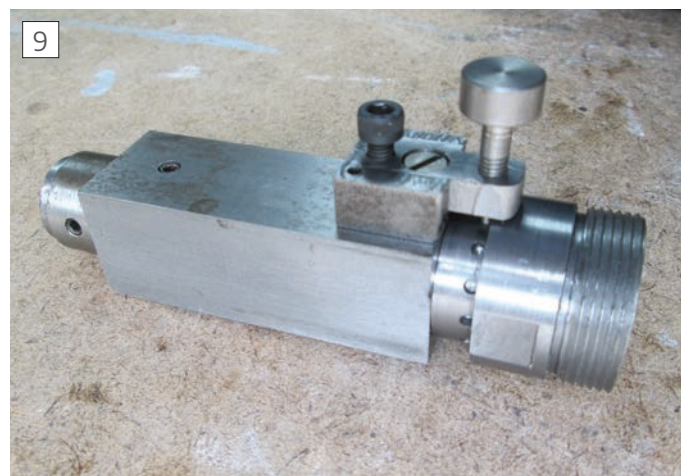
Drilling index marks utilising a rotary table and Tom Senior M1 mill



Drilling holes to take locating roll pins



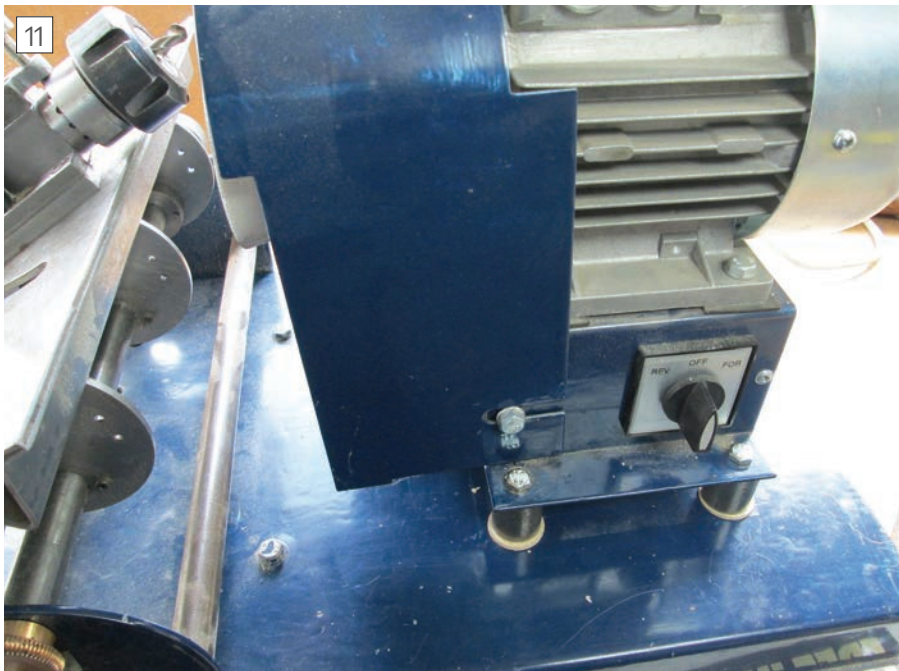
Roll pins fitted to the indexing block



Completed ER25 chuck mounted in the Worden tool holder



Drill loaded in the new chuck missing the grindstone – too high



Motor/Grindstone mounted on elevating columns

end was cut back to aid vision but the increased width at the tool holder end enabled locating pins to be provided to hold the block stationary. These holes were centre drilled and then drilled through to mark the tool holder block, **photo 7**, to accommodate roll pins, **photo 8**.

The completed job is shown in **photo 9** where it will be noticed that a cheese head screw is used to hold the index block down instead of the Alan screw because I had one and a socket head screw used instead of the made finger screw because the latter

had got damaged and would not enter properly.

A Problem

All ready for a trial cut now but when setting the angle of the table to the twist drill half angle I could not get the drill near the grindstone, **photo 10** (guard removed for access – flying pieces of grindstone are not to be battled with). The grindstone needed to be raised. Another recollection led me to an article in MEW145 “Worden Wheel Height Adjustment”; Jim Whetren, where he describes making



Wad punch used to make resilient washers

an adjustable mounting system for the motor/grindstone. Whilst one day I may construct this mount I did not have the material to hand and wanted to finish the job in so ended up by making some elevating collars and fitting them utilising longer bolts, **photo 11**. I recall during my apprenticeship being advised to use a resilient washer in applications like this where a machined surface met an un-machined one so cut some out of a cereal packet using a wad punch, **photo 12**.

Putting all the above work into context, the completed collet chuck is shown with a bought in closure nut in **photo 13** and ready to insert into the Worden Grinder tool holder with the mounted index block as previously referenced in photo 1. Quickly sharpening a twist drill and viewing

I recall during my apprenticeship being advised to use a resilient washer in applications like this where a machined surface met an un-machined one...



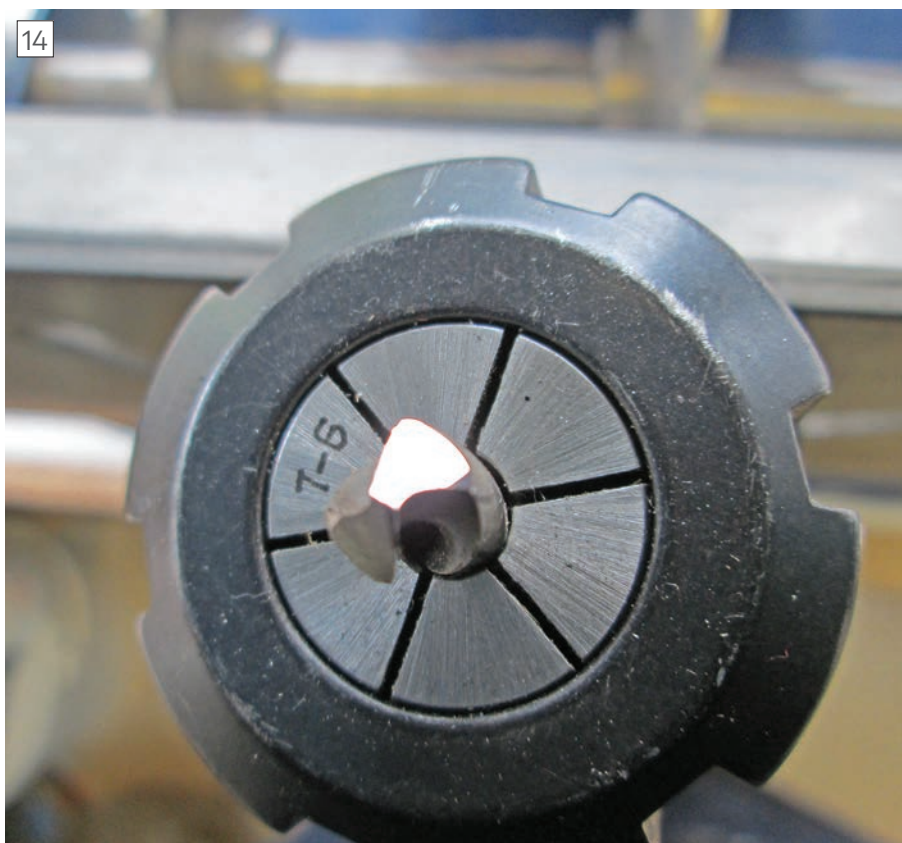
Completed ER25 chuck with bought in closure nut

Once again, I think that the successful conclusion of this project shows the value of the MEW magazines.

the result, **photo 14**, indicates that we are in business even though the trial was the normal two facet at this stage!

Conclusion

Once again, I think that the successful conclusion of this project shows the value of the MEW magazines. They contain a wealth of ideas and contributor's experience that can be adapted/utilised when the need arises and in this case led to the successful completion of another useful accessory. ■



Twist drill trial sharpening

In our Next Issue

Coming up in issue 322
On Sale 18th November 2022

Content may be subject to change

**Look out for your copy of MEW 322,
the December 2022 issue:**



Howard Lewis explains how to make a ball centre for taper turning.



R. Finch adds versatility to a vice.



Workshop photography – hints and tips for more engaging images.

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

Modifying my Mini Lathe Part 3



In this third instalment Geoff Andrews details another selection of excellent practical modifications for mini-lathes.

Although I very much like my mini lathe which is quite suitable for my purposes, I did find that the geared head was noisy. My machine had steel gears which overcomes the problems of broken plastic gearing which many people have commented on, and this may be part of the cause. However, I decided to look at eliminating the internal gears of the head by converting this to a direct drive. This means exactly that: there would be no more high and low gear ratio just one continuous variable drive. It occurred to me that the design of the head had not seemed to change over the lathe's evolution although the motor had been improved. The brushed motor of older machines had now been replaced by a brushless motor, more powerful and more controllable via the electronics.

Making this change would entail deleting the function of the small drive shaft in the head and fitting a toothed drive belt directly from the motor to the main spindle. One difficulty here is that the direct line for the drive belt from motor to spindle would pass beyond the width of the existing belt cover, right through the side of it in fact. Another question of course is would the electronics be affected by this change? On this second point I decided that the brushless stepper motor and electronics are designed to work under a wide range of conditions. As my lathe is seldom used under anything like a heavy load, I decided to take a chance as a preference for a quieter machine was well settled in my mind.

To start I have to say my modification has worked out fine and I am glad that I did it, but this is my experience, and I can take no responsibility if you do decide to follow my example. I would point out that this modification was reversible if it had not worked, barring a



The new drive installed.

burn out of the electronics panel which I am pleased to say has not happened. My machine does have a brushless motor and associated electronics. **Photograph 1** shows the finished arrangement.

After some head scratching it was apparent that I would need to obtain a new toothed drive pulley for the motor, another for the spindle, a new toothed drive belt and a couple of small ball

bearings. The pulleys and belt were bought via the catalogue of RS components and the bearings from Arc Euro Trade, listed at the end of this article, but of course there are other suppliers for all items. Neither of the toothed pulleys was directly suitable this meant that the nearest best items available would have to be made to work with some modification. After all that is what the

hobby is often about.

Both pulleys come with metal flanges. These are ideal for the motor pulley except the bore needed to be increased to 8mm diameter and also a keyway needed cutting to suit the key in the drive shaft of the motor. A tapped hole would also be needed for a clamping screw.

After drilling the 6mm diameter bore of the pulley to 8 mm I decided the most expedient way to produce the keyway was to drill a hole running parallel to the bore and the same diameter as the width of the key. Using a junior hacksaw I put two cuts from the bore to the drilled hole. This produced a slot which was then finished to size by a small file. I drilled and tapped an M4 thread on the opposite side of the bore for the retaining grub screw. That was the easy part done.

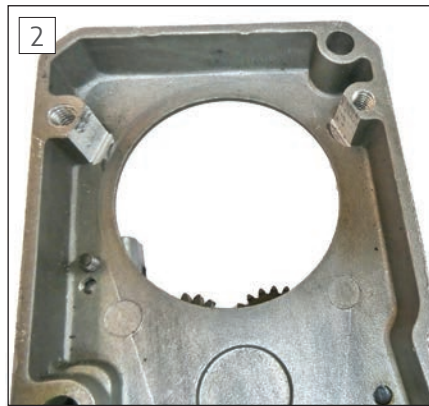
The pulley I chose for the spindle was the largest available to get into the belt cover. To do so however, this needed a small modification to the belt cover as two bosses for the screws which retain the gear train cover would be just interfering with the new drive belt. The belt cover was set up in the vertical slide and the internal faces of the two bosses were partially machined off down to the internal face of the belt cover. This did not affect the two retaining screw threads which pass through the bosses, **photo 2**.

The plastic spacer between the bearing and the new drive pulley of the spindle needs to be reduced at this stage. It could have been possible to use the existing spacer, however, I found that this part was available from Arc Euro Trade, at a very reasonable cost, so I purchased one as it allowed me to keep the original in place to ensure that the machine could stay in operation while the new spacer was faced to length.

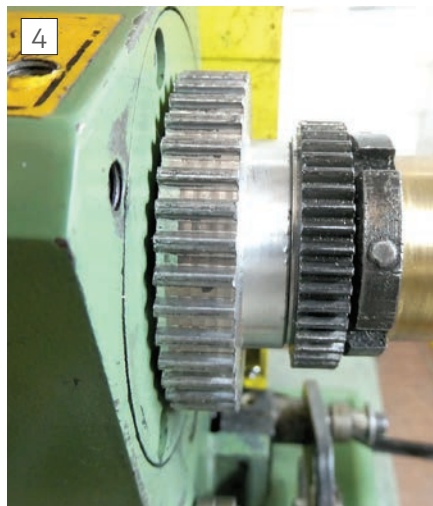
I allowed a 1.5 mm clearance from the rear of the lathe head to the new pulley; this is sufficient as space between this rear face and the inside of the belt cover is very limited. As there may be a variation from one lathe to the another if you wish to do this modification you would need to measure the distance from the bearing to the rear face of the head and add the additional 1.5 mm to give the length for the new spacer. This length was parted off from the plastic spacer.

The next job was to machine the spindle pulley while the machine was still fully operational. **Photograph 3** shows the pulley before machining.

The first operation was to hold the boss in the lathe chuck and bore the pulley by drilling and boring to just less



Small modification inside of belt cover.



New toothed pulley fitted to the spindle.

than the spindle diameter, this will be brought to finished size later. The pulley is then faced from the centre outwards and in the process undercutting and removing the steel flange. Finish off by cleaning the sharp edges which will have formed on the teeth.

The pulley is then reversed and fitted into the external jaws of the chuck with a strip of emery cloth for protection as it is to be held on the teeth. The depth of the jaws on my chuck is 8 mm which is conveniently less than the finished width required for the pulley.

The face is machined as previously to undercut and remove the steel flange. The toothed part of the pulley is also reduced to give a tooth width of 11.5 mm. The diameter of the boss was reduced to 40 mm and faced to give an overall pulley width of 19 mm. Again remove any sharp edges which form on the teeth.

The retaining nuts, drive gear and spacer now need to be removed for the spindle which allows the spindle diameter to be measured.

The bore of the pulley is now increased to suit the external diameter of your spindle. Careful measurement

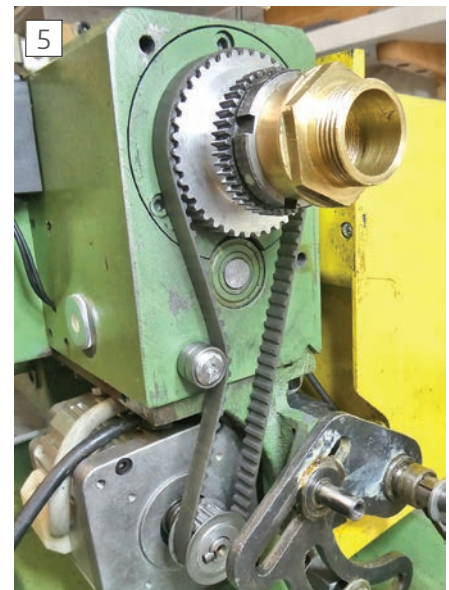


Spindle pulley before machining.

of the spindle and the bore is needed at this point. Depending upon your measuring equipment and accuracy for measuring the bore it may be necessary to remove the pulley to try the fit on the spindle. Before removing the pulley from the chuck mark it so that if a small increase in diameter of the bore is needed the pulley can be replaced back in the chuck at the correct position.

If it needs opening up a little this can be done at this point without refitting the spacer, gear etc as the very little axial load is toward the lathe head. Check the bore until it is a good fit. Once the bore is completed a keyway needs to be cut. I used the same process again as described above for the motor pulley.

In order to provide a drive for the new spindle pulley onto the spindle itself I marked the centre line on the spindle then drilled and tapped two M4 threads, within the width of the pulley position, into the spindle. Then two short M4 grub screws are fitted into these. After checking that the new pulley fitted well onto these and they did not protrude



New drive arrangement.



Standard 22mm to 1 inch connector.

into the bore of the spindle they were temporarily removed in turn, given a spot of Loctite and refitted.

Remove the existing drive belt from the lathe and remove the circlip holding the small drive pulley in place and remove this also. Put the high / low range lever at the back of the head into the neutral position, this will not be needed any more. When I later changed the bearings in the head to angular contact bearings, I removed the original internal gears and change lever from the head completely. I have kept the drive shaft itself in position otherwise there would be hole where the shaft had been.

The reduced spacer and the new toothed pulley are now fitted onto the spindle checking that it does not bind onto the rear face of the lathe head. Then the drive train gear and nuts refitted to the spindle, **photo 4**. The drive pulley needs to be removed from the motor shaft and replaced with the new pulley but do not secure the M4 screw to the shaft yet.

When all parts are assembled onto the spindle and secured the drive pulley of the motor can be aligned and secured. The drive belt has to operate within the confines of the original belt guard and as can be seen from the photographs a jockey is fitted to divert the lower section of the belt to fit into the belt cover. The drive as seen from the rear of the head is in a clockwise direction and therefore the belt is fitted to give a straight line from the spindle to the motor pulley for normal forward operation. The slack of the drive belt is taken up by the jockey wheel for which in this case I used two 15 mm diameter bearings held simply by an M6 bolt screwed directly into the rear of the head and having a washer between the bearings and the head, **photo 5**.

This method also ensures the correct tension on the belt and that the motor or its support fixing do not need changing in any way. After checking the alignment of the belt the M4 screw in



The spindle extension.

the drive pulley on the motor shaft can be tightened.

Photograph 5 also shows the original small drive shaft still in position in the lathe head although reduced back to the rear face. This was done later when the head was dismantled for the bearings change and this reduction is not strictly necessary. It is however left in place to fill up the holes in the front and rear of the head.

The modified brass plumbing fitting shown on the end of the shaft replaces one of the spindle nuts and extends beyond the change gear cover to ensure swarf in the spindle does not drop into the change gears. This separate



Nut and blank disc.

modification also became the base of a system I have for dividing using the standard change gears and a few additional purposes, see below.

After checking all was secure the time had come to test my idea. Starting slowly and steadily increasing the drive was smooth and thankfully very quiet. After checking the alignment of the belt the belt cover was replaced.

The speed range had changed slightly whereas the original slowest rev, according to the tachometer of the lathe was 60 rpm this was now 40 rpm. The highest speed had reduced also from 1850 to 1392 rpm. A reduction in the higher speed is not of concern to me although a reduction in the lower speed I thought to be a possible advantage. All however would depend upon torque.

I did not have any equipment for measuring this so decided upon the



Support for long material in spindle.

10



Spindle handle with spigot.

practical application i.e. how does it work when in use. I mounted the faceplate on the lathe which is of course 150 mm diameter, far larger than I would ordinarily need to turn, and was able to easily take cuts across the rim. Then I tried facing it (which was needed as the surface was a little rough) and again I had no problem. In my last article on making a replacement swivelling top slide, I needed to part off a 40 mm diameter steel bar, as far as the parting tool would safely penetrate. With steady speed, even pressure on the tool and drops of lubricant this also proved no problem with my TCT parting tool.

I have found the surface finish generally to also be very good perhaps because there is a little less vibration with not having gears operating within the head. And the lathe now has a quiet hum rather than a growl.

A versatile spindle extension

It seemed strange to me that the rear of the spindle is within the gear train cover. This results in swarf in the spindle being able to drop into the gear train. The solution was simple, remove the fold away cover and extend the spindle so swarf drops away beyond the lathe completely as many people have done.

I was in a DIY shop looking of some plumbing fittings for a totally separate requirement at home when I saw the fitting shown in **photo 6**. It seemed to me that this could easily be adapted as the spindle extension and probably

cheaper than buying raw material for this purpose. Then seeing the nuts and blanking plates for this fitting gave me other ideas. From this came a number of useful and simple applications.

Spindle extension:

This fitting gives a 26.3 mm bore. The spindle on my lathe has 27 mm diameter

with a 1mm pitch. The minor diameter of a female M27 thread is 25.917 mm. The theoretical depth of thread should be .545 mm. With a 26.3 mm minor diameter of the fitting the theoretical depth of thread would be .35 mm. i.e a difference of .195 mm. So theoretically not a good fit. However, from experience I know that when cutting a small pitched internal thread in brass, burrs do form on the threads which affect the fit. So armed with this, less than precise information in mind, which would abhor the purists but I'm always looking for practical solutions, I thought it was a worthwhile experiment to see how it would go.

The result? Well actually a pretty good tight fit. After all the fitting cost about £3 (including the nut) that is less than the cost of raw materials and was partly made. As can be seen in photo 5 I turned off the external thread of the 1" section of the fitting really for cosmetic reasons. Internally there are shoulders for pipes to locate against which reduce the internal diameter, these were removed by boring through to ensure that I had a clear path at least equal to the bore of the spindle through the fitting. The M22 external thread was left intact.

The new m27 x 1 mm female thread now needed cutting. The fitting placed in the chuck which could not be removed during the thread cutting was at one end and the M27 x 1 thread was at the

11



Spindle handle in place.

12



Spigot for changes wheels.

other end of the spindle. To ensure the best fit I turned up an m27 x 1mm external thread on a short length of steel bar. I used one of the lock nuts from the spindle to make this thread as close a fit as possible. When complete this was then the test piece against which the new internal thread of the brass fitting was measured.

As mentioned above the fit of the brass fitting to the spindle in practice has worked well. **Photograph 7** shows the fitting as an extension protruding from the rear of the cover as originally intended. Now what to do with this very tempting M22 thread on the extension.

Support for long materials.

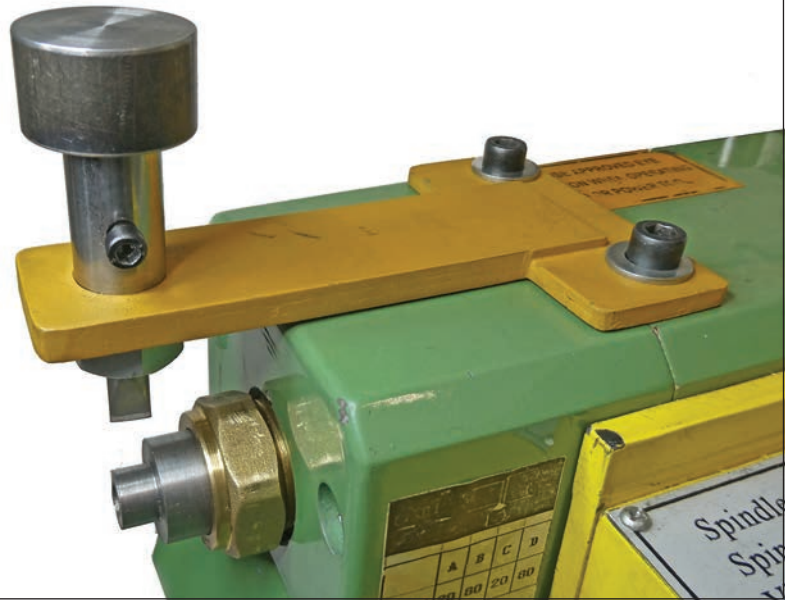
The first and most obvious use to use a standard blanking cap held by the nut of the type shown in **photo 8**. By simply drilling a hole in the centre of this it makes a simple means of supporting longer stock in the chuck which otherwise would fly around. A number of plugs with different hole sizes could accommodate any material which can pass along the spindle bore, **photo 9**.

Spindle handle

The next obvious use is to fit a handle to manually turn the spindle; photos 10 and 11 For this I turned a spigot to be a close fit inside the brass fitting with a shoulder so that the standard brass nut is captured between the handle and this shoulder. This is permanently fitted to the handle so that in use the spigot is located into the spindle bore and the nut tightened. The handle I had available was only 100 mm diameter so the turning force is fine for smaller size tapping etc. but a larger handle would be needed for larger sizes. Always unplug the lathe before fitting the handle.

I turned another spigot to be located into the bore and fastened by a nut. This has a tapered shoulder to match the brass nut. Another spigot turned to the bore size of the change wheels and just a little shorter than their thickness is turned at the other end, **photo 12**. I tapped a hole in the centre of this small

13



Detent pin and spigot in position.

spigot for a screw to retain a blanking cap with a hole which is used to clamp a change wheel in place.

Photograph 13 shows the detent pin which is fastened directly into the lathe head casting. For the detent pin I did not have a reamer or suitable spring for this. Therefore the pin fits into a drilled hole in its holder. This holder in turn has a thread on one end so that it is held into the tooth of the change wheel the pin in firmly pressed in then securely and repeatedly held in place by a small screw on the detent pin holder at each location. The end of the pin is of course shaped to the tooth profile.

The bracket on which the detent pin holder is held is made from a 'T' section bracket reinforced with an additional strip bonded onto the top for additional rigidity. There is plenty of cast iron in the head casting for drilling and tapping holes to secure this bracket in place.

There are a wide variety of change wheels supplied with the lathe and with these a very wide combination of positions is possible. **Photo 14** shows a 60 tooth wheel being used.

Cost for this dividing system, less than £2 for the 'T' bracket. Plus some stock odds and ends.

This method is also ideal for using to hold the chuck in one fixed place when required.

I have made a number of micrometer dials by this method of 60 divisions. The change wheel and detent hold solidly. By the time the dial has revolved a full 360 degrees the tool for cutting the divisions lands precisely in the first mark.

I have not given any dimensions

for this modification as I think the photographs tell the tale well enough and anybody using this idea will adapt according to materials available. ■

Items Required for the direct drive modification:

RS Components:

- Timing Pulley for motor 286-5641
- Timing Pulley for spindle 745-668
- Timing Drive Belt 474-5549
- Arc Euro Trade
- Ball races x 2 696ZZ
- Spacer C2-15 gear spacer

14

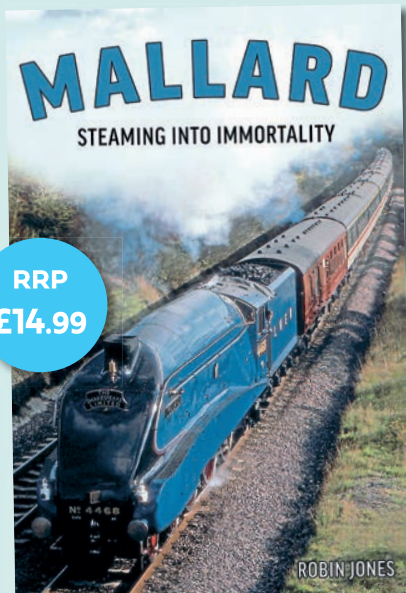


Dividing arrangement.

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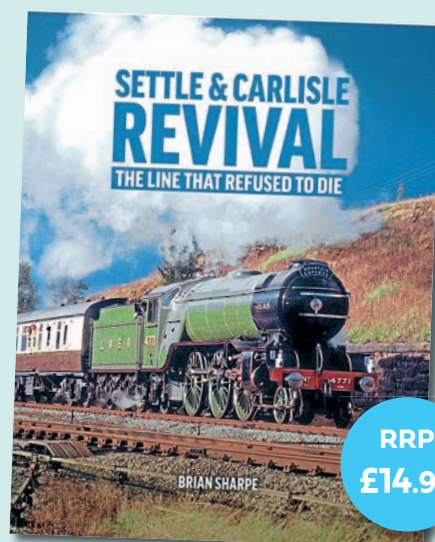
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Overhauling a Vintage Churchill Lathe

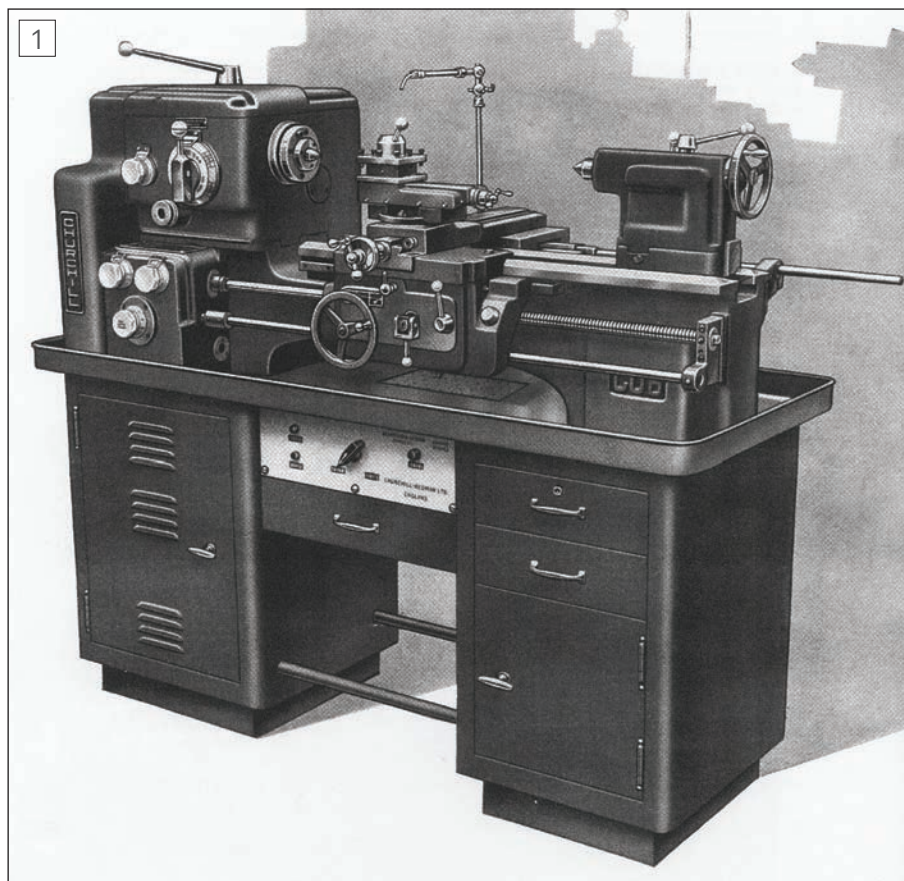


In 2019 Brian Wood bought a dirty and neglected 1947 Churchill-Redman Cub lathe as a restoration and overhaul project to use as a 13-inch swing lathe in his workshop.

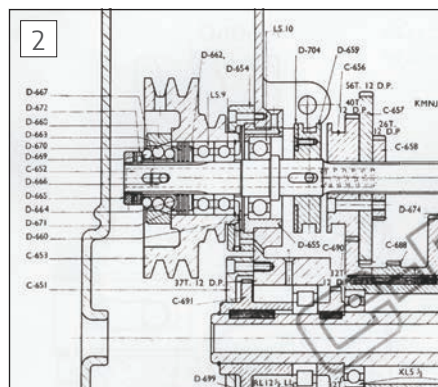
A major part of the work needed to get the Churchill back into working order was on the spindle clutch/brake control. Neither of these functions were found to be working correctly. A novel but entirely satisfactory solution to both problems is described which neatly avoided the need for major internal surgery to the all-gear headstock just to fix the brake.

The problem

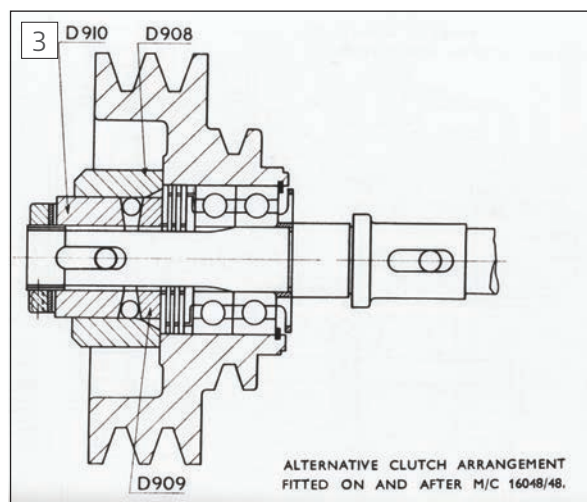
The lathe is shown here in **photo 1**, it has been copied from a picture in the handbook of a Churchill publicity



Churchill-Redman publicity photo of lathe in 1948



Drawing of Mk 1 version of clutch on my lathe



Drawing of redesigned clutch on later machines

photograph in 1948. It is a remarkably modern looking lathe for its time and was billed as being strong and equivalent to the Colchester Bantam in capacity and performance.

Without power at the seller's venue, the crude tests I was able to apply to it could not have shown that the spindle suffered from creep when powered up. To test the brake function itself, I could not pull the chuck over by hand when the brake was applied.

At the time I observed

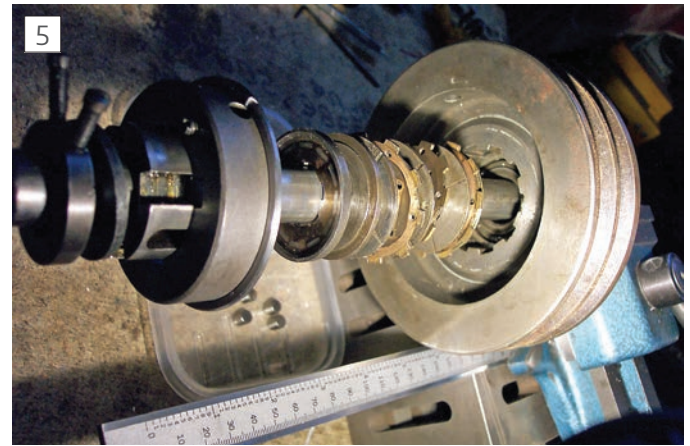
that the clutch control would not stay engaged but assumed that after such a long period of inactivity, it had drifted out of adjustment and would respond satisfactorily to being set up correctly again.

How wrong could I have been! This combined control on the headstock gave me the most work of any part in the entire overhaul, the rest of it was pretty much what might to be expected for an old machine.

The clutch is a compact multi-plate design, neatly built into the hub of the input pulley. It is shown in cross sectional view in **photo 2**. The design obviously gave trouble in use and **photo 3** shows the redesigned version of the



New 8.2 mm diameter sliver steel rollers



"Exploded" view of clutch components

clutch that replaced it on lathes made in 1948, just 44 machines later than the one on my lathe. Both illustrations have been reproduced from the handbook. Alas, history appears not to record how the new design fared in service.

Following the instructions in the handbook, no amount of adjustment to the 'bite' point on the clutch made any improvement, the ability to hold engaged was simply no longer effective. The handbook was of no help at all in the case of the brake. It merely said it is not adjustable and was lightly spring loaded to prevent creep.

Taken together, these two faults meant that the lathe could not be used satisfactorily in this condition. It was rather late in the day to discover a fundamental problem of this magnitude affecting the use of the lathe and the way ahead needed to be resolved.

The options seemed to include: - a) finding spares; b) selling it on as unfinished work or c) finding or making a working solution. Being realistic, finding spares, new or refurbished, for a machine of this age was quite impractical; stumbling across the philosopher's stone might be a more likely outcome!

Widening the search to include

Following the instructions in the handbook, no amount of adjustment to the 'bite' point on the clutch made any improvement...



Splined input shaft

robbing another lathe might only yield parts in poorer condition to my own, even if one could be located. They do not appear to be a machine in wide and popular use. I was in any case rather heavily committed financially with the purchase of the lathe itself and the outlay on the new inverter-controlled motor, plus the other necessary sundries that had been replaced during the overhaul.

None of that expense took any account of the time invested in the work of course. Any sale would be treated as a fire sale and at a heavy loss. In any event, who would be willing to take on a lathe with those faults anyway? The thinking was obvious; "what else might be wrong with it?"

In any case, the very thought was far too depressing to be considered seriously. I had put months of work into the lathe already and was most reluctant to throw in the towel to have to start all over again with some other machine

that could have other hidden and potentially expensive to fix faults.

Viewed purely technically, rectifying the brake might be feasible by building in a spacer behind the spring to increase the pressure on the brake disc; it would also be sensible to reface the brake disc at the same time while it was stripped out and accessible to do the work.

To get to the brake required a full strip down of the headstock to get to the parts involved and it was an area I had very carefully avoided up until now for the very good reason of preserving the existing running clearances and bearing condition. There appeared to be nothing wrong with the bearings and the headstock condition was also remarkably good. Any such action also raised other questions such as what material to reface the brake with. Would it be available and by how much to increase the spring pressure?

Even with a lot more information and detail, making a copy of the redesigned

clutch was outside the capabilities of the workshop. Heat treatment and grinding would have to be subcontracted for example. The analysis left me with no other option but to somehow make the system work correctly again.

I had up until now no experience of multi plate clutches but there was no avoiding taking this one to pieces to see if there was any way it could be improved upon in its current form. With some trepidation therefore and due reference to the handbook drawing in photo 2, I took it to pieces to see what I could learn from the way it was put together and what might be possible to modify or adjust yet keep it within the space available.

I was very mindful of the risk of hidden springs leaping out to vanish into dark corners of the workshop.

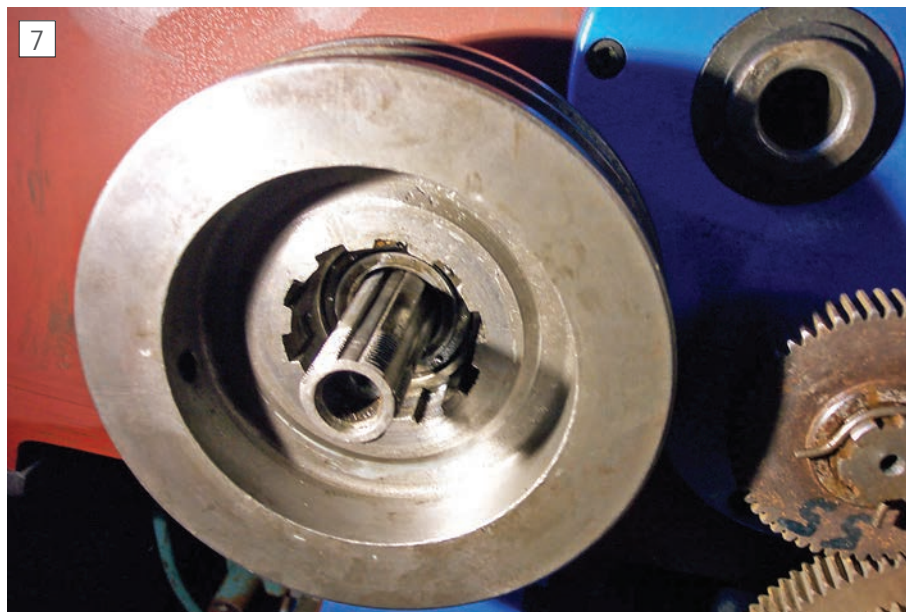
How does the clutch work?

The drawing shows what appear to be bearing balls on the ramp features. They are in fact cross sectional views of roller bearings, the eight smaller ones [D-669] are 7 mm in diameter, the four larger [D-670] are 8 mm in diameter. All are 8 mm in length, and they are contained within four cruciform slots 8 mm wide in the disc D-660.

When the operator pulls the clutch control lever towards the lathe chuck, an internal fork, not illustrated, moves the brake disc D-659 to the right. That motion is transferred via a parallel sided cross pin through the brake disc to the short intermediate shaft D-666 in the centre of the input shaft.

The far end of this shaft is connected via an identical cross pin to the cruciform disc, and that is also pulled to the right. The roller bearings are thus put under an axial compressive load.

The designer has rather cleverly exploited the difference in diameter of the rollers, the larger diameter rollers, by virtue of their increased size, are



Twin sheave input pulley with internal splines

squeezed between the others and urged up the ramps in the cruciform slots.

The ramp angle of those slots was carefully chosen so that the larger rollers, once up the ramps, bear down on the smaller rollers to their right. They in turn load a pressure plate at the end of the multi plate stack; within which friction grip between the plates transfers the drive from the pulley to the input shaft.

To complete the working cycle, when the clutch lever is moved back to the left, the intermediate shaft follows, axial loading is relaxed, and the rollers run down the ramps to disengage the clutch.

Further movement of the control to the left moves the brake disc further to the left and the brake lining [D-704] is forced into contact with a machined face on the inside of the headstock housing to brake the spindle. More pressure on the control increases the braking effort.

When the clutch was new, the transition edges of the ramps were

sharply defined, and they had flat ground floors. These features kept the clutch engaged. As wear has taken place, ramp edges have rounded off, the ramps are no longer truly flat and the ability to hold the clutch engaged has thus become eroded.

Limited adjustment was built in within the screwed collar D-665 to compensate for some wear but that had now been exhausted, the clutch releases in a short period of time. I had observed that it did not take a lot of pressure on the operating lever to keep the clutch engaged and for a short period I was able to use a strategically placed wooden wedge to enable me to machine a new mounting plate for a replacement 8-inch three jaw chuck.

The Pratt chuck I had inherited with the lathe was truly knackered with sloppy guides and badly gaping jaws. A whole section was missing from the internal scroll and there were other areas that looked badly strained. Cobbling the



Stack of pressure plates



Thick bronze plate, first to be fitted

lathe operation together like this was clearly not a satisfactory solution, but it gave rise to a train of thought.

By adding a thin plate to the cruciform disc on the face abutting the pulley would have the effect of displacing the disc to the left and presenting the ramp edges earlier to the rollers.

And, by increasing the diameter of the larger rollers slightly to 8.2 mm this would enhance the effect of starting the rollers over the transition edges and on up the ramps. There was little free space available, and I hoped these two changes might be sufficient to present new surfaces to the rollers further up the ramps and keep the clutch engaged.

Photograph 4 shows the new rollers I made in silver steel, drilled through for a wire to hold them for quenching in brine for maximum hardness.

Rebuild of the clutch in its new form

For those who are interested, what now follows is a pictorial record of the re-assembly, rather on the lines of a Haynes manual. It is shown here in **photo 5** starting as an “exploded” view of the components built up on a bar.

Sticking out of the lathe is the bare six spline input shaft into the headstock, shown in **photo 6**. Onto this shaft fits the pulley on its twin ball bearings, **photo 7**. There are ten internal splines cut into the bore of the pulley.

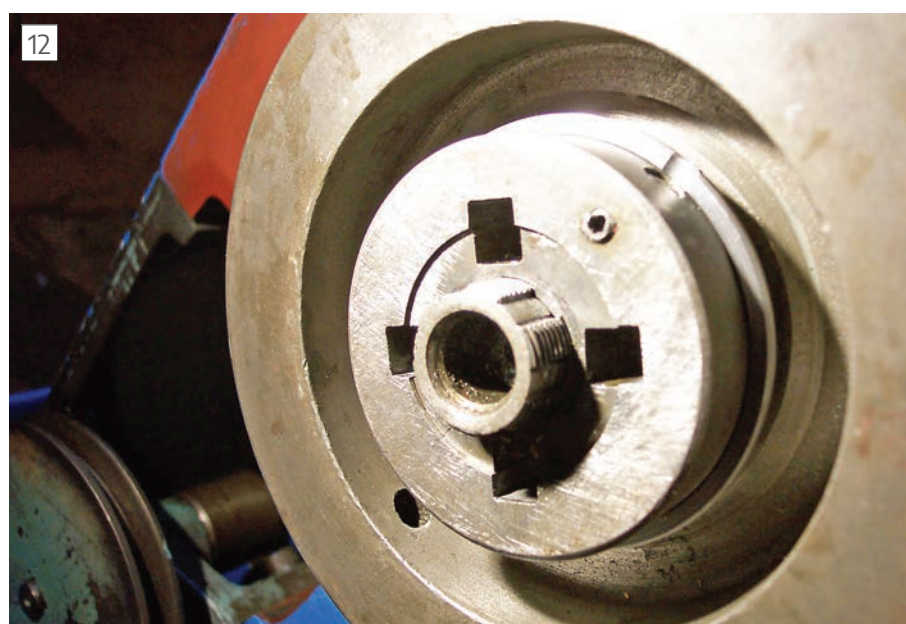
Next is the stack of clutch plates, **photo 8**, with the thicker bronze plate in **photo 9** being the first on, plain side facing the pulley bearings. The stack then alternates between slim steel plates and equally slim bronze plates.



Steel pressure plate



Two-part cruciform fitting, shown misaligned



Cruciform correctly fitted

The bronze plates, with the exception of the plain bored bronze plate, fit the shaft splines, the steel ones fit the pulley splines. There are three of each type.

Next on is a thick, hardened steel plate with the stepped face to the outside, followed by the hard dish pressure plate that the rollers bear upon. The plain side of this faces the clutch plates. **Photograph 10** is a view of the pressure plate in position.

Next to fit is the two-part cruciform, shown deliberately mis-aligned to emphasise the construction in **photo 11**. In this view the new 1mm thick displacement plate I made can be clearly seen. It is secured to the outer cruciform by Loctite.

The cruciform is shown again, now fitted in position in **photo 12**. This view shows the small hexagon headed grub screw that grips the cross pin in



Clutch ON



Clutch OFF



Scalloped section of nylon bar with magnets embedded



As things look with the clutch engaged

position through the whole assembly. It is fitted through a hole drilled in one of the belt sheaves in the pulley. A light grip on the pin is all that is necessary to keep it in place.

Now the twelve pressure rollers are fitted. The sequence starts with four small diameter rollers, followed by the four 8.2 mm diameter ones and then the final set of four small diameter rollers.

The rollers will stay in place against gravity as they are assembled if each is lightly greased. The two final components of are the thick six splined washer to hold the rollers in place and finally the threaded nut D-665 with two radially fitted set screws. It has two holes for a pin spanner that face outwards. This nut allows fine tuning of the clutch bite point, having twelve positions over one full turn. Each positional step provides 0.004 inches of axial thrust adjustment.

Fully assembled, an outside view on the clutch looks like **photo 13** when engaged in and **photo 14** when disengaged. The rollers are visible but still contained in this view.

On test after this work, the results were frankly rather disappointing. While

some basic improvement in operation afterwards was noted, for example the clutch action felt more positive, it still did not hold engaged for any worthwhile length of time. Time for plan B.

The final solution

Bearing in mind my earlier observation that a light restraint was all that was needed to keep the clutch engaged, I hunted about in my collection of "useful stuff". The solution, when it came is unconventional, but it avoided invasion of the headstock.

Amongst this treasure trove I came upon the remains of the disc drive unit taken out of a failed tower block computer. At the time, I was particularly impressed by the remarkable strength available from the slim and flat rare earth magnets that had once flanked the disc and had preserved them clipped to a shelf bracket. Could magnets like these be used in some way for this job?

As part of the reincarnation, **photo 15** is a view of part of the sheet metal tooling tray I made and fitted to the top of the headstock. Attached to the side is a section of black nylon bar scalloped out to fit over a long collar of cast iron

gripping the control lever. Bonded inside the scalloped shape can be seen two round rare earth magnets. The clutch is not engaged in this view.

The nylon is held back on the tray side by two slack bolts with springs behind the heads to give it a deliberately sloppy restraint. It self-aligns when snugged over the cast iron piece, and the magnetic hold it provides is sufficient to keep both items in contact.

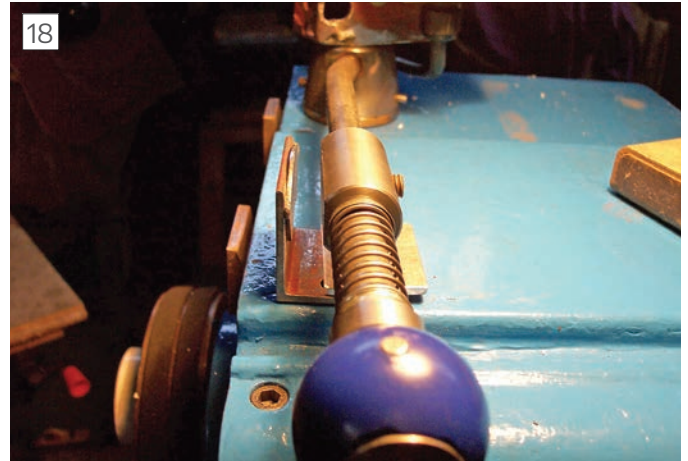
The clutch will now hold on as intended but will release instantly by nudging the operating lever in the appropriate direction. **Photograph 16** is a second view showing what it looks like when the clutch is engaged.

Rather more grip was needed to hold the brake engaged. An angle iron plate was bolted to the top of the headstock and the other side of the cast-iron coupling piece was machined to present a flat face to one of the flat magnets that is bonded onto the angle iron.

When the brake is activated, the magnet grabs the machined face of the cast iron to hold the brake engaged. The two actions are shown in **photo 17** with the brake on and **photo 18** when it is



Brake ON



Brake OFF

off. Only a small degree of travel of the operating lever is needed between these two conditions. The grip is remarkably strong and needs pulling apart to break the hold. Cast iron has been chosen for the 'keeper' as it does not become permanently magnetised, unlike steel. There is an intermediate position in the lever travel which provides a relaxed position it can settle into when the lathe is not in use.

After this phase of the work was completed, I was delighted by the

outcome of testing. Both the clutch and the brake worked successfully and repeatedly. Furthermore, if it becomes necessary, the brake can be slammed onto the magnetic stop to bring the spindle to a rapid halt and hold it there.

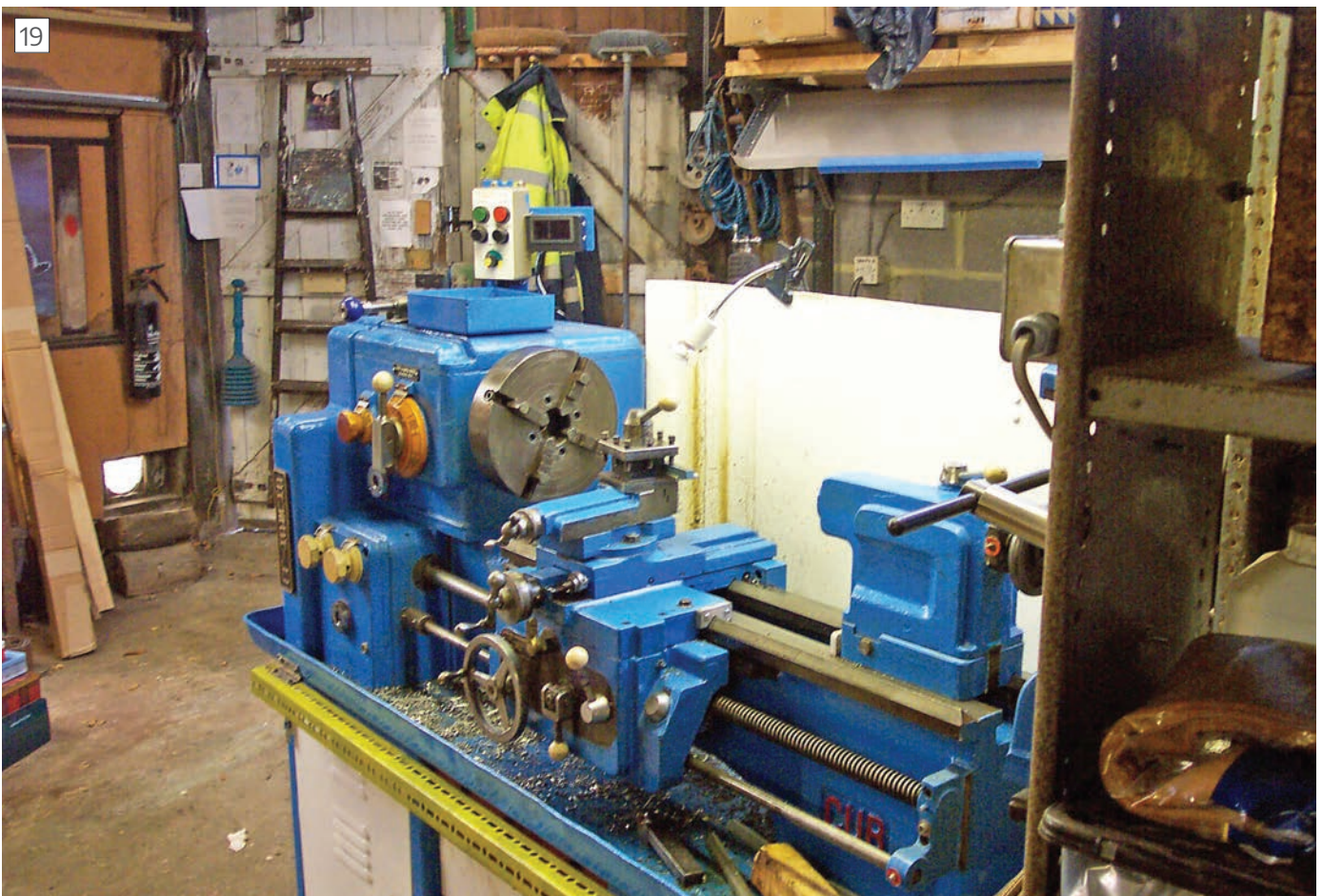
None of these new fittings are intrusive where they are, the tool tray will usefully hold micrometers, spanners, and gauges etc. conveniently to hand. I don't think this result could have been achieved without exploiting the opportunities made possible by

modern technology.

It may not be up to the rigours of industrial use of course but that is not how this lathe is intended to be used in future. Finally, **photo 19** is a photo of the lathe in its present restored and working form.

Acknowledgements

I am indebted to Tony Griffiths of www.lathes.co.uk for permission to use the photos from the digitally restored handbook.



Finished project, ready for work

The Stevenson Trophy 2022



Regular readers will be aware that the last round of the Stevenson Trophy was held in 2020, under the rather trying circumstances of the first few rounds of covid lockdowns. The complications of running even an online competition – chiefly being able to get the trophy from the past winner and pass it on to the new one – mitigated against running the competition in 2021, indeed I will only meet the 2020 winner, Ian Johnson, for the first time when I collect the trophy from him at the Midlands Model Engineering exhibition! The photos shows Alan's winning entry, a quick change tool system for a Sieg KX1 CNC mill.

This is the fourth year of the competition, the trophy being funded by readers and members of the www.model-engineer.co.uk forum in memory of John Stevenson. In accordance with John's feelings about competitions and 'glass case models', all entries must be a piece of practical workshop equipment i.e. a tool, jig, fixture or a modification to or accessory for an existing piece of equipment.

The Stevenson Cup was first awarded in 2018. The cup is engraved "John Stevenson, 1948 – 2017, Remembered by his



many friends" with "Awarded for Excellence in Practical and Useful Workshop Equipment" on the plinth.

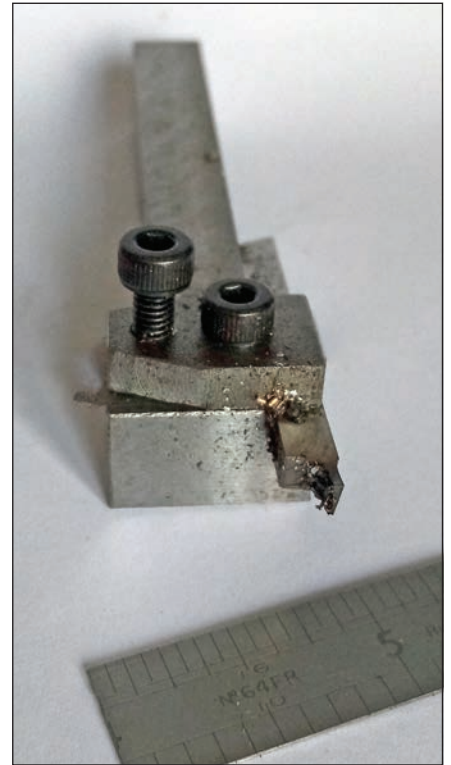
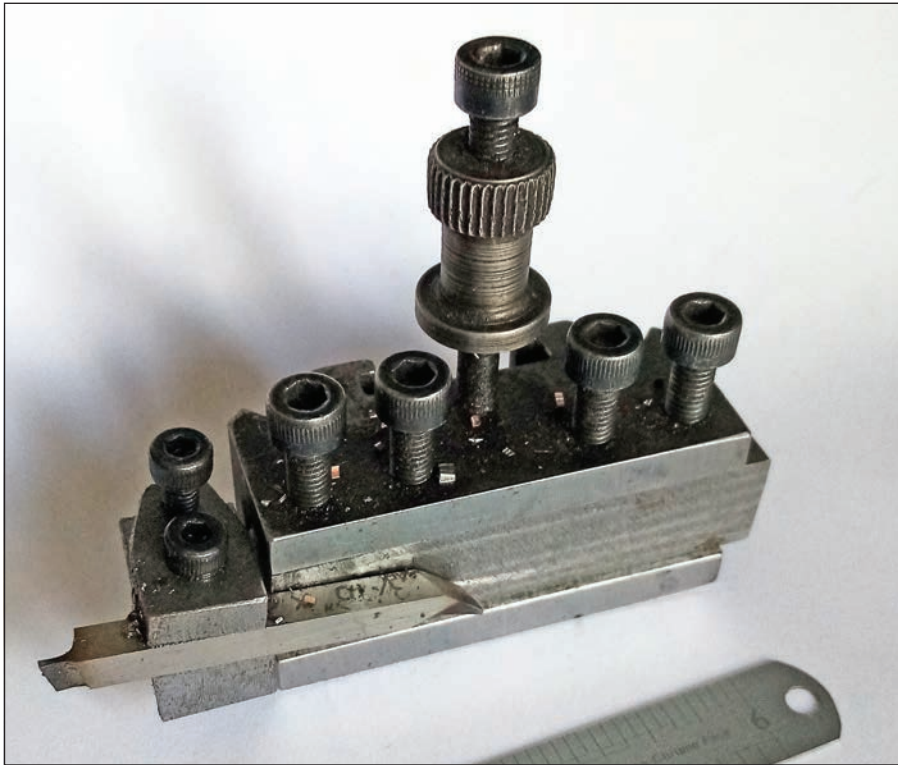
The John Stevenson Trophy is presented for just that, a wellmade and usable piece of tooling, a modification to a machine or an accessory for a tool where the fact it works well is more important than making it look good. Unlike traditional judged trophies, we decided on a different approach to reflect John's reticence about traditional competitions.

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

The decision on which wins is up to you, all readers of MEW and forum users can vote (note you don't need to be a forum member to vote).

Details of how to vote can be found online at <https://www.modelengineer.co.uk/stevenson>.

Duncan Webster - Custom Tool Holder



This is a holder to support $\frac{3}{16}$ " square toolbits in a bigger toolpost. Different to the GHT one which is for round bits. The toolsteel is sloped backwards at 6 degrees which makes grinding easier.

It came about because I had to machine some narrow grooves in 4mm pins for circlips. I could have ground a bit of $\frac{1}{4}$ " HSS, but it's a lot easier grinding $\frac{3}{16}$ ", only half as much metal to remove. It would be difficult to clamp $\frac{3}{16}$ " in my toolpost,

so I adapted an idea from Geo Thomas, his uses round toolbits, mine uses square. The main shank is 14mm * 9.5mm, this suits one of my QCTP holders. The front is machined away at 6 degrees to provide back rake to the tool and then a little clamp plate holds the toolbit down. Sorry, no proper drawings, but photos from several angles. The 2" rule is really useful, might have made more sense to start from the other end, but that had been damaged in some long-forgotten incident.

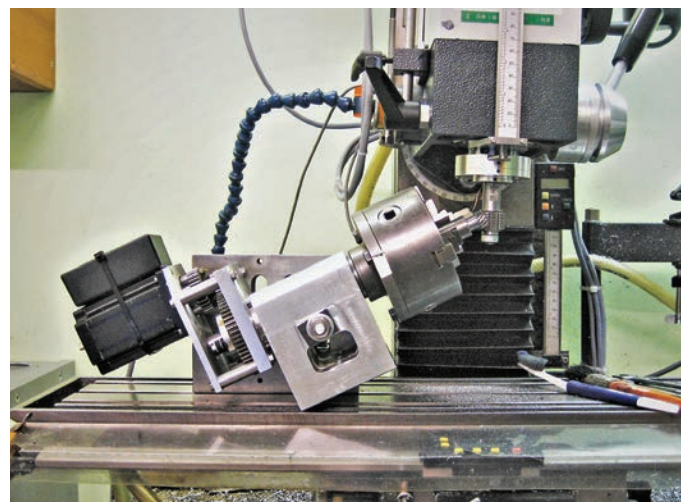
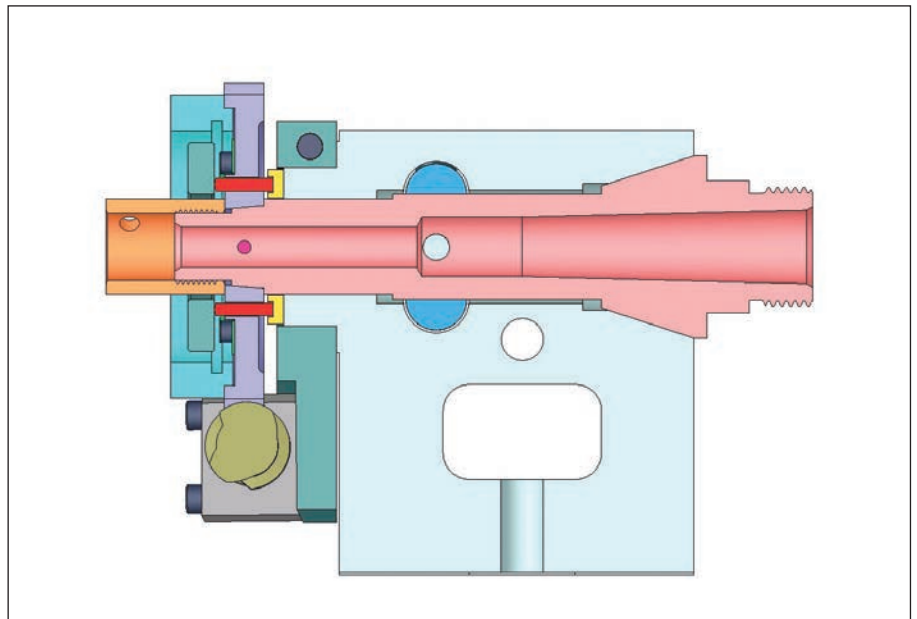
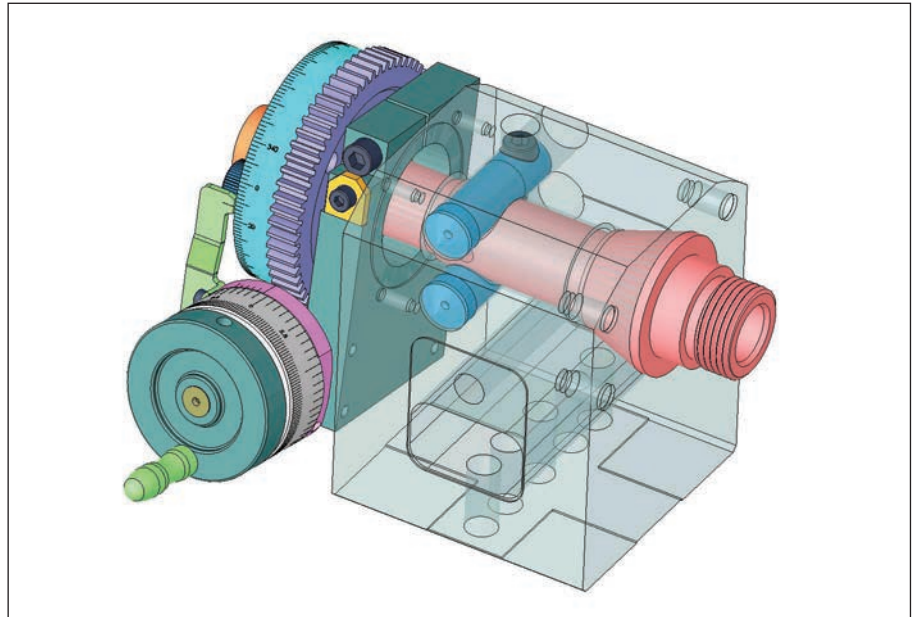
Chris Hallaway - Compact Dividing Head

I designed and made this Dividing Head about 30 years ago for use with hobby size milling machines having limited daylight above the table. In order to make maximum use of existing lathe accessories (3 and 4 jaw chucks, collet holder, centre, catchplate, etc.) the spindle nose and bore replicate those of my Myford S7.

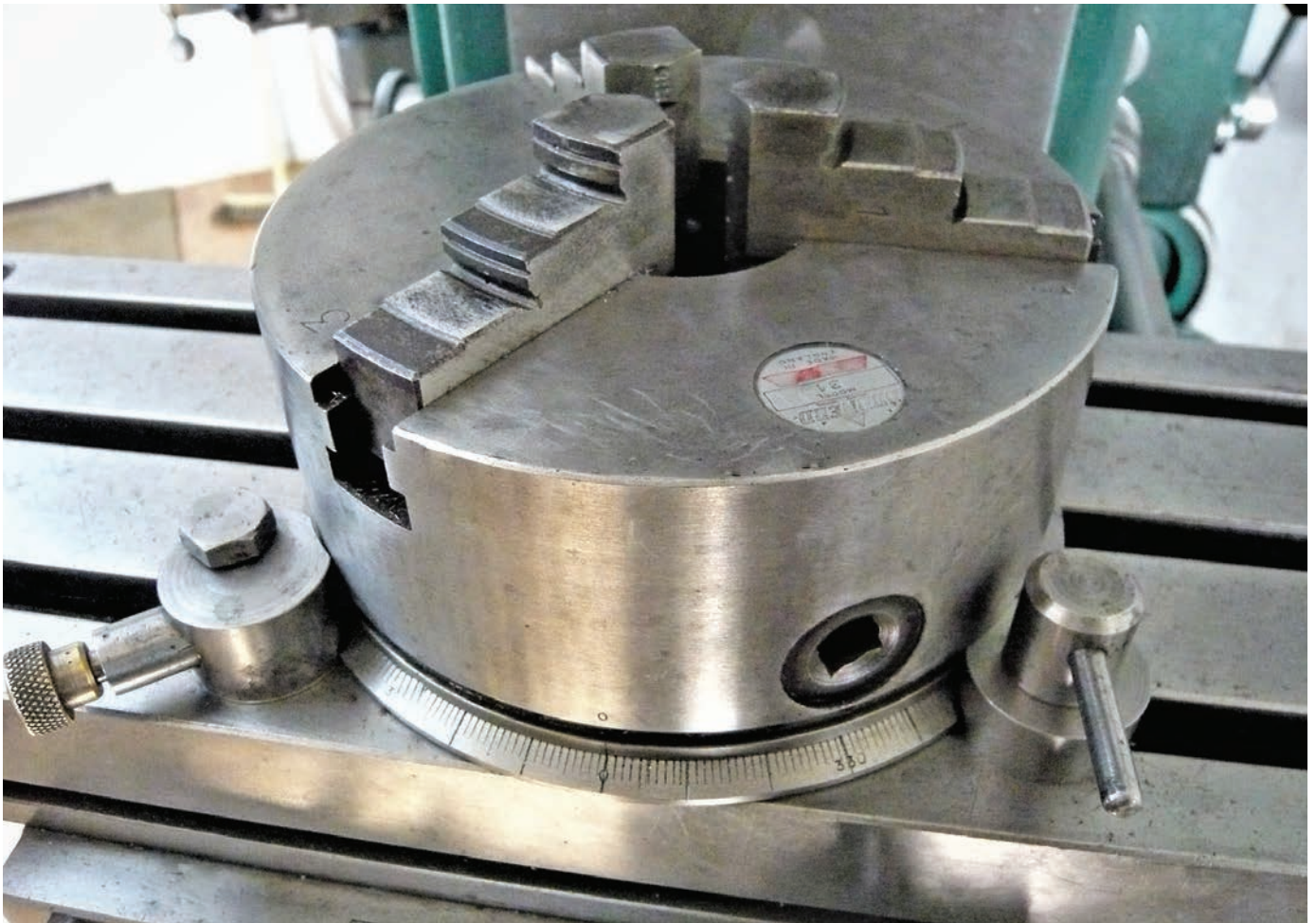
Both the Mainshaft and the Worm shaft are fitted with friction setting dials, the latter carrying a vernier allowing angles to 2 places of decimals to be easily dialled in. Division plates were not included as, for model engineering where repetition work is rare, you may as well drill holes, etc. into the job itself rather than into a division plate and then into the job. Any number of equally spaced holes, faces, etc. may be set up from a table of angles calculated using a hand calculator.

The Body was machined from 6 inch diameter aluminium bar and contributes to the rather low, easily handled overall weight of 8 lbs. It can be clamped to a milling machine table by bolts, tee nuts etc. through suitably spaced vertical holes in the lower section or, if angled mounting is required, to an angle plate via horizontal holes and bolts.

All parts, with the exception of the 60 tooth gear, were machined using my Myford S7 and Dore-Westbury mill. It was found later that, with suitable additions, the Dividing Head could serve as the work holding part of a spur and helical gear hobbing set-up inspired by an article in MEW 193 by John Pace.



Alan Jackson - Indexing Chuck

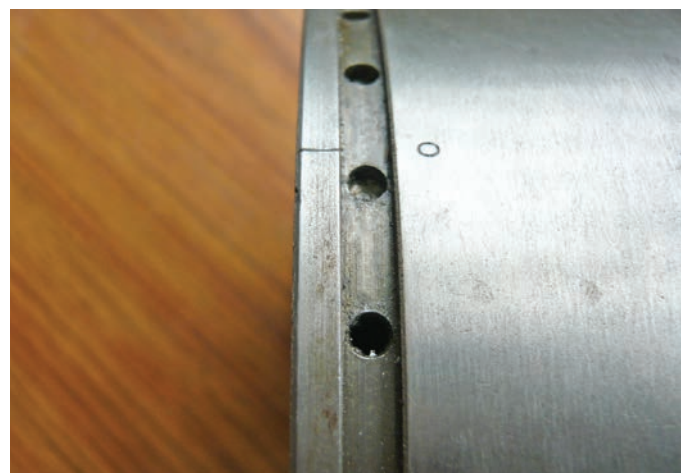


A while ago I acquired a slightly battered 6-inch three jaw chuck. I used it to make a mounting fixture on my milling/drilling machine for holding items in the vertical for milling and drilling etc. A plug that fits closely into the chuck bore is bolted in place via a tee nut to provide a centered location point, enables the chuck to be rotated about this plug. To complete the mounting I made an index ring that fitted

between the base of the chuck and the table top. The index ring has a raised locating step that fits into the chuck mounting register. The index ring has been graduated in one-degree steps with every 30 degrees numbered. A locating dowel projects from the underside of the ring. This fits closely into a tee slot to locate the index ring and prevent it from moving when the chuck is rotated.

To complete the set up I have drilled shallow holes at the bottom of the groove in the chuck body every 10 degrees to accept an indexing plunger. The spring-loaded plunger fits the index holes and can be pulled back and rotated 90 degrees to disengage its operation.

Finally the chuck body has fiducial graduations at 90-degree intervals, numbered 0, 90, 180 and 270 degrees.



Bernard Towers - ER16 Indexer



I am sure that quite a few of you have a 5c indexer. I thought that perhaps a smaller version with the problems ironed out might be a useful tool. The design has moved the dividing mechanism to the end away from where the work is carried out and the mainshaft is ER from the outset. As the Sherline is made from a lot of hard anodised aluminium, I thought that the main body and mounting plate could be made from the same material.

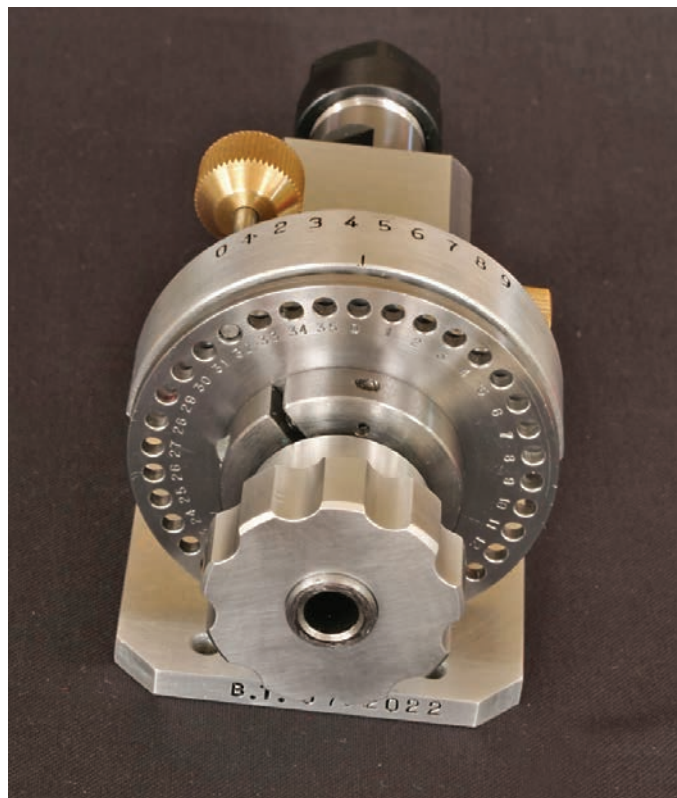
The mainshaft is a bought in item. It is ER16 with a 16mm shaft, 150mm long which leaves room for some

modifications (screw cutting and size reduction for the knob fitting) and cutting to length. All the rest of the parts are workshop made.

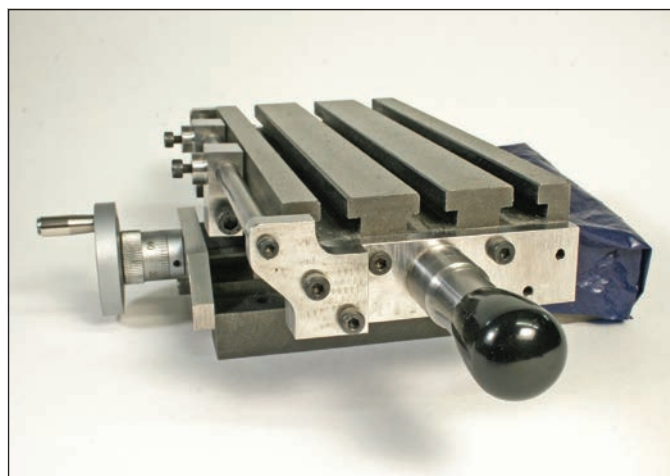
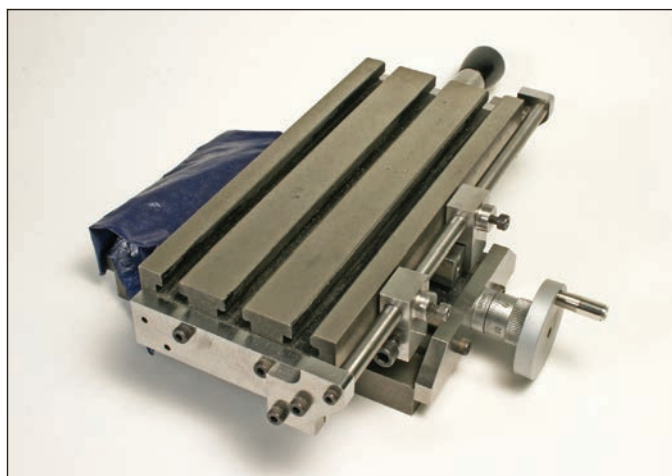
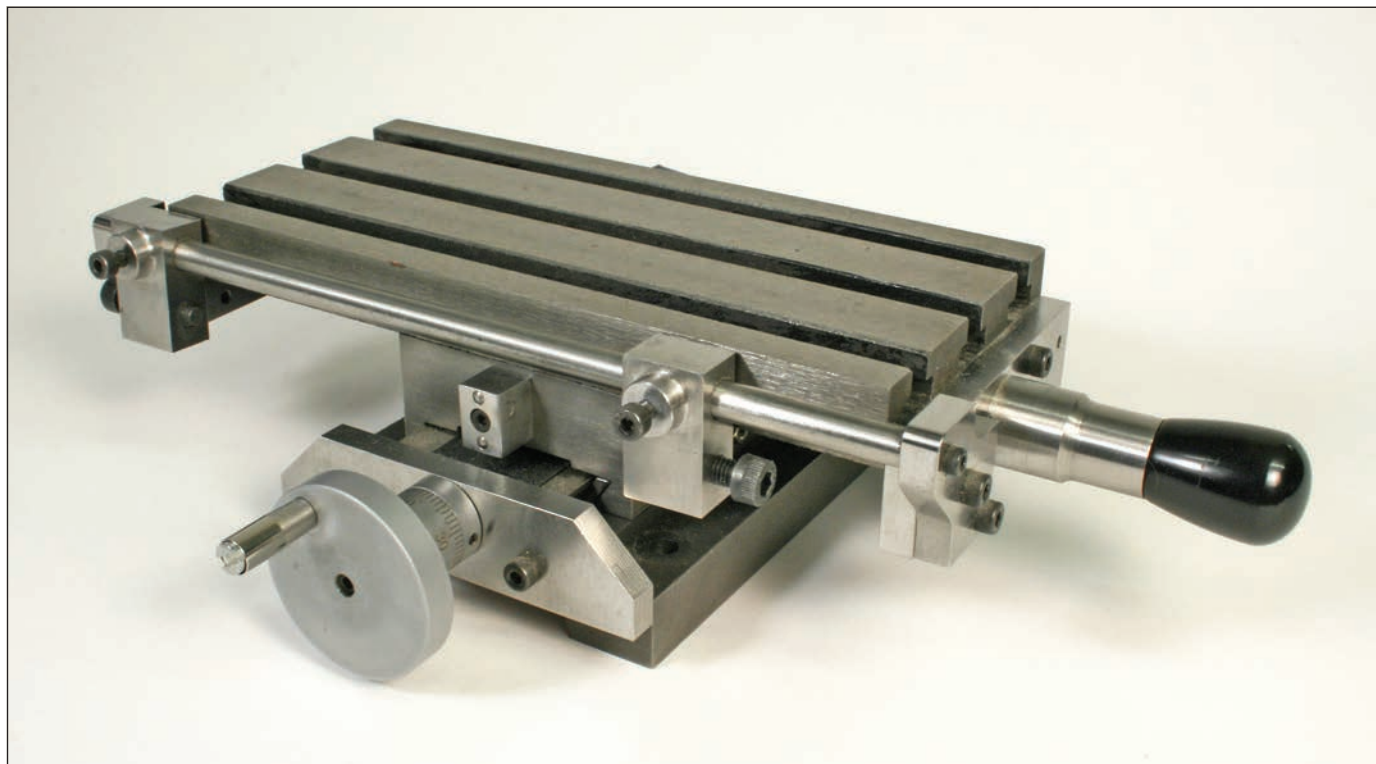
The baseplate is bolted and pinned to a block which is the main body of the indexer. The vernier quadrant is pinned and bolted to the main body (this is where a casting would be nice). The main body is bushed in phosphor bronze. The 36-hole plate was made using the hole circle function on a larger mill and the holes have a $2\frac{1}{2}$ degree taper to enable the tapered locking pin to lock in place. The holes were done with a

homemade tapered D bit.

The mainshaft is threaded 40 tpi for fine adjustment of end float, and the corresponding nut is split for locking purposes with two pins added to drive the dividing plate. Thrust washers made from hard steel shim washers and bronze are at both ends of the body. The mainshaft can be locked in place while work is carried out using the screw provided. On the opposite side of the body is an oiler to lubricate the bushes and shaft. The knob on the end is there to make it easier to index the shaft to the next position required.



Marcus Bowman - Grinding Table



This project is based on a commonly available XY co-ordinate table. The competition element lies in the modifications to the table, and the associated parts.

The commercial parts which remain are: the base, XY saddle casting and table top, the Y axis leadscrew with handle and graduated collar, the gib strips and associated adjustment screws, and the Y axis sliding leadscrew dust shield.

The new parts are: the X axis end plates, the Y axis front mounting plate and bearing, the rear dust shield and its clamp, the central table stop, the front rail and its mounting plates, and

the adjustable stops. The end knob body is new, but the black rounded end was 'rescued'.

The X leadscrew was removed and replacement end plates made, with provision for a fixed handle at the right hand end. That allowed the table top to be pushed or pulled manually at an appropriate speed. At that stage, the saddle and table top were removed, turned through 180 degrees, and replaced. That placed the gib strip and its adjustment screws at the rear, in preparation for other modifications.

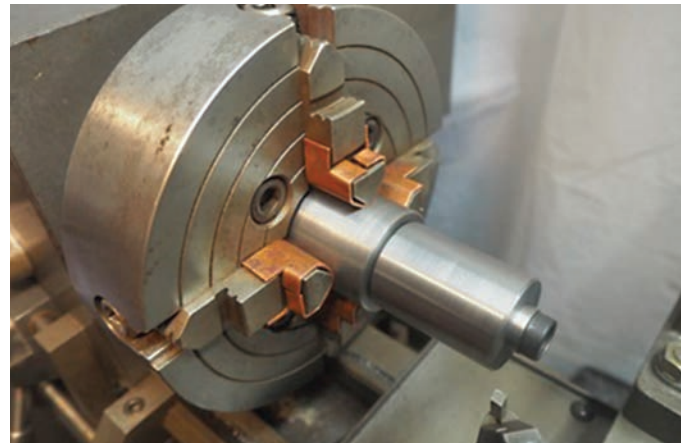
The Y axis leadscrew was left in place, but the front leadscrew support plate was replaced by a new plate

of a modified design, which allow attachment points for a dust shield at the opposite end of the Y axis. The X and Y axis gib strips were hand scraped to improve fit and movement.

The central limit stop was milled and provided with two dowel location holes and a recessed cap screw hole. Once fitted in position, the dowels positively establish and maintain the position of this fixed stop.

The table normally carries a selection of home made tool holders, and does a good job of providing controlled feed and traverse.

Brett Meacle - Morse Taper Fixture



If you were making a new Morse taper from scratch as suggested by George Thomas in his Book "The Model Engineers Workshop Manual", Holding the work is not a problem as you can follow two basic machining principles, plan the work to complete as many operations as possible at the same setting and only remove the item from the parent bar or chucking piece as late as possible in the machining sequence. Because the object we are trying to hold firmly is tapered, slippery and awkward as well as not wanting to damage the finely machined surfaces in the process, a cunning plan had to be thought up.

A two-part holder was devised with a threaded depth stop those screws in and stops the MT arbor from moving forward and loosening in the holder during machining operations. The adjustable stop is to accommodate the lengths of differing sizes of Jacobs Tapers.

It is a bit of an extravagant work holding method but is a good skill building project and once made can be used for as many tapers if you have the need. Once it is set up for a particular size arbor, it is just a matter of unscrewing the assembly, removing the already machined one and inserting a new one then screwing together again.



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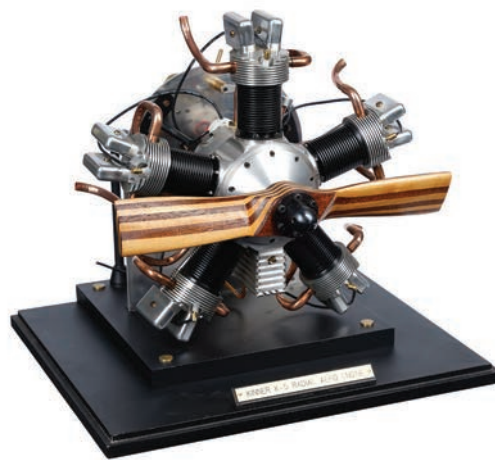
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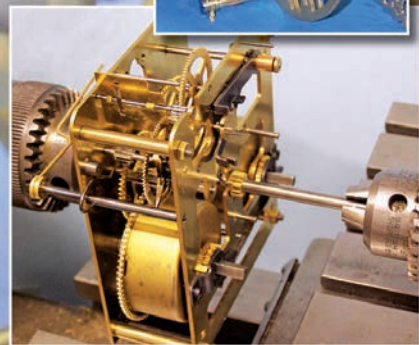
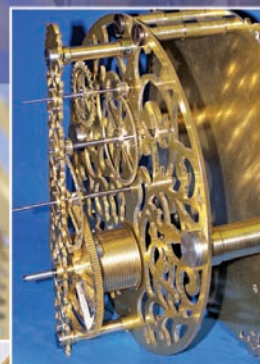
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Artful Dodge #1 —

Always use at least two clamps to hold a workpiece when milling or drilling



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



Using an SPI angle plate.

I realised that I have enjoyed our hobby for nearly 50 years but that there are many who only take it up after retiring from work. Perhaps I could pass on to them some of the “dodges” that I have picked up over the years which have helped me to stay safe and produce good work. So this series is aimed at the less experienced model engineer.

A picture is worth a thousand words, so my plan is to present each “artful dodge” as some photographs accompanied by as few words as possible.

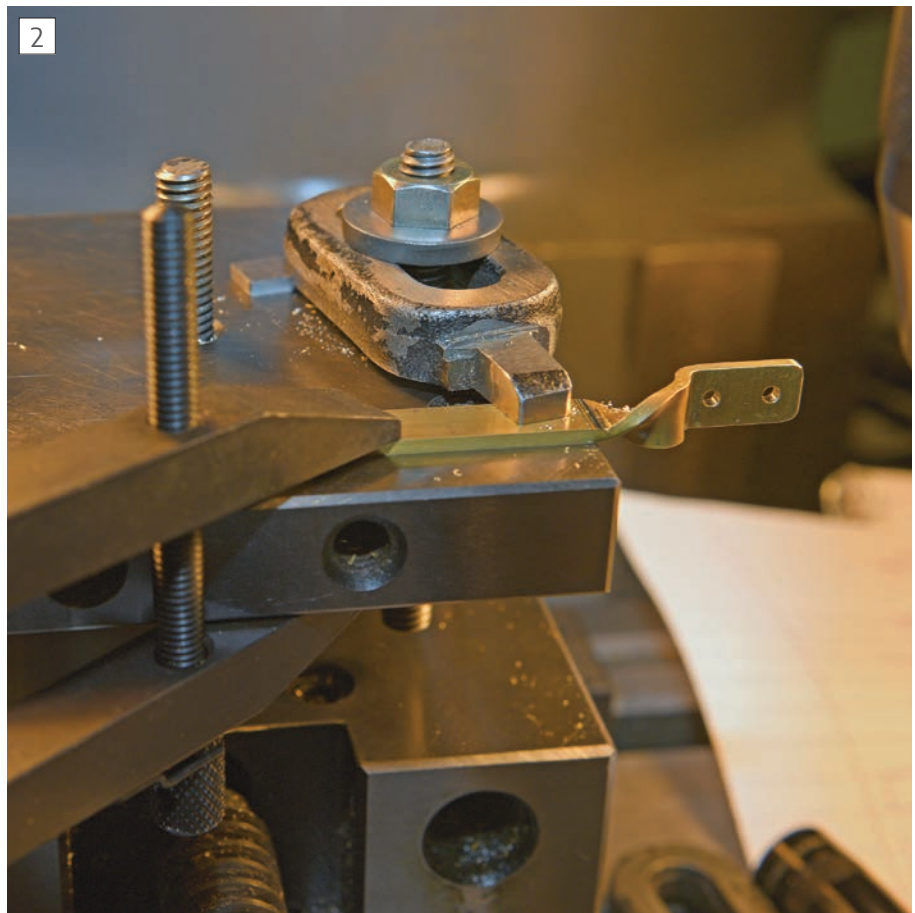
Safety is not a very interesting topic, but it is important, particularly as many of us are acquiring larger machine tools with very powerful motors.

Clamps are very important when drilling large holes on the drilling machine and when drilling holes of almost any size in sheet material – particularly brass, which can “catch” the drill and give one a nasty shock. Using two clamps minimises the risk that the workpiece will slip, be spoilt or fly across the workshop to cause injury.

When milling, a good machine vice (accurately ground all over) can hold most workpieces. Large or awkwardly-shaped workpieces can be clamped directly to the table of the mill. An accurately ground angle plate (without webs), held in the vice, can be very handy for small workpieces. I use SPI angle plates for this purpose. They have tapped holes all over for holding clamps, **photo 1**. This type of angle plate is also well suited to the use of toolmakers’ clamps, **photo 2**. For tiny workpieces, particularly when several have to be made, a simple jig which can be held in the machine vice or on the drilling machine table is the answer. This can be very simple – just a groove to register the workpiece and a couple of small clamps to hold it down, **photos 3, 4 and 5**. **Photograph 6** shows another jig in use on the swivelling angle plate. The common feature? At least two clamps!

Now for the boring but necessary bit:

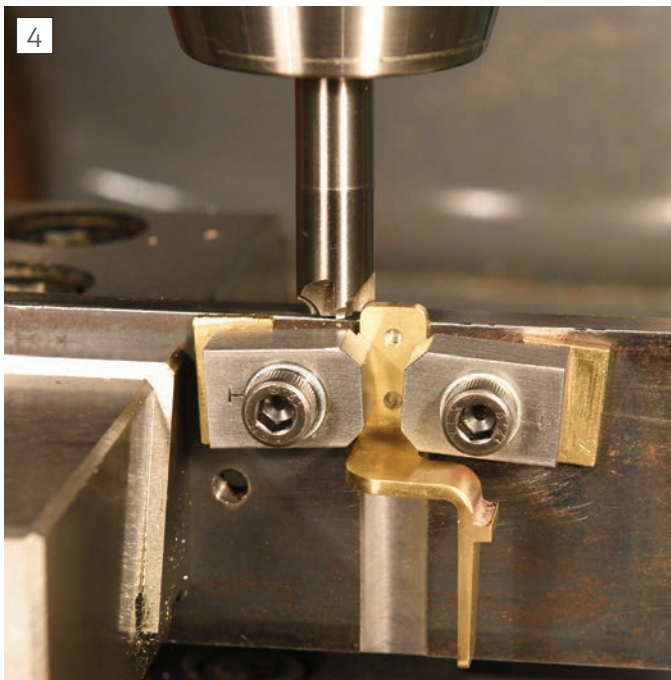
- Always wear eye protection. If you shop around you will find plastic safety glasses which are comfortable to wear over glasses.
- Keep the workshop tidy and the floor near your machines free from electrical cables and other trip hazards.
- Ensure that the workshop is well-lit; you can see much better when your eyes are not dilated (like “stopping down” a camera lens to get more depth of field).
- Wear lightweight cotton gloves; these will protect your hands from splinters.



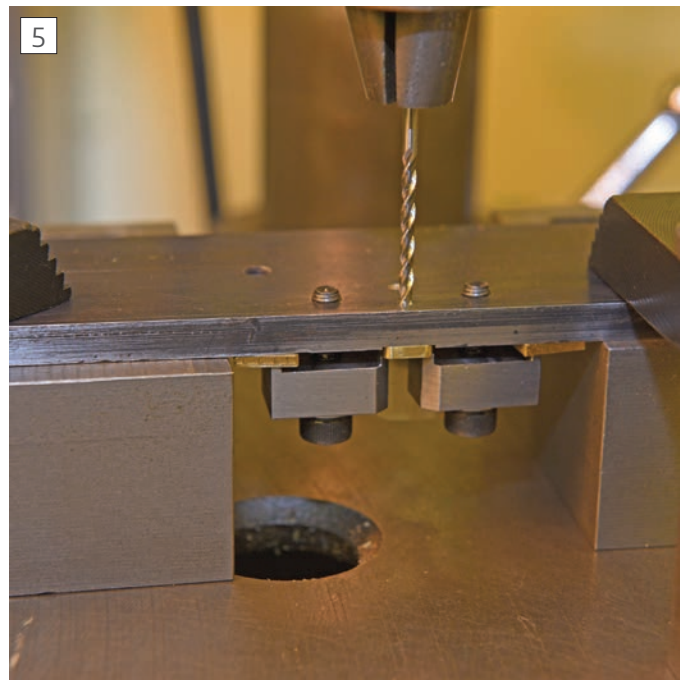
A toolmaker's clamp (at left).



John's skill is demonstrated by the many precise operations on these superficially simple parts.

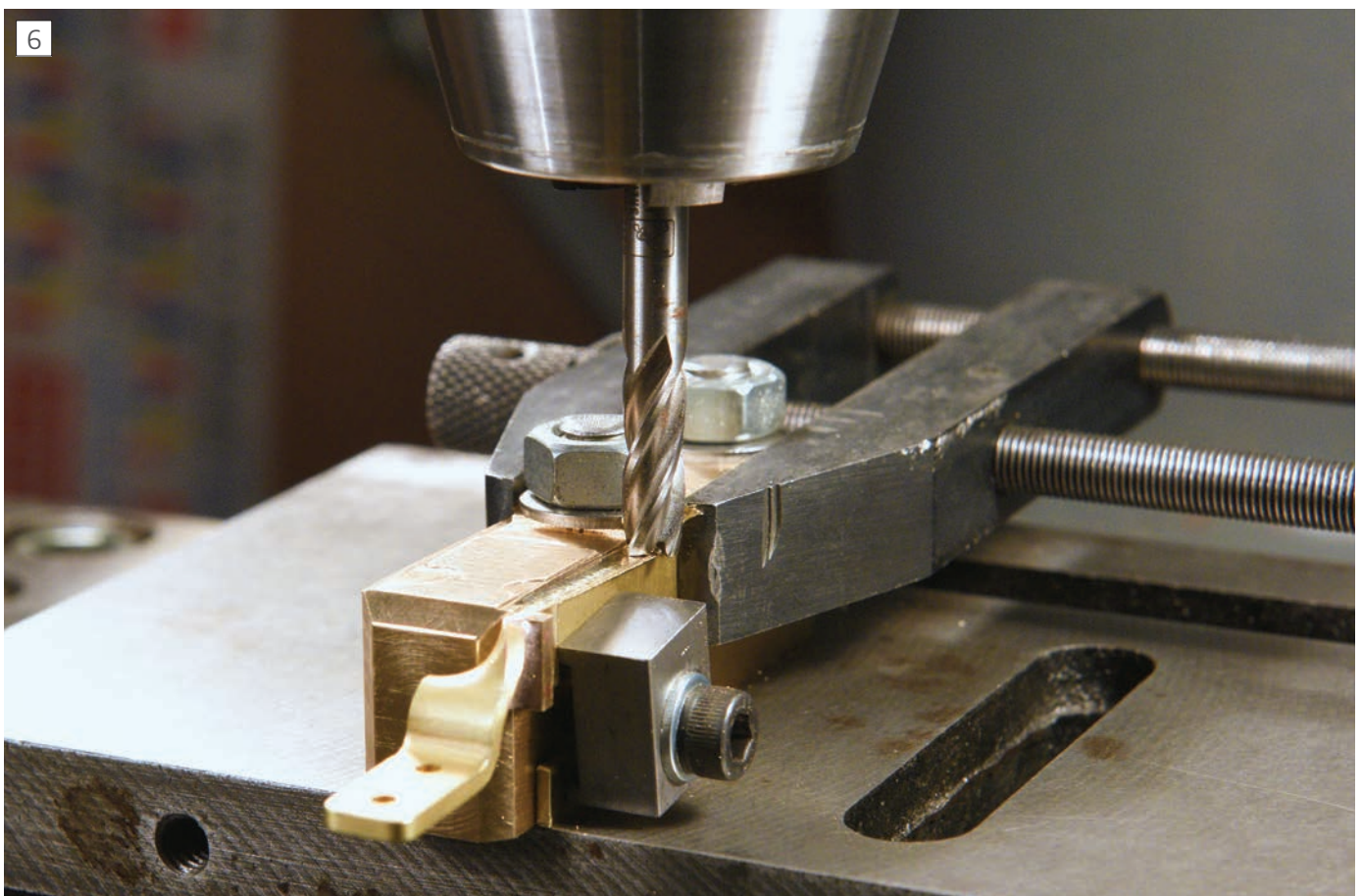


Careful clamping, even for a tiny cut.



Precision placement of a hole.

- Don't wear a tie when working at the lathe; if it gets caught in the chuck, you will be badly injured.
- Don't be in a hurry; take small cuts, use a modest spindle speed and a fine feed. This will reduce the risk of the workpiece slipping.
- Always wait for the spindle to stop before measuring a workpiece or inspecting it with a loupe.
- When removing sharp edges from a spinning workpiece in the lathe using a needle file, put the tang of the file into a wooden file handle drilled out to suit. This will stop the file going right through your hand if it catches a jaw of the chuck.
- Don't operate machinery when tired or when you have had a couple of drinks; it isn't worth the risk. ■



Clamps used to make a jig on an angle plate.

Readers' Photography Competition

Many readers will remember that in 2015 we produced a 'special' that celebrated 25 years of Model Engineers' Workshop. In sorting through things following the recent changes, I discovered a modest number of copies of the special, which we originally thought had sold out. Rather than trying to sell these, I am offering them as prizes for a photography competition. Email a good quality picture of yourself in your workshop, along with around 3-400 words of description and your address to meweditor@mortons.co.uk.

If your picture is chosen for publication, you will win a copy of the 25 Year Special together with a £25 gift token. No alternative prizes can be sent, and the editor's decision is final. Overseas readers please note we can only send gift tokens in UK pounds.

Our first winner is Allan Qurashi with this simple but effective composition. He writes:

A manual turning handle for my ML10, also from scraps, but inspired by someone on the forum pointing out that cutting metric threads on an imperial ML10 almost always requires a 63-tooth driver gear, which partially eclipses the spindle bore.

The body is from a 25mm hydraulic actuator ram, and the knob is a bronze bush with an interference fit brass plug... because that's what I had. The taper pin is brass, pulled up with a bit of M8 studding, so not much cross-section left at the waisted part, but it works great, and is now the most used tool I have for the lathe for tapping and single point threading. I always thought wood turning a bit too scary, with the high rpm and risk of it snatching the chisel, but I made a woodworking rest for the ML 10, and chisel turned the handle knob from nylon.... nice and soft, so very forgiving to novice wood turners.





Scribe a line

YOUR CHANCE TO TALK TO US!

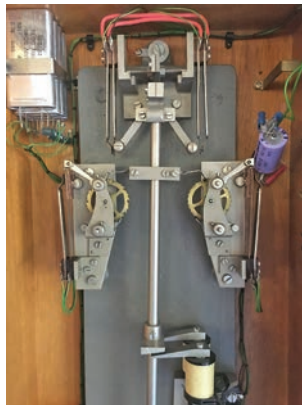
Readers! We want to hear from you! Drop us a line sharing your advice, questions or opinions. Why not send us a picture of your latest workshop creation, or that strange tool you found in a boot sale? Email your contributions to meweditor@mortons.co.uk.

Telephone Exchange Clocks

Dear Neil, Mike Mathews asks if any telephone exchange clocks still exist. I have one on a wall in my lounge. Mine is in a modern light oak case and according to the maker's label was made in February 1939 by Chloride Gent and, I understand, was originally installed in the East Chilton exchange. My son has an older version in a dark oak case in his workshop.

As I don't have a telephone exchange to provide the power to excite the pendulum, I have devised a circuit to charge an electrolytic capacitor from an old 'wall wart' power supply from my store of 'useful' items. One day I will get round to tidying up the bird's nest.

The 'clock with no dial' provokes a lot of interest from visitors who can't understand why I would want anything as useless as a clock that doesn't tell the time.



Dick Ganderton by email



Wood versus Metal

Dear Neil, I saw this by Easby Abbey, North Yorkshire and thought it might amuse readers.

Wood 1, Metal 0!

John Johnson, by email

Thoughts on the Magazine Content

Dear Neil, In the latest MEW, 320, you invite thoughts on the content of future issues. Here are some of my thoughts

- although there must be variety, I too thought one recent article had gone a bit too far. I really thought it was an advert!
- it is the editor's job to hold/increase sales with the content offered. Reduced interest = reduced sales = no magazine.
- as stated in a couple of my articles I use ideas gleaned from MEW and lift then for my own application -do not re-invent the wheel.
- I like the odd article, workshop related. My favourite to date was the article "Modern Flute Making in a Small Workshop" (MEW256).
- I agree with limiting the size of articles, more specifically the number of parts on a specific project (updating the "thingy" on a "what's it lathe"). I have subscribed for many years and, before your time, I nearly cancelled as there were several sequential issues that contained nearly nothing except series as above which were of no interest at all. These issues were literally Opened and then Shut.

I await with interest your survey and its findings

Laurie Leonard, by email

Tony Jeffree's Clock

Dear Neil, I read with interest Mike Matthews' letter in the 'Scribe a line' in Issue No: 320.

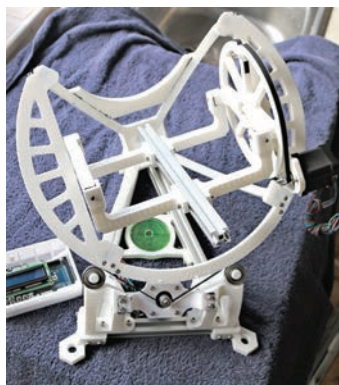
At present I am restoring one as described & to date I have not been able to obtain any information, but the P.O. 36 is the nearest I have found. My clock has dictograph England on the dial face and functions as Mike describes.

All slave clocks are connected in series with the master, therefore a constant current circuit & all impulse at the same time.

This one has survived.

Brian Francis, Devon

Tony's clock series has generated a great deal of discussion and feedback from readers, almost all of it positive. Earlier articles that focus on problem solving and unusual devices have also proven popular, so I'd be interested to hear from readers who may be able to offer articles on their own inventions and adventures in less well trodden areas of engineering – Neil



Further Thoughts on the Magazine

Dear Neil, a few thoughts on Model Engineers' Workshop content. I have been reading MEW since the early days and generally find lots of interest in every issue. I am sure there are lots of (vocal) traditionalist who don't want to read about modern techniques and electronics, but I am not in that camp. Personally, I see a gap in the UK magazine market for a monthly that covers

mechatronics. Existing electronics magazines seem to shy away from projects involving anything beyond the most basic metal bashing and every time an article on electronics sneaks into the model engineering press there seems to be howls of derision from those who seek to maintain the purity of the hobby. (I had high hopes for the Hackspace magazine which initially looked quite promising but seems of have degenerated into a lot of vacuous product reviews).

Motion control is a fascinating and important field. How about articles on making a 3D printer or improving a Chinese import laser cutter? Robotics and CAM are the way that industry is moving, and it may be the way to kindle interest in the next generation of hobbyists.

Another topic close to my heart is operating old lathes and mills from domestic single phase power supplies. There seems to be a lot of information about converting the machines to run using VFDs but not

so much on the electrical requirements between the consumer unit and the VFD. It would be helpful if you could find a 'tame' electrician who could give authoritative advice on what is required in terms of MCB types suitable to operate two stage (ie 240V AC single phase in 415V AC three phase out) VFDs without tripping the earth leakage for the whole installation. I know that every 'sparks' I speak to gives a different opinion.

I would be interested in more in-depth articles on CAD drawing packages, particularly low-cost packages available to hobbyists. I have in mind Autodesk Fusion that is currently available (with some limitations to hobbyists) at no cost but I have found it a steep learning curve and difficult to adjust to after 20+ years of using ProDesktop. I would also be interested in articles on designing parts for laser cutting.

Finally, I know you have an interest in astronomy. How about a tracking telescope mount suitable for astrophotography? I am sure that a design could be hatched up using laser cut steel plates and stepper motors that would give acceptable results at a fraction of the cost of some of the top end mounts reviewed in the astronomy magazines. If a film camera on a barn door mount made of bits of floorboard, a door hinge and piece of threaded bar could produce results back in the day then surely we can do better with the cheap microcontrollers and motion control 'stuff' that is now easily available to the hobbyist?

Bob Cannon, by email

The photograph shows a 3D printed astronomical tracker that Bob has made – Neil

Rewinding Motors

Dear Neil, I would like to add some comments regarding re-winding electric motors.

While employed as an Electrical Fitter- Mechanic one of my jobs was rewinding motors. Thus, from practical experience to soften up the varnish in the old winding we used a Caustic Soda bath. The usual method was to submerge the motor in the bath overnight and the next day the windings could be easily removed, but there is one proviso... the frame must NOT be Aluminium.

How do I know this? Another tradesman left his Aluminium frame motor in overnight and the next morning there was only the stator left! No motor housing.

Another tip is to join the winding wires by melting them together using an oxy torch.

John Chappell, Caloundra Queensland, Australia.

Off Grid Solar Power

Dear Neil, there was a particularly interesting inclusion in John Arrowsmith's description of his visit to the Stockport and District SME (in ME 23 Sept) with regard to the solar power installation in their clubhouse. This seems to essentially consist of two full size solar panels on the roof, two batteries (presumably for a 24V system) and an inverter with a 3 kW output at 220V AC. This is just the sort of smallish off-grid solar power system that would be suitable for a small home workshop with, say, a lathe and a milling machine plus lights and power, in a shed or outbuilding.

What would be very useful would be more details of their clubhouse power system – perhaps as a short article in Model Engineer or Model Engineers' Workshop?

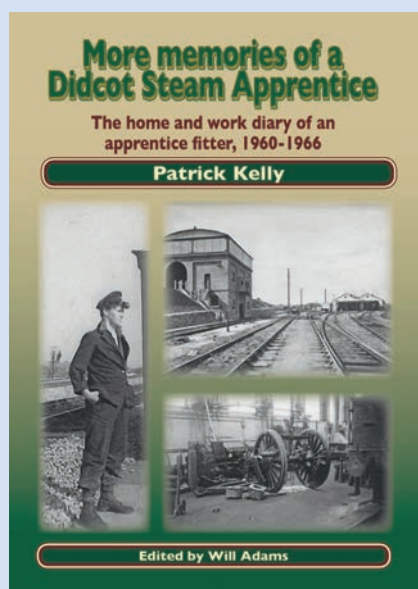
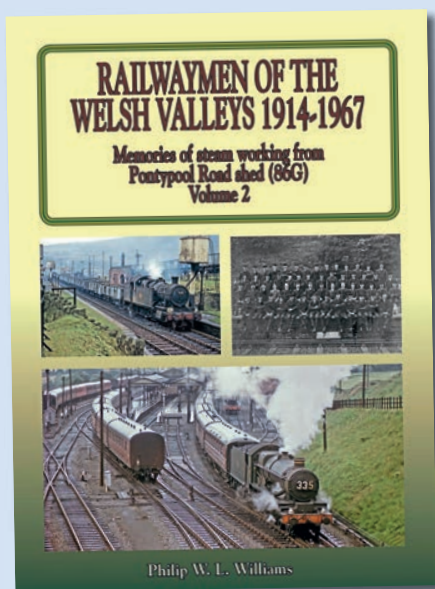
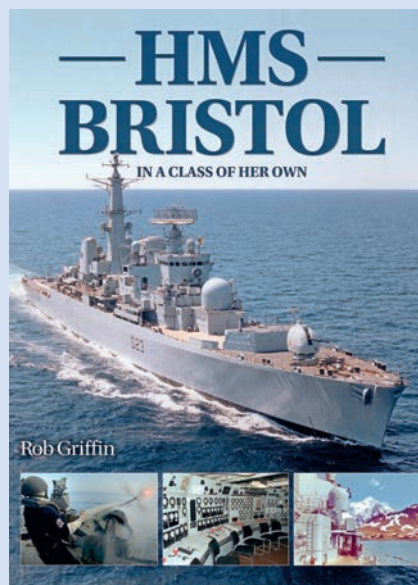
Keith Keen, Ceredigion.

Can anyone offer an article on this interesting topic? – Neil.

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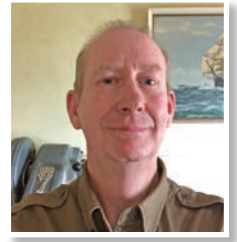


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Replacing a Vintage Thumbscrew



Brett Meacle explains how to remove broken screws and an unusual way to 'age' replacement parts.



Broken screw job mounted in mill vice.

A small project I had recently was to remove a broken off screw and fit a new one to return an old tool to useful service. The replacement needed was one of the spade head thumbscrew types.

Whilst not in common usage these days, some sizes and threads are still available. The broken thread was removed but on inspection of the part, the threaded hole was found to be a standard TPI but over size on the diameter compared to a standard screw. As thumb screws were not

available in that thread size as well as being an oversized special, I set about to make a new one. Once it was completed it didn't quite fit in with the rest of the tool so thoughts turned to finishing the component.

Removing a broken screw

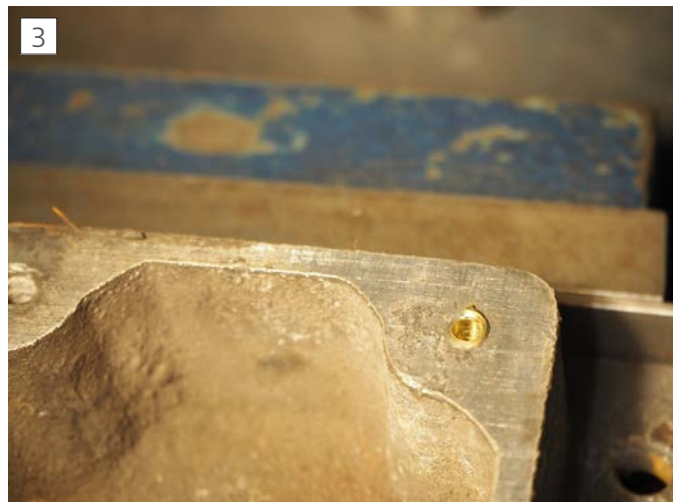
Broken screw removal and repair is a whole subject on its own, with a variety of ways to complete the job. From drilling oversize and tapping the next size up or fitting a helicoil, machining and fitting an oversized threaded plug,

to welding up the hole and starting again, through to having to work carefully and save the original hole and thread, which is necessary on some jobs. This is the way I approach this type of job. Drilling out a broken screw can be done clamped on a drill press table, but a milling machine yields a little more accuracy **photo 1**.

Centre the spindle as accurately as you can over the broken screw or bolt; normally I just fit a piece of steel the same size as the broken part in a Chuck and centre by eye till it looks like it's



Flatten end of broken screw using a slot drill.



Hole drilled in centre.

over the broken stub. To ensure the drill starts and runs true, it helps to first use a slot drill to flatten the end of the broken screw **photo 2**.

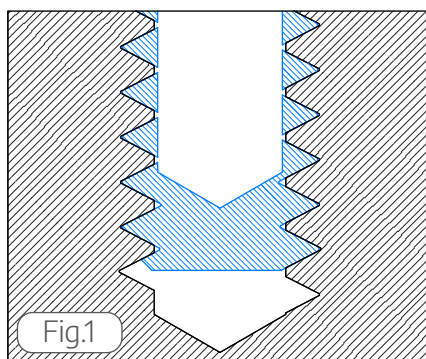
Use a stub or spotting drill to start the hole but only until a countersink is created. Start drilling with a drill a few sizes smaller than the tapping drill size. If you have left hand drills and a machine with a reversible motor, it is possible that when the drill bites, it can wind the broken part out. It happens sometimes but don't bet the farm on it.

If you are lucky, the hole is centred in the broken stud. If it's to one side or another, a needle file can be used to remove metal to centre the hole again, as well as slightly moving the drill chuck in the correct direction. Move to the next drill size up and inspect again. Metric drill sets that increase by 0.1mm steps or imperial number/ letter drill sets give you smaller increments between drillings. Eventually you will be working your way up to the tapping drill size in the correct position **photo 3**. As you are getting close you will have started to drill away the core of the screw and see faint lines starting to show in the hole. They are an indication of how accurately the hole is centred. Partial lines on only one side means material needs removing on the opposite side to centre the hole.

Figure 1 shows a partially drilled through thread and how the core is removed before you reach the full tapping drill size.

Using a scriber or sharp pointed tool and pliers, you can start moving and pulling the remaining broken thread out of the grooves **photo 4**, if you are lucky the whole thing will come out leaving an undamaged threaded hole **photo 5**.

If the broken screw has a long thread engagement you may be only able to



Section of partially drilled thread

clear the first few threads but once they are clear it gives a tap a good starting point in the original thread and will dislodge and break up the deeper bits. Go gently and clear swarf from the hole out frequently. I have used the above methods for screws down to 4mm. The photographs show

a repair job removing a $\frac{3}{16}$ " Whitworth brass screw in an aluminium part. These corrode together over many years due to the electrolysis between the dissimilar metals. Broken steel screws are only slightly harder to remove. If for some reason things don't go to plan and the threaded hole cannot be saved, then some of the other options mentioned earlier will have to be considered. Broken taps on the other hand are a whole different ball game.

Replacement thumbscrew

The making of the thumbscrew is a matter of setting up your stock in the lathe, you could choose from round material or flat bar depending on your workholding method. Flat bar will save some material but requires setting up in 4 jaw chuck.

Photograph 6 shows the screw cutting



Remaining thread being worked out of the hole.



Broken screw fully removed showing undamaged tapped hole.



Single point screw cutting the oversize thread.



Job on mill machining scallops.

setup used to cut the thread to fit the component, in this case a standard TPI but oversize on the diameter.

I was using round stock so removed most of the excess material with a hacksaw then transferred the job to the mill to create the scallops using a carbide tipped endmill on either side, **photo 7**. A boring head could also be set up to the required size to do the job.

You could also revert to time honoured hand methods and file the scallops. I

have completed a number of jobs in the past, first thinking I needed to purchase all sorts of expensive tooling to carry out a job, but hand tools in the end saved the day and, to be honest, gave a greater sense of achievement.

Trial fit the thumbscrew while still attached to the parent bar to see if the flat of the thumbscrew is in the correct locking position if this particular detail is important to the functioning for the tool. It is easier to re-chuck in the lathe

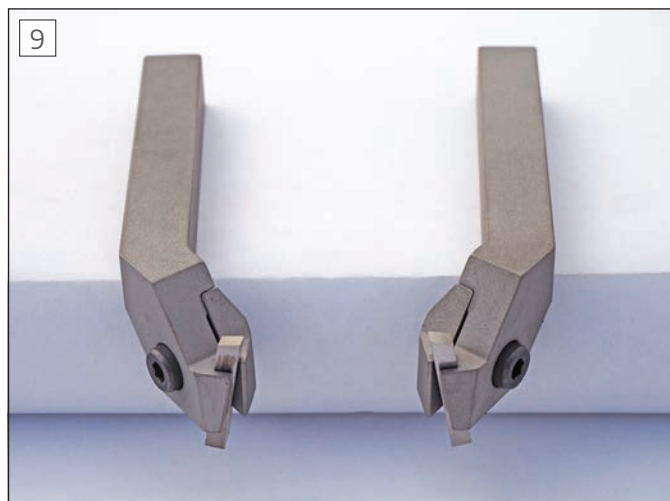
and shorten the thread while it is still attached to the chucking piece.

All that is left is to cut the embryo screw from the stock and to shape the oval section to match the job in hand or to suit your tastes.

The new completed part was fitted to the tool and did its job admirably but looked out of place compared to the other screws, **photo 8**. A shiny new addition on a tool having grown old gracefully.



New thumbscrew standing out from the originals.



Diamond tool holders with grip blast finish.



Metal Blackened Tool holders.



Needle Descaler attachment fitted to an air chisel.

The finish line

When thinking of how to finish the new screw, I considered the usual methods to finish components, paint, draw filing, belt finisher, polishing but sometimes a shiny new look is not what is required. I have read of others using vibrating style engravers or Dremel bits to rough up areas to create a textured finish.

In the past I have finished items with grit blasting to good effect.

Photograph 9 shows the fine grey grit blasted finish on two homemade Diamond tool holders, they are modelled on the Eccentric Engineering LH and RH Versions but in a smaller size that uses 1/8" toolbits. The grey finish is pleasing to the eye, smooths the surface removing small machine marks and retains oil to help with rust prevention. The finish depends on the different grades and types of abrasive grit, aluminium oxide, glass beads, and walnut shells to name but a few. For tooling like the toolholders, my preference is to then finish the components with a blackening solution

for a more professional look, **photo 10**.

On other jobs like fabrications or castings, I have used a needle descender to rough up the surface to simulate a

cast surface, **photo 11**. Needle descenders can be purchased as a stand-alone air tool or as an attachment that fits onto a standard air chisel. The finish works



Original Tee handle ratchet and replacement aluminium handle.



Spark Engraver Transformer and Handpiece.

well on softer materials eg aluminium, brass, copper fabrications but it is also an option for steel or even cast iron to texture an area to match another section or rough up the surface of a steel welded fabrication that can then be machined and look like a casting. The finish depends on the thickness of the needles, the thinner the needle, the finer the outcome. I randomly grind some of the needle tips to different point sizes to give a more pleasing random finish.

Photograph 12 shows the needle descender finish on a replacement aluminium handle for a ratcheting T handle screwdriver. The original soft rubber handles perish after a period of use, losing its shape and good looks so a

new one was made for a longer lasting tool. The finish provides a good surface to grip during use.

I felt the thumbscrew being relatively small that the needle descender would be too damaging and the grit blast finish would be too smooth, so I used the newly repaired tool and continued to ponder options for a time.

Sometimes I fabricate items using silver soldering and welding techniques instead of making a pattern and having a casting made. Building up components saves material, instead of starting with a big block of stock and turning most of it into a pile of swarf. I have welded reasonably well in the past but am a little rusty now. As normally happens,

when you want to do a perfect welding job, you haven't welded for a while and inadvertently touch the rod to the work in the wrong spot causing damage to a finish you didn't want to sully. This literally sparked a thought, I had seen spark engravers used at work and one of my tradesmen had marked some of my early tools with one, but I never really took to the results especially for marking tools. The bit kit usually comprises a small extra low voltage transformer as used with a soldering iron and a hand piece with a spring-loaded tip that makes and breaks contact with the work **photo 13**. Maybe using the spark engraver to rough up the surface, was the finish I needed. A series of small pits and arc marks, simulating a cast or forged surface instead of a freshly machined one.

Safety is important if using a spark engraver as the process is a miniature version of a welding arc. Use UV-blocking sunglasses to prevent any eye damage from ultraviolet radiation and only use on small parts. The parts also get hot so wear gloves and be careful when handling.

Photograph 14 shows the thumbscrew after going over the surfaces with the spark engraver in comparison to a grit blasted finish.

Photograph 15 shows the thumbscrew after a period of use, it now looks more at home with the others.

While this repair was not a big job, repairing and returning a tool or anything for that matter to usefulness, is a satisfying experience. Along the way you will learn new skills and hone existing ones to better master the next challenge. ■



Spark finished thumbscrew compared to grit blasting.



Screw after some use with some originals.w

BEGINNERS WORKSHOP

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

HAND FITTING METHODS

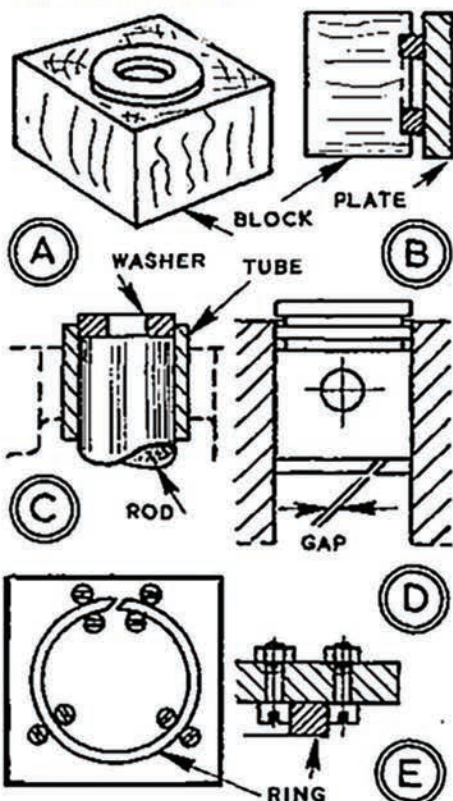
Reducing thicknesses and widths of distance washers and piston rings

By GEOMETER

IN HAND FITTING there is, on occasion, the problem of reducing the thickness or width of such parts as distance washers, collars, piston rings, etc.

A lathe and time being available, the solution is, of course, simple in the case of steel or brass washers, for they can be tinned and soldered on to the faced end of a piece of bar to hold in the three-jaw chuck, or even on to a piece of flat plate which can be mounted in the independent chuck to spin facially true. Machining will then reduce the thickness, picking up the depth of cut from the top-slide feed screw.

When such a part has to be thinned by filing, however, other methods are possible. If a piece of bar or plate is used as a holder, this can be tinned in the centre and, while it is still warm, the washer can be laid in place and some solder run in to adhere to the bar and form a spigot for holding the washer—which will lift off, but which will lie flat for filing with the bar held in the vice.



Another method, A, is to force the washer into the end-grain of a block of wood, where, with care, it will adhere during filing. The washer can be "tapped in" as is sometimes suggested—but at the risk of bending or defacing it. A better way, avoiding damage, is as at B, placing a piece of flat steel plate against the washer and squeezing the assembly in the vice, when a fairly deep indentation can be made. Alternatively, small nails or screws can be located inside or round the washer to hold it.

Should there be available a piece of rod the size of the washer, and a length of tube to slide over it, a quick set-up can be effected, C.

Way with piston rings

The normal piston ring (which is of cast iron) must be checked for gap in the cylinder, filed if necessary and on rare occasions, may require thinning to fit in the groove in the piston. To check gap clearance, the ring is entered well down in the cylinder and the piston pushed down after it, D, to ensure alignment for testing with a feeler gauge. Clearance being insufficient, the ring is gripped carefully in a smooth-jawed vice and one side of the joint filed, maintaining the correct angle to match the other side.

Should the ring require thinning, a sheet of fine abrasive cloth is laid on the surface plate and the ring rubbed on it. This can be done with the fingers—though it is better to employ a holder, maintaining even pressure on the ring.

Making a holder

A suitable design of holder, E, consists of a piece of flat steel plate with small cheese-head screws located in pairs to secure the ring. If necessary, the plate can be faced on the abrasive cloth on the surface plate, then the ring laid on the plate, compressed and scribed round. Positions can then be centre-punched for holes to be drilled, bringing the edges of the screw heads just clear of the scribed lines.

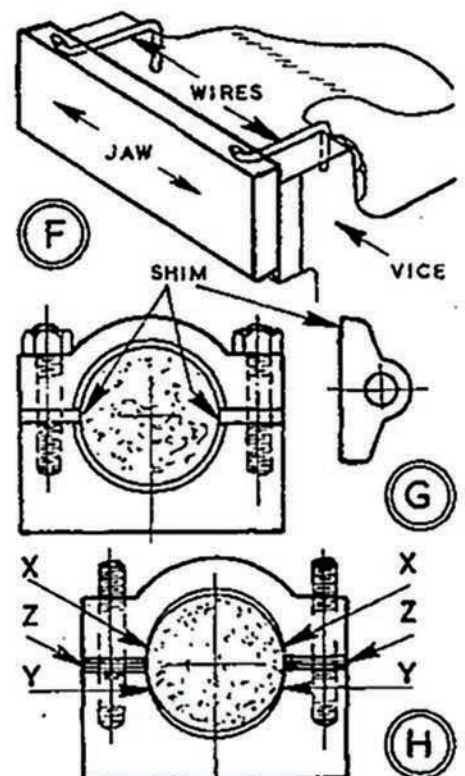
Lacking a smooth-jawed machine vice to hold piston rings and other

delicate parts (for new jaws of ordinary vices are sharp, and old ones not accurate), smooth pads can be made from rectangular mild steel bar, F, filed and rubbed flat. Holes drilled from the back and small ones from the top, enable wires to be hooked in and soldered for the pads to be clipped on.

Standard soft-fibre jaws can be used for most work, or pieces of cardboard or thick paper; but they are inadvisable for piston rings owing to the danger of breakage.

Important points in the hand fitting of bearings appear at G and H. Where a thick shim is fitted each side, this can be thinned by filing to reduce reasonable play, the shim being rubbed on the file, or held by tacks or screws or impressed in a wood block, A, for filing.

Where a bearing has been made too tight for the shaft, the method is to scrape each half at X and Y to eliminate nip, then fit the required number of foil shims, Z, to provide diametral clearance.



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

Europe's first 3D printed office extension is completed in Austria



Europe's first 3D printed office extension is now complete in Austria

Europe's first 3D printed office extension has opened in Hausleiten in Austria. The project is a result of a collaboration between the construction technology group STRABAG and the scaffolding and formwork manufacturer and 3D concrete printing pioneer PERI. The building is a 125 m2 office extension to an existing building in Hausleiten.

"The building in Hausleiten is a milestone for STRABAG, for PERI, for all involved. And a milestone for the Austrian construction industry as a whole," said Thomas Imbacher, Member of the Board for Innovation & Marketing at PERI SE. "We are convinced that 3D printing of buildings will be part of the future of construction as this technology offers solutions for challenges that are currently occupying our industry."

The extension building was printed with a BOD2, the best-selling 3D construction printer globally from COBOD. The maximum printing speed of the BOD2 3D construction printer at one meter per second is the fastest in the world, and consequently the shell construction in Hausleiten was completed in around 45 hours of pure printing time.

London Transport Museum launches new London Underground S stock models

London Transport Museum is launching a brand new 1:76 (OO) scale London Underground S stock model train produced exclusively for the Museum by Bachmann Europe. The new DDC ready four car set, which includes two driving cars (A 21002 and D 21001) and two trailer cars (M2 25002 and MS 24001), is now available to pre-order.

The museum first launched an exclusive London Underground S stock model train in 2015. This new limited edition set for 2022 is finished in standard 2014 S Stock London Underground livery with the destination board displays showing 425 Baker Street. It also features the S Stock moquette pattern printed on the interior seating - a first for Bachmann.

The exclusive four car S Stock model train set costs £595. It is available to pre-order online now. It will be on sale online and in London Transport Museum's Covent Garden shop in late autumn. To pre-order visit: www.ltmuseumshop.co.uk



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A Mobile Workshop Crane



Des Bromilow achieved an easily manoeuvred workshop crane with this hybrid of a pallet jack and an engine crane.



Engine crane.



Key pallet jack dimensions.

The problem I am trying to solve is getting older and weaker, advancing age but also I want to work smarter. Since I don't have an easy solution for that problem, I figure I can design and build something to reduce the impacts.

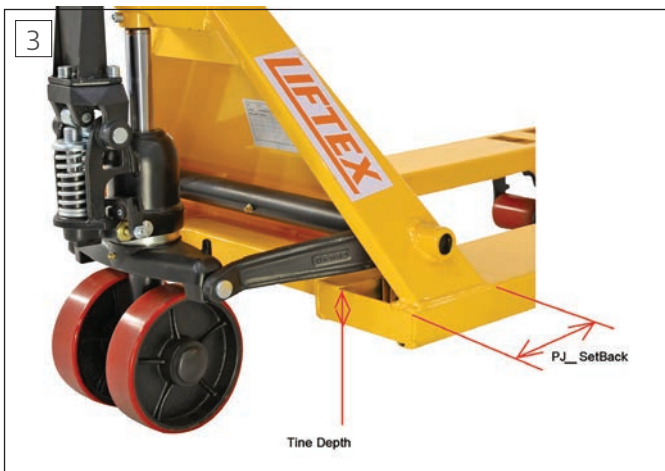
One of those impacts is lifting heavy things, such as chucks on to the spindle of the lathe or lifting a vice or universal

dividing head on to the table of a milling machines and so on. The tasks I've mentioned would require a crane with very fine levels of adjustment on the crane hook, especially when handling a chuck on to the threaded spindle of my big lathe.

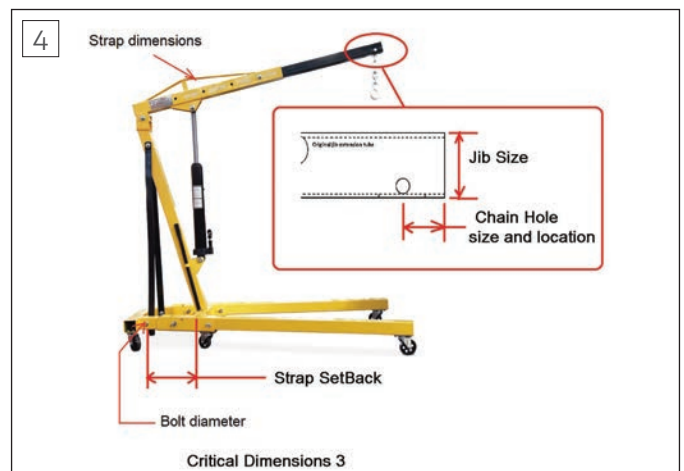
I already have an "engine crane", and it is quite capable of lifting weights exceeding 2T, but it has limited mobility

when something is on the hook due to the large footprint of the fold out legs. The small diameter steel castor wheels do not lend themselves to fine movement when under load. An example engine crane is shown in **photo 1**.

I already have a pallet jack in my shed, and a number of my benches, my big lathe, as my big milling machine are able



Additional jack dimensions.



Crane dimensions.



Palette jack ready to engage crane.

to be moved with a standard 2.5T pallet jack. One thing pallet jacks are designed for is their maneuverability even when fully loaded.

Some years ago I saw a webpage where someone had grafted the mast and jib of an engine crane to the shortened base of a pallet jack to create a manoeuvrable crane, and it looked like a good marriage of the benefits of both machines, but it had some limitations. One of the biggest limitations was the modification was a permanent modification which prevented the pallet jack from being fully utilised for its original purpose.

My design is to make the incorporation of the crane to the pallet jack as a temporary attachment which can be added or removed with minimal effort, and no modifications which impact on the original utilisation of the pallet jack. This design not only retains the functionality of the pallet jack, but also allows the crane to be stored with a minimum footprint of valuable shed floorspace.

My design also includes a small winch as an auxiliary lifting point, this has use for items less than 500kg, and at maximum jib extension. You could consider the addition of the winch as optional, but I include it in the description, so you know how to add it if you wish.



Crane on jack.

Step one: obtain a pallet jack, and an engine crane

My engine crane was a damaged one found in a garage sale for a very modest sum, and as mentioned, I already have a pallet jack which a number of shed items were designed around. I repaired the damage to the engine crane and obtained a 500 kg winch which will be incorporated into the design. I salvaged a few pulley sheaves from wrecked exercise machines and purchased a clevis hook to suit the winch cable.

Step two: measure some critical dimensions

Whilst both pallet jacks and engine

cranes are fairly standard, there are often subtle differences in design and materials. All of the dimensions given in this article are based on the equipment I have, and I will explain where those critical dimensions are used so you can determine what the equivalent adjustments would be on yours.

Some critical dimensions (photos 2, 3 and 4) are needed to ensure pieces will fit together – these include:

- the dimensions of the end of the jib (material size, and size/ location of the hole which secures the short hook chain often fitted),
- the mount for the mast to the base (hole size and centre to centre distance),
- the dimensions of the top strap on the jib sleeve,
- the hole size of the crane straps at the base connection,
- the distance between the pallet jack tines,
- height of the tines when in the lowest positions (top of tine to ground),
- the details of the winch mount (bolt sizes and centres),
- and the dimensions of the pulley sheave (axle bolt size, hub width, and overall diameter).

Other dimensions are needed for stability – these include:

- the dimensions of the rear of the pallet jack,
- and the distance of the setback on the crane straps compared to the mast base.

Step three: make the base.

The base of the device is an H shaped piece which sits on the shed floor whilst in storage, and the tines of the pallet jack can fit under it to move it in and out of storage and support the

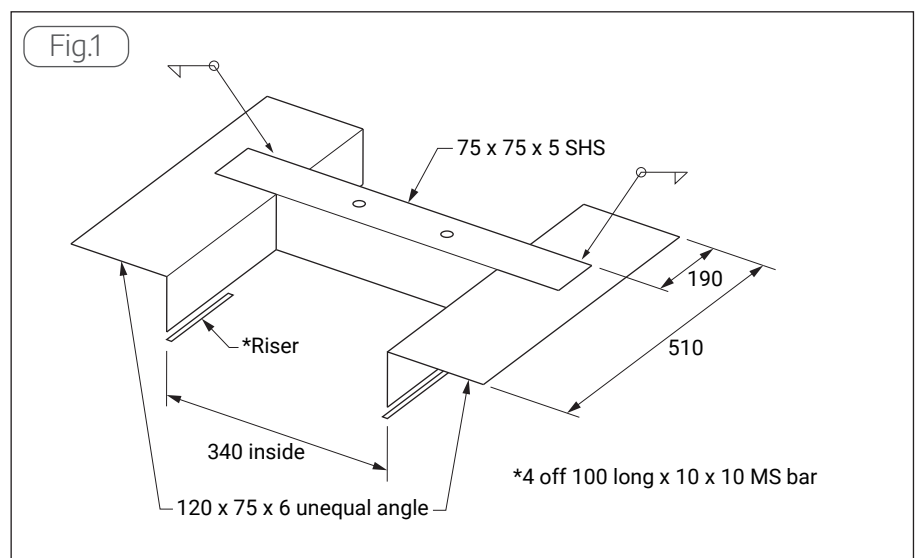
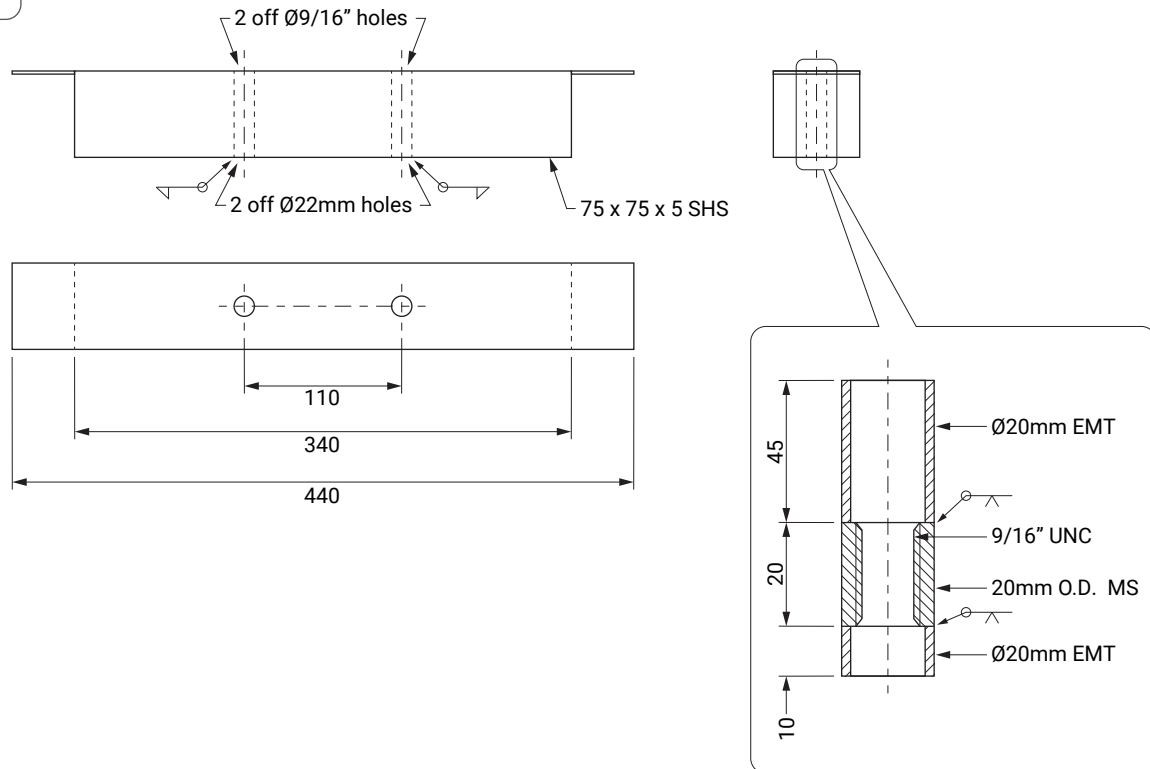


Fig.2



crane during operation, **photo 5**. The distance between the tines of the pallet jack will dictate the length of the cross piece (minus allowances for material thickness, and operating clearances) and a suitable piece of SHS (Square Hollow Section) tubing was marked out to suit. The original crane base was made of 70 x 70 x 3mm SHS, and I had some 75 x 75 x 5mm SHS offcuts of a suitable length to make the cross piece. I marked and drilled the holes for the mast attachment bolts and cut out the steel in preparation for welding. Refer to **fig. 1** for details.

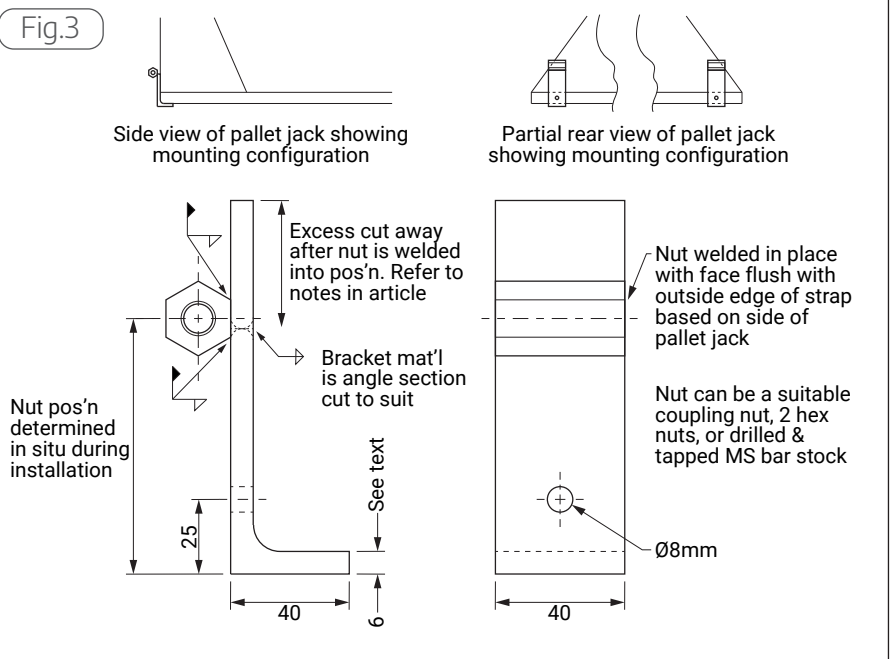
The original mast base had 14mm bolts which passed through the SHS with exposed thread and a hex nut on the bottom surface. In my application, the thread and nut would cause issues with ground clearance, so I made up two "sleeve nuts" so the thread was contained within the SHS tube. **Figure 2** has detail on these sleeve nuts which were made using some common black steel bar, and some short lengths of round tubing (steel electrical conduit or water pipe will suffice). I drilled, bored and tapped the $\frac{9}{16}$ " UNC thread in the 20mm bar on the lathe, and faced the short lengths of pipe so I had good surfaces for welding them together. I then turned the welds down to nominal size to keep the sleeve uniform diameter. I could have used 14mm bolts but did not have the appropriate tap in my set.

The holes drilled in the SHS were $\frac{9}{16}$ " clearance on the top wall of the SHS, and loose clearance holes for the finished sleeve nut diameter in the bottom wall. I bolted the mast base to the SHS using vice-grips to hold the sleeve nuts whilst the bolts were spun tight, and then fillet welded them in place on the bottom wall of the SHS. After disassembly, I ground the protruding sleeve down so it only protruded by ~4mm. The bolts used

to secure the mast to the base were 3" long (75mm), so no thread from the bolt protrudes below the SHS bottom wall regardless of the mast base plate thickness.

The cross piece is positioned between two angle iron pieces such that the vertical legs of the angle have a clearance fit between the tines of the pallet jack, and the horizontal legs rest on the top surface of the tines, **photo**

Fig.3



6. I used a clearance on the tines of 5mm. The cross piece is tacked in place and fit and squareness checked before completely welding in the piece.

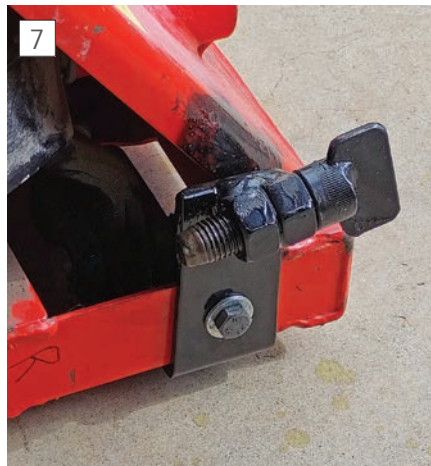
The dimensions of the angle iron section used will need to be determined – this is the process I used. The overall length of the angle sections was to be the same or longer than the wheelbase of the original crane base, that would provide similar stability whilst in the folded (storage) configuration.

The width of the vertical leg was to be within 10% of the width of the walls in the original SHS since the resistance to bending in a beam is mostly influenced by the depth of the beam. The tines of the pallet jack contribute to that, but rather than calculate something that complex, I choose to remain close in size. The thickness of material in the angle section was to be close to twice the wall thickness of the original SHS base since the new base had two fewer “walls” in the beam structure to reduce deflection. Luckily, I had some offcuts of 120 x 75 x 6 unequal angle which met all of my criteria, but I could have used 75 x 75 x 6 equal angle and still been comfortable with my material choice.

The offset from the rear of the pieces to the cross piece was to ensure that the back straps contacted the back of the pallet jack with an angle which prevented “peeling forces” on the mast base. The distance between the original crane mast and straps was used as a guide and increased marginally to allow some ease in fitting. The straps have to be vertical or angled so the top of the strap is towards the front of the pallet jack to achieve this. Essentially, if you copy the angle of the original straps, the forces on the mast base should be manageable by the mounting bolts.

Once the base was welded up, I then added some small “feet” on the lowest edges of the angle to ensure the tines of the pallet jack (when in the lowered position) could slide underneath the base with a clearance of approximately 5mm. This clearance allowed for any deviations in the floor of the shed, or debris adhered to a wheel of the jack. This clearance, plus the inherent stability of the base when folded means I can use the tips of the tines to pick up the finished unit from its storage location in the shed, move it out into the centre of the shed floor, put it on the ground and then slide the entire length of tines in to position it on the jack properly before attempting to use the machine.

The feet were 100mm lengths of



Bracket at rear of jack.

10 x 10 square bar but had they could have easily been adjustable screw feet, or offcuts of some other steel section. Looking back, if I was to make another version of this machine, I would use

short lengths of angle section with the feet on the inside, and that would allow the machine base to be easily positioned with a standard moving trolley, as well as the pallet jack tines.

Step four: the strap connectors

At the conclusion of Step three, the base is fabricated, and if the crane mast (with jib and boom) was bolted in place, the unit is quite stable in the folded storage configuration, and testing showed that my unit was stable with the jib extended to horizontal, with the boom fully extended. HOWEVER, it only took a heavy touch (say 2 kg down force) on the boom tip and the machine would attempt to topple off the pallet jack.

The original crane design has two 40 x 4 straps which are bolted high on the mast and connect to the base some distance behind the mast base plate. These straps prevent the forces on the



Nosepiece.

mast from peeling the base plate bolts and add incredible stability to the mast when it is loaded.

The straps from the original crane are retained at the mast connection by a single bolt at the top which connects a strap on each side of the mast, and one bolt per strap at the bottom. The bottom of the straps is splayed out to add rigidity against sideways movement. In order to retain that effect, the bottom of the straps is brought to the rear of the pallet jack, one on each side. If you are planning to reuse the straps from an original crane, take note of the bolt hole size at the bottom connection – my crane was 16mm bolts, with clearance holes to suit.

Two “L-shaped” brackets are made up with a short (40mm) leg designed to sit underneath the rear of the pallet jack (the back of the welded tines) and sit flush with the rear surface of the jack. I made my brackets from 40 wide pieces of the angle section used to make the base, and I cut one leg at 40mm long, and then welded the cut off pieces to the other leg to make it longer for the fitting stage. A single hole (8mm is what I chose) is marked and drilled so it intersects the centre of the tine depth. My tines were 35mm deep, and the thickness of the leg was 6 mm, this means the 8mm hole would be positioned at 6mm, plus 18mm ($6 + 18 = 24$ which I rounded to 25) up from the corner of the bracket. Refer to **fig. 3** for an overview of these brackets.

A pair of “bracket nuts” will need to be sourced or made. These are to receive the bolts which retain the strap, so in my case should be M16. Since I did not have any long (coupling) nuts in M16, and no tap in M16, I chose to use a pair of standard M16 hex nuts to make up each bracket nut. It is better to use a coupling nut or fabricated deep nut (drilled and tapped bar stock), since 2 hex nuts welded



Mobile crane with winch fitted.

together are prone to binding due to welding distortion – which can only be eased by passing a tap through the finished nut.

With the crane mast bolted to the baseplate, and the pallet jack lifted high, a pair of clamps can be used to stop the crane toppling as you position one strap to the back of the pallet jack and mark an approximate intersection with the angled rear of the jack. (I used a strip of masking tape on the side to mark the hole position)

Position the bracket (L piece) so it intersects the mark so a nut flush on the bracket would be completely proud of the rear of the jack when viewed parallel

with the tines. Drill the mating hole through the rear of the jack tine or use a clamp to secure the bracket in place.

Place a bolt through the bottom hole of the strap and affix the nut so it is tight. Position the nut against the back of the bracket, ensuring that the face of the nut is flush with the bracket, and the strap is not binding against the sloped side of the jack, and tack weld the nut into place on the bracket. Repeat for the other side strap. The alignment of the nut to the outside edge of the bracket will make each bracket a mirror image of the other.

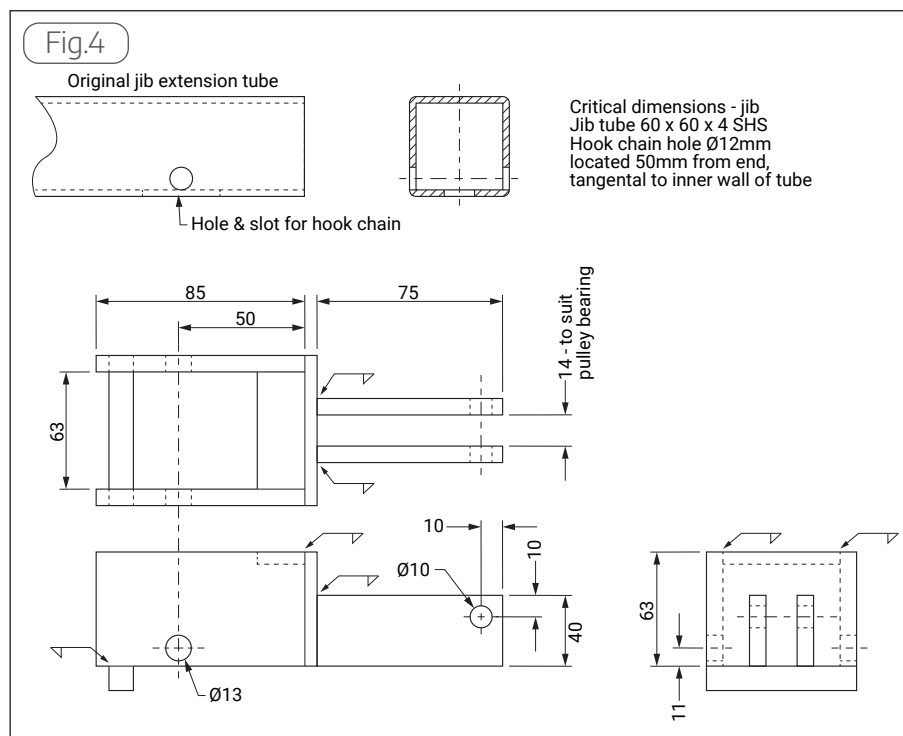
Remove the bolts and remove the brackets from the pallet jack. The nuts can now be fully welded to the brackets, and any excess metal removed from above the nuts.

The two holes (M8 in my case) drilled into the back of the jack tines are the only modifications made to the pallet jack, and the brackets can be left in place with no impact on operation or footprint of the pallet jack. I recommend the use of lock nuts or nylock nuts to ensure the bracket retaining bolts do not come loose in normal operation of the jack.

Photograph 7 shows the bracket in place on the rear of the pallet jack.

My installation uses M16 bolts for the lower strap connection, in order to make this a “tool-less” installation, I welded thumb tabs on a pair of M16 x 50 cap head screws. The tabs are short enough that they do not stick out the sides of the jack footprint, and approx. 45mm wide, enough for me to tighten into

With the crane mast bolted to the baseplate, and the pallet jack lifted high, a pair of clamps can be used to stop the crane toppling...





Mobile crane with winch fitted.

place by hand.

As noted earlier, an approximate 2kg load on the boom tip was enough to topple the unit without the straps connected, but with the straps connected to the brackets, the crane should be able to perform at original design capacity (typically 2T). At the time of writing, the heaviest load I have lifted has been just over 180 kg, and the unit was quite stable through all motion tests.

Steps 5 and 6 are about the addition of a winch to increase versatility of the unit, these additional steps could

be considered optional if the range of motion required is already met with the hydraulic jib and pallet jack movements. The other advantage of the winch installation is that I can use the winch independently of the hydraulic lifting, allowing me to use it for trimming a lifted load for alignment should the situation require it.

Step five: the nosepiece

This is fabricated piece which is a slip fit over the end of the extending boom section of the jib. In most engine cranes, this is a SHS piece with a single bolt and

slot arrangement to connect the hook chain to the crane. Since I utilize this bolt hole to retain the nose piece, some measurements need to be taken from the donor crane.

The fabrication is simply built up around the SHS, with a suitable clearance (I added a couple of millimetres). The pulley sheave from an exercise machine was used to redirect the winch cable, and a pair of stand-off pieces made to support the axle bolt. I positioned these stand-off pieces such that the pulley rim sat approximately 10mm above the top of the nose piece so the cable would not rub on anything along the path of the jib. **Photograph 8** is a good overview of this piece.

The original hook chain bolt may need to be replaced with a longer one to compensate for the thickness of the cheeks of the nosepiece.

I have supplied example drawings of the nosepiece I made with dimensions which suited my donor crane, you will need to determine any adjustments to suit your crane, and pulley dimensions **fig. 4**.

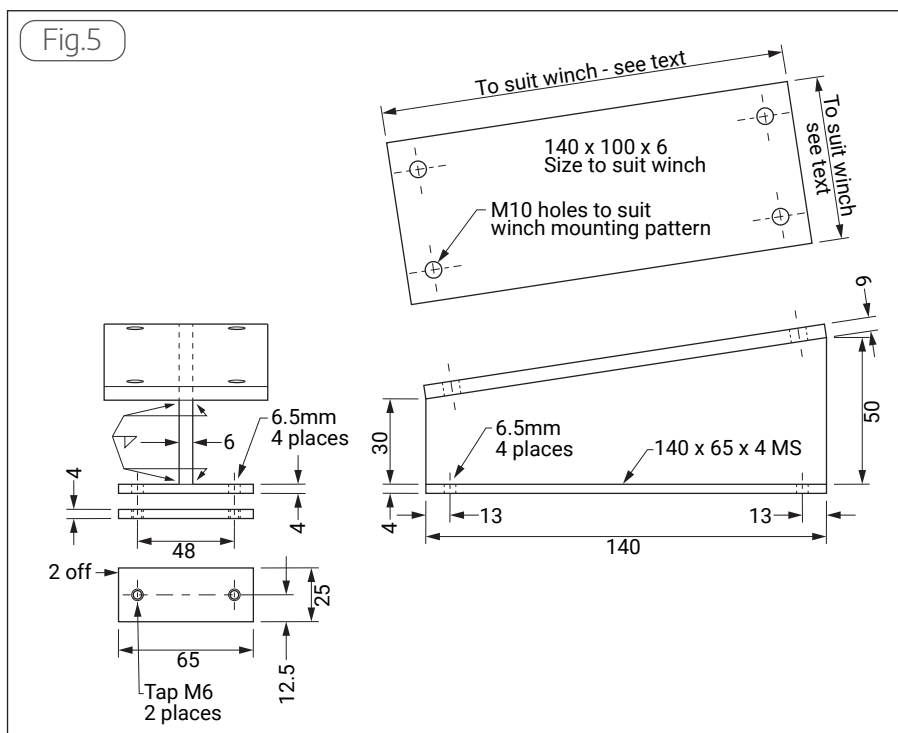
You will see in **photo 9**, I also fabricated a two-piece guard which provides a cable guide between the winch and pulley sheave, and then forms a cover over the pulley sheave to reduce the stiff winch cable from rising out of the pulley when unloaded. There is also a loop mounted on the side which allows the hooks to be clipped to it so they aren't "flapping around" when the machine is in storage.

This guard is retained by the same hook chain bolt, and both pieces are mounted from the same side to make it easy to fit. I have not included any sketches of these guards since they were simply fabricated "on the fly" from light weight galvanised steel sheet.

Step six: the winch base

I selected a 500 kg winch and made up a base plate to suit it, ensuring I did not utilize any mounting holes in the centre line of the base plate. My base plate was 140 x 100 x 6 MS, with 4 x 10mm holes for attaching the winch. Check your winch to ensure it is "pointing the right way" since most winches have a direction marked for the cable to operate in. This is particularly important with any type of brake winch.

I then determined the angle to mount the winch so the cable would not rub on the job/ boom at any extension setting. I did this by holding the leading edge of the winch against the strap and lifted



the back edge until the cable was clear. I measured the "lift" and used that as a "rise vs run" to determine a starting angle. The determined angle was then offset by an additional distance to allow room for bolts, tools, and welding operations to occur between the plates which will be above and below the centre web piece. I then made a wedge-shaped piece to go between the base plate and the tension strap on the top of the jib.

The strap on my crane jib is 40mm wide, so I made a clamping plate from 140 x 65 x 4 MS, with 4 off 6mm clearance holes spaced on 48mm centres, spaced 13mm from each end of the plate. Two matching straps were made from 25 x 4 MS strip in 65mm lengths with M6 tapped holes on the same 48mm centre spacing. These dimensions are outlined in **fig. 5**.

The wedge-shaped web was welded to the centreline of the plates with a fillet weld on each side of the web.

After cleanup and painting, the winch base was mounted to the top strap of the jib using 4 short M6 bolts, and then the winch was bolted in place using the appropriate size bolts (M10 in my case). The cable was paid out through to the pulley sheave, and a hook attached to the thimble eye. **Photograph 10** shows

the conclusion of mounting the winch.

That concludes the fabrication of all the components, all parts were primed and painted and assembled for use.

Notes on use of the device

Someone asked what it's called... I call it a "Bitsa-crane" since it's bits of an engine crane, bits of a pallet jack, and bits of a winch, plus whatever else I add on for the lift. It can be broken down for storage relatively quickly, photo 11.

I found with my winch, I gained 3mm for each "click" of the winch and could get very fine control using a combination of the hydraulics of the jib ram, and the pallet jack.

You will quickly develop the habit of paying out the winch cable before attempting to extend the boom, otherwise the cable will restrict movement.

I used a maillon (aka quick link) to attach the hook to the thimble of the winch cable, this allows me a high degree of flexibility to change the hook for some other lifting device to suit the job at hand. Equally a maillon or shackle could be used to change the hook on the hook chain. Remember that ALL components of a rigging set-up should be rated for the load

(including a safety margin), the failure point will be the weakest link, and that link could be parts of the bitsa-crane, or it could be a weld on the load, a rope, a sling, or bolt, or any other component in the load path.

The original crane manual (or various online copies) outlines guidelines and rules regarding the use of "short as possible" boom extension and keeping the load within the footprint of the crane to avoid toppling. These guidelines apply to all lifting arrangements, and this device is bound by those as well.

Always ensure the jib boom is locked in place with the cross pin as originally supplied. These typically come with a wire "R-clip" to lock the pin in place, I added a short length of chain between the pin and R-clip so I couldn't lose the clip.

The test load in **photo 12** is a milk crate containing one 8" 4 jaw lathe chuck, two 10" lathe chucks, a 13" faceplate, a fixed steady from a 16" lathe, a disk of steel (300 dia x 50mm thick), and a 16kg kettlebell weight. ■

Acknowledgements: Photos from Wholesale Superstore and Verdex are used with permission.

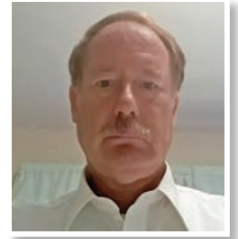


In storage with original crane.



Load testing.

Making four-lobed knobs in the home workshop



Al Hanson, from Illinois, makes some four lobed control knobs from aluminium alloy.

I developed these lobed knobs, **photo 1**, after making a carriage stop, for my Clausing 6933 Lathe, **photo 2**. I started out with a 1.5" knurled aluminium knob, that hurt my hand. Especially bad in the position that it was in, just in front of the rack. I get lot of turning power with the lobes, without needing a guerrilla grip. It didn't help that the knob needed to be a maximum of 1.5" in diameter. I no longer seem to have a gorilla grip, since I'm over sixty!

This time around, the knobs are to hold the door on the headstock of the Wilton lathe I use at work. The knobs have to be 1½" max to clear the Collet closure.

The design is very easy to execute, providing that I can remember how I did it last time? Anyway, I keep a notebook of my shop projects, I hope that you do too? I find it to be worth the effort!

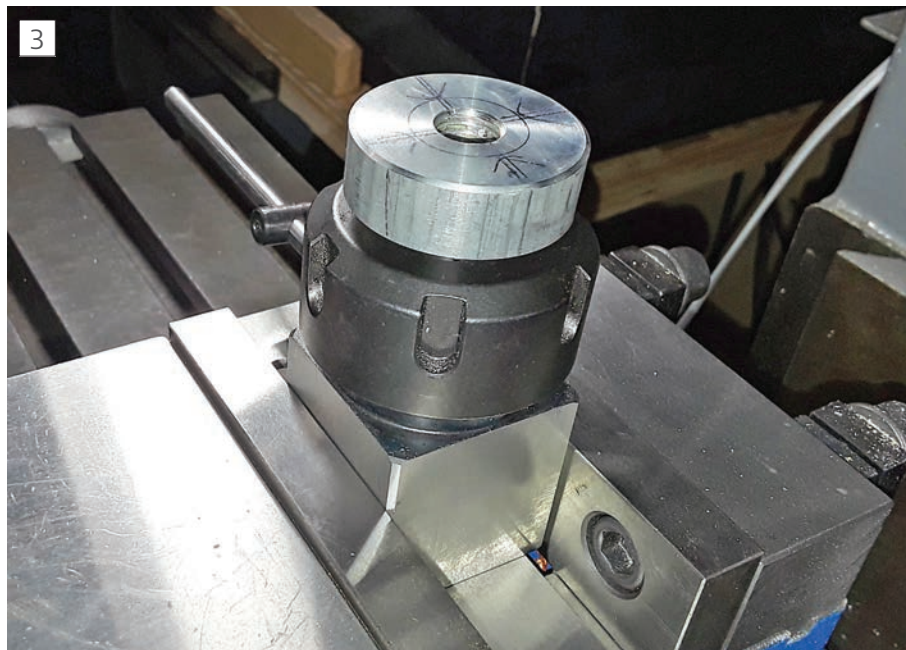
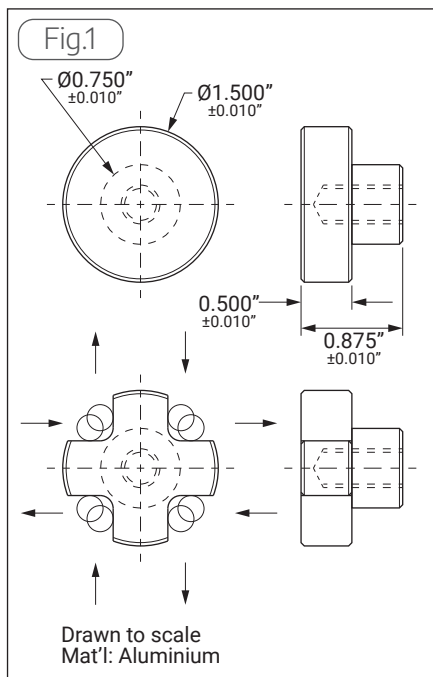
I first turn up the blank, to the profile shown in **fig. 1**. I then grip the ¾" tenon in my ER32 collet block (aren't they



Four lobed knob.



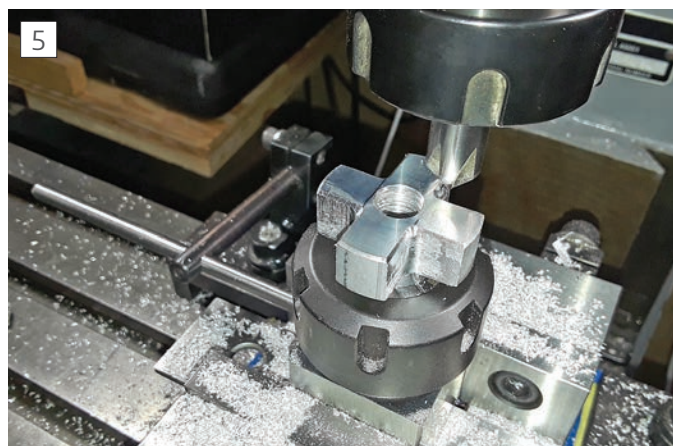
Carriage stop for Clausing lathe.



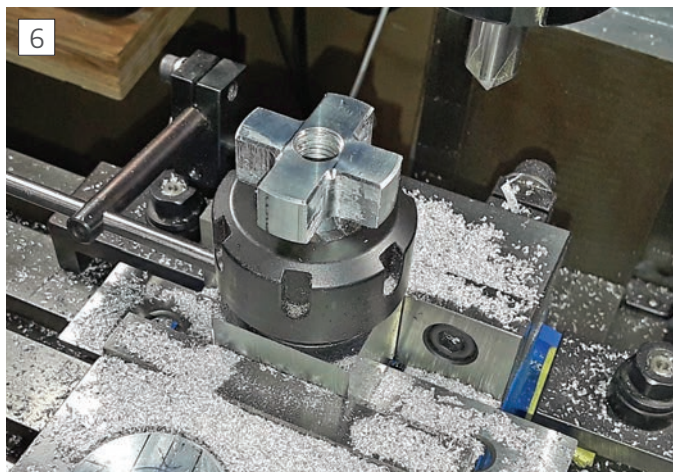
Blank held in ER32 collet.



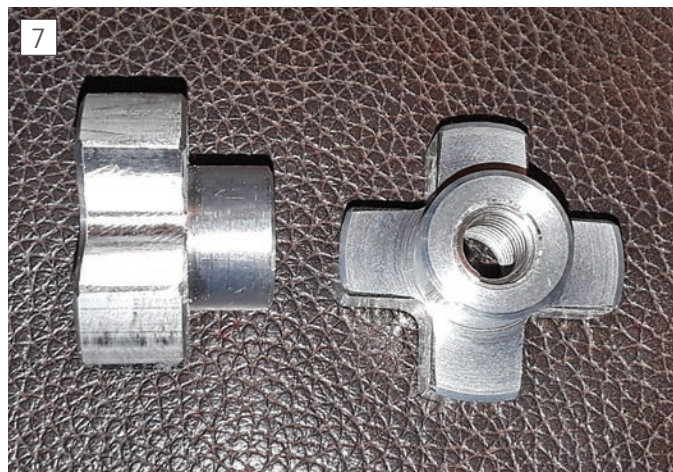
Milling lobes.



Chamfering edges.



Tapped for helicoil insert.



Finished knobs for the Wilton lathe.

great!) in my Kurt vice, **photo 3**. I zero the X & Y coordinates with the centre of the collet block. Then with a 1/4" two flute end mill, I mill in and out with the coordinates at 0.368/0.368, 0.015" deep per pass until I get to full depth, **photo**

4. Also, I get the best finish, with the in/out direction.

With a 1/4" slot drill at these coordinates, I cut the four lobes, without ever touching the 3/4" shank. After the lobes are cut, I switch to a

chamfer bit, then go around again, until I break all the top edges, **photo 5**, but I just file the underside.

I installed a free running 3/8"-16 helicoil in each knob to finish, **photos 6 and 7**. ■

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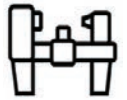
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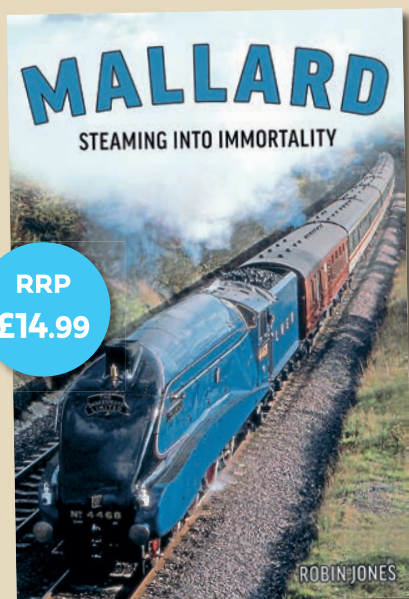
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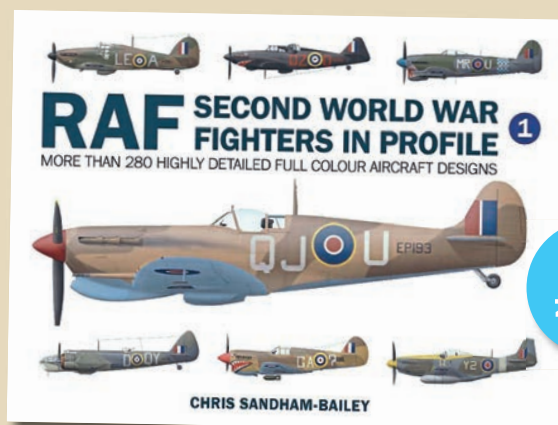
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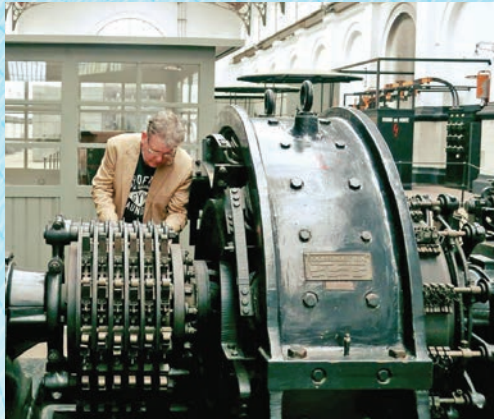
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