No. 325

CASTING IN THE WORKSHOP
– more useful tips.

MODEL ENGINEERS' WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS MARCH 2023 ISSUE 325 WWW.MODEL-ENGINEER.CO.UK

FRANKENSTEIN'S MILL!
Dore Westbury and Tom Senior combined to make an exceptionally versatile machine.

SMEE & MODEL ENGINEER
Celebrating 125 years
A Joint History of Model Engineering

LATHE SPEED INDICATION
Fitting a digital speed readout.

Mar. 23

MARKING OUT
Improve your accuracy in the workshop.

INSIDE THIS PACKED ISSUE:
■ MYFORD SPLASHBACK – SHEET METAL PROTECTOR FOR YOUR LATHE. ■ NOTES FOR NEWBIES – BEGINNERS START HERE. ■ CUTTING GROOVES FOR CIRCLIPS WITH MIKE COX. ■ REVIEW: TAILSTOCK DIGITAL READOUT. ■ A LATHE CLUTCH DESIGN FROM THE 1960S. ■ SHARPENING BLUNT THREADING DIES. ■ WORKSHOP PHOTOGRAPHY – LIGHTING YOUR SUBJECT. ■ POWER SOURCES – A MULTI VOLTAGE POWER SUPPLY. ■ FITTING POPPET VALVES. ■ PLUS ALL YOUR REGULAR FAVOURITES!

MORTONS

Get more out of your workshop with MEW

Join the conversation at:
www.model-engineer.co.uk

We are the UK distributer for Cormak Engineering and Woodworking Machinery and much more...

Visit our Website at www.ariesductfix.co.uk

HK25L VARIO Milling Machine with Power Feed

Machine Features

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

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

PRICE: £1,995.00 INC VAT

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




TYTAN 500 Universal Lathe with Stand

Machine Description

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

PRICE: £1,495.00 INC VAT

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



Aries Duct Fix Ltd

Unit 5-6, The Foundry Business Park, Seager road, Faversham, Kent, ME13 7FD

Office: 01227 751114 **Email:** sales@ariesductfix.com **www.**ariesductfix.co.uk

MODEL ENGINEERS' WORKSHOP

EDITORIAL
Editor: Neil Wyatt
Designer: Druck Media Pvt. Ltd.
Publisher: Steve O'Hara

By post: Model Engineers' Workshop, Mortons Media Group, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR
Tel: 01507 529589 **Fax:** 01507 371006
Email: meweditor@mortons.co.uk
© 2022 Mortons Media ISSN0033-8923

CUSTOMER SERVICES
General Queries & Back Issues
01507 529529
Monday-Friday: 8.30-5pm
Answerphone 24hr

ADVERTISING
Group advertising manager: Sue Keily
Advertising: Angela Price
aprice@mortons.co.uk Tel: 01507 529411
By Post: Model Engineers' Workshop advertising, Mortons Media Group, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR

PUBLISHING
Sales and Distribution Manager: Carl Smith
Marketing Manager: Charlotte Park
Commercial Director: Nigel Hole
Publishing Director: Dan Savage
Published by: Mortons Media Group, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR

SUBSCRIPTION
Full subscription rates (but see page 54 for offer): (12 months 12 issues, inc post and packing) – UK £56.40. Export rates are also available – see page 46 for more details. UK subscriptions are zero-rated for the purpose of Value Added Tax.
Enquiries: subscriptions@mortons.co.uk

PRINT AND DISTRIBUTIONS
Printed by: Acorn Web Offset Ltd., W. Yorkshire
Distribution by: Seymour Distribution Limited, 2 East Poultry Avenue, London, EC1A 9PT
Tel No: 020 7429 4000

This issue was published on June 17, 2022.
The next will be on sale on July 22, 2022.

On the Editor's Bench

The Law of Diminishing Returns

In economics there is a principle that, grossly simplified, the more you invest in something the less you make per unit of investment – the law of diminishing returns.

Let's backtrack a bit. I rather like using old-school tools and equipment in my workshop, but also in the day to day of life. I'd rather read a real book than an online one, for example. I also prefer vinyl to CDs and CDs to MP3s, simply on the grounds that it is nice to have a physical object that encapsulates the music.

Now, despite having a beard, I engage in a bit of topiary to keep things tidy and that means a blade razor to deal with my wire-wool like fuzz. For several years I used an old fashioned razor, the type to take apart and fit a 'real' razor blade into. Eventually I accepted that it just wasn't the best thing and went back to my old twin blade razor with its rubber strip and soothing aloe gel.

Now, a few weeks ago I discovered my twin-blade razor had effectively become obsolete and had the choice of going elsewhere or buying a five-blade one instead. Much to my annoyance, I discovered that five blades did actually give me a smoother, faster shave. Also, I didn't bleed like a stuck pig.

When the three-blade razor appeared (it seems like a few years ago, according to Wikipedia it was a quarter of a century ago) my reaction was where will it end? Apparently there have been six and even seven blade razors. However, it seems the law of diminishing returns has deemed that it ends at five blades. Just how more effective five is than four, or three, I don't know, but it does seem to have an edge over two.

One of my hobbies is playing bass guitar. Traditionally they have four strings, like a double bass (although these started off with three). I have a couple of five-string basses, and these feel very different to four-stringers, and make you take a very different approach to playing the instrument. There are six, seven and even eight-string basses out there – my head rattles trying to imagine finding a way around eight strings.

Another example is the number of pistons on an internal combustion engine. Interestingly, the optimum numbers for cars and aircraft seem to be very different. In these and many other engineering challenges, having more always seems to offer new opportunities, but at some point the law of diminishing returns brings us back down to earth.

Neil Wyatt

Contents

9 Transplanting a Dore Westbury Mill Head.
Brian Wood grafts a Dore Westbury mill onto a Tom Senior base to create a new, more capable machine.

15 Lathe Speed Indication
Chris hobday had a lathe with interesting mechanical speed indication, but modifications meant he needed a different solution.

19 Low Voltage Power Sources
Stub Mandrel concludes his roundup with some practical examples of module based power supplies.

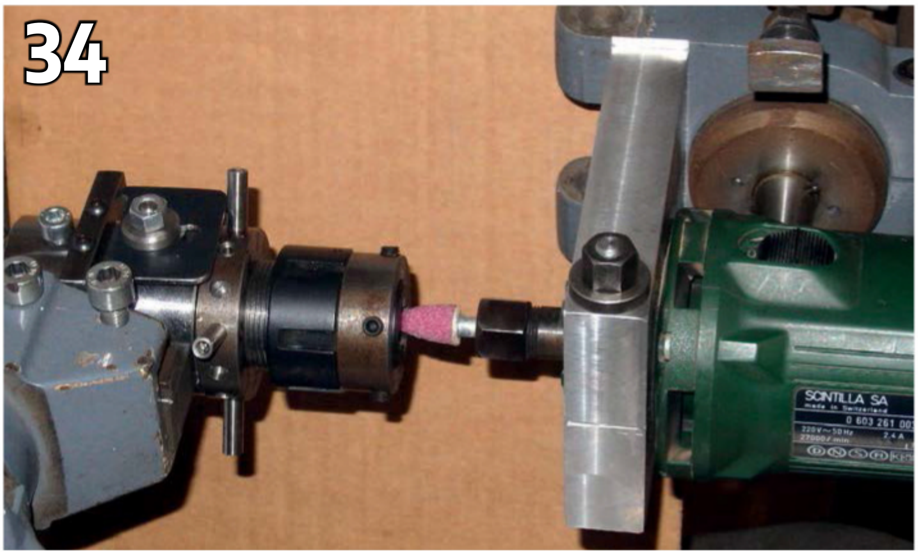
24 A Foray into Casting
Laurie Leonard continues his tales of casting different materials in the home workshop.

26 Die Sharpening
Jacques Maurel adapts last month's tap sharpening accessory for bringing dulled dies back into use.

37 From the Archives
We travel back to 1962 for a clutch release design in our series celebrating 125 years of Model Engineer.

46 ML7 Splashback
Mike Joseph explains how to fold a sheet metal splashback for your lathe, using his Myford machine as an example.

49 Beginner's Workshop
This month Geometer looks at poppet valves and machining their seatings.



52 Model Engineers' Workshop - Be part of it!
New readers may not realise how many ways there are to get involved in the community around Model Engineers Workshop.

53 Cutting grooves for circlips
It's a little while since we heard from Mike Cox, in this issue he details an easily made device for cutting narrow grooves.

55 Tailstock DRO Review
Often bodged up from digital callipers, SMAC takes a look at a purpose built alternative.

52 Artful Dodges
John Smith looks at achieving a good surface finish.

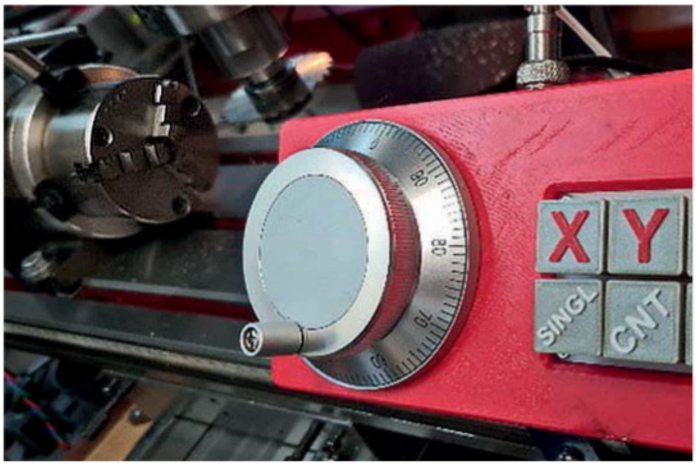
58 Notes for Newbies
Useful advice for anyone setting up a workshop, whether a new one or a relocation.

40 Workshop Photography
This month we look at different approaches to lighting your photographs workshop photography, including some of the pitfalls to avoid.

Coming up...

in our next issue

Chris Gabel explains his ‘Fly by Wire’ controller for CNC machines.



Regulars

3 On the Editor’s Bench
The editor muses on the law of diminishing returns.

44 On the Wire
A giant tidal turbine and an autonomous car in this month’s roundup from the world of engineering.

56 Scribe A Line
A bumper postbag from our readers with feedback on recent issues. We are always keen to hear from you – again send an email to meweditor@mortons.co.uk.

64 Readers’ Tips
Our winner this month shares a great storage solution. Send your tips to meweditor@mortons.co.uk.

66 Readers’ Classifieds
Another fine collection of readers’ sale and wanted ads.

ON THE COVER

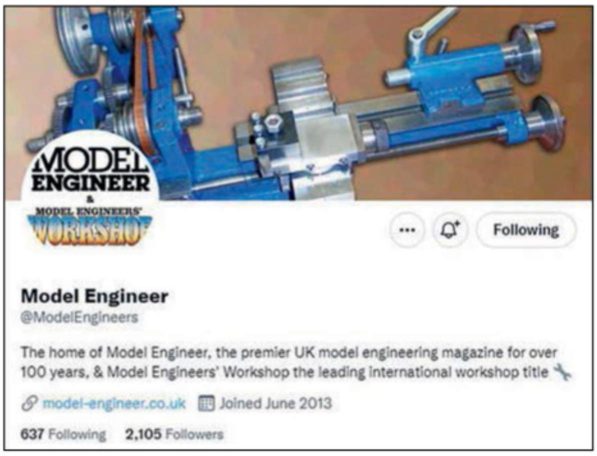
The cover of this issue shows Martin Berry’s collet block stop in use, in this case to enable the accurate drilling of a phosphor bronze ball. See page 23 for more details.

HOME FEATURES WORKSHOP EVENTS FORUMS ALBUMS

Visit our Website

www.model-engineer.co.uk

Why not follow us on Twitter? twitter.com/ModelEngineers hashtag #MEW



THIS MONTH’S BONUS CONTENT

Log On to The Website for Extra Content:

Visit our website to see advice on how to deal with the day when we need to leave out workshops behind.
www.model-engineer.co.uk/disposal

Other hot topics on the forum include:

Steady Rest principles a simpler approach to steady by Samuel Heywood.

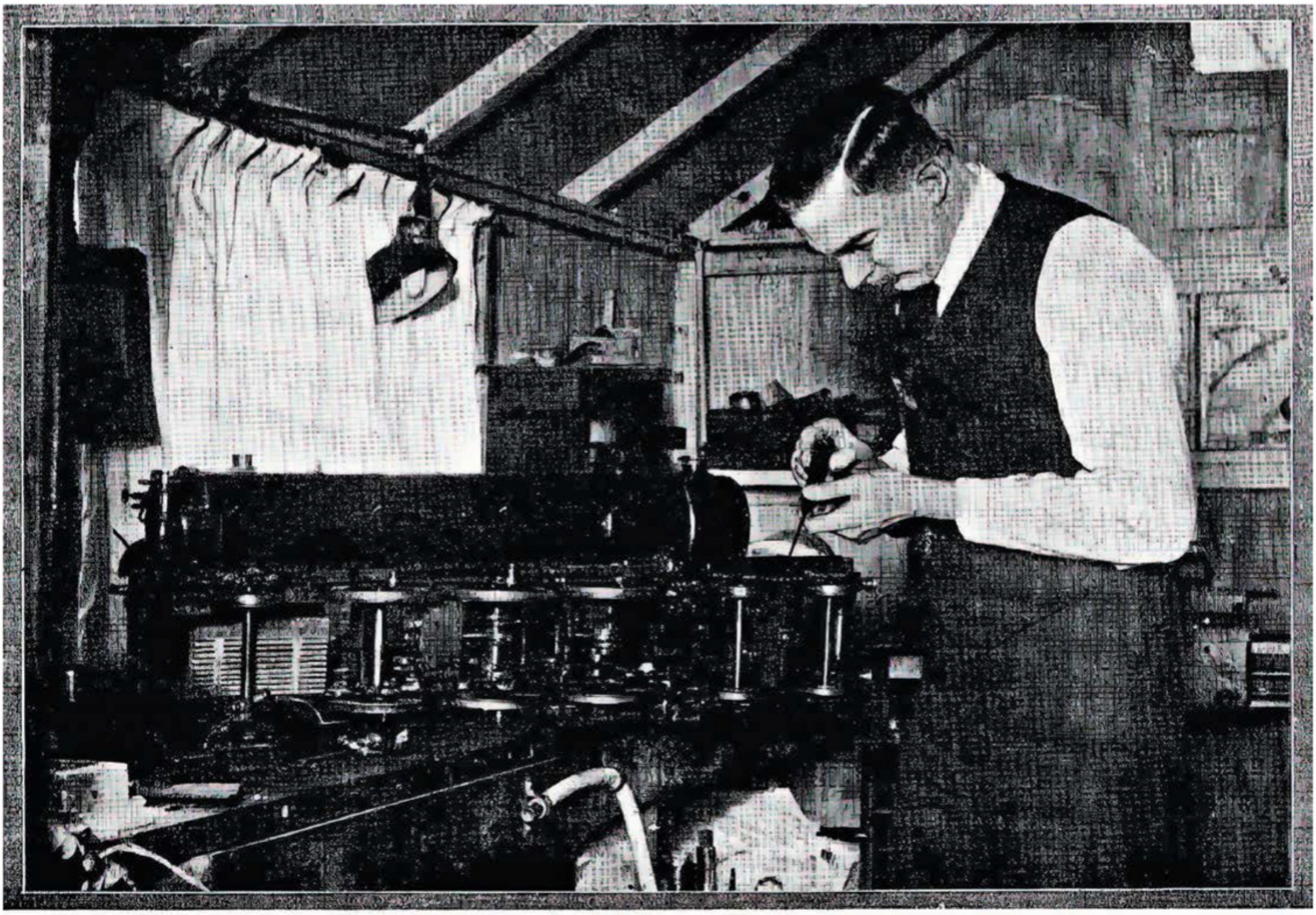
How to make concrete last 2000 years What have the Romans ever done for us? By Russell Eberhardt

Why are 3 phase motors with VFD so popular in the UK? What do you think? By Simon Collier

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. Come and join us – it’s free to all readers!

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS



MR. JAMES C CREBBIN IN HIS WORKSHOP OVERHAULING HIS MODEL LOCOMOTIVE "ALDINGTON."

Transplanting a Dore-Westbury mill head

Brian Wood grafts a 'Frankenstein' milling machine together inspired by a number of other people's approaches to similar 'transplants'.

Some time ago, Alan Jackson did a transplant onto his Tom Senior M1 milling machine and wrote up his work in the January 2020 edition of Model Engineers' Workshop, **ref. 1**. In this article, the receiving machine is the Junior model Tom Senior mill, the design of which imposes some important limitations on what can be done with a machine graft of this kind onto the smaller model.

Background story

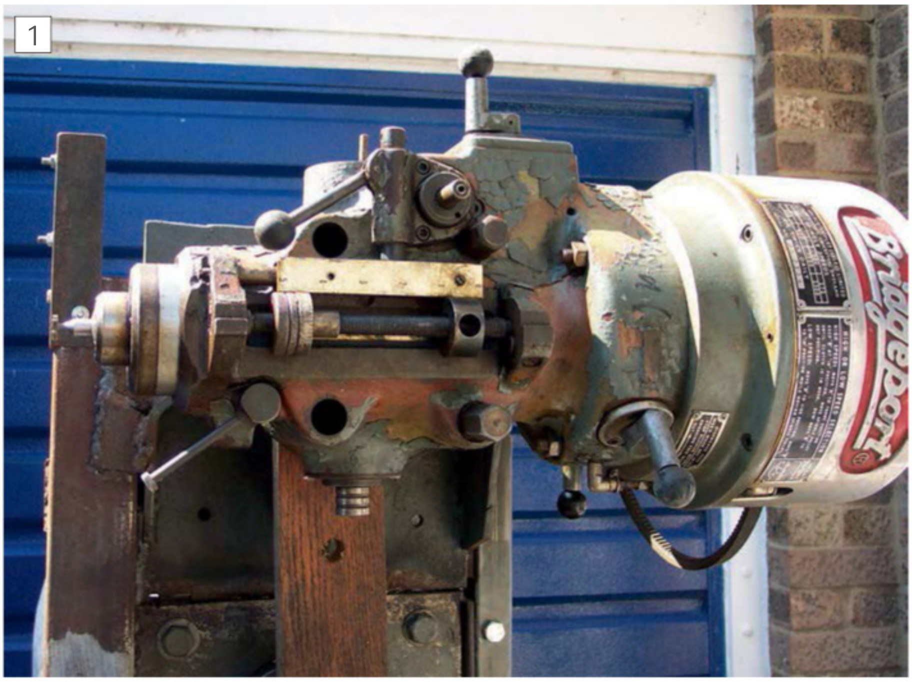
Alan's conversion is inspired. In essence it combines the function of vertical and horizontal milling machines into one unified whole, and it was one of several factors that led me to thinking about converting my own machine.

Adam Booth in his superbly equipped US workshop (from where he produces many YouTube videos of his work under his brand name Aborn79) has a huge Kearney and Trecker (K&T) horizontal mill. A notable feature of this machine is the pair of overarm bars of a very generous size. It also has a Bridgeport mill head attached to the side so mounted that it can be swung into use over the table on an articulated hinge. This machine is big and must weigh close to four tons

K & T made at least one other horizontal mill which includes a Bridgeport head attachment. In that example, the Bridgeport head is suspended to the side when not in use on a fitting much like a tow hitch ball. Keith Rucker of Vintage Machinery has one of this design

On a rather smaller scale to the big K&T, but still a full-size industrial machine; a friend has recently bought an Elliott Victoria mill. This one has an owner/engineer fitted Bridgeport head built onto it that can be swung into position over the table. It is a clever and well-constructed conversion; shown here in **photo 1** in the "as received" condition. In this picture, the head is in the parked position.

1



Bridgeport head on an Elliott Victoria mill.

To use it, the four-hole anchorage plate upon which it is mounted is unbolted from the ring of bolt holes on the mill body, then re-aligned vertically on its support collar (which is a very close-fit over the spindle bearing cap) to be bolted back again to the mill body. The Bridgeport head can then be swung round over the table from the left-hand side on a big hinge made especially for this application.

These examples convinced me that I could do something along similar lines and in doing so add the benefit of knee elevation that is sadly lacking on the otherwise well-designed Dore-Westbury mill.

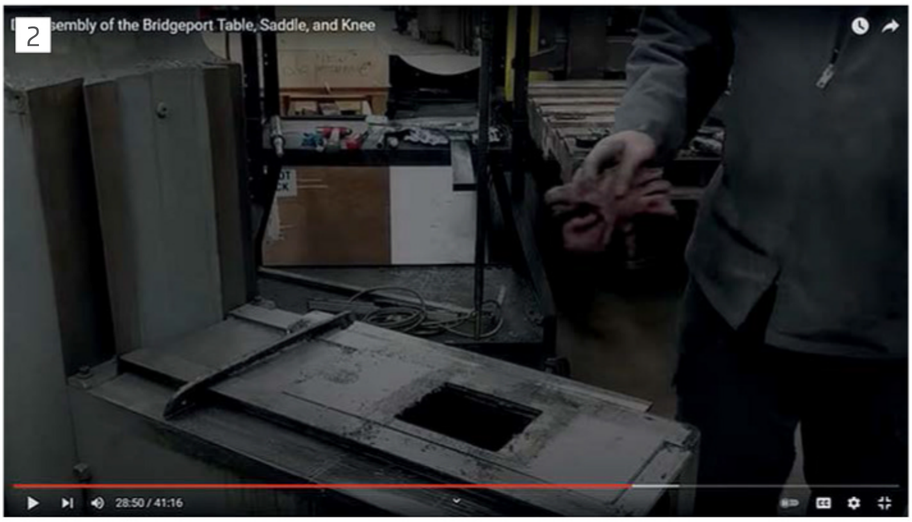
Since building it thirty years ago it has done sterling work for me and has benefited from some notable upgrades and working improvements over that period.

One of these was to include motorised elevation combined with a shop built thrust bearing on the column, another was for a stronger and easily extracted front mounted winding key for the column helix. The original had cracked and was close to complete failure; it was discovered just in time by pure chance.

But now, my tolerance to the constant problem of adjusting the work head height to suit changes in the height of the job being worked on, using a mill that is supported on a round column, has become largely exhausted and it has become a tiresome chore to be endured.

Despite my developing dislike of this design restriction, (it is easy enough to manage it must be said) I wanted to retain the added freedom of operation it undoubtedly brings to usefulness on a small machine by allowing it to operate in a limited way as a miniature radial arm drill.

Without this ability, a repair job on my metal cutting bandsaw (**ref. 2**) some years ago could not have been done in my workshop.



Screen shot of genuine Bridgeport plates.

Design and planning

I devoured Alan's article and realised very quickly that the differences in size between our two mills made any kind of direct copy of Alan's conversion impractical. It was not my intention to do that anyway. Because this adaptation is not a repetition of Alan's design, there are some other design aspects involved which are specific to the smaller machine. One of these allows a very simple and easy to use adjustment for "nod" on the machine head. It is a great improvement over what was required for the original D-W design where the support column had to be shimmed at the base.

I remember it being a rather hit and miss business and difficult to achieve a result that was good enough. Because of that, I have actively put off the upheaval involved in checking and resetting the alignment again after many years of use. The new adjustment is described in a little more detail further on.

One of the design improvements Alan included was to fit sliding plates to close off the swarf engulfing gaps on either side of the table that are revealed on so many designs of mill as the cross slide is moved about.

They are a direct copy of Bridgeport practice, scaled down for this size of machine. Fitted around the cross-slide feed screw nut, the two plates slide over one another as the cross slide is moved, making the action automatic.

Photograph 2 is a screen shot copy of a 1981 Series 1 Bridgeport table and knee restoration, taken just prior to where these plates are to be slid out of the dovetail slot cut for them in the knee. The plates on this machine are about 15 inches long. I found it difficult to visualise some of the details of these from his article, they were not shown, and with it being such a good idea, I wanted to copy the concept into my conversion.

Knee mounting on the Junior mill.

The secret of mounting is revealed.

Knee and jib on Junior mill.

Plate slot milled on the D-W mill.

Modified cross slide nut.

Left open, these gaps direct swarf straight into the knee and onto the bevel gearing that operates the elevating screw for the knee, as well as adding chips to the lubrication of the cross-slide feed screw.

I got in touch with Alan to see if he had pictures surplus to those published in his article which I could use as a guide. He didn't have other pictures available, but he very generously sent me a copy of the drawings he had prepared for these components instead; they helped me a great deal.

The plates slide in a slot milled into the top surface of the knee and now a big difference between our two mills became apparent. To cut the slot means taking the knee off and for some time I puzzled over how it came off my Junior mill. **Photograph 3** shows the jib housing for the knee on my mill but the jib itself is trapped in place with no frontal bolted release, which is a general feature on most knee mills.

I then remembered seeing two holes through the vertical column dovetail slide on that side when I had raised the table high up for some milling job in the past and wondered at the time what they were for. Shown out of sequence really, here they are in **photo 4** and now the secret is revealed; the jib had been fitted from the rear and bolted through from inside the column! **Photograph 5** shows the knee and jib as separate items. The brass cylinder that can be seen in this view is the slug that clamps the knee in any chosen position.

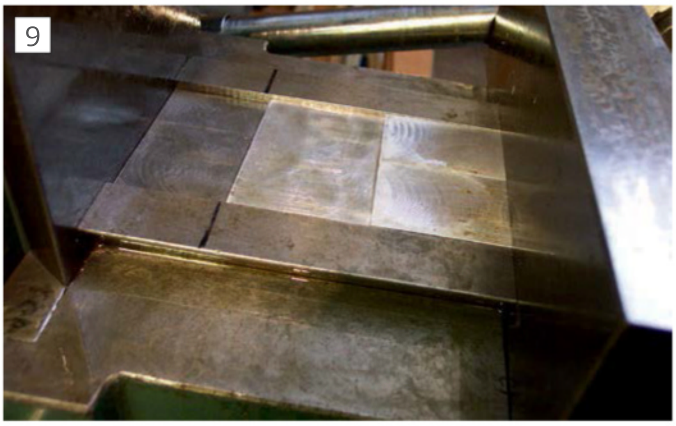
With the knee off my mill, the D-W mill was pressed into service once more as a final job in this form to machine the slot before taking it to pieces. **Photograph 6** shows the part finished slot; the knee was still bolted to the D-W table when this picture was taken. Slot width in my case was 60mm without encroaching too far into the sliding surface that the cross-slide casting needs. Slot depth is 5mm and the sides were left square cut for simplicity.

During the fitting work that followed, more space for plate movement was necessary and the feed-screw nut needed to be relieved to the same depth from the rear edge to allow the lower plate edge to close over it. Fortunately, there was enough material available on the nut for this relief to finish very close to the threaded mounting hole. The modified nut it is shown here in **photo 7.**

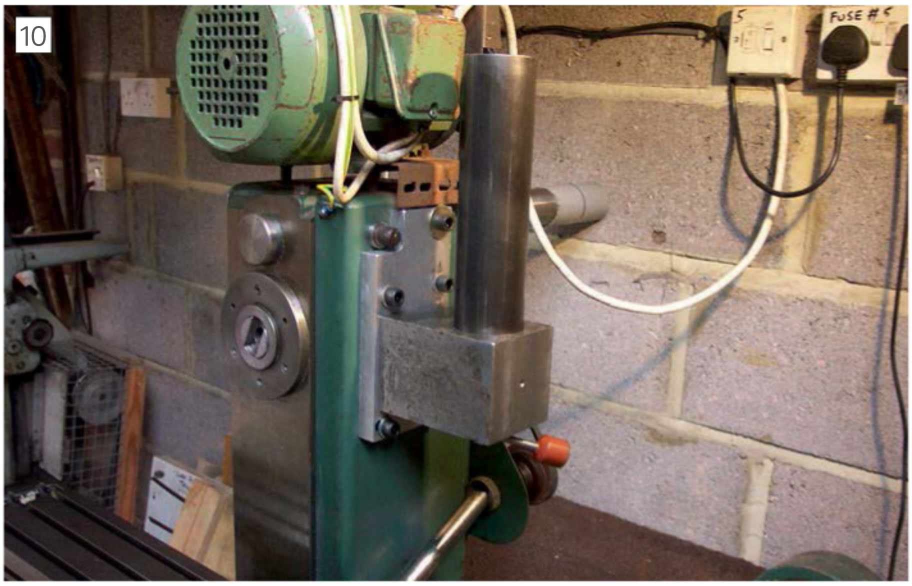
The front support index bracket for the feed screw also needed to have the top milled down to the same depth to provide somewhere for the lower plate to slide out onto. The modification is

›

Frontal view on Junior mill.



Plates in position at rear of table.



"Carriage lamp" support.

Evidence of heating to break Loctite joint.

unobtrusive and is shown here in **photo 8**. It was interesting to see that the Bridgeport design also requires their plates to slide out into the frontal space on their mills in this way.

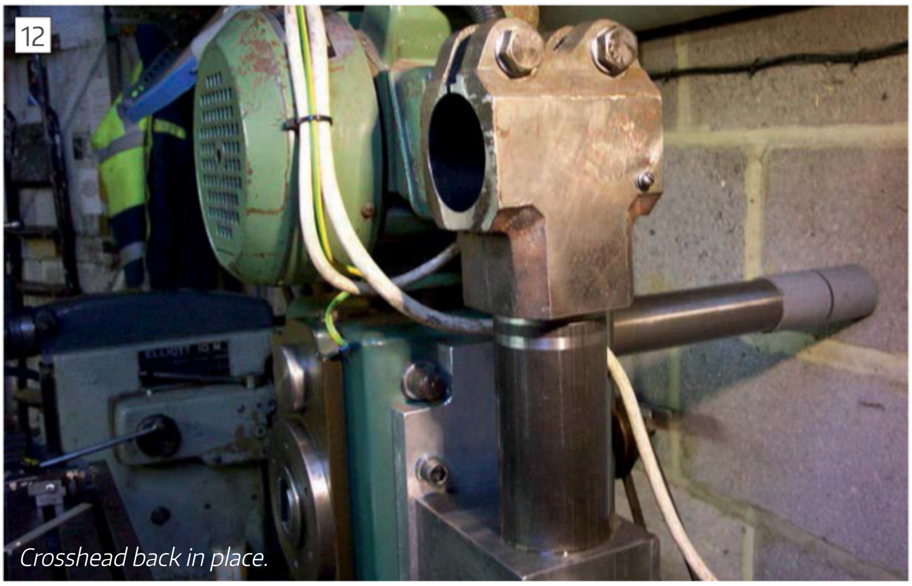
Several trial runs were necessary using one alloy plate and a second overlapping cardboard plate. I used a pair of scissors to trim it to arrive at an aperture size which suited the full travel movement while still sealing the gap.

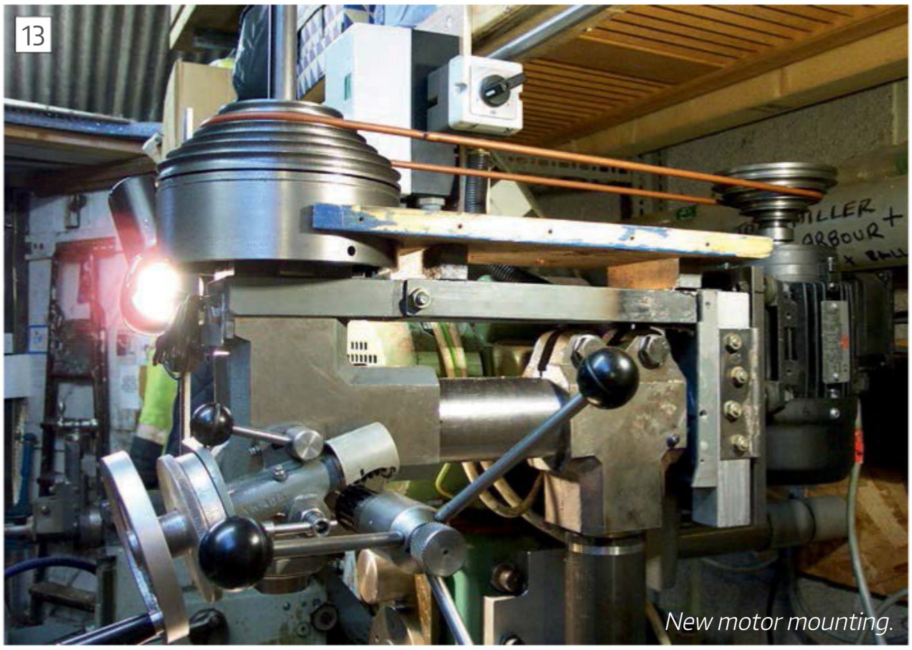
The plates themselves were made from duralumin alloy sheet, 3.2 mm thick and faced down to 2.3 mm thick. With the D-W mill out of action at this stage and the Senior mill without a table, the plates were bonded to thicker flat material which could be held in a four-jaw chuck and then carefully turned to thickness on the lathe, taking light cuts. Being a cold rolled material, it is rigid and stable even with sizeable slots cut out of the centre. **Photograph 9** shows the plates in position.

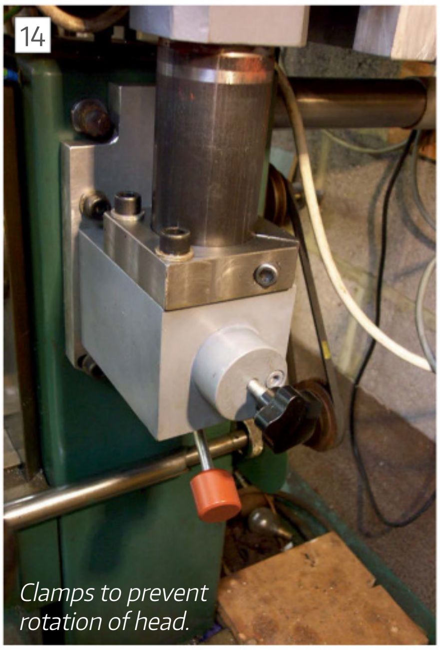
The Junior mill is built around a relatively narrow column in both axes and there is no room within it to accommodate the main motor inside, as Alan did. I didn't regard that as a special impediment as I rather liked the concept of an articulated hinge to 'fold' the head back out of the way.

In the event, clearances around the machine and other limitations made the concept of a hinge impractical anyway. Instead, the D-W head has been bolted to the righthand side on the machine column with a fabricated support where it is held off rather like a carriage lamp support of olden times. Fitting this bracket needed careful optimisation to maximise the swing over the table within both table movement and reach from the ram that the head is fitted to. The position finally chosen was determined very much by trial-and-error methods.

Photograph 10 is a view of the new partly finished support feature. It is made in three parts; first the thick aluminium mounting pad, bolted to which from behind is a block of 90 x 95 mm steel bar into which a socket


12 Crosshead back in place.


13 New motor mounting.


14 Clamps to prevent rotation of head.

has been bored to accept a length of thick-walled seamless hydraulic pipe mounted vertically.

The top end of the pipe was machined later to fit the socket in the crosshead casting and later still bonded into it with Loctite. The lower end of the pipe is free to swivel in the socket in the "carriage lamp" block until clamped. Because these are relatively large diameter joints, I had to use an oxy-acetylene torch to get sufficient heat into the original glued joint of the round column in the crosshead casting to break the joint.

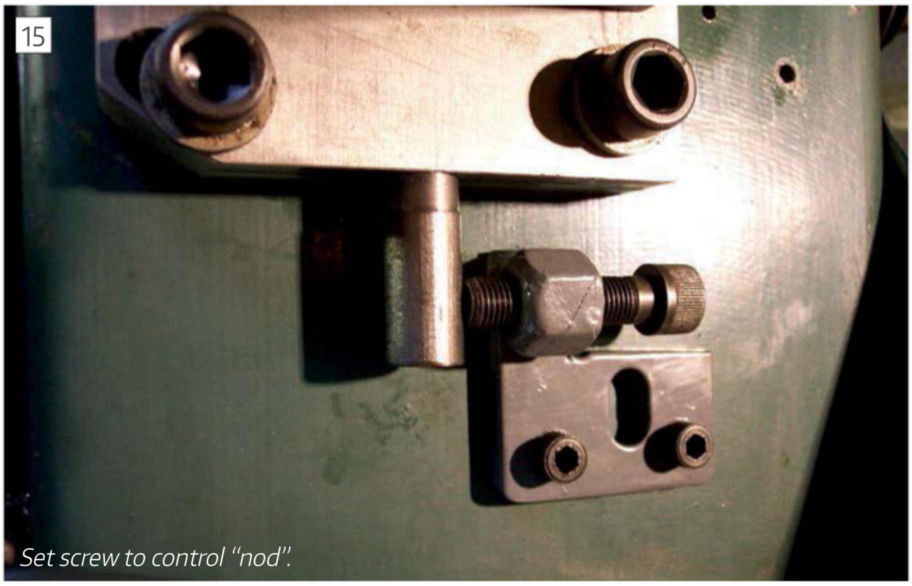
Even when the joint was smoking hot, I had to use a piece of aluminium scaffold pipe through the hole for the head ram to work the joint about before it finally gave up and separated. **Photograph 11** is a view of the old column 'post battle'. **Photograph 12** shows the cross head back in place on the new tube support.

In this conversion I had hoped it might be possible to mount the motor upside down, as in a turret mill, to give more space for belt adjustment and suchlike. The plan was thwarted by the large overhead storage shelf which I had installed only the previous year above the Senior mill. There was simply not enough clearance left to fit the motor that way up, so it went back again to its original location.

It would have happened anyway but at this stage of the rebuild I took the opportunity to make up a completely new hinged mounting for the motor that gives a very much better range of belt tensioning than before. Round polyurethane belting has a lot of stretch in it, and it needs a correspondingly generous degree of tension adjustment to avoid slip That is now provided by a thick pad of packing foam pushed into the 'gape' of the hinge. It can be removed and refitted in moments for major speed changes which require belt movement. **Photograph 13** shows the new arrangement, but not the foam pad wedge, an especially awkward place to get a camera view of.

As noted earlier, the bottom end of the new vertical support tube is free to swivel within the socket in the steel block to allow the mill to reach along some of the right-hand side of the table. Once in the chosen position it can be restrained by a bolt from the bottom pulling it down into the socket in the steel block. This is supplemented by a side bolt gripping onto a flat groove machined in the vertical tube wall, but that didn't provide as good a grip as I had hoped to resist snatching actions by milling cutters, so a further measure was needed. This was provided from a top mounted steel slab having a corner pinch bolt to squeeze the hole through it tight around the tube. This is by far the most effective of the three methods

The combination of all three restraints now resists the turning efforts of a three-foot length of scaffold pole in the cross head. I judged that to be good enough. **Photograph 14** shows these three clamping methods in the one view. ›



15

Set screw to control "nod".

16

My preferred method of setting for tram.

17

The finished job.

Forward lean or 'nod' of the mill head, mentioned earlier, was always the more difficult one to set correctly in the old design. It is now controlled by a jacking screw acting on one side of the stub secured into the mounting pad of the side support and shown here in **photo 15**.

It only needs to act in one direction as the natural tendency for the head, the heavier element of the mill, is to lean forward, simply because of the leverage of its greater mass over that of the motor at the far end of the ram.

With a fine adjusting thread, it can be set very precisely with the plate just restrained by pivoting on the top bolt, after which all five bolts are tightened up.

To set the head tramming I use my preferred faceplate method where both axes can be checked and set in the one operation. **Photograph 16** shows the method which has the great advantage of revealing the tramming error visually without any need for dial gauges and peering in awkward directions using mirrors. It is simple, quick, and easy to do and would very probably make use of already existing equipment in most people's workshops.

Testing and Evaluation.

Has it been a worthwhile exercise? The answer must be yes, quite emphatically. It has made the mill into a more compact and rigid machine and given it the big added advantage of knee control which will be a pleasure to use.

The degree of radial arm reach in this incarnation is restricted to the right-hand side of the table but at the time of writing I don't see that being a serious impediment.

To finish, **photo 17** is a view of the finished job

Acknowledgements

I am indebted to H&W Machine Repair of Fort Wayne, Indiana for their permission to use the screen shot copy in photo 2

References

1 A Dore-Westbury head on a Tom Senior M1 mill. Alan Jackson MEW 289 January 2020
2 A big job for a small machine. Brian Wood MEW 247 October 2016

Lathe Speed Indication

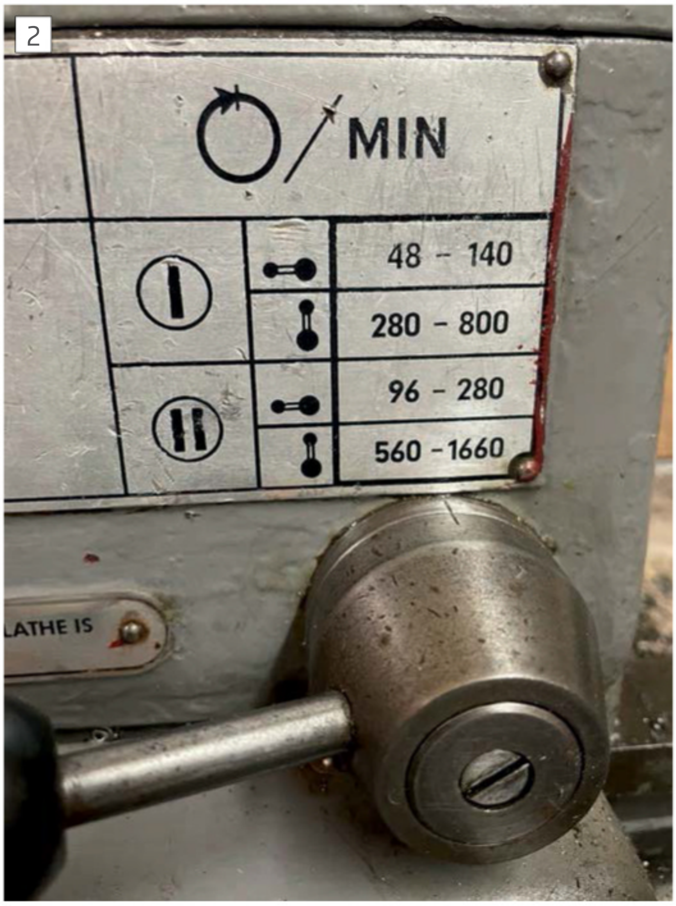
Chris Hobday had backed himself into a corner and had no idea at what speed his lathe was spinning around. This article explains how he came to be in this position, how he got myself out of it and how he got to knowing exactly what speed the lathe was actually doing.

The Weiler model LZ 280.

It all started back in the early "Noughties" when my mate had gone by a boat company on the River Arun at Littlehampton that had just ceased trading. He'd seen they were selling off their assets and were open for viewings. He had a good nose about, then phoned me up, knowing I was looking for a lathe, saying they had one going at a good price. I shot off down there at once. The guy selling would not drop on an already very good price but would deliver free of charge - deal done. Not only that, but he even positioned it exactly where I wanted it in my garage. Good service! However, it ran off a three-phase supply; no worries said my mate, I have an old inverter, no longer used, you can have that. And so, I started.

The lathe is a Weiler model LZ 280 **photo 1.** The LZ 280 lathe is not well known, it would appear, but it was and still is a quality German lathe, built in the late 1960's to early 1970's, well specified, able to cut a good range of metric and imperial threads, and with power longitudinal and transverse feeds. It is obviously well used, as it has slight wear on the bed in the area most used; however, this can be taken out by jib strip adjustment and so far, I have never needed to machine over longer lengths, so it has done me very well.

Even better for me, this one having been built for the UK market back in the day when we all still worked in imperial, was graduated in 'thous'; perfect, as I am of an age when we were all taught and then worked in imperial. Although I can and do work in metric, bits of a mm mean nothing to me, I cannot visualise them, I work in them, but I find myself continually mentally converting them into thous so as I understand what I am



Standard speed ranges.

Variator control.

doing. Sad it may be so to some, but true; I suspect I am not the only one!

Now the three-phase motor was also a two-speed motor, driving the lathe via a variator (a mechanical variable speed device), plus the lathe had a back gear. So the lathe had effectively four speed ranges, high and low variator ranges on full speed and half speed normal, and the same again on back gear. **photo 2.** So far so good. The stand-in inverter, no longer required by my mate, was really very under powered for the 1kW sized motor, but it worked and I never pushed the lathe hard, so it coped. I simply read what sort of speed I was doing by looking at the readout on the variator dial, **photo 3**. From these two photos one can see clearly the four ranges, 'I' being low speed, 'II' being high speed, 'two circles' being back gear and 'two little circles joined by a belt' being normal running.

Then came the day, fast forward a few years, after the lathe had been cleaned, repainted and resettled and put to work in my shed in our new home after retirement, that a fault developed on the motor. After fiddling about trying to fix it my fears were confirmed - the motor needed a rewind, and the inverter was damaged too. A rewind cost was out the question, a new motor was going to be far cheaper. A very helpful salesman at Transwave Converters talked me into buying a TEC 1. 5kW motor, up from the 1 kW original motor and also, thanks to progress and being single speed, now physically smaller - and he even threw in a few metres of 4 core three phase cable as well.

As luck would have it, a Telemecanique inverter of the right size was also available online at a reasonable price so I was back in business quickly.

Although the motor was not a two speed one, two speeds could be gained from the inverter via switching between inputs; I was back machining, using either 50Hz for full speed or 25Hz for half speed and switching between the two via a metal clad light switch. Unconventional maybe, but it worked.

Now, I had also realised that the inverter could be also controlled via a variable resistor but I lacked the will to implement it, until one day I thought, just go for it, bought a suitable

Test of uncased 12V DC power supply before fitting of an outer enclosure and securing of cables.

potentiometer and away I went. Why I had prevaricated for so long I have no idea now, the connections potentiometer to the inverter were there in the instruction manual and the

Lathe spindle with cover removed.

potentiometer was only a couple of quid or so.

I also phoned up TEC technical support at that time and asked what range of frequencies their motors could comfortably run at. The answer was between 70Hz down to 20Hz on a continuous rating (I think I remember those limits correctly!) - below 20Hz additional cooling or interrupted running was required to prevent possible overheating of the motor. Using the inverter with a frequency range of 10-70 Hz now give me a speed range of between 19rpm, lowest speed on back gear, right up to 1900rpm on 'normal, not that I ever go that far. The lathe at that speed frightens me to death! The original speed range was 48 - 1660rpm and that top speed was fast enough for my needs. But the wider range of frequencies and use of the potetiometer does mean less twiddling on the variator dial is needed, so a definite plus.

So now I could twiddle a rheostat to vary the inverter output frequency and also twiddle the variator and between them therefore vary the speed, but now the readings on the variator dial bore absolutely no correlation to at what speed I had the lathe whizzing around. I had backed myself into a corner.

What to do about it was the question. Then I remembered, and found on the ME forum, a thread to which the late great John Stevenson had highlighted a cheap digital readout available from China. I searched and found on a supplier in Hong Kong who would supply a 4 digit readout, the required PCB, a proximity sensor and the little magnet it needed, plus deliver it to me in England, all for less than £7. 00 all in. To get this cost into perspective, the plastic enclosure for it cost over £4. 00 from Maplins (it was all a few years ago!), plus I had to drive there and back using nearly half a gallon of petrol. The digital readout and PCB fitted into the enclosure, and the inverter potentiometer - although wired into the inverter -was also added to the side of the enclosure for convenience of location, so one step forward.

I had bought a 240V AC/12V DC power supply, **photo 4**, also online, to give a 12v DC supply in my shed, so that gave the supply to the PCB in the enclosure. These are designed to be fitted inside equipment, so they need a ventilated outer case or enclosure for final installation. All it needed now was the input from the sensor. But where to put this sensor? The only part that would give lathe spindle speed was the headstock spindle, but where abouts on it? No obvious point shouted at me, **photo 5**. I finally decided the only spot I could see that would work would be to utilise the very end of the headstock spindle where it exited the headstock. This would mean blocking up the end of the hollow spindle with the idea I had in mind, but if I made that idea easily removable, I could then work around the very rare occasions when I needed stock held in the chuck to go all through the headstock and out the back end.

I like taper lock bushes, so I made up a taper lock bush to fit in the end of the headstock spindle, **photos 6** and **7**, that was easily removable. It is of a very simple construction. The main body is machined to be a close sliding fit, a thou or two clearance, in the end of the headstock spindle with a wider flange on the end to stop it sliding in too far and to provide a platform on which to mount the magnet. About half to three-quarters of the body was bored out from the inboard end to a slight taper, about 10 degrees, and the remainder drilled through to accommodate a 6mm socket cap bolt.

At the same taper turning setting, a small wedge-shaped cone piece was machined to nearly completely, but not quite fully, fit inside the body and was then drilled through and tapped 6mm. The body was then drilled through radially every 90 degrees at the inner end of the internal bore and then set up in the mill and a slitting saw used to machine the slots to the drilled holes.

Taper lock bush parts.

Taper lock bush assembled.

Bush with magnet and sensor in place.

The idea is that with the body being a close fit on the internal bore of the headstock spindle only a very small amount of expansion created by pulling the wedge cone into the body will enable the body to firmly grip the headstock spindle, but not to take up a permanent 'set'; releasing the bolt will therefore enable the taper lock piece to be easily withdrawn, and so it has proved.

Lathe speed display.

On the exterior flange of the body I used Araldite to glue the magnet to it, then made up a little bracket to hold the sensor in a suitable position to 'see' the magnet and glued the bracket to the headstock casing. **Photograph 8** shows the completed fitting in place on the end of the headstock.

All I had to do then was wire the PCB and sensor in. Easier said than done, as the bits from Hong Kong had come with no wiring diagram supplied - well, what do you expect at that price? However, the ME Forum, **www.model-engineer.co.uk**, came to the rescue again, a further search revealed the wiring diagram (others, including John Stevenson, had come across the same problem) and in the end it was simple, after all, it was only five connections to make, easy if you get them in the right order.

The result was as shown in **photo 9**, the enclosure with the readout, which is located above and behind the lathe chuck, very conveniently located both to adjust speed and give an indication of lathe speed. Eagle eyed readers will also notice another little switch (a little silver rod) located above the speed controol, fitted to the left side of the enclosure. This is a supply on/off switch I added later, when I had added other items to the general shed 12v DC supply, so the supply is only 'live' to the readout when I need it and the lathe is being used.

So, in the end, for really very little money, I had added a speed control and readout which gave me a very easy control of speed and a very clear indication of lathe speed, exactly where I needed it, right in front of where I stand when using the lathe.

As usual, the final question was, why hadn't I done this years ago?!

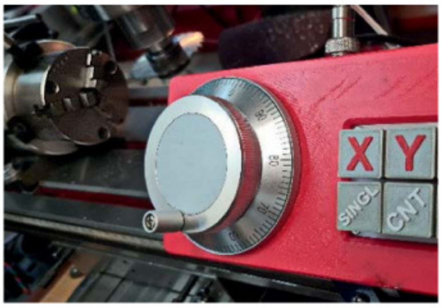
In our Next Issue

Coming up in issue 326

On sale 17th March 2023

Contents subject to change

To pre-order you your copy of MEW 326 the April 2023 issue visit www.classicmagazines.co.uk or call 01507 529 529



Chris Gabel introduces his 'fly by wire' CNC controller.


Robert Trethewey shows us how to replace the spindle bearings on a Myford lathe.


Simon Davies explains how extend the versatility of your milling machine by fitting a high speed spindle.

Low Voltage Power Sources

Stub Mandrel continues his look at ways of supplying power to your projects.

Wiring the modules referred to last time is simple, **fig. 1**, just connect the positive and negative leads from the cell to the BAT+ and BAT- connections on the board. You can supply power via the USB socket (which does not have any signal function) or supply up to 8V across the IN+ and IN- connections. It's important to bear in mind that these modules are not suitable for use with a 12v supply!

One issues with using Li-ion batteries with many projects is that because they only produce rather less than 4V they are unsuitable for many applications that require a full 5V to work properly. The simple solution to this is a voltage booster module, such as that in **photo 14**. This example is based around an MT3608 chip and can deliver up to 28V from a 2V input. The connections are simple, the cell should be connected across Vin+ and Vin via a switch, usually in the positive line, fig. 1. Before connecting the output, its voltage must be adjusted using the multi-turn potentiometer.

The maximum output current is 2A but in practice this is optimistic, especially if the step up ratio is large as the input current is larger in proportion to the voltage step up, plus an amount to allow for inefficiencies in the circuit.

For example, running a stepper motor at 12V and 1 Amp via one of these modules could require up to 4 amps from a single Li-ion cell and is probably over-optimistic. On the other hand, a small geared 28BYJ-48 stepper motor, only requires about 260mA maximum at 9V, which would draw less than an amp from the cell, fine if the load is only required for brief periods. Using a boost module for this application could be a viable alternative to using a PP3 battery for a project.

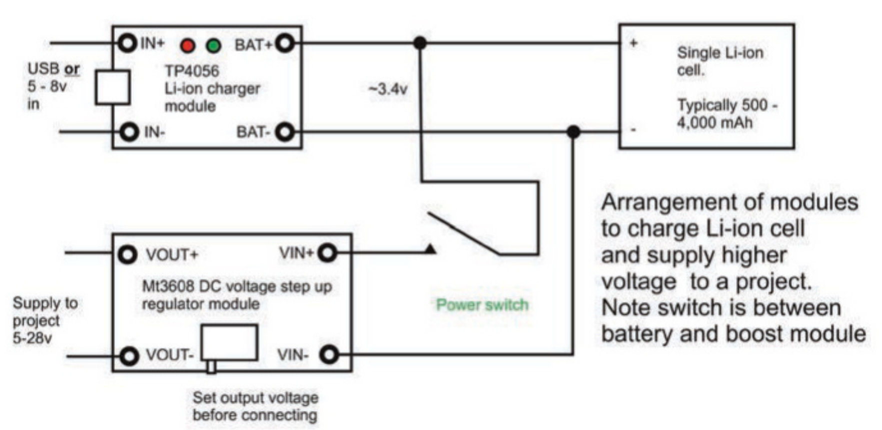
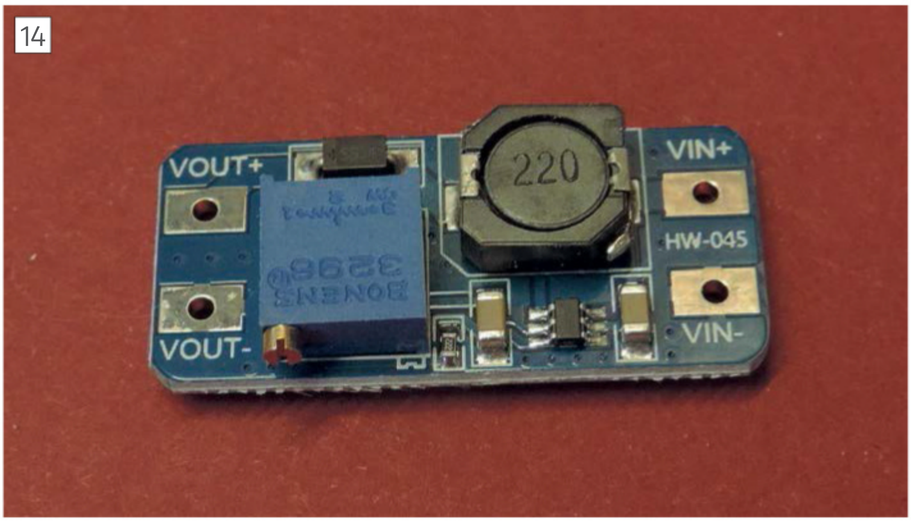


Figure 1. Schematic for a versatile portable power supply, based around a single lithium-ion cell.



Step up voltage booster, the brass screw on the multi-turn potentiometer adjusts the regulated output voltage.

liFePo

Lithium-iron-phosphate batteries are more robust than Li-ion cells and less likely to catch fire if they are damaged or mistreated. They are relatively cheap to manufacture and because they can keep their capacity over many charge/discharge cycles they have become popular for electric vehicles. Their voltage of 3.2v means that using four together can mimic a 12v lead acid battery so they have become popular for portable 'power packs', although the cost of these is often much higher than equivalent pack with lead-acid gel batteries.

Battery Eliminators

Some equipment comes fitted with rechargeable batteries that are easily replaceable (e.g. DSLR and bridge cameras). These typically have an external charger, although some can

This simple box helps keep track of batteries, charged at one end, discharged at the other.

This two-battery power grip is bulky but contains a self-timer giving a self-contained solution for a night of wide-field imaging.

'top up' their batteries when connected to a computer. If you use a DSLR, for example, a battery is unlikely to last the whole of a long imaging session, so you need to keep track of multiple batteries, **photo 15**, and it can be very frustrating if an unaccompanied camera goes flat. Incidentally an alternative is a combined battery pack/hand grip that can take multiple (usually two) batteries. The one in **photo 16** adds quite a lot of bulk but has the advantage of including a self-timer.

Few DSLRs have a socket for an external power supply, but most can use a 'battery eliminator' in the form of a dummy battery with a flying lead to an external power supply. Many cameras, e.g. Canon, have a small rubber plug that can be removed to allow their use without removing the battery compartment cover. A claimed advantage of using a battery eliminator is that they generally run cooler than batteries, which may help marginally reduce noise in long exposures.

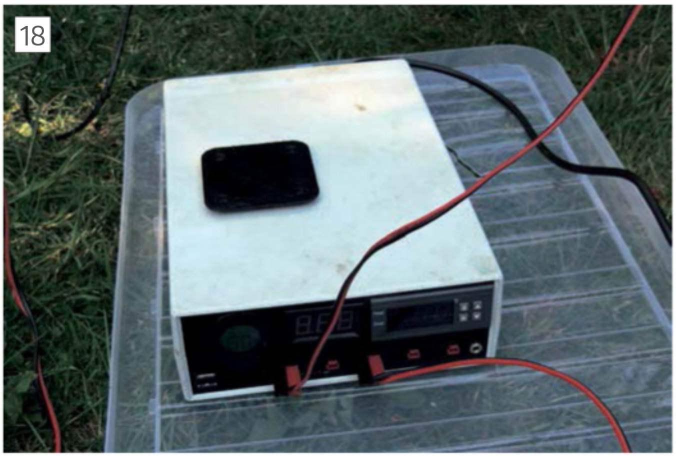
External Power

While being able to operate away from a mains connection is useful, much of the time you may be operating at home, in the workshop or perhaps in a clubhouse or similar. Sometimes we do need to work outdoors, and although we will do our best to avoid rain this means that for safety all of our mains equipment should be suitable for outdoor use. In particular, your power should always come via an RCD (residual current device) whenever you wish to use mains electricity outdoors. Such a device, regularly tested before use, is a relatively inexpensive way to achieve a high level of protection against electric shocks – you cannot rely on ordinary fuses or circuit breakers to provide such protection.

When using any electrical equipment outdoors, I always power my equipment from an RCD protected socket or an extension lead fitted with a RCD circuit breaker, **photo 17**. Being of a 'belt and braces mindset, I place my mains-powered supply on a large plastic box lid, if there is any risk of it contacting damp grass, **photo 18**.

Much equipment does not run directly from the mains supply but relies on a power adaptor or a portable battery/power pack. Increasingly, a 5V USB supply, which can nominally provide about an amp or so of current is popular for powering or charging small equipment. Smaller items may run directly from the USB connection to a host computer. This can lead to problems when you have several greedy items all competing for that one ampere. In theory the USB protocol says they should request an allocation and make do with what the computer tells them they can have. In practice, overloading USB can result in a dropping voltage

This ten-metre extension lead with the plug removed and an RCD safety device fitted provides peace of mind.



Multi-output power supply placed on a plastic lid to keep it away from damp grass.

USB 3 hub with switched sockets.

Li-ion power bank suitable for powering 5V equipment, especially those which use a USB lead for power.

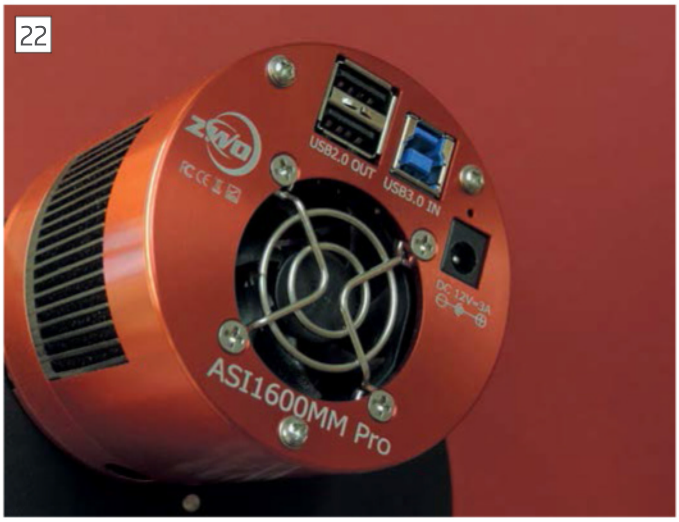
level and unexpected errors, especially when long leads are used. An effective solution to this problem is to use a powered USB-hub. The hub pictured in **photo 19** can be used with or without an external power 12V supply and has individually switched sockets; beware cheap versions that can supply incorrect voltages.

For equipment that runs of a 5V USB supply that does not need a data connection it is perfectly acceptable to run it off a standard USB charger or a portable 'power bank', **fig 20**. One issue sometimes encountered is that a device uses little current causing the charger or power bank to assume it is 'fully charged' and switch itself off after several seconds. Ironically cheaper power banks often do not have this feature and work better in this way.

Much other equipment uses a nominal 12V supply. As mentioned earlier, such equipment is normally tolerant of the 14.4 volts supplied by a freshly charged 12V lead-acid battery. It can be tempting to use a battery charger as a source of a 12V supply but be aware that some battery chargers actually output around 16V without a battery attached and this may be too much for such equipment. Often such equipment will not fail straight away, but the overloaded power regulator will overheat and fail prematurely, possibly taking more expensive components with it. It is far better to use a proper 12V power supply.

For a lot of equipment, a 5.5/2.1mm 12V jack has become relatively standard, **photo 21**. 5.5mm is the external diameter and 2.1mm is that of the central pin. These are usually wired with the tip positive. These are not universal standards, so always check your equipment first and if in doubt use the manufacturer's own adaptor. As an example, my ZWO ASI1600MM-PRO astronomy camera operates from the 5v of its USB connection, but also has a socket for an external 12V supply which operates its cooler and powers an integral USB hub with two outlets, **photo 22**.

5.5/2.1mm jacks have become ubiquitous, not just for astronomical equipment, but always check voltage and polarity first!



This astro camera has a USB3 input as well as a 12V 5.5/2.1 jack for a 1V supply that powers both its cooler and an integral USB 2 hub.

A Power Box

The multi-output power supply includes 5V USB outlets and 12V powerpole connections, one of which is controlled by a thermostat unit. The output voltage is now regulated to 12, rather than 13.2V.

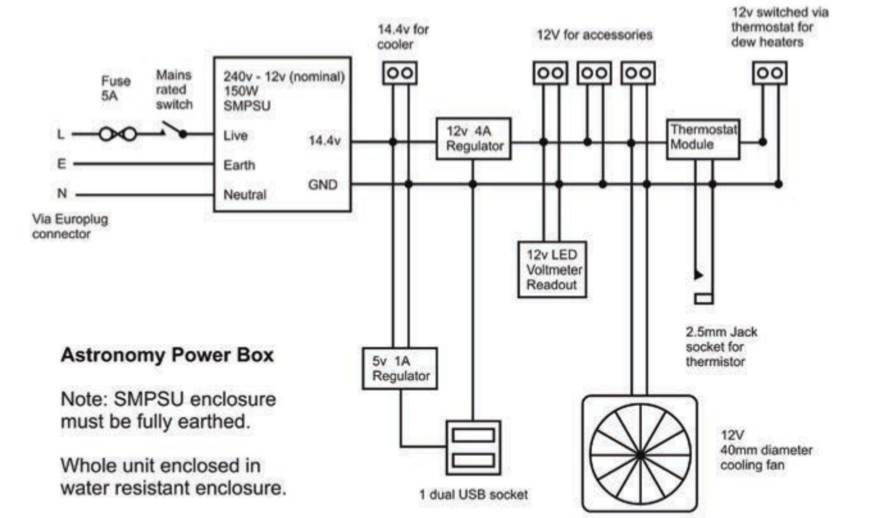


Figure 2. Wiring diagram for the power unit.

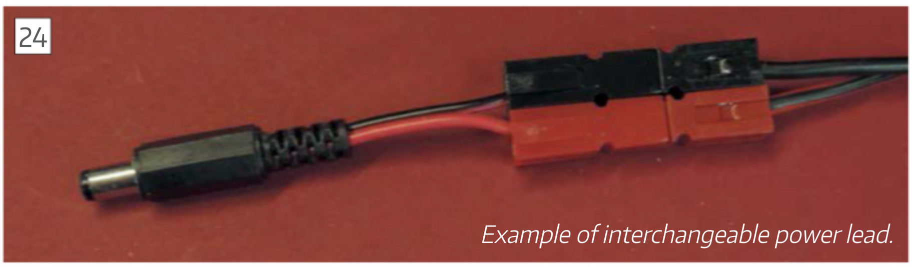
In order to rationalise my power arrangements, I built a multi-output power box for astronomy, but it could have many other uses, **photo 23**. The core of this is a 150W switched-mode power supply module, of the kind often used to power 3D printers, chosen to have plenty of headroom, even if running a cooled camera, a mount, several accessories and dew heater straps. The module is housed in a perforated steel enclosure for cooling, but this is clearly unsafe to be exposed outdoors, so for safety the module is built into a larger plastic enclosure, mounted on insulated stand-offs to allow air circulation and a fan is fitted to the top of the box. The fan is baffled to stop anything getting into the fan. The box is fully insulated and the module with is earthed via a standard Euro connector. The layout of the internal circuitry is shown in **fig. 2**.

If you do not feel competent to work safely with mains powered equipment, then you can either find someone who is to help or use a suitable an external self-contained unit. In the latter case you can arrange the unit to use either this external source or a 12v leisure battery for use away from home.

I have used Power Pole connectors as they give a reliable connection that requires a good pull to separate, unlike 5.5/2.1mm jacks which easily pull out or cigarette lighter connectors which are just clumsy and unreliable. Anderson Power Pole Connectors are available in various current ratings and colours comprise a rectangular housing into which a contact is pushed, after connecting it to the end of a cable. They are ‘gender free’ which means that the same connectors can be used as ‘plugs’ and ‘sockets’. The housings have dovetails one the side and can be attached to each other in different orientations so you can build up multi-way plugs that can only be combined in certain combinations. My main connector uses two 30 amp connectors in red and black housings side by side which I use for all my 12V connections and has the advantage it is impossible to connect it the wrong way round in the dark or when fumbling with cold fingers.

The power supply is set to 14.4V wired to a power pole socket on the back of the unit. This simulates a lead acid battery to get the best performance from my Peltier-cooled DSLR. A high power adjustable voltage regulator drops this to 12V for several power pole connectors on the front of the unit, these are used for powering my mount, cooled astro camera and focuser. One outlet is controlled by a thermostatic controller that uses an external thermistor, this is suitable for controlling both coolers and heaters if required. There is an LED voltage display to give an early warning of any faults. A further voltage regulator drops the output to 5V for two USB sockets that can be used for various accessories.

Typically, I use just two leads, one of these goes to my HEQ5-PRO mount, I have replaced the built in 5.5/2.1mm connector with a short fly lead and a Power Pole connector as the original connector had become unreliable. The other lead has a Power Pole connector at each end, one connects to various leads such as a ‘Y’ lead with two 5.5mm/2.1mm plugs, one for my camera’s cooler, the other for my auto focuser, **photo 24**. ∎



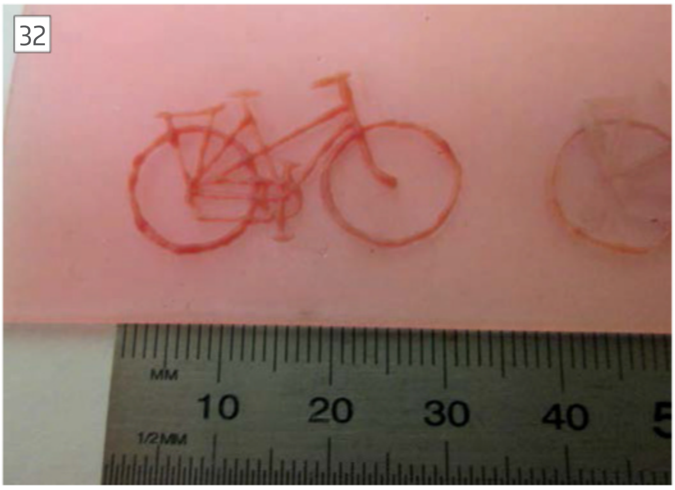
Example of interchangeable power lead.

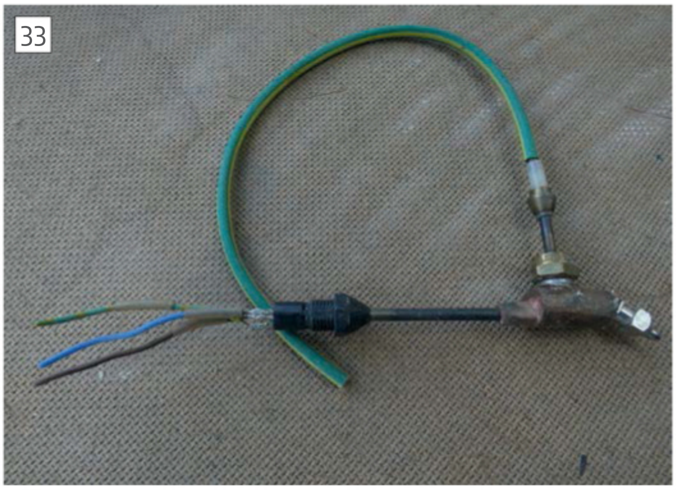
MODEL ENGINEERS' WORKSHOP CLASSIFIED

All advertisements will be inserted in the first available issue.
There are no reimbursement for cancellations. All advertisement must be pre-paid.
The Business Advertisements (Disclosure) Order 1977 - Requires all advertisements by people who sell goods in the course of business to make that fact clear.
Consequently all trade ads in *Model Engineers' Workshop* carry this 'T' symbol

A foray into casting – Part 2

Laurie Leonard shares more of his experiences of casting in the home workshop.





One project I made by the lost wax method was a silver brooch depicting a bicycle. The wax pattern was made from a thin sheet of wax on which the outline of the bicycle was drawn. **Photograph 32** shows one of the trials. To draw the outline a wax dispensing pen was made, **photos 33** and **34** and **fig. 3.** The "nib" was an old hypodermic needle which was a push fit on the manufactured "pen". The latter had a reservoir at the top from which protruded a tube through which air was blown to force the molten wax out of the nib at the desired rate. The body of the pen was made from copper which was bored to take the heating element of an electric soldering iron, the power to which was controlled by an adjustable electric regulator. The power setting was adjusted by trial and error to obtain fluid wax with no excessive temperature.

Two further examples are shown in **photos 35** and **36**. A small plaque of "cuckoo pint" was cast in silver and the other illustrates a test casting made from a "found" item. In this case I was attempting to make a jewellery mount from an acorn cup. The cup was attached with three sprues and the investment mould burnt out as if a wax pattern was being used. The result was not a great success possibly because burn out was

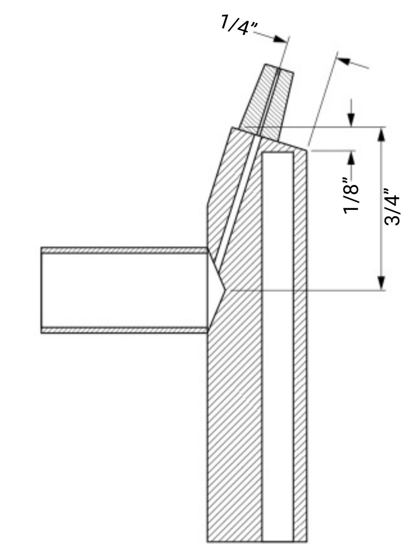


Figure 3. Wax dispensing pen

not complete thus leaving the staining although an old toothbrush fitted to an electric toothbrush made a difference. It is possible to use this method to make castings from a found object pattern.

I mentioned above the need for an accurate burn out cycle so was very interested in the article, **ref. 2**. In this article the Editor used 3D printing to create a pattern in PLA which was subsequently encased in Plaster of Paris not a proprietary investment plaster and then dried using a radiator followed by completing the burn out cycle using an oven. Definitely food for thought.

CO_2 Sand

I found this to be an interesting method. I had heard the expression but could not quite visualise using CO_2 (Carbon Dioxide) to solidify the sand. CO_2 is used as a freezing agent but that does not fit with casting!

During an Access to Art and Design Course I produced a pair of ceramic boots as part of one my projects, **photo 37**. I took them to a local art foundry to see how much it would cost to have them cast in bronze (£££) but whilst there I was taken on a quick tour and shown the steps that would be involved. The mould is made by placing the pattern in moulding boxes as in green sand casting, but the sand is clean dry sand to which has been added 3-6 % sodium silicate. The latter is a very viscous liquid which was used as an egg preserver in days gone by. It is intimately mixed with the sand which is then rammed up in the moulding box.

To harden it CO_2 gas is injected into the mixture which then solidifies by chemical reaction.

I used the method for a couple of projects, both connected with my narrow boat. The first was to make a support for my mug of tea/glass of wine whilst at the tiller, **photo 38.** I happened to have to hand some sand of dubious origin and although it had been kept

39

40

42

41

in a sack it was wet. It was dried in the sun, **photo 39**, and then finely sieved. **Photograph 40** shows the rejects but I was ready to go. **Photograph 41** shows my equipment; ok it mainly shows my white mixing bucket. The pattern is actually a polyester resin casting of a pattern I made from MDF but that is another story. The pile of homemade moulding boxes is present because I had not finalised which size of box to use. The sand and the sodium silicate are measured in the correct proportions, **photo 42,** and then mixed. I used an eye mixer I made from ¼" mild steel rod, **photo 43**, rotated via an electric drill. This was very effective as can be seen in **photo 44**. With the centre line of the vertical curve of the cup on the top of the bottom moulding box, the box was rammed up and then pricked all over, avoiding the pattern, to permit the CO_2 gas to react with the sodium silicate. A large plastic bag was place over the moulding box with a pipe taped into a top corner to inject the CO_2, **photo 45.** With the sand now hardened, graphite separating power was dusted over the mating face, **photo 46**. The top box was then fitted and rammed up and gassed as above. Aluminium was then poured into the mould using the furnace mentioned at the start of the article to melt it. Break out time, **photos 47** and **48**. This showed that I had a casting but I was a little disappointed as the bottom should have a curved central groove to fit over the tiller tube, but I concluded that the head of metal was insufficient to fill the cavity correctly indicated by the metal in the riser not coming as high as the ingate. A bit of machining and the fitting of a pin to locate it on the tiller still produced a useable result.

The second example is the production of two sets of serrated locking brackets to be used to set the tilt of a solar panel on a battery charging circuit. Whilst there is a nominal angle for the inclination to meet our position on the globe there was thought to be some advantage to make the tilt setting support adjustable and the panel had to be able to fold to enable it to pass under bridges. At the same time it had to be solid when erected thus the choice as

43


44


45


46


47


48


49

50

51

52

shown of the joint. A pattern was made out of MDF. **Photograph 49** shows the modified pattern which had the addition of an arm to connect it the structural parts of the support. The modification took place after proving the geometry as related below. As MDF is a very fibrous material I stabilised it by immersing the blank in a proprietary "Wet Rot Treatment" liquid which bound the fibres before machining the grooves using my milling machine. The process of casting was the same as above and an "as cast" trial serrated profile is shown in **photo 50**. Minimal finishing was required to produce a mating pair of trial discs, **photo 51**. As stated above after having proved the mating of the discs the disc pattern was modified to include an arm to produce a bracket for use in the final adjustable support, **photo 52**.

53

Silicone Rubber

This is a very versatile material for making moulds. It is available in several grades which have different properties for different applications. One common property is the price! I have used two different grades; a general-purpose flexible one that can easily cater for undercuts on the pattern/model and one specifically chosen for its ability to enable casting with low melt alloys but it is less flexible. I used lead free pewter with a melting point of around 245 C


54


55

with a casting temperature of 280 – 295 C.

Depending on the size of the pattern/ model there can be several stages needed in the process. First, a look at a relatively large pattern for a plaque. The pattern was created in ordinary stoneware clay as used by potters, **photo 53**. A box was made from plywood to go around the modelling board (this turned out to be a little small for the job), **photo 54**. The pattern was then covered in cling film and a lump of clay was rolled out to a sheet about 6-8 mm thick and placed over the cling film**, photo 55**. The volume occupied by this clay layer will become the silicone rubber portion of the mould. It is possible to make the mould completely of silicone rubber, see next example, but it is expensive, and the softer grades used to enable the casting of undercut patterns often need physical support. Support is provided by a plaster jacket. To hold the silicone rubber part of the mould in the jacket a set of keys are cut in the clay, detailed in **photo 56.** To enable the silicone rubber to be poured into the void to make the detailed part of the mould when the layer of clay is removed, gates and vents are needed, and provision is made for them by incorporating the clay columns also shown in photo 55. Before the plaster can be poured the corners of the mould box need to be sealed, once again using clay, **photo 57**. The plaster jacket is now formed by pouring plaster into the box to fill it. When the plaster has set the mould box can be carefully removed and the plaster jacket carefully lifted off the pattern which ideally should not be


56


57

58

59

60

61

disturbed for alignment reasons. The added layer of clay is now removed from the plaster and the latter cleaned, **photo 58**. Special attention is paid to cleaning the "key" areas and rough plaster can be attended to with a knife, **photo 59**. A slight undercut of the key will help hold the silicone rubber part of the mould in situ when in use. The plaster around the gate/fence areas are also cleaned up, **photo 60**. This is to permit clean entry of the silicone to minimise aeration although the products I have used do not seem to have suffered from this. Trapped air bubbles tend to rise, dependant on mould shape, to a vent or the gate.

Having removed the cling film and rectified any resulting damage to the pattern/model, the plaster jacket is re-placed on the base board, ensuring correct orientation, and clamped, **photo 61**, sealing the plaster to board joint with clay. Silicone rubber is mixed to the manufacturer's instructions and then poured into the mould until it can be seen in the risers, **photo 62**. When cured the piece of rubber at the top of the filling gate is cut away to permit the removal of the silicone rubber part of the mould from the plaster jacket,

62


63


67


64

photo 63. **Photograph 64** shows the rubber part of the mould after the pattern has been removed but before the last of the clay pattern has been removed with a toothbrush and water. By easing the rubber complete with pattern out of the plaster jacket it is often possible to salvage the pattern for future use hence cutting the filling gate funnel off as above to prevent the shape retaining the rubber in the plaster. **Photograph 65** shows the rubber part of the mould and its mating surface in the plaster jacket. The hollows adjacent to the central vent indicate that there was trapped air when the rubber was poured. Provided that the remaining rubber is firm this is not a problem but I have had to "butter" such an area where the remaining thickness permitted too much flexing. The rubber part of the mould is shown in **photo 66** with some slivers of clay still be removed. When the pattern was being made it was found necessary to add more clay to the basic plaque. Subsequently the join must have opened letting the silicone rubber into the crack as can be seen in **photo 67**. This demonstrates the searching power of silicone rubber.

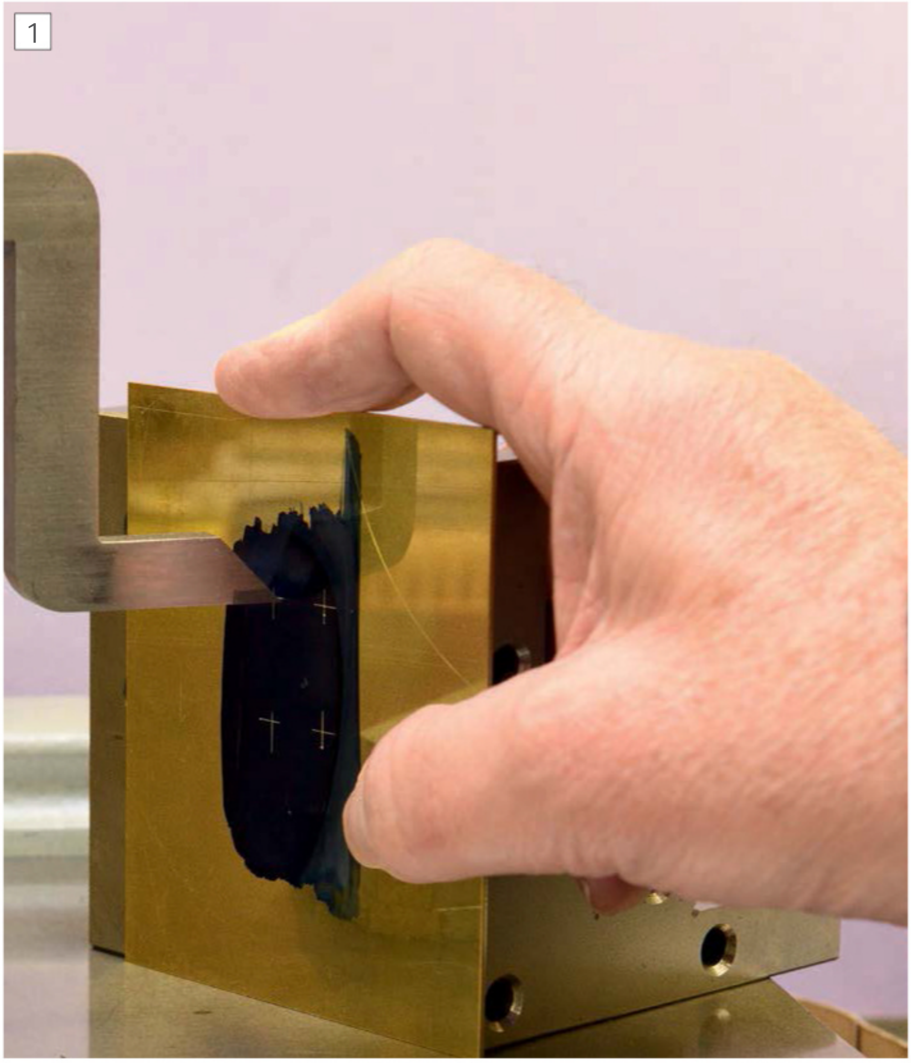
● To be continued


65


66

Artful Dodge #5 – Marking out

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



Marking out with height gauge and spray blue.

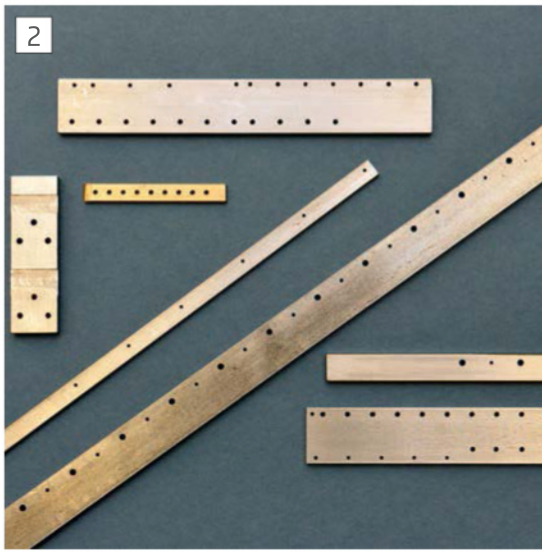
Marking out is yet another dying art, due to the widespread use of CNC machines in industry. However, we will keep it alive!

Most marking out is done on a surface plate, using a height gauge with the workpiece upright against an angle plate (or resting on a previously-machined surface) and the surface of the workpiece coated in blue marking-out fluid applied by brush or spray, **photo 1**. A surface plate which is 12" or 300mm square – or larger - is ideal, as sometimes you will want to place a sizeable rotary table or angle-plate on it (holding the workpiece) and still have plenty of room to work with the height gauge.

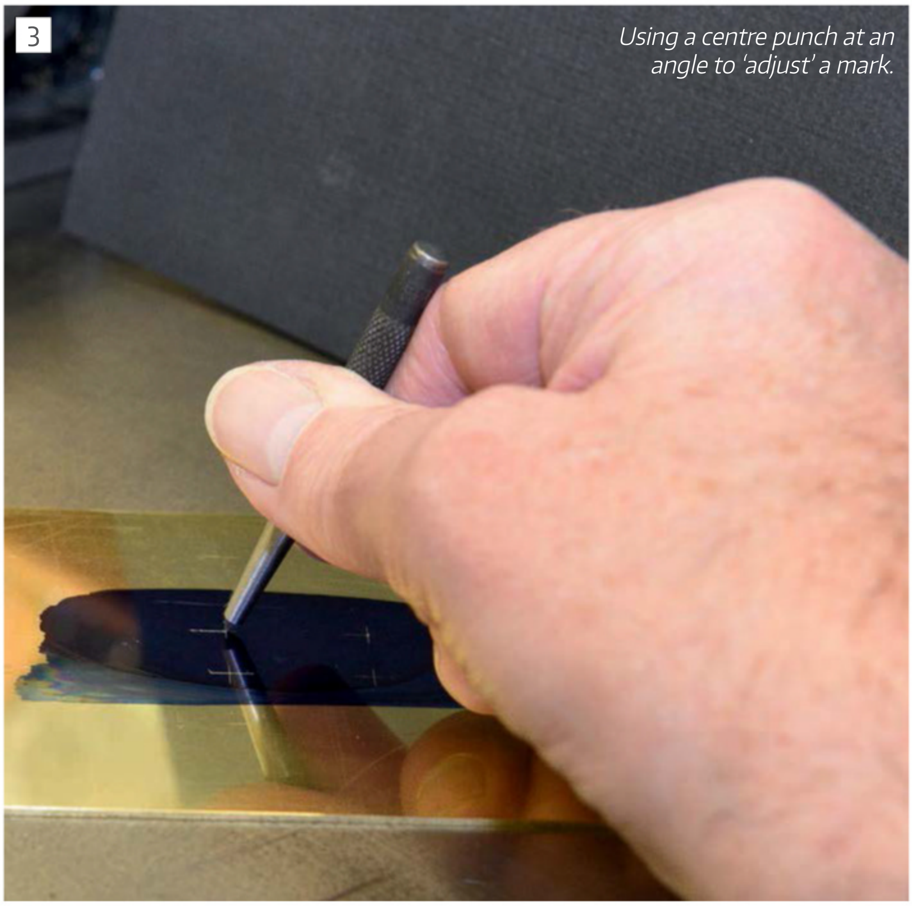
Excellent surface plates and height gauges can be had second hand on eBay; they can also be found regularly on specialist engineering auction sites such as Peaker Pattinson. If you buy a used height gauge, it will be as good as new once you have had the scriber re-ground.

When marking out the position of a large hole on a virgin or machined surface, try to keep the scribed lines inside the hole diameter so that, after drilling/boring the hole, there are no visible scribe marks. This is not practical when marking out the position of very small holes, but there are ways to avoid visible scribe marks on the workpiece:

1. Mark out the rear of the workpiece, for example the underneath of a footplate or the inside of a side-tank,
2. Don't mark out the workpiece at all; just mark out a drilling jig, **photo 2**. These are perfect for the vertical rivet holes in a side-tank and for the rivet bolt holes in footplates. Just mark out and drill the bottom rivet hole in the tank, pop a rivet or a drill shank through both jig and bottom hole, use a square to position the jig in a vertical position, clamp it to the tank and drill away,
3. Don't mark out twice when once



A selection of drilling jigs made for different tasks over the years.



Using a centre punch at an angle to 'adjust' a mark.

will do. For example, spot holes in a frame through the holes in the brackets which attach to it.

One dodge I use when marking out is to scribe the horizontal holes rather more deeply than the vertical holes. I then move the tip of a really sharp centre punch down each vertical scribe mark until it drops satisfyingly into the horizontal scribe mark. A gentle tap on the punch follows and the centre pop is inspected. I use an old 85mm camera lens for this task, the optics being brighter and crisper than those of most loupes. Look through the rear of the lens; this will give you a larger image and also give you more working room between the front of the lens and the workpiece.

If the centre pop is in the right place, the punch is replaced and given a smart blow. If the centre pop is slightly "off target", the punch is held at an angle, **photo 3,** and tapped to "push" the centre pop into the right place. Finally, the punch is given a sharp blow in the vertical position. The resulting centre pop might not be pretty, but it will be accurately positioned.

Dies and Die Sharpening

Jacques Maurel shows how to make die holders to increase the versatility of the sharpening attachment the described in last month's issue.

Please see **fig. 1** for a definition of terms in die geometry. The most interesting features for sharpening are: the taper β (or chamfer) usually 20° to 30°, this is steeper than the one found on taps, the clearance angle α, the number of flutes, and the land width.

There are three different types of button die:

1 – Solid die, see **photo 1.** No adjustment is possible.

2 – Split die with an intregal conical adjusting screw that can widened the split for adjustment, just visible in **photo 2**.

3 – Plain split die the adjustment of which is made by 3 screws set in the die holder one for opening and two closing the die, **photo 3**.

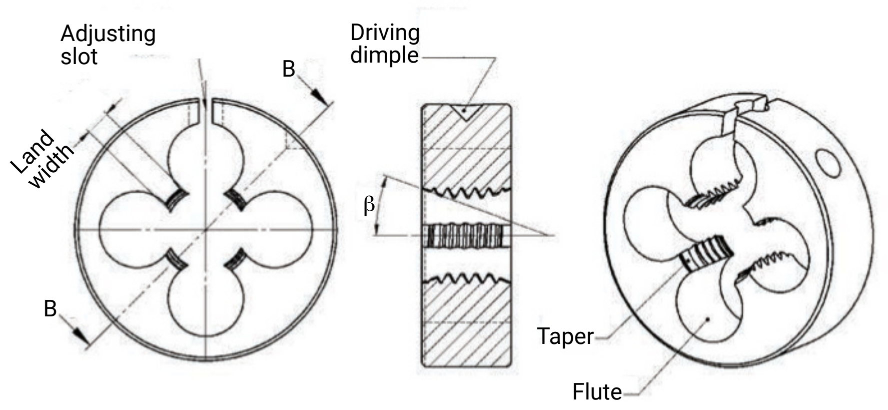
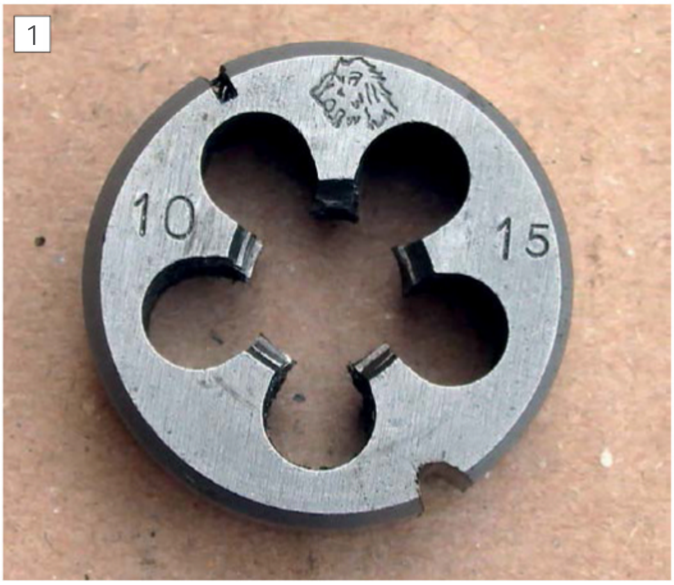


Figure 1

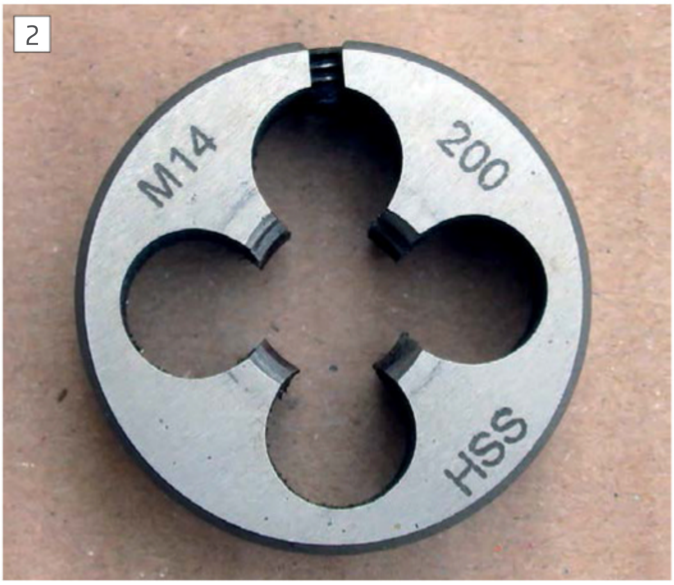
Die sharpening

Here I'll use my attachment (see my article on sharpening taps in MEW 324) to grind the taper of the die which is the working part, **photos 4** and **5**. The same principle is used, the main difference being the grinding wheel, is of the "pencil" or small diameter cylindrical type, set in a router spindle to get the highest cutting speed (27000 RPM for my router), a Dremel type rotary tool can also be used (33000 RPM) see **photo 6,** but the router spindle is far more sturdy. These wheels are more scraping than cutting as the right speed would be 100,000 RPM for a 5mm diameter grinding wheel and 25m/s cutting speed.

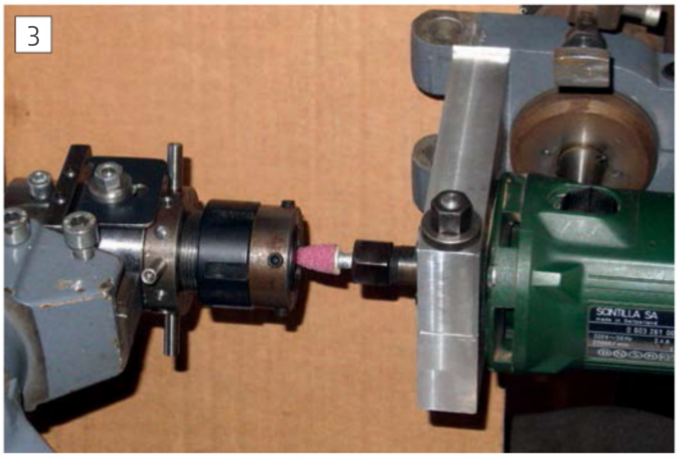
The die taper being 20° for the big dies and 30° for the small ones, the grinding wheel is shaped with a carborundum or boron carbide stone to get a 30°angle (easy to control with a thread gauge, see



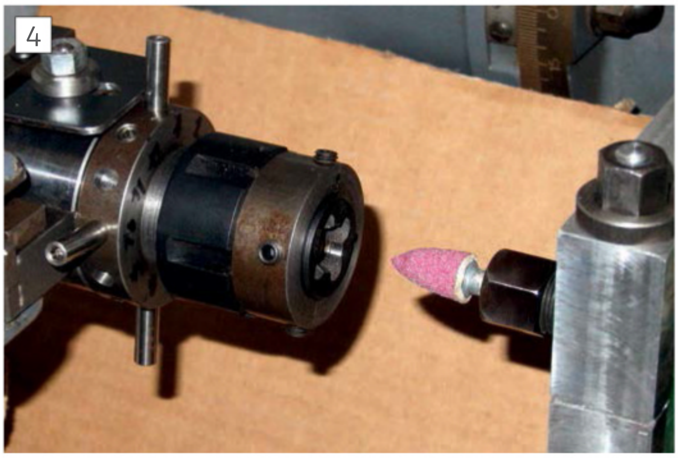
Solid die (note this is not a cheap die nut)



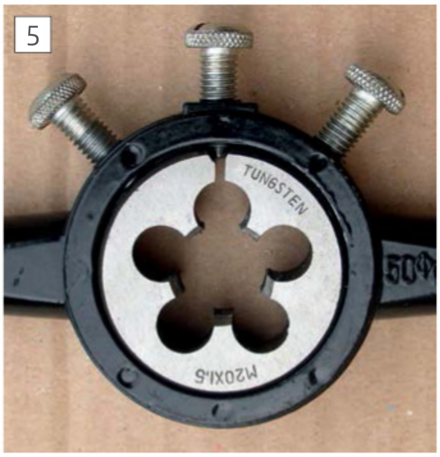
Split die with integral adjustment screw.



More usual split die in holder.



Using last month's attachment to sharpen a die.



Freshly sharpened die, note high speed spindle.

photo 7). The wheel axis can be set at a 10° angle to the attachment spindle to get the 20°, if necessary. This way there is less stuff to remove for wheel shaping and the wheel is more sturdy. Small cylindrical wheels could be used (the ones used for chain saw sharpening are ideal). Small conical diamond coated wheels can be used with good results for small dies, their cone included angle is 35° so you will need to set them at five or fifteen degrees.

Die holders must also be made to hold the dies using ER collets (see later).

Use of the attachment:

1 – Set the router on the tool and cutter grinder, equipped with the grinding wheel. The router spindle and the attachment one must be in the same horizontal plane, and their axis set at right angles.

2 – Set the right number of cutting flutes (see previous article).

3 – Adjust the cam angle (same calculation as for the taps to get the packing value h, given in the article about tap sharpening) the formula was:

$h = 0.011xdx\alpha / \sin\beta$

Sizes h and d are in mm, α **clearance in degrees (usually 5°),** β **in degrees, a chart was given in the article about tap sharpening.**

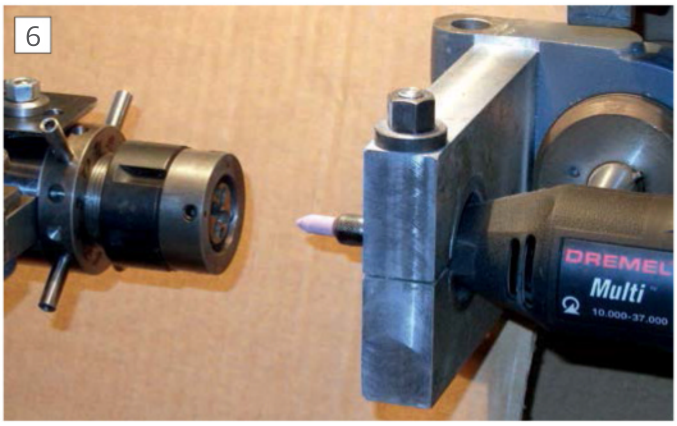
Note: Use the 60° cam for 3 and 4 flutes, the 45° cam for 5 and 6 flutes.

4 – Set the die in its die holder and the die holder in the collet, turn the whole in the collet for the wheel to be in the middle of the flute when a stem is just contacting the cam start, tighten the collet.

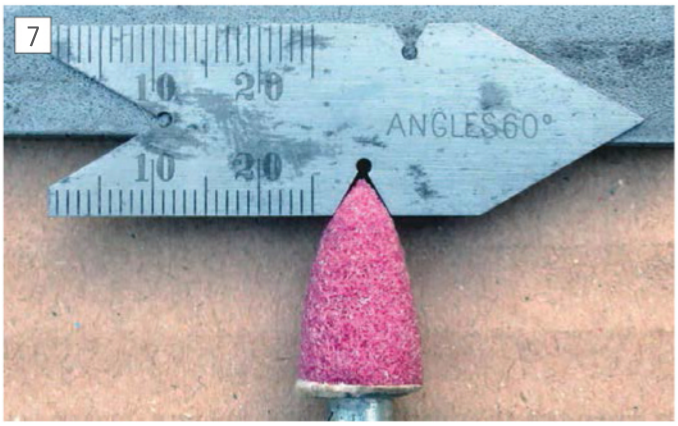
5 – Set one flute in the middle of the cam and feed the transverse axis for the running wheel to contact the die taper and take a zero reading on the collar. Repeat this for as many times as the flute number (not disturbing the initial zero), this is for finding the highest part of the taper as the dies are usually not true running (see later) and as the grinding feed is 0.05mm maximum, any run out (0.1mm for example) would overload and spoil the small grinding wheel, so it is important for the feeding to start on the highest part of the taper and to turn the spindle slowly when grinding.

6 – Turn then the spindle and feed 0.02mm each turn for sharpening the whole taper (blacken the taper before grinding with a felt pen to help you see progress).

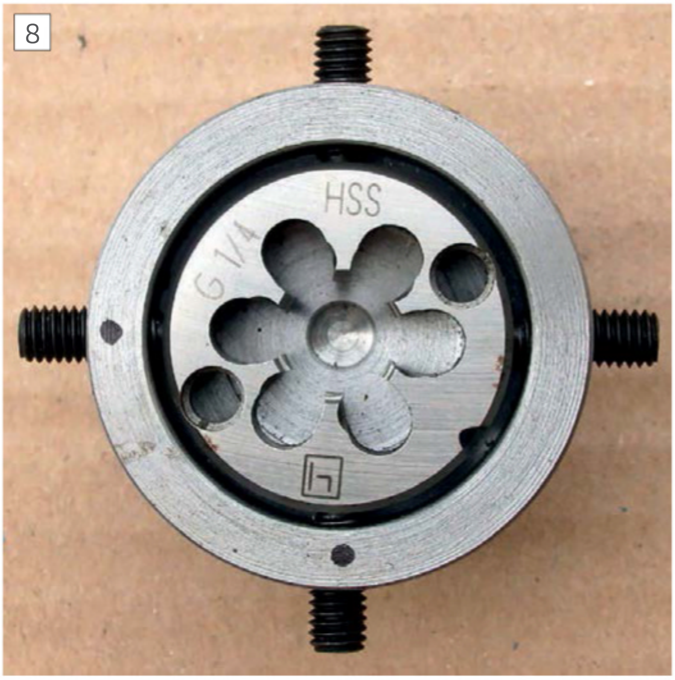
A problem is that the taper depth is increasing, so it won't be possible for the sharpened die to thread against a shoulder. This was not a problem



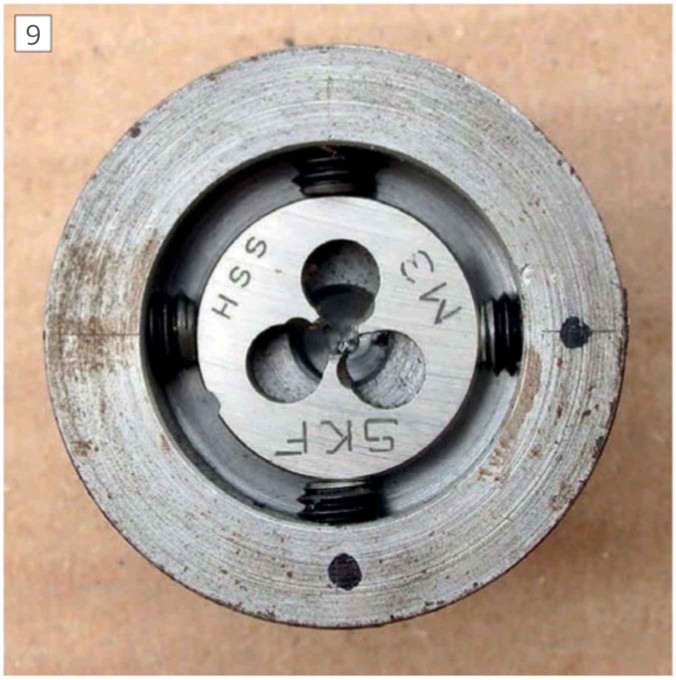
Using a Dremel to hold the mounted stone.



Checking stone angle. Perfect accuracy is not essential.



Four-point holder for large dies.



Holder for smaller dies.

for a tap that can be shortened but is a problem for dies that cannot conveniently be shortened. However, dies are usually sharpened on both sides, so sharpen only one side for cutting the main part of the thread and then turn the die end for end for finishing the last threads against the shoulder.

Using the die holders:

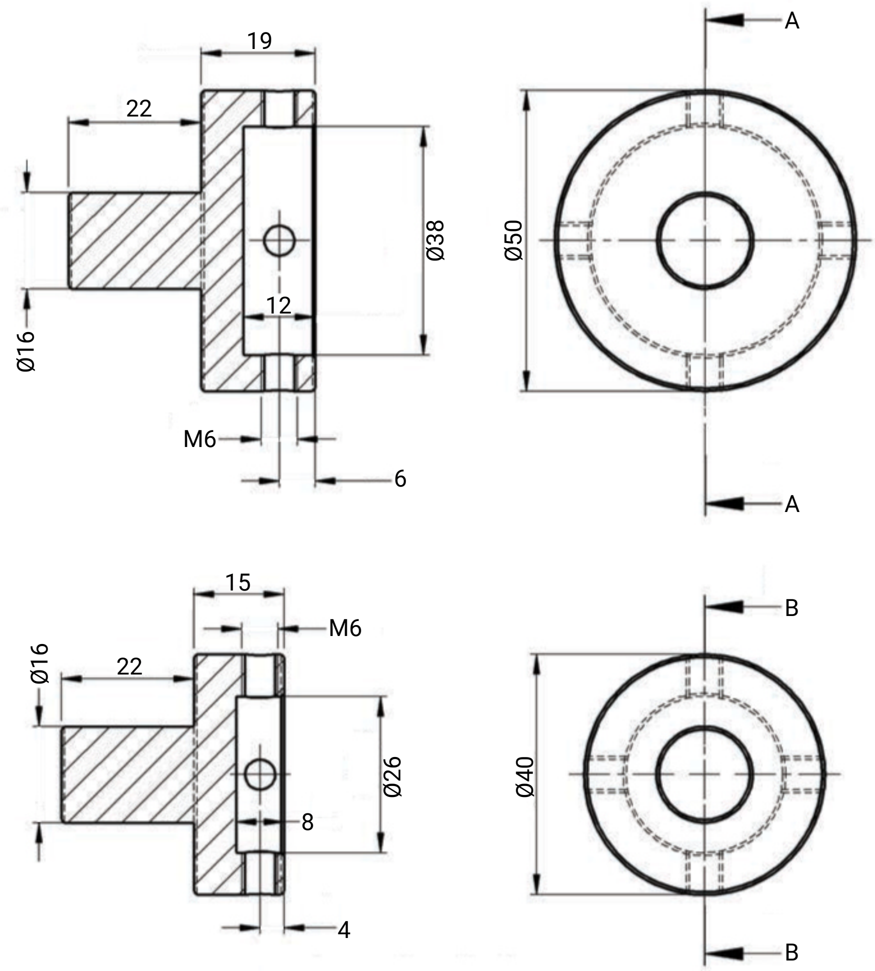
The problem is to hold dies of different diameters and thicknesses, some being driven by radial dimples, others by axial holes as can be seen on **photos 8** and **9**.

The die holders, **fig. 2**, (small, bore diameter 26 mm and big, bore diameter 38mm) are equipped with four flat-ended grub screws. The rear part of these holders is 16mm in diameter this being the maximum diameter that can be tightened into ER25 collets.

Example: holding a 30mm diameter die.

Use the big adaptor and adjust two adjacent screws so that their flat ends are protruding by 4mm (38-30)/2 inside the bore. Measure 34mm from the bore to the screw end with a sliding caliper or better with a 2 jaws micrometer for the best coaxiallity. Tighten the two other screws on the die.

For a plain split die, it's worth using a pointed end grub screw for the third one to fill the adjusting notch with no force and then tighten the fourth one. ▮



Die Holders

Figure 2

A HEIGHT ADJUSTING TOOLPOST

By James Smith

THIS DEVICE REPRESENTS a method of lathe tool height adjustment and though I do not claim originality, I cannot recall having seen the idea published before.

I have been using this tool holder nearly seven years, and it has not given me the slightest trouble. In fact, it has saved me considerable time in tool setting. The holder itself is simply an improvement on the Drummond split toolbox type, which clamps to a pillar, cast integral with the topslide.

This pillar on my lathe has a ½ in. Whit. tapped hole in the centre about 1½ in. deep—for what reason I am not sure unless it was for holding the slide in a jig, the pillar having been turned first while the vee-slides were machined. However, I thought that the tapped hole could be used for tool height setting, so the improved tool holder was evolved.

Would not reach centre

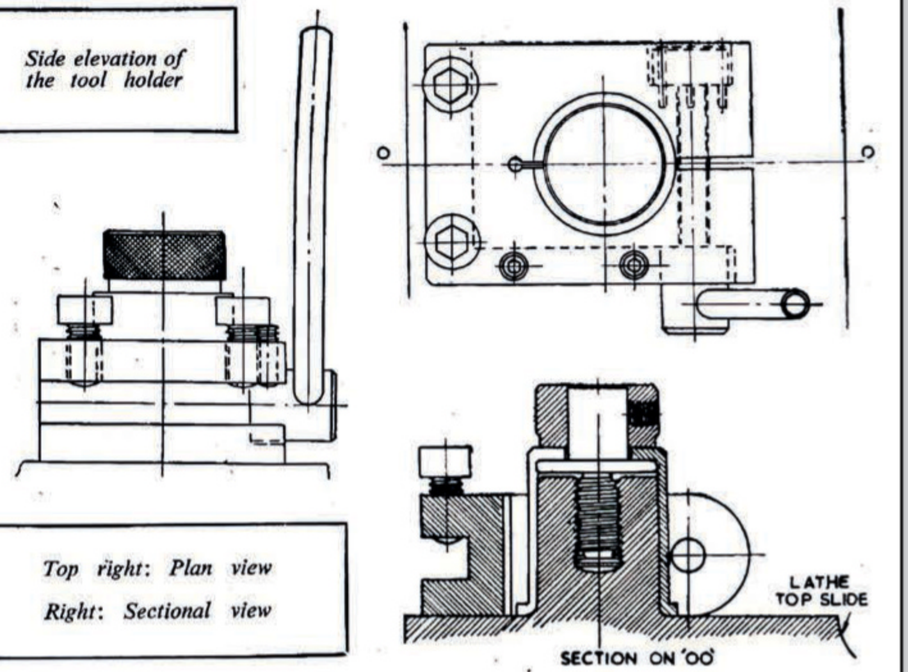
The original toolbox had a square hole for the tool, which, when using a right- or left-hand cranked tool, meant bringing the cross-slide well out or turning the box almost through 90 deg. I did not like this at all. And when the toolbox was set with the square hole parallel to the bed for boring and the cross-slide was screwed in as far as it would go, the toolbox would not reach the centre unless I took off the whole topslide and put it in the farthest tee-slot.

So I decided to make a new one with screw-height adjustment, and which would reach the centre without the necessity to change to another tee slot.

The modified toolbox is made out of a block of cast steel, but cast iron would do just as well. The split bush is made of mild steel and the ring of holes under the bolt head is for turning back the clamping-bolt should there be any thread stretching, thus the nut handle is always about 45 deg. off vertical. The drawing will show how simple the adjustments are. Personally, I do not like any tool holders in which the front and top rake angles are altered so as to obtain dead centre.

This improved tool holder is only adaptable at present to the Myford Drummond, but it would be easy to fasten a 1¼ in. dia. pillar either with a square flange or shouldered and screwed with a fine thread to many existing lathes.

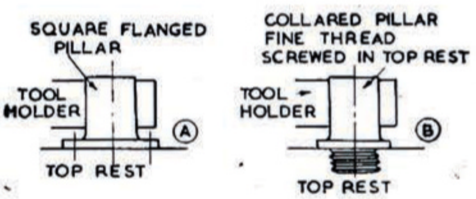
I am surprised that this simple holder has not been thought of before. I can assure readers that it is quite solid when taking very heavy cuts. ■



Side elevation of the tool holder

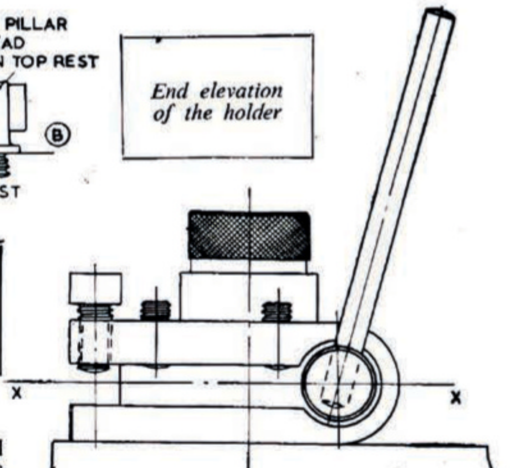
Top right: Plan view

Right: Sectional view

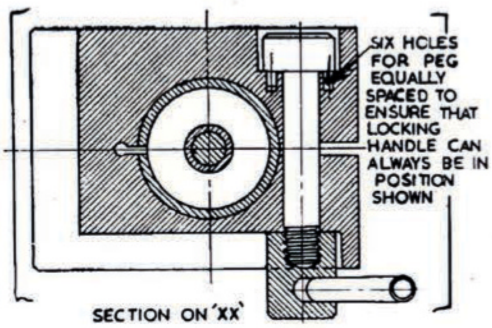


Above: Adaptation of tool holder on other lathes

Below right: Sectional plan

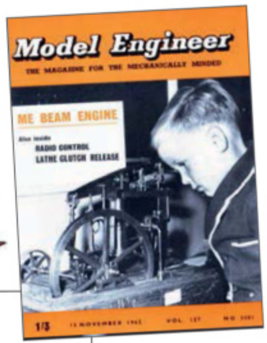


End elevation of the holder



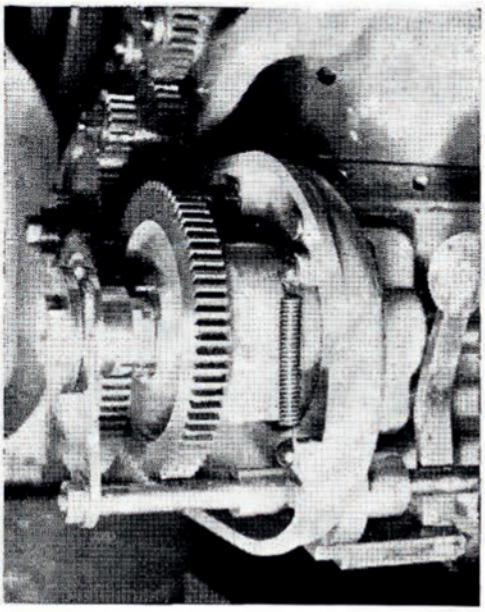
From the Model Engineer Archive

To celebrate 125 years of Model Engineer magazine and the Society of Model and Experimental Engineers, each issue in 2023 features some historic content from Model Engineer relevant to workshops, tools or techniques. These pages from Model Engineer Volume 127, No. 3201 feature a 'lathe clutch' from 1962.



CLUTCH RELEASE

Here is a device which saves trouble when a new gear set-up is needed on the Myford Super Seven lathe



Clutch disengaged

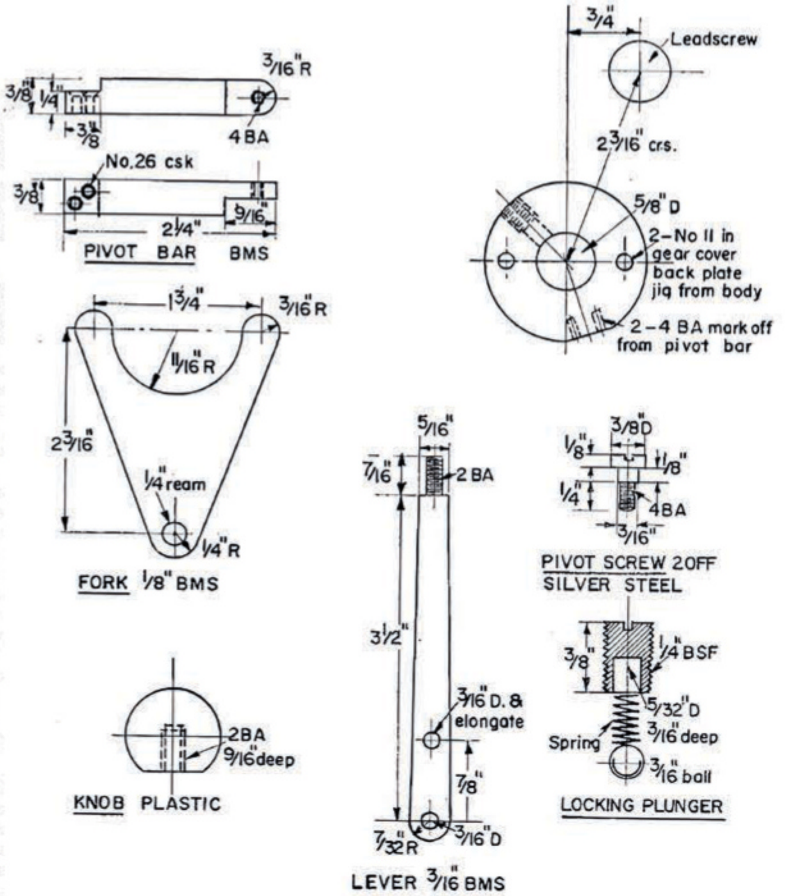
THIRTEEN years ago, in November 1949, Duplex described in these pages a release for the fine feed on the ML7. I made the attachment for my own lathe. It was still in working order when I sold the lathe recently and bought a Super 7.

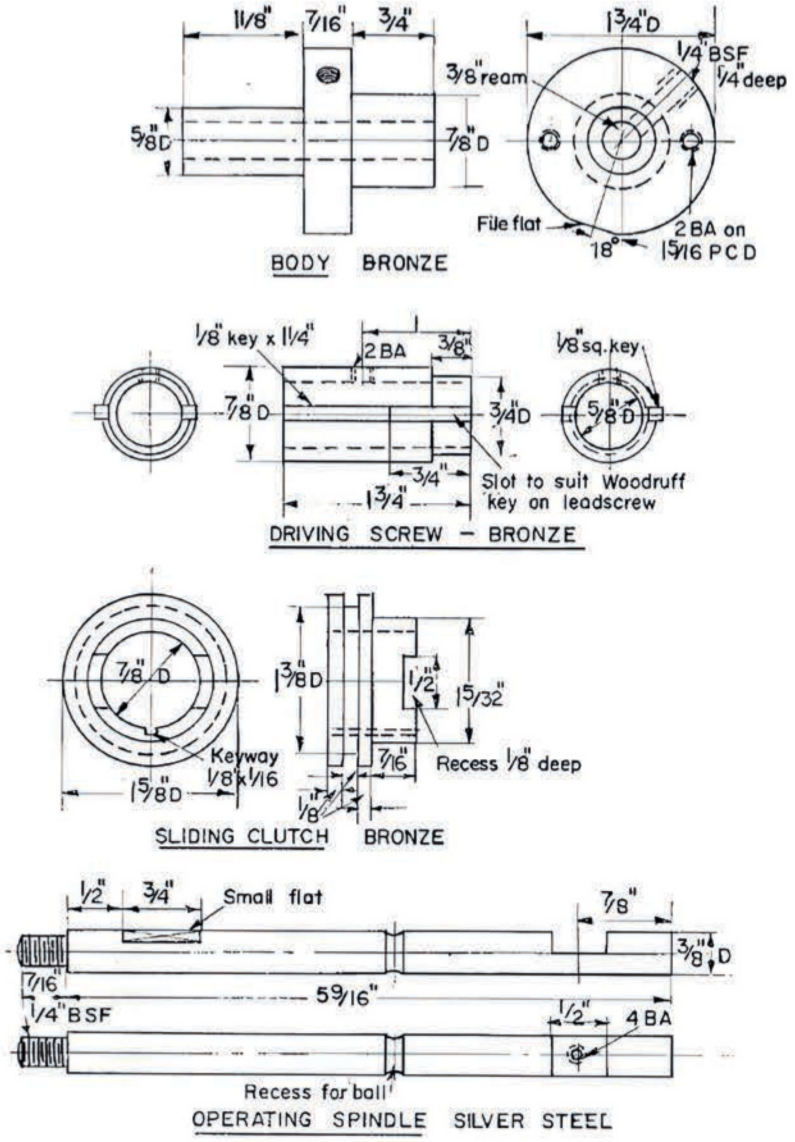
I have since designed a clutch release for my new machine, to save my dismantling the gear-change quadrant whenever a different gear set-up is needed. The new Myford feature of quick-release change-wheel studs is not interfered with in any way and is used normally, even with the clutch in place on the lathe.

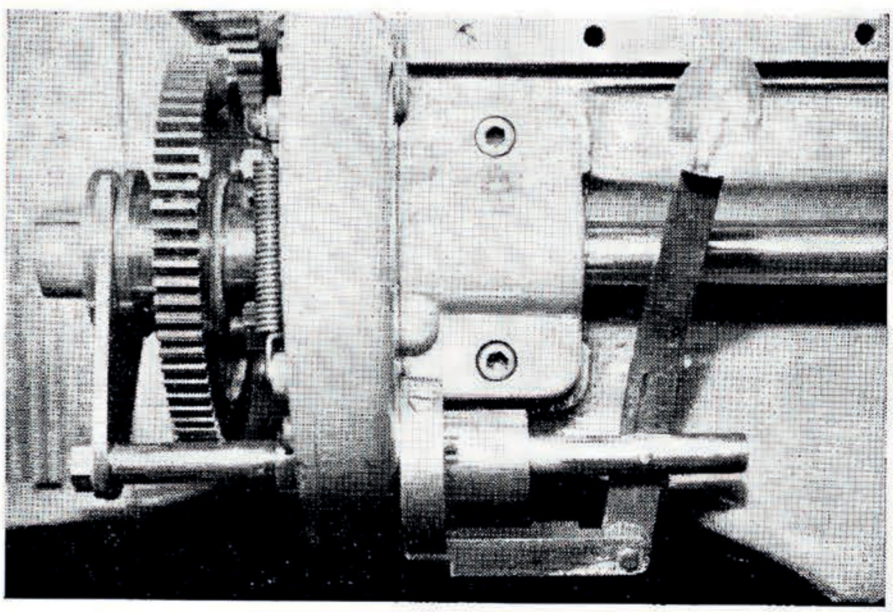
Three holes are drilled in the fixed portion of the gear-change guard. The 75-tooth gear wheel is bored out to ¾ in. dia., and two silver steel pins are pressed into holes drilled diametrically opposite on one side of it. Boring out the gear does not affect the use of the machine as the 75-tooth wheel is employed only in the leadscrew position on any of the set-ups given on the charts supplied with the lathe; this can be done with the clutch set up and left in the engaged position.

If the gear is needed at any time to fit on the ⅝ in. studs, or direct on to the leadscrew, a bush can be made and keyed with very little trouble and removed when the clutch is put into use again. If you prefer you can make the clutch without opening out the gear. When the clutch is in the disengaged position, the 75-tooth wheel which is running free (through the complete gear train) in the leadscrew position would eventually wear a groove in the leadscrew. But when the gear is bored out and mounted to run on the ⅝ in. diameter sleeve of the bronze clutch brush, there is no wear on the leadscrew at all. Therefore all the other gear wheels will fit direct on to the leadscrew.

The Woodruff key in the leadscrew will now fix into a slot formed in the sleeve as shown on drawings, and will transfer the drive through







Clutch engaged

the leadscrew when the clutch lever is put into the engaged position. This slides the dog-clutch arrangement through the fork piece up to the gear face, and the two pins drive the whole clutch round when they register with the lugs on the dog-clutch. The 2 BA screw registers in the small recess on the end of the leadscrew and stops the whole arrangement from sliding endwise.

To set up any gear train which has a different wheel on the leadscrew, you have only to release the 2 BA screw on the end of the leadscrew, remove the $\frac{1}{4}$ in. BSF nut holding the fork piece, and slide the whole off the leadscrew. Then you can place any other gear wheel on the leadscrew without further dismantling, as all the other gears are smaller in diameter than the 75-tooth wheel and so the sliding shaft does not interfere with any gear train set-up.

The making of this unit is quite straightforward turning and fitting. Note that the pins must be kept to their size and positions or they will foul on the 65-tooth gear wheel. The key in the clutch body is made a tight fit, and the operating handle may be bent to suit your taste. For positioning, it is furnished with a Perspex knob, tapped 2 BA to suit the thread on top of the handle.

The design of clutch release has a further advantage. It can be put into use if any repetition turning is being undertaken and any definite lengths have to be machined, such as collars and faces.

The clutch can be made to work automatically by the traversing apron, on the same basis as a Capstan lathe, with the use of the knock-off-stops. A piece of rod or strip is attached to the apron and bent so that its outer end will come into contact with the projecting end of the $\frac{3}{8}$ in. dia. sliding shaft of the clutch, disengaging the clutch by the travelling apron. The rod or strip is set to come into contact with the $\frac{3}{8}$ in. shaft when the cutting tool reaches any length which is wanted, and when a number of similar articles are needed.

It therefore does away with the need for you to keep measuring the length of cut by hand. I find this a great asset in making any screws or small spindles where a distance is wanted up to a face or collar, and when a number of the things is needed. It guarantees that the things are all of the same length.

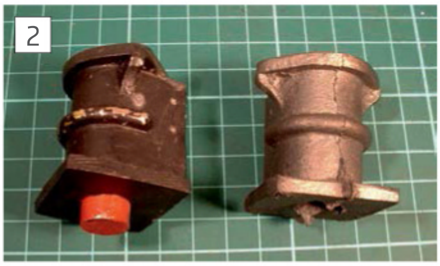
I think you will find this clutch worth the time which it takes to construct. It will add to the scope of the Myford Super 7.

STANLEY S. KENT.

Workshop Photography Part 4

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

The peril of unwanted reflections.



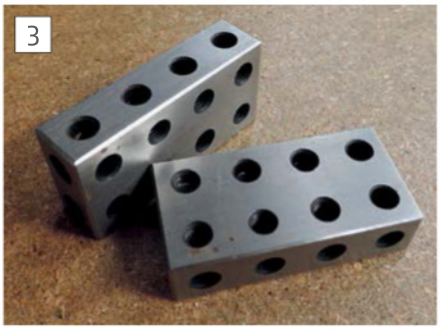
Cutting mats can exaggerate lens distortion.

In the previous instalment we looked at composition and framing your images then moved onto backgrounds. I keep several items specifically to use as backgrounds or bases for photographs.

Some recent additions to my 'background' collection have been relatively neutral, but textured, wall and floor tiles with matt finishes. The matt finish is definitely a good idea, **photo 1** shows a lathe stop on my 'surface plate', which is a piece of granite composite kitchen worktop; while it is flat enough for my practical needs and makes a good solid surface to measuring and marking out, the high gloss results in lots of distracting reflections. Wood effect worktops with a less shiny finish often work well. People often choose a cutting mat as a background. The 1cm grid in **photo 2** helps give a sense of scale, but the lines highlight some unpleasant 'barrel' distortion in the lens.

Some detail in a background is good and can help 'lift' the image a little; in **photos 3** the subtle woodblock finish (it's just a kitchen worktop) adds more texture to the image without drawing attention away from the subject.

Try to avoid over-complicated backgrounds the Wilton carpet in **photo 4** is clearly not a very good choice of background as it completely dominates the picture.

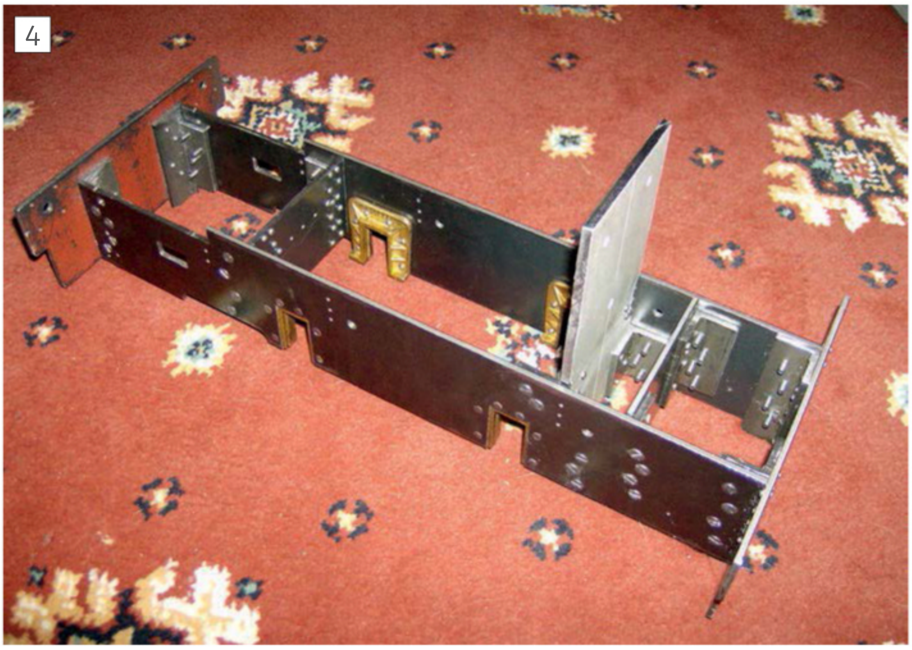


A subtle pattern on the background is good.

Often you want to take a quick photograph in the workshop and get on with your project. A quick and easy solution is to have a small but clear area of bench and something as simple as a piece of wood or card you can stand up to obscure background clutter. **Photograph 5** is a great example, the angle of the card (which is a neutral grey rather than white) makes the image look a bit more 'composed' as well.

It's not unusual to see workshop photographs where a dust sheet or some sort of cloth has been used to cover up background clutter. While this can work fine if done carefully, if the cloth has many folds or noticeable stains it can be a distraction. Another fault that is often seen is not covering a great enough area, so the edges of the picture contain distractions.

Sometimes a very simple background at all works well, especially for relatively dark, well-defined subjects, **photo 6**.

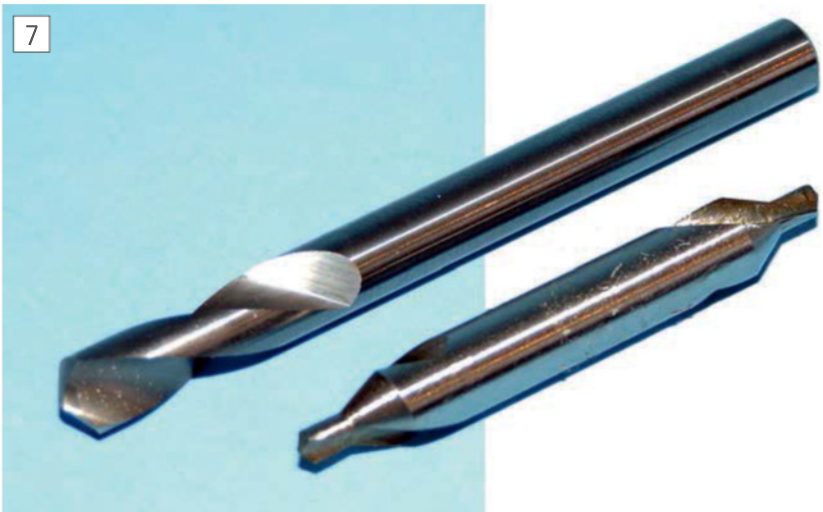


This is not a subtle background pattern.

Top hat style tapping guide.

A sheet of coloured card makes a simple but contrasting background.

A usable image spoilt by an awkward shadow.



Background removal.

An unwanted reflection.

In a worst case a bad or just uninspiring background can be removed to create a 'cut out' as in **photo 7**, but this can create a challenge for the retouched if the shapes are complex.

Lighting

One of the things that makes a huge difference to how workshop photographs appear is the lighting. While setting the camera for auto-exposure will usually produce a usable image some care in lighting can make a really big difference.

From a basic 'record photograph' perspective the aim is generally to minimise harsh shadows and evenly illuminate the subject so all pertinent details can be clearly seen. An otherwise decent image can be easily spoiled by poor lighting choices, look at the background shadow in **photo 8**. Another problem is reflections of the light source in the image, such as the very obvious light in **photo 9**. These examples could have been easily avoided with a quick glance at the preview image on the phone or camera – never assume an image is sharp or well lit, always check it before moving on to taking the next photo.

An otherwise good image spoilt by to flat illumination giving a lack of contrast.

Photo 10 after retouching.

A more subtle problem is in **photo 10**, despite the nice highlights and well-balanced lighting the whole image looks rather flat and clinical, although with some retouching (gamma correction) the image could be perked up a bit, **photo 11**. Sometimes a subtle approach to lighting can add interest and depth to an image while still allowing it to demonstrate a point, in this case a brass fabrication for a small carburettor, **photo 12**.

In a practical workshop situation, there are generally three options. Ambient lighting, using flash lighting (including the bright LEDs used with phone cameras), and setting up other light sources. Sometimes other options arise, such as when objects generate their own light. In all cases, it pays to do a little experimentation to get the best results. If taking many shots you may only need to set things up carefully for the first, and then keep using the same setup for further images.

Ambient Lighting

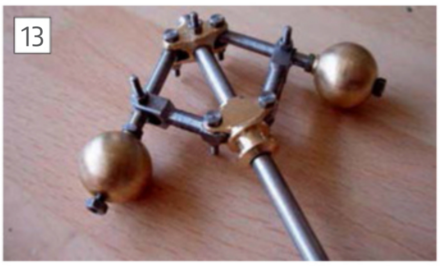
Ambient lighting is the easiest solution – take a photo using whatever illumination is already there. This approach can work well. **Photograph 13** was taken in the kitchen, using ambient light through the window (not direct sunlight, though you can see the window reflected in the balls) with the ceiling light giving additional top down illumination.

My old workshop had tiny windows but very bright, even fluorescent lighting, white walls and a white ceiling. This gave a bright, pleasant working environment without strong shadows. This was also very convenient for workshop photography, **photo 14** shows my minilathe with no extra illumination, even the boxes under the bench are reasonably well lit. I often found that a supplementary light was useful, as in

12

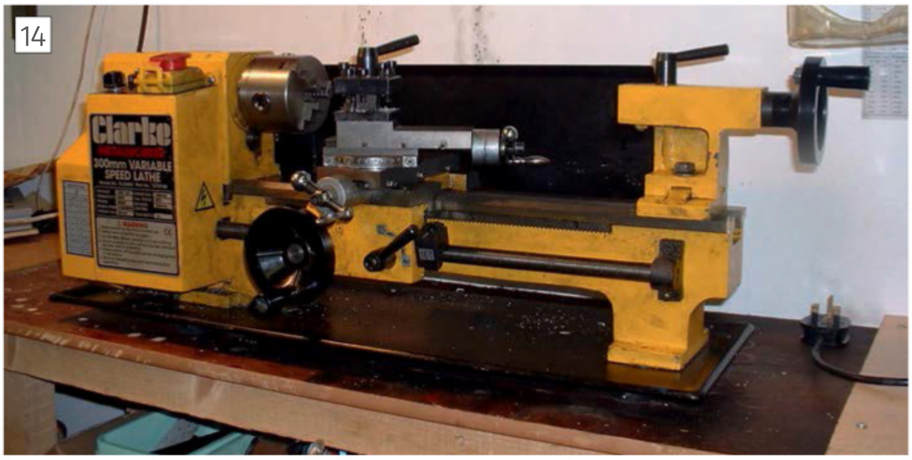
Atmospheric lighting of a small part.

13



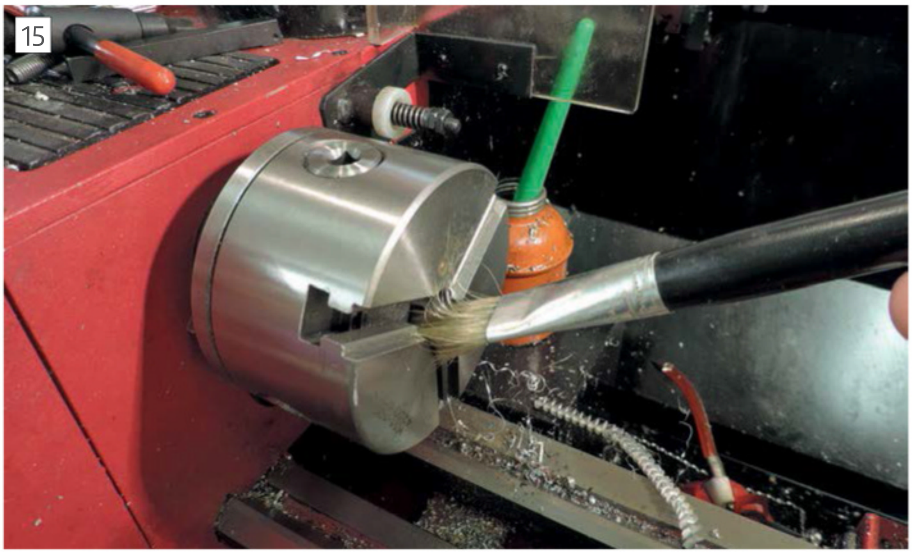
Using ambient lighting.

14



Good workshop lighting can be good for photography.

15



Additional lighting was used for this image.

photo 15 where I have used at least one additional light. Incidentally, I fitted a fluorescent bulb in an Anglepoise lamp to give better illumination over my lathe and this was often used for photography as well, a benefit being that it more or less matched the illumination from the ceiling lights avoiding strange colour effects from using very different light sources. In my new workshop, I exclusively use use LED lighting and have fitted an LED lamp to my very venerable Anglepoise.

If you have a workshop lit by a single window or a lamp, then things may be very different with deep shadows being

16

Possibly too much shadow.

17

Additional light softens the shadow but has created glare, also there is an unwanted shadow from my head!

a problem, **photo 16**. Something as simple as a large sheet of white card or a desk lamp placed to fill in the shadows becomes almost essential, but beware of poor light balance and unevenly illuminating the subject, both faults in **photo 17**, although the problem shadow could be easily cropped out.

Flash

It's tempting to use the flash as an 'easy' way to light indoor subjects properly.

A single flash gun (or just the 'light' in a phone tends to leave a 'rim' of shadow

A very unnatural shadow created by the flash.

A big problem with simple flash arrangements is bright reflections.

on one side of the subject. This can look very unnatural, **photo 18**.

A DSLR fitted with a 'ring flash' that completely surrounds the lens will almost guarantee an evenly lit image without noticeable shadows. This can be very good for straightforward shots, but the results can look 'flat'. One of the ways around this is to blank off two segments of the ring flash with black tape to leave a large and small section. Done carefully this can add soft, subtle shadows.

A professional studio approach is to use several flash guns, often with diffusers and/or reflectors – but most of us will find this over the top for a workshop. Simpler ways of reducing this effect include:

- A single, smaller fill-in flash triggered by the first.
- Using 'bounce' flash where it is aimed at a white ceiling or similar to give more even 'top down' illumination.
- Placing white card on one or both sides of the subject to reflect flash into the shadows.
- Careful placement of additional illumination, such as a desklamp.

The biggest hazard with using flash is bright reflections, especially when using direct flash onto the subject, **photo 19**. I would go as far as saying that unless you are just using 'fill in' flash to brighten up the subject, a camera or phone mounted flash directly above the lens is unlikely to improve your image.

Setting up other light sources.

Perhaps the easiest way to get good results is to set up a number of controlled light sources to illuminate your subject. As you can see the results with your own eyes this is easier to do than setting up flash (professional photographers often use 'modelling lights' to help them visualise the effects of the flash) making it easy to achieve decent results. I have already mentioned the benefit of using matched light sources, but with modern digital photographs this is not absolutely essential. I have found that mixing real daylight with 'daylight' balanced LED lights doesn't seem to cause any strange colour effects.

My personal preference is to take one of two approaches. Usually I set up a suitable background several feet from a window that is not in direct sunlight and have overhead light on. I then position either a white card or small, mobile light

Taken with careful use of ambient light supplemented by an additional light to the right.

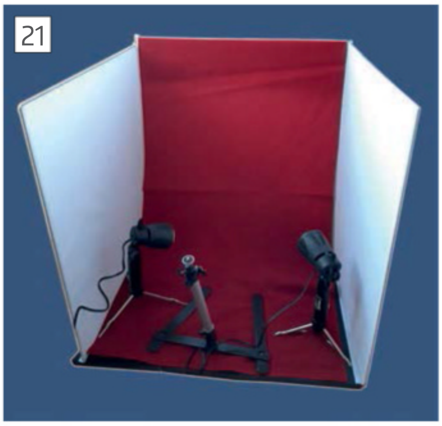
Care is still needed to avoid poor shadows.

source to soften the remaining shadows, **photo 20**. This literally takes a minute or two to get set up and the same arrangement will usually work (with minor tweaks) for a whole session.

My other approach is to use an inexpensive 'mini studio', **photo 21.** This folds up into a cube about 80cm on each side. The left and right sides are translucent white and diffuse any light sources behind them or reflect lights aimed at them inside back towards the centre. There is a selection of (now rather scruffy) velvet-textured fabric backgrounds that provide neutral, non-reflective backgrounds. The setup included two spot lamps with small stands – I replaced the halogen bulbs with daylight LED spots to work better with daylight and my overhead lights. The supplied lights, used alone, can give rather poor shadows if used unsubtly, **photo 22**, bouncing the light of the sides give better results.

While this allows me to rapidly produce many usable images, especially when photographing tools, for example. I find the results are often a bit bland, **photo 23**, and tend to prefer the results of more 'experimental' lighting.

● To be continued



Mini studio – set up in an untidy workshop which has been carefully edited out.

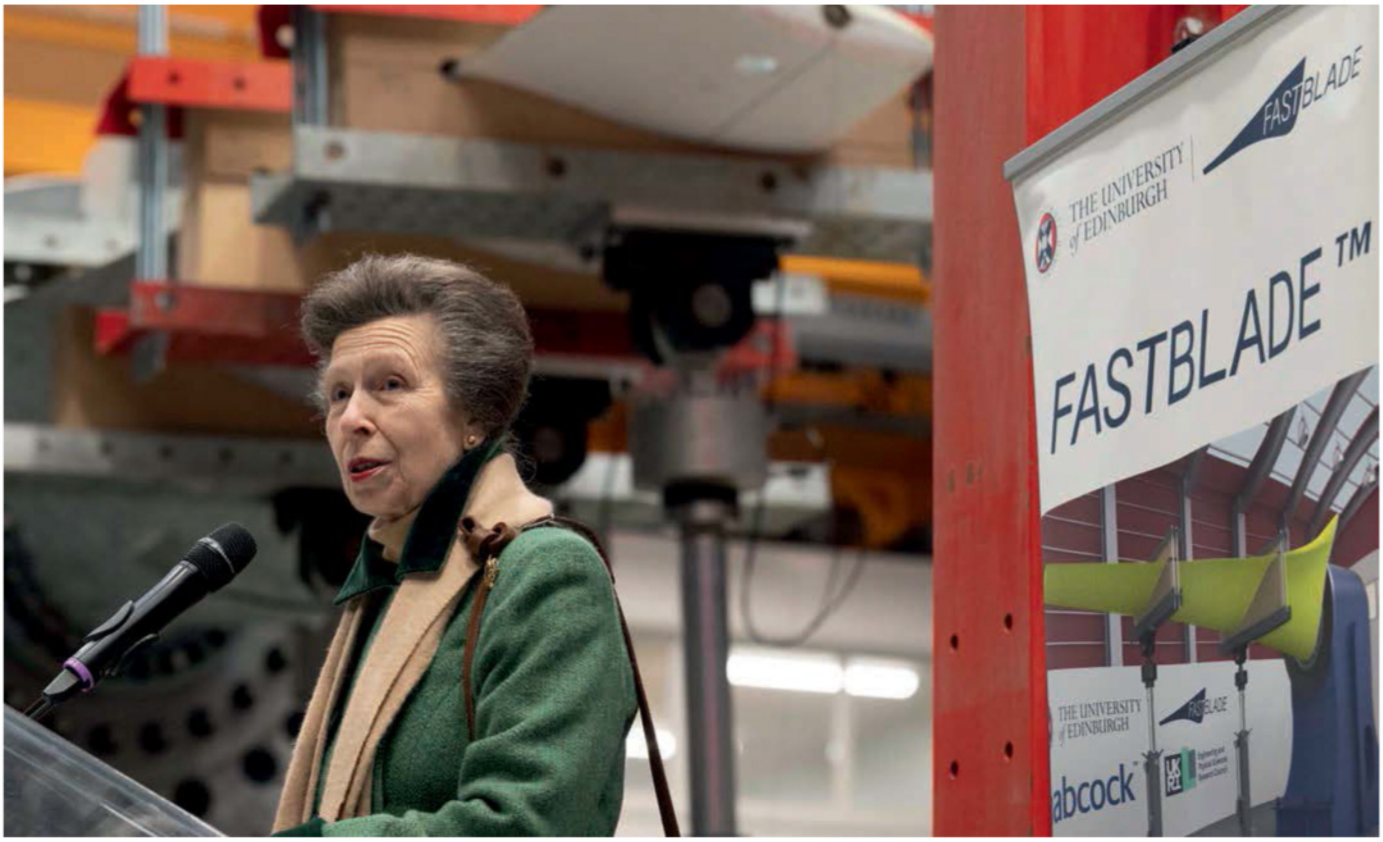
Illumination that is too even can result in usable but bland images.

On the

Wire

NEWS from the World of Engineering

Royal visit marks bid to develop world's largest tidal turbine blades



A project aiming to maximise tidal energy generation has been launched in the presence of Her Royal Highness, The Princess Royal, at the University of Edinburgh's FastBlade facility.

The €10 million project – funded by the European Union and UK Research and Innovation – aims to deliver a range of innovations to improve the performance of tidal turbines and reduce costs.

It will investigate the full lifecycle of tidal turbine blades, from materials, manufacture and operation, to decommissioning and recyclability. The project's long-term aim is to ensure the European composite sector becomes the international leader in tidal blade manufacture.

MAXBlade will increase the length of the turbine blades from 10 to 13 metres – making them the longest of their kind in the world. The team says that boosting blade length will have the single greatest impact on reducing the cost of tidal energy.

Modelling by the University of Edinburgh's Institute of Energy Systems estimates £40bn could be generated for the UK economy by harnessing wave and tidal energy. The project will involve a two-year design and development phase, followed by an 18-month build, during which blades will undergo advanced structural testing at FastBlade.

The technology will then undergo two years of real-world testing at the European Marine Energy Centre (EMEC) in Orkney. Two of Orbital Marine Power's O2 floating platforms – the world's most powerful tidal turbines – will each be fitted with four of the newly developed blades.

Innovations from MAXBlade will be integrated with findings from its sister project, FORWARD2030, to enable large-scale production of Orbital's O2 turbine technology. This will pave the way to the tidal energy sector making significant contributions towards Europe's energy systems, energy security and industrial development by 2030 and beyond to 2050, the team says.

Politecnico di Milano wins the Autonomous Challenge, setting a new Speed World Record for a Racetrack.

Team PoliMOVE from Politecnico di Milano (Italy) won the second annual Autonomous Challenge @ CES reaching max speeds of 180 mph (290Km/h), a new autonomous speed world record for a racetrack on January 8. Pushing boundaries of head-to-head autonomous-racing, PoliMOVE competed at the Las Vegas Motor Speedway against a field of nine teams from seventeen universities spanning six countries, seeking to break autonomous racing records. TUM Autonomous Motorsport from Technische Universität München (Germany) took second place in the heated battle. A confirmation for the Politecnico car, last year it won the first competition of the IAC.

The Rules of the IAC Competition consist of a single elimination tournament with multiple rounds of head-to-head passing matches culminating in a championship round. The world's fastest autonomous racecars, Dallara AV-21s, took turns playing the role of Leader (Defender) and Passer/Follower (Attacker) in front of a global crowd of CES attendees. Passes were attempted at ever-increasing speeds until one or both cars were unable to complete a pass.

On April 27, 2022, on the straight of the Space Shuttle landing strip at NASA Kennedy Space Center in Cape Canaveral, the Politecnico di Milano-PoliMOVE car broke the world speed record for a fully autonomous-car on a straight line.

Using Onshape for Model Engineering

Graham Meek recently asked for suggestions for 2D CAD packages, Graham Sherwood responded with this useful overview of the Onshape CAD program.

I have settled on Onshape as my drawing software of choice, www.cad.onshape.com. Like many model engineers I like to sketch a part out prior to cutting metal, and I find Onshape ideal for this.

My reasons for choosing Onshape:

It is free - there is a limitation for the number of active documents (projects) , but no limit to the number of drawings in a project , so far I have not found this a limitation.

It is cloud based - i.e. it runs in a browser (so no lengthy downloads , version compatibility issues etc, it is updated regularly with new features without charge or technical issue etc.) . Drawings are stored in the cloud (i.e. on a remote server) but can be easily downloaded or printed directly. You don't need to back them up !

To start, all you need do is create a login (similar to creating a Google gmail account) and you are up and running.

3D and CAM - Optionally, a 2D drawing can be developed further into 3D and exported to an .stl file for 3D printing. I have 'played' with this, a friend who owns a 3D printer had produced nameplates from a photo I loaded in to Onshape, creating a 3D drawing from the photo and exporting as a .stl file.

It is current - It is still being worked on and enhanced so you are not dealing with 'retired' or out-dated software.

Like all technical software there is a learning curve but overall it is intuitive, especially if you have used other CAD packages. Also there are lots of free online resources to get you up and running. Although chargeable, I find the online training website Udemy a good place to start. There is always Google and YouTube.

I use the Chrome web browser (again free) to run Onshape and have had no issues. This is quite important, some older web browsers may well be incompatible.

So in summary, regardless of age of machine, if your computer can get online, can run the Chrome web browser , give Onshape a go!

Graham Sherwood

ML7 Splashback

Mike Joseph explains how he made a lathe splashback using sheet metal, in this case for his ML7 lathe.

'Bending Machine'

I have recently completely revamped my workshop – insulated the roof, new lighting etc (last year) and have now, insulated the walls, plasterboarded and painted them white. I have also put another layer of flooring on top of the existing rather battered chipboard floor and used flooring paint. I can now sweep the floor easily!

In my pretty new workshop I did not want to have oil and suds sprayed over my nice clean walls if at all preventable, hence this mini project. And so I have to confess that I am presenting this short article about mangling some poor unsuspecting aluminium!

Steel rule guide

Wooden square

Test piece

I do not have a sheet metal bender for aluminium nearly 2ft square and so improvised. Visit a local scaffolding company and explain – can I please have an old bit about 8ft long please? To my surprise it was gratis – cheek pays!

Photograph 1 shows the bender – three tubes of scaffold pipe, the lower two bolted firmly together, the upper one does the hard work, I (*just*) remembered to oil things, else the friction is a lot... And it worked. Joy! Ignore the plugs in the ends, this was an idea for maintaining parallelism but was not necessary. The whole thing was bolted to a wooden bracket and placed in the vice.

To ensure that I was bending squarely, I used a very old spring steel rule as a guide, **photo 2,** (with safety glasses in case it snapped) and aligned with a purpose built square, **photo 3**, (use once and then becomes firewood) – the heel had to be much deeper than normal because of the pipe curvature.

I did try this contraption out first on a piece of aluminium strip to check the fit at the back of the lathe, **photo 4**, – it worked first time – what is 'luck' if you don't ride it a little? I then used this as a template for the sheet and the brackets. Afterwards, I straitened it again – waste not want not!

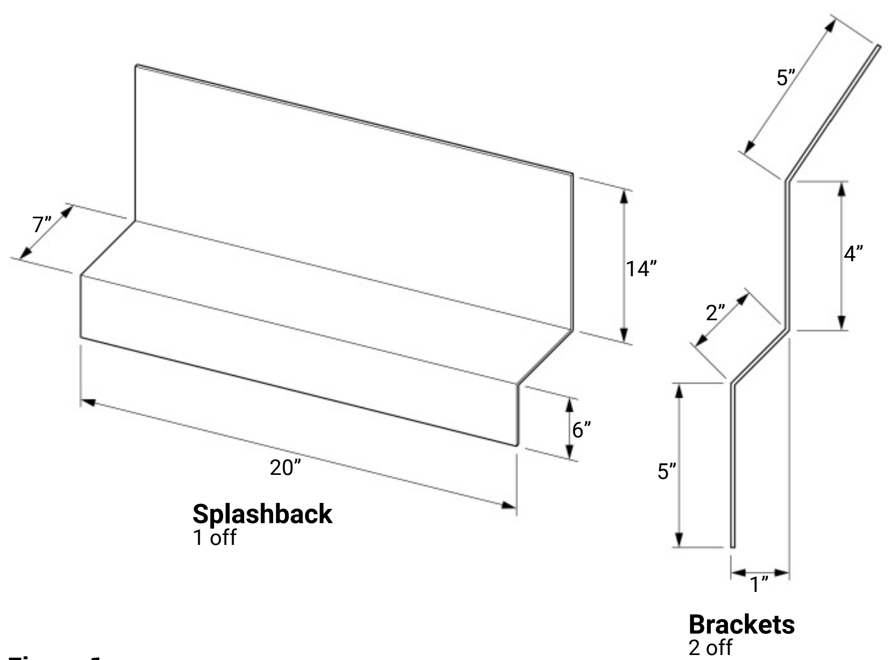
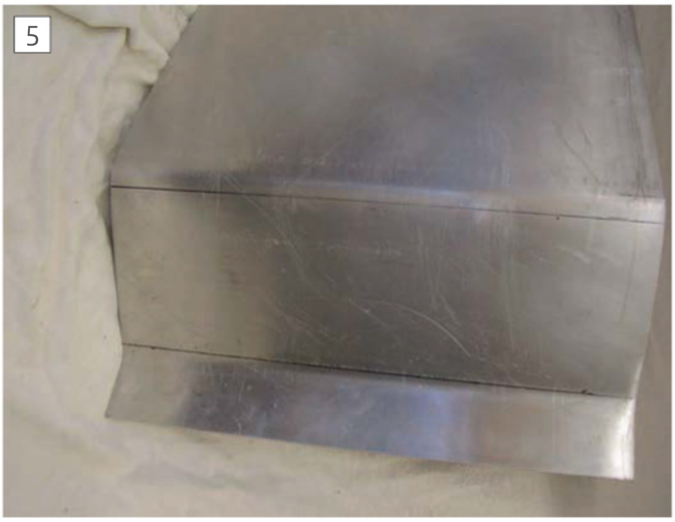


Figure 1

The end result was very satisfying, **photos 5** and **6**.

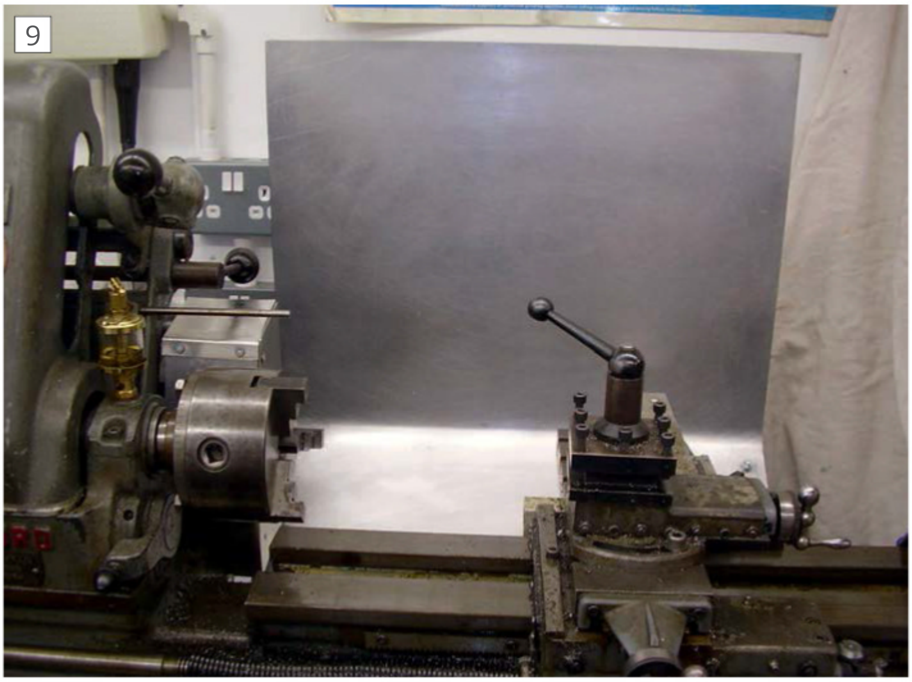


Splashback 1

Splashback 2

7

Bracket



9

Splashback mounted - from front

10

View of splashback and DRO arm

8

Splashback mounted - from side

The support brackets, **photo 7**, were bent up with a little bending brake purchased at one of our exhibitions (St Albans and District MES), drilled and sprayed. In the end, I have not bolted the splashback to the cabinet – not needed and I can now easily remove it for cleaning (that reminds me of something I ought to do...)

I clamped the brackets to the splashback and with a little trial and error found a suitable position for them so that it was vertical. The final result is shown in **photos 8** and **9**.

Photograph 10 shows the final arrangement with the DRO, note the tray on the DRO arm to keep tools handy near the work area – very useful.

Finally I went back to the company that had very generously given me the scaffold tube. They must get plenty of people who come begging for a length like I did and then never hear anything again – I wanted to give something back and so I took the 'bending machine' and splashback to show what I had done with the scaffolding tube and the result. I also took a nearly finished ball turning tool to demonstrate that I could do some reasonable work. The boss of the company was an ex-engineer and said that I could come back *any* time for tube if I wanted. ∎

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 may be out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

Beginner's Workshop

Poppet valves and seatings

AFTER FIFTY YEARS, and despite ingenious alternatives,. the poppet valve has established itself as the standard valve for four-stroke i.c. engines. Its construction and servicing inevitably concern in some degree all who have to do with such engines-motorcyclists, car owners, mechanics and engineers.

Though the causes of valve (and seat) trouble may be various and often interacting, all stem broadly from the following; the heat to which the valve is subjected; the hammering it receives along with the seating from the spring action on closing; wear of stem and guide; incorrect servicing or adjustment.

Valves run very hot, exhausts in particular. They scale on the heads, burn on the faces. Added to this, the "skin" acquires a burnished impacted structure from hammering, different from the clean precision before use. In time, faces indent, seatings broaden. When stem and guide wear occurs, the valve may not strike the seating squarely, but tilt or roll on closing, eventually causing a wide or eccentric seating.

Correct fitting

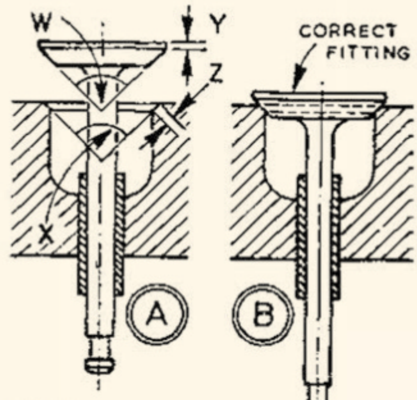
Main features of correct fitting appear at *A*. The included angle of the valve face, W, is usually 90 deg. or 120 deg. Taking measurements from the seating these are 45 deg. and 30 deg. angles. All valves may be the same angle, or exhausts may be 90 deg. (45 deg.) and inlets 120 deg. (30 deg.). The included angle of the seating, X, is the same as that of the valve, except in the case of some exhaust valves, when there is about 1 deg. difference. For example, with W = 90 deg., X may = 89 deg., this tending to cause sealing on the outer part of the seating.

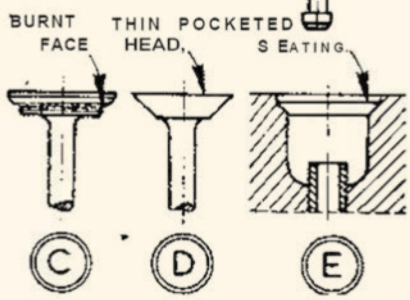
For most cars and motorcycles, the valve head width or land, Y, new, may be 1/16 in. to 3/64 in. Facing the valve reduces this, and advisedly it is not made less than about 1/32 in. The seating width, Z, new, averages 1/16in. (a few thou. bare to full). Valve hammer and grinding increase this and when exceeding about 3/32 in. it is advisedly reduced so the valve face contains the seating centrally, B.

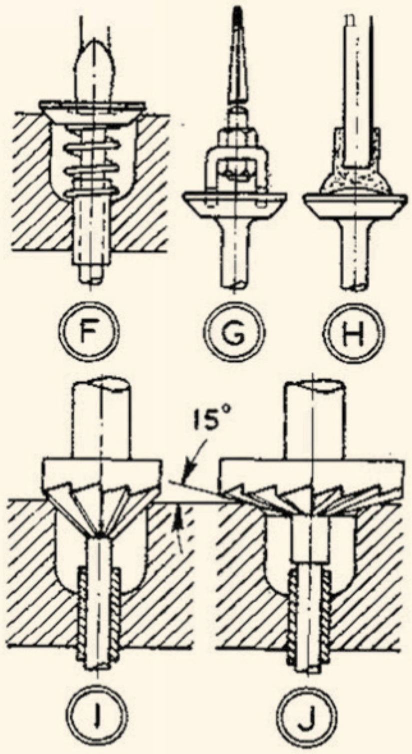
Common faults arc shown at C, D and *E*. Burning and pitting on the face are typical of all exhaust valves after considerable use, and to some extent of exhaust valve seatings. On valves, faces are trued to original angle by turning or grinding (usually requiring a lathe or valve facing machine) and unless the seatings are bad, this can be followed by grinding in. When the seatings are defective, however, they must be trued in turn, either with a cutter or coned abrasive stone located from a stem in the valve guides-the cutter turned slowly by hand and the abrasive stone rotated rapidly by a machine like a portable electric drill.

After facing, valves must not be thin on the heads, *D*, or the edge may overheat and burn quickly, particularly on exhaust valves. Actual pocketing of seatings, *E*, only occurs after considerable time and numerous grinding in of valves. Nevertheless, it is what tends to occur, and should be watched for on older engines.

To permit rotation when grinding in, valve heads may be slotted for a screwdriver, *F*, or carry two holes to accept a tool like a small fork, G. Where heads are plain, a rubber suction tool, *H*, is used-wetted and pressed on the head to force out air and obtain a firm hold.







A forked tool, G, can be made from flat stock, rod, nuts and a file handle. The flat stock is bent U-shape, drilled for the rod, fixed by the nuts and the ends tapered and rounded to enter the holes in the valves. The other end of the rod is tapered square to drive in the file handle.

For true valves and good seatings, fine grinding paste is sufficient and should always be used for finishing, even though when seatings are pitted coarse paste may have been needed previously. A smear is applied evenly to the valve face, and grinding is accomplished with an oscillating movement, frequently lifting the valve and changing its position on the seating -for which a light spring below the head is helpful, *F*. Valve faces and seatings at the finish should be a uniform grey colour without excessive rings.

For truing defective seatings, a typical cutter is as Z, while for narrowing wide seatings, or eliminating pocketing, a chamfering cutter, is used.


Jaw Regrinding - Pete Barker

Model Engineers Workshop – Be Part of It!

Model Engineers' Workshop isn't just a magazine, it's a community of like-minded people who love to share their ideas and expertise and experiences of hobby engineering and related subjects. There are a whole host of ways you can get involved and get even more out of your magazine – and your hobby.

Join us on the Forum!

The forum at www.model-engineer.co.uk is one of the biggest and friendliest online forums for model and hobby engineering – and it's free to be part of it! The web site also includes a digital archive right back to issue one of MEW, available to digital subscribers.

During the Covid-19 lockdowns the forum provided an invaluable way for hobbyists to keep in touch with each other. If you have questions to ask, ideas to share or just want to chat about workshop topics, come and join in.

Write for us!

Model Engineers' Workshop is a magazine that has almost all of its content written by its readers; from beginners recounting their first experiences of the hobby to old hands passing on the wisdom of many years in the workshop and all points in between. That's why every issue covers such a broad range of topics and content. We pay a good rate for articles, so it's a great way to help fund your hobby.

If you would like to submit an article for possible publication in MEW send an email to Meweditor@mortons.co.uk and we will send you a free author pack with everything you need to know.

Send us your tips!

Why not share your favourite tip with readers? You could win a prize. Every one of us has devised interesting solutions to all sorts of workshop problems, from clever fixes to sneaky shortcuts.

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. See page 64 for full details and how to enter.

Tell us what you think!

In each issue of MEW we feature a selection of readers letters in Scribe a Line. If you want to give feedback on articles, request information on tools or techniques or just have an interesting story to share, dop and email to meweditor@mortons.co.uk.

Share your best workshop photos!

Email a good quality picture on a workshop theme, along with some words of description and your address to meweditor@mortons.co.uk.

If your picture is chosen for publication, you will win a hard-to-get copy of the 25 Year Special from 2015. No alternative prizes can be sent, and the editor's decision is final.

Advertise!

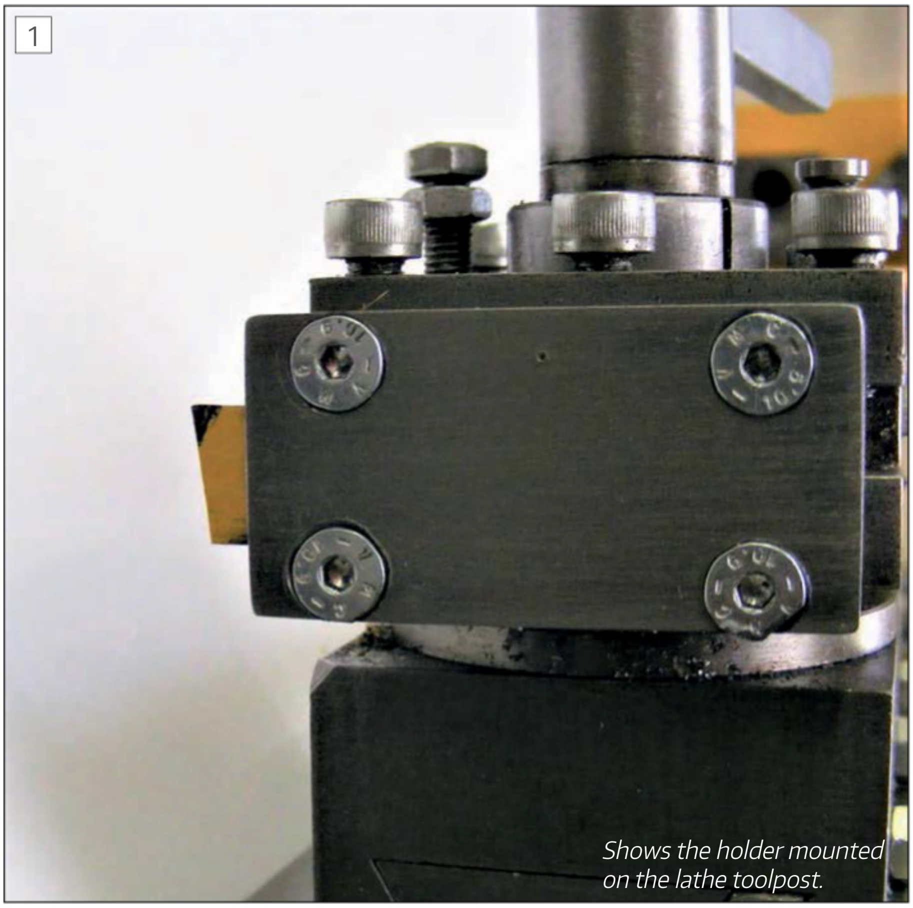
Do you want to sell surplus workshop equipment? Are you looking for a hard to get item? Then why not place a free readers' classified ad? See the page near the back of this issue to see how to place your free ad today!

Subscribe!

Make sure that you get your copy of MEW every month. You can get print, digital or combination subscriptions. You can get your subscription at www.classicmagazines.co.uk/subscription/MEW or see the offers in this issue.

Cutting grooves for circlips

Mike Cox explains how to cut narrow grooves, using his Mini Lathe as an example.


1

Shows the holder mounted on the lathe toolpost.

A few years back I needed a tool for cutting narrow grooves for circlips and E-clips. My first approach was to try grinding a 6 mm square piece of HSS tool steel to form a very narrow parting tool to cut the groove. Using just a bench grinder to do this proved to be very difficult as it was very difficult to control the final width of the tip and try to put on some side clearance proved almost impossible without weakening the tip. After a few unsuccessful attempts it occurred to me that most of the circlips that I were using were about the same thickness as a hacksaw blade. A quick check with a pair of calipers indicated the the hacksaw blade was in fact 0.7 mm and this was only slightly thicker than the circlips. Would it be possible to make a toolholder to hold and support a short piece of hacksaw blade?

The simple holder that I made is shown in **photo 1**. It consists of two pieces of 3 x 25 x 50 mm steel and a 50 mm piece of 6 x 6 mm square steel, see **fig. 1**.

After cutting the pieces the piece with 6 holes was marked out first and the

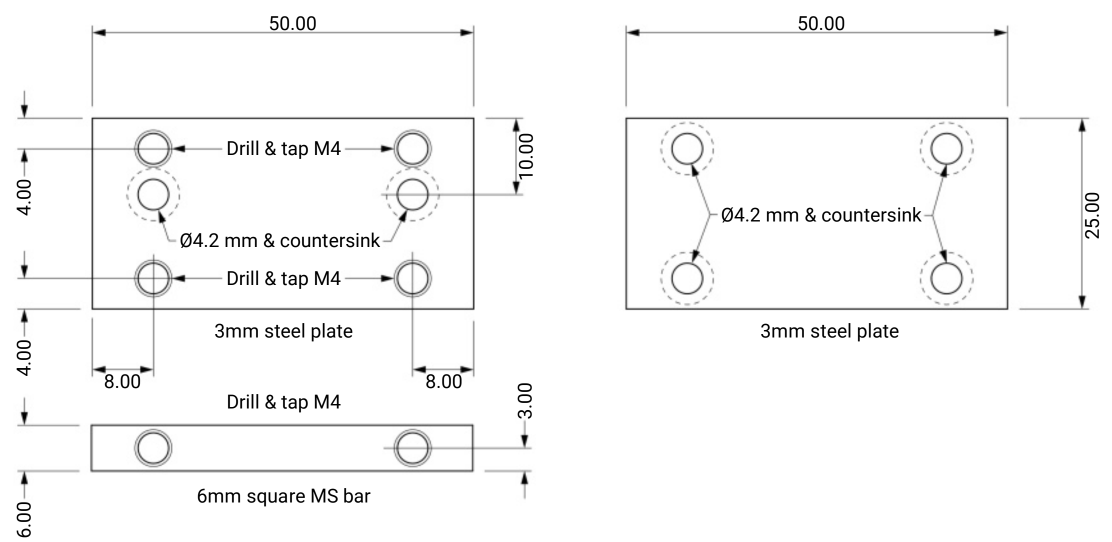
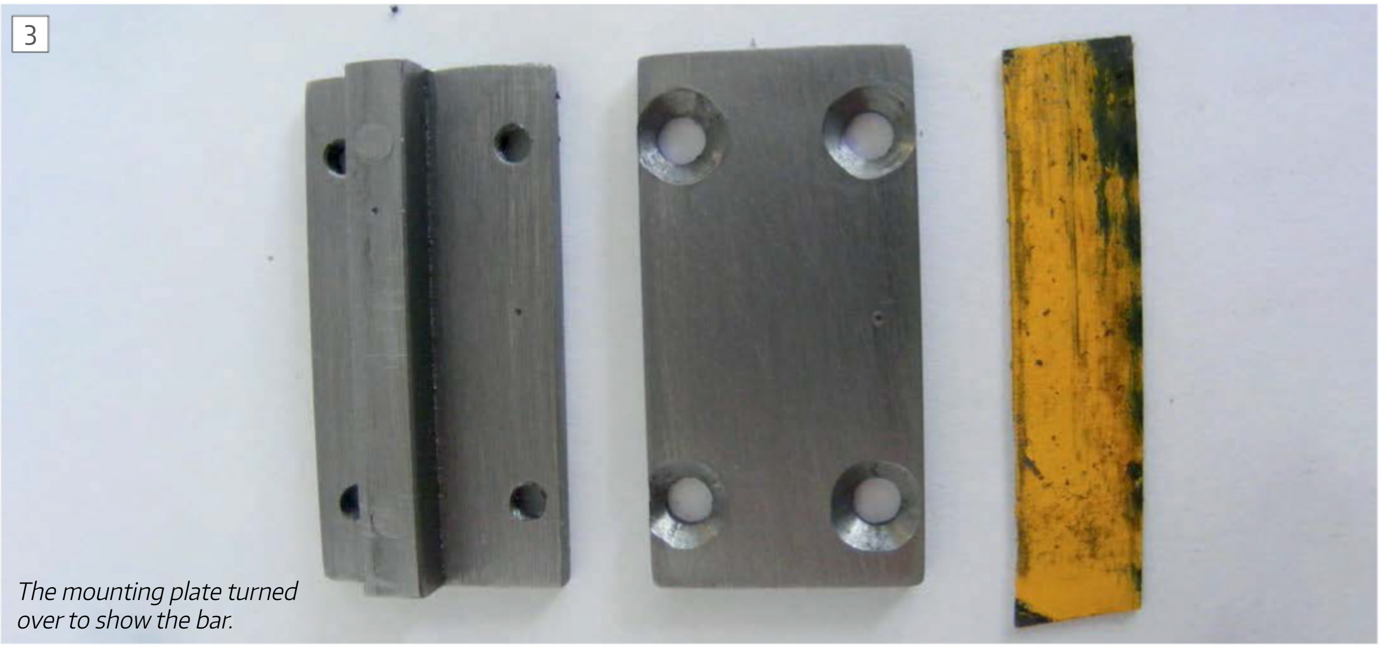


Figure 1

Shows the two plates and the hacksaw blade.



The mounting plate turned over to show the bar.

position of the holes centre punched. The holes were drilled out using a 3.3 mm drill on the drill press. Once this piece was prepared the other large piece was clamped to it using a toolmakers clamp and carefully squared up to the original piece. The four outside holes were then spotted through onto the new piece on the drill press and drilled through. The assembly was un-clamped, and the four holes were drilled out 4.2 mm and countersunk to accept M4 countersink screws. The two finished pieces are shown in **photo 2.**

The piece with six holes was mounted on the drill press and the centre two holes were drilled out to 4.2 mm and countersunk to accept M4 screws. The four outside holes were tapped M4.

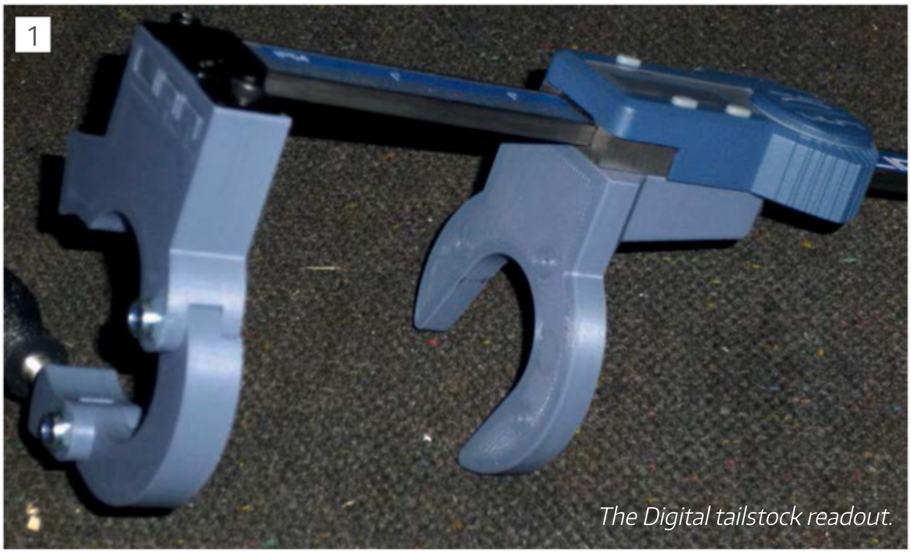
The 6 mm square bar was then marked out and drilled at tapped M4. This was attached to the plate with 6 holes using 9mm long M4 countersunk screws as shown in **photo 3**. The bar is used to clamp the hacksaw blade holder into the standard lathe toolholder. The final assembly is to attach the plate with 4 holes using 6mm long M4 countersunk screws. This completes the toolholder.

I use Irwin HSS all hard 12.5 mm wide hacksaw blades. A 55 mm length was broken off an old blade and the teeth were ground off on a belt sander being careful to avoid over heating the blade. The front edge of the blade was ground at an angle of around 10 degrees to provide clearance. It was mounted between the two plates of the toolholder and the four outside screws tightened to clamp the blade securely in position.

After fixing in the QCTP on the lathe and adjusting the height so that the tip of the blade was on centre height the unit was ready for test. A piece of 8mm round mild steel bar was mounted in the lathe and the tool cut a very neat circlip groove despite having no side clearance. The tool has been in use for a number of years, and it has cut many dozens of circlip grooves. ▮

Tailstock DRO Review

Many people have come up with ways of improvising a tailstock. Now an off-the-shelf version is available from Linn Tools. SMAC takes a look at this interesting new device.



The Digital tailstock readout.

First, I have no connection with this company and review this kit as it may be of interest to other readers. I discovered this kit by accident when I was researching for a digital readout for my Myford ML7S. The idea of a DRO on the tailstock had never occurred to me but with deteriorating eyesight and worn graduations on the barrel of the tailstock it appealed to me straight away. The discovery was online, and the supplier is LINN tools. This appears to be the only outlet but if you search LINN tools online there are several videos illustrating their products, including a demountable carriage DRO and tailstock DROs for other makes of lathe etc.

The Kit

The DRO comes in a one-piece configuration. The construction follows the standard digital calliper construction of a fixed and sliding jaw on a linear measuring bar. The fixed portion consist of a readout mounting plate and a circular open jaw, which accommodates a space for the tailstock barrel to pass through. It is secured to the face of the tailstock by three magnets The moving jaw has a similar open jaw but is provided with a clamp enclosure. This swivels and has a screw down securing arm. Thus, securing the moving part to the tailstock barrel. The clamp is well engineered and the Knob which locks the clamp is very tactile which makes locking the screw very easy. The readout is powered with a lithium battery (CR2032) and a small plastic device to open the battery compartment is supplied. (This might not survive in the workshop unless you devise a means to keep it secure). **Photograph 1** illustrates these features.

Fitting the DRO to the tailstock is a simple operation you offer the unit to the tailstock with the barrel slightly extended, the fixed jaw is secured to the face of the tailstock by three powerful magnets as described above and the moving jaw clamped to the barrel' The readout can be positioned in any front or top facing surface that suit your preference. Again, the readout is provided with the usual ON/OFF, zero and in/mm buttons. On retracting the barrel, you will probably generate a reading which can be returned to zero in the normal way with this type of calliper, **photo 2**. Finally, the redout in use is shown in **photo 3**.

Conclusion.

The DRO will be of greatest use when drilling blind holes but as I indicated at the start if your eyes are not what they were and the graduations on the tailstock barrel are well worn then it is a useful addition to your lathe.

Fitted and zeroed.

In use.

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.**

Royal Engineers

Dear Neil, I enjoyed your editorial in MEW 323. My Father was also a 'Don-R' in the RE's.

He went to Egypt via Cape Town, served right across North Africa. Was attached to the American army, landed at Salerno (Italy) with them, (he saw Vesuvius erupting in 1944), eventually to end the war in Leverkusen (Germany) where he met my Mum. The rest is history.

Please find a photo attached of my dad at a mobile workshop somewhere in Germany with Fritz the dog on the tank.

I also served in the Sappers some 25 years later.

Pete Summerscales, by email

Watches

Dear Neil, watches, may I recommend "wristwatch_revival" on YouTube? The person is Marshall Sutcliffe, very practical and down to earth approach, knows his skills and tools. On all the watch repairs I have followed, never has magnetised been mentioned. You say "new" but is it old enough for the lubrication to have dried? Also slipping mainspring not mentioned along the way.

Ken Willson, by email.

Mystery Object

Thanks to Tom Wisdom, Al Hanson and David Palmer, all of whom correctly identified Seamus William's mystery object as a Bosun's Pipe or Call. It's a special whistle historically used by a boatswain (pronounced and often written 'bosun') to make commands on ship and now used chiefly for ceremonial purposes.

Origins of Engineering

Dear Neil, I was recently reading edition 319 of MEW, and read with interest the article by Stub Mandrel on the Origins of Modern Engineering. I recently finished reading a book titled "Exactly" by Simon Winchester and I commend it to anyone interested in the development of accuracy in Engineering and the resulting leaps forward in technology as a result. It is not too technical but explains the evolution of engineering. I particularly found interesting the origins of the metric metre fascinating.

Ken Lonie, by email

Bovington

Dear Neil, the arrival of MEW 324 prompted me to pick up my copy of 323 to which I had not given my full attention. I do hope we have already thanked you for the kind mention of SMEE in your 125th coverage. It is much appreciated. We seem to be very busy following up all sorts of new opportunities and our resources are stretched.

I was particularly interested in your editorial in 323 about Bovington. My wife and I visited a few years back and I agree with your description and your comments. I spent nearly 4 years as Production Director at Self-Changing Gears in Coventry. SCG was founded by Major Wilson after his exploits developing the tank during the First World War and was the design parent of the pre-selector gearboxes used in Daimler and Armstrong Siddeley cars, Leyland buses and transmissions for Alvis light tanks. Whilst I was at SCG we made gearboxes for Chieftain and Challenger tanks in partnership with David Brown Gear Industries and transmissions for British Rail DMUs. It was a very interesting business.

Elliot Hirst, by email.

POST BAG

Metric pitches with a quick change gearbox

SIR, - Some years ago, I remember reading a lengthy correspondence in the pages of *M.E.* on what metric threads might be cut on an imperial lathe using standard and non-standard change wheels. The solutions were both fascinating and ingenious, but of little practical use to those of us who have a lathe with a quick change gear box. Such boxes might be extremely convenient, but they remove some of the flexibility of the basic lathe. You can of course buy a metric conversion kit, but that is rather a pricey solution if the facility is needed only rarely. Besides which, there is no challenge in buying off-the-shelf items.

All my 'serious' model engineering is imperial, and metric threads are only needed very occasionally to mend the odd food mixer or car door catch. Although accuracy is not the highest priority for such jobs, we all know that threads have to be reasonably well made if they are to fit all! I therefore looked for the simplest possible answer which provided metric pitches with less, preferably much less, than 1% error. The solution which has served me well for a number of years requires only two additional gears, 33T and 34T, used as replacements for the outer (driving) 24T gear on the tumbler stud of my Myford Super 7 lathe. It takes only a minute or so to slacken off the quadrant, replace the stud gear, and reset. The gears were cut from nylon blanks, and were therefore easy to machine. They have stood up to several years' occasional use very well indeed.

Pitch (mm)	Gearbox setting (tpi)	Tumbler stud gear	Error (%)
0.7	36	24	+0.79
0.75	48	34	-0.05
0.8	32	24	-0.79
0.9	40	34	-0.05
1.0	36	34	-0.05
1.25	28	33	-0.21
1.5	24	34	-0.05
1.75	20	33	-0.21
2.0	18	34	-0.05
2.5	14	33	-0.21
3.0	12	34	-0.05
3.5	10	33	-0.21
4.0	9	34	-0.05
4.5	8	34	-0.05

The table below shows how the most useful metric pitches are generated, and what the errors are.

The quick change gearbox does not of course cover every imperial thread which might be required. Some of the gaps can now be filled, though admittedly these TPI will be rarely needed:

TPI	Gearbox setting (tpi)	Tumbler stud gear	Error (%)
7	10	34	+0.84
17	24	34	-0.34
27	38	34	-0.65
29	40	33	+0.31
31	44	34	+0.18
35	48	33	-0.26

The versatile two little gears will also help generate the larger BA pitches:

BA	Gearbox setting (tpi)	Tumbler stud gear	Error (%)
0	36	34	-0.05
1	40	34	-0.05
2	44	34	-0.93
3	48	33	+0.20

The 2BA error of 0.93% is getting rather too large to be ignored!

Finally, for those who need to machine worms or gear-cutting hobs, several quite good approximations to commonly used diametral pitches and metric modules become available with these two gears -but you can work those out for yourselves! Incidentally, adding a third gear of 25T increases the options significantly.

The Rev'd David W. Hoskin BSc. Beverley, Yorkshire.

Ralph Thompson's Gear Query

Dear Neil, I have Model Engineer going back to 1970, I was still at school in Manchester then, and MEW back to issue 1.

I think that the enclosed is what Ralph Thompson wants. I didn't see any other gear references in that issue. Vol 171 Issue 3955 has a date of 15 Oct to 4 Nov1993 and retail price of GBP 1.50!

Victor Croasdale. Spring Valley, Illinois

Thanks also to Brian Wood who offered further help to Ralph. Here's Victor's scan which may be of use to other readers - Neil

Division Master

Dear Neil, several years ago I purchased a Division Master from Lester Caine Electronics.

Now the stepper motor has stopped working. I have tried to contact Lester but to no avail. With all the contacts you have, would you know if anybody has now taken over the sales and services of this item? I would be grateful for any feedback you may have. It has been a wonderful addition to my workshop, and I am missing It terribly.

Brian Wiffin, New Zealand.

Notes For Newbies – Part 1

Howard Lewis is a long-standing model engineer, he shares some of the lessons he has learned on operating 'the King of Machine Tools' in this two part series.

In September 1958, I had scarcely laid eyes, let alone hands, on a lathe, when I entered the Training School of the Rolls Royce Oil Engine Division, at the Sentinel Works in Shrewsbury. Over the next six months that situation changed, and I operated, with varying degrees of success, all types in the Training school. This period did not make me a skilled machinist, nor have I ever made my living from being a machinist, so make no claim to being an expert.

Of late there have a number of posts on the Model Engineer and Model Engineers' Workshop Forum from newcomers to the hobby, asking basic questions. I hope that at least some of the questions may be answered by some illustrations, and words, from the notes provided. My objective is provide a better understanding of a lathe and its operation, for the benefit of newcomer.

If you already know some, or all, of what follows, please bear with me as we try to help the absolute beginners. If, to begin with some of the terms are unfamiliar, please continue reading and they should become clearer, possibly visible, later on.

Because my notes date from 1958, some dimensions and speeds are shown in Imperial units. Some of the illustrations are some sixty years old, and are not of the highest quality, so the editor has had some of these redrawn.

The centre lathe has been described as The King of Machine Tools, and as being the only machine tool capable of reproducing itself. In the right hands, it can be capable of impressive work. Some reading will improve understanding of the lathe and its uses. There are a variety of books on the lathe and its operation, available:

1

Vernier, dial and digital callipers

L H Sparey's "**The Amateur's Lathe**" is a good guide to the hobby lathe, setting out basic principles.

Dave Fenner, a past Editor of MEW wrote a book on Mini Lathes (Workshop Practice Series).

Neil Wyatt the present Editor of MEW has also written a book on The Mini Lathe and another on "**Lathework**" featuring the Sieg SC4 lathe (both Crowood Press).

Harold Hall, another past Editor of MEW , has written "**Lathework**", No 34 in the Workshop Practice Series.

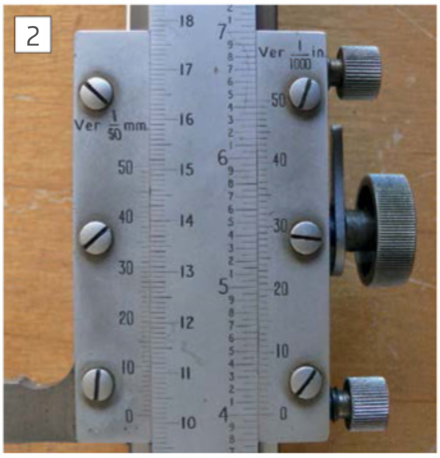
Tubal Cain's "**Model Engineers Handbook**" is an invaluable reference book on many aspects of model engineering (Special Interest Model Books).

Another good investment, will be a set of Zeus charts, which contain a lot of information on a host of matters of interest and use to a model engineer. I still use the, now grubby, set bought in 1958!

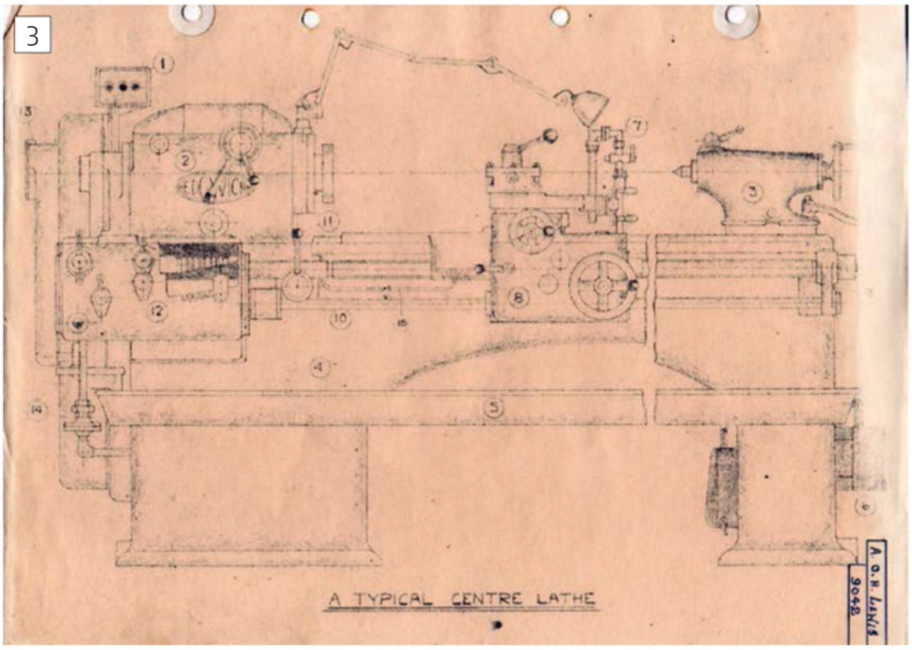
There are also other books specifically about lathework and books in the "Workshop Practice Series" deal in greater detail with all manner of model engineering subjects.

Measuring equipment will be required to provide greater precision than a steel rule. (Although these have their uses!). As a minimum, a calliper of the vernier, dial or more recently, digital types will be a good starting point, **photo 1** All these types will cover a range of sizes in one instrument. I still have my Rabone Chesterman vernier calliper from 1958! A magnifying glass is a good accessory for any measuring device incorporating a Vernier, to aid distinguishing the final graduations. **photo 2.**

One of the advantages of a digital calliper is the ability to change from Imperial to Metric units, or vice versa, at the press of a button. Keep a spare battery. It will probably go flat when you most need it! If your digital calliper "freezes" or behaves oddly, removing



Close up of a vernier scale



Line drawing of a centre lathe

the battery for 30 seconds often solves the problem.

Outside measurements can also be taken using a micrometer of the size most suited to the job in hand. Learning how to read a depth micrometer needs a little more care than a conventional micrometer.

Our first lecture dealt with Safety, advising of the risks of rotating machinery, electrics, advising against handling swarf with bare hands, and the use of barrier creams.

If it needs to be said, swarf can be hot, and sharp enough to cause serious cuts. Anyone who has had a drill jam when using a pistol drill will know that even a small ¼ horse power motor can twist out of your hands and will know to be careful with rotating machinery. Chuck guards are there for a very good reason! Gloves are not recommended with rotating machinery, lest they catch and drag a hand into the machine, in same way that excessively long hair will.

One of the first things that we had to learn were the names of the various parts of the lathe. Since the context was that of Industry, the lathe illustrated will be bigger and include features unlikely to be found on a hobby lathe. But the basic principles remain the same and will apply whether the machine is a watchmaker's lathe or an ex-industry machine.

Photograph 3 shows a Centre Lathe that would have been used in industry the 1950s, having some features which some hobby lathes may lack. (Such as the Norton selective gearbox, a Traverse Shaft for the power feeds, or a pumped coolant supply). Parts shown in the illustration of the Centre lathe are:

1 – Electric Start / Stop; 2 – Headstock; 3- Tailstock; 4 – Bed; 5 – Swarf Tray; 6 - Electrics; 7 – Coolant supply; 8- Apron; 9 – Leadscrew; 10 – Feed shaft; 11 – Mechanical start / stop; 12 Selective (Norton) gearbox; 13 – Disengagement for coolant pump; 14 – Coolant pump; 15 – Gap.

Some lathes have what is known as a gap bed. This has a lower portion, close to the chuck which allows work larger than can be swung over the bed to be machined.

A training lathe will be so basic that it does not even have a Leadscrew, and all feeds have to be provided manually. (The leadscrew is a long-threaded bar running along the front of the lathe, which can be arranged to rotate at the same time as the chuck.)

One of our earlier lessons was to learn to how turn a Handwheel to provide a steady and consistent feed. Some hobby lathes use the Leadscrew to provide a longitudinal feed for turning, or sliding. Some more sophisticated machines have a keyway in the leadscrew which is used for the power cross feed on the cross slide. The most complicated will have a separate traverse shaft like an industrial machine, to provide a powered feed to both the saddle and the cross slide.

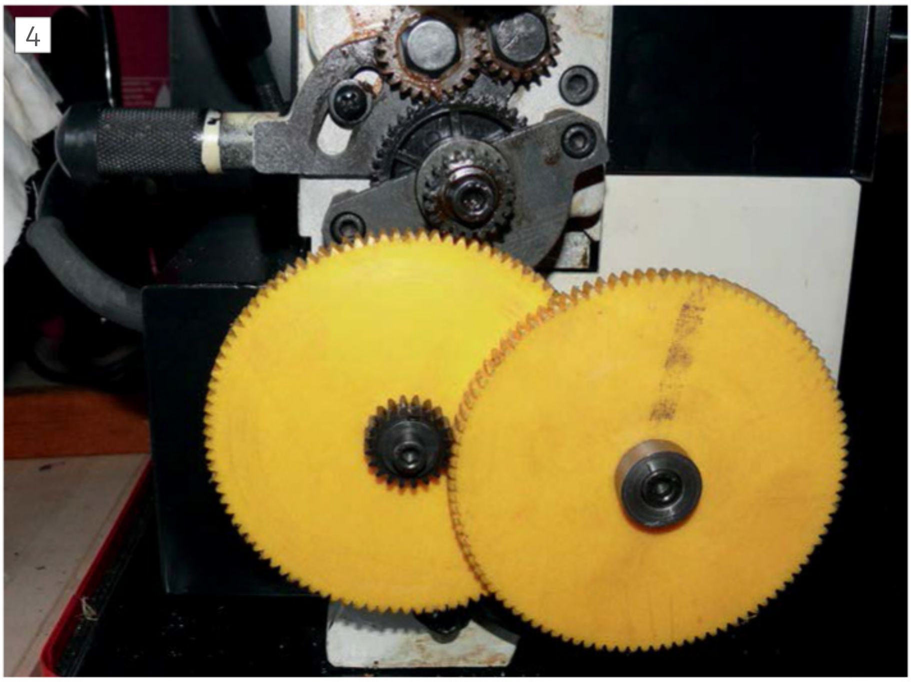
The headstock is the part of the lathe that provides the drive to rotate the work. The bed of the lathe may be flat, dovetail shaped or prismatic.

The saddle or carriage is located by the bed. On a flatbed lathe, this is guided against the vertical surfaces of the bed. On a lathe with a dovetail bed, the saddle is located by the angled faces of the bed.

A lathe with a prismatic bed has one flat area and one like a raised triangle. The flat carries the saddle, but the prismatic area locates it across the bed. Some lathes use another flat and prism to carry and locate the tailstock. The portion hanging down at the front of the saddle and carrying the handwheel is known as the Apron. Usually, the saddle moves along the bed by the handwheel driving a small gear which engages with a rack on the bed of the lathe. On a few hobby lathes, the leadscrew is used for this purpose. If the lathe has power feed facilities, the control mechanism for this is within the apron.

In the absence of a Norton selective gearbox there will be changewheels which can be arranged to transfer a drive from the mandrel to the leadscrew. There will be a number changewheels, with different tooth counts that can be arranged to produce different ratios between headstock and leadscrew.

A typical set might comprise two 20-tooth (20T) wheels and then increment by 5T up to 80T, of which there would be two. These would be arranged on the spindle below the tumbler reverse to drive one or more gears on an intermediate shaft, known as a stud, mounted on a bracket known as the banjo, to carry the drive to the leadscrew. So a geartrain to provide ›



Tumbler reverse

a fine feed rate, might be 20T on the mandrel driving a 80T on the stud, which is keyed to the second 20, which drives the second 80T on the leadscrew This means that the leadscrew would rotate at 1/16 of the speed of the mandrel so that for every turn of the mandrel, on a lathe with a 1.5 mm pitch Leadscrew, (With Half Nuts engaged) would advance the tool by 0.09375 mm.

If it was then desired to advance the tool by 1 mm for each turn of the mandrel the driving gear would be changed from a 20T to a 40T, with a 60T on the leadscrew with any gear placed on the stud to act as an Idler and just "fill the gap". The banjo can be moved to provide the correct mesh of the gears with sufficient, but not excessive backlash between them.

The tumbler reverse would be used to determine the direction of movement of the saddle, towards or from, the headstock, **photo 4.** This picture, of a mini lathe, also shows specially made larger changewheels set up to provide an extra fine feed rate.

Gears are not normally interchangeable between machines made by different manufacturers. Gears may differ in dimensions and be made to different standards. A gear with 20T made with a diametral pitch (DP) of 20 will be a different size to a 20T gear with a 14 DP, and cannot mesh properly with it. Metric gears are made to a similar ratio between tooth number and diameter, known as module. This a 1 Mod 40T gear will be half the diameter of a 2 Mod 40T gear and unable to mesh with the larger one. The bore and thicknesses may differ, as well as the means of locking a pair of gears together to make a compound gear like the 20/80 mentioned above.

Work Holding

Work is usually held in a chuck of some description. The three-jaw chuck, as the name suggests has three jaws, and is ideal for holding round or hexagonal material. It is self centering, as the jaws are operated simultaneously by a spiral groove within the chuck body, driven by a pinion on the bottom of each socket. On used machines these sockets may have been damaged by putting a tube over the chuck key to obtain extra leverage. This is not good practice and can damage the socket, chuck key, or chuck jaws. There should be two sets of jaws with each chuck, one set known as external jaws (because for most work, they grip on the outside of the material) being moved inwards to grip round or hexagonal material, in a similar way to a drill chuck.

The other set of jaws, (Internal), should carry the same numbers as the External set, but are effectively a mirror image, where the steps, on the jaws are on the inside. This allows work of a larger diameter to be clamped by the steps when the jaws move inwards. If the jaws are moved outwards, they can grip large diameter hollow material, such as tubes.

The chuck body will have a number by each slot, and only the jaw with the same number should be inserted into that slot. Starting with No.1, the key is rotated until the scroll engages with the teeth on the back of the jaw. No.2 jaw is then inserted and the scroll rotated again to engage it, before No.3 jaw is then inserted and engaged. If everything is in order, all three jaws should meet at the centre,

It is not unknown for a secondhand chuck to have a jaw where an inner tooth is missing. If this is the unfortunate case, it may be that that particular jaw will not engage until the scroll has been given another complete turn. The jaws should also carry a number which matches a serial number somewhere on the chuck. If new jaws have been fitted at some time, this will not be the case.

Even a new three-jaw chuck is unlikely to hold work absolutely concentric. A run out of 0.005" (0.127 mm) would not be unusual. The Grip Tru type can be adjusted to hold work concentric. Work of a different diameter may require further adjustment.

There are two forms of four-jaw chuck. One type is self centering and operates in a similar manner to the three-jaw self centring chuck. The more common type is the four jaw independent, where each jaw is moved independently of the others, and each can be reversed, so that there is only one set of Jaws. In some instances, work can be held by having one or two jaws acting as Internal jaws while the others act as External jaws.

The four-jaw chuck is ideal for holding square, octagonal or irregular work. It is used when it is important that work is held absolutely concentric, or if it has to be placed off centre deliberately. Since the jaws are independent there are occasions when to hold work it be necessary to have one, or even two jaws, in the opposite orientation to the others.

Sometimes work is done by fixing it a faceplate, but this calls for great care in mounting the workpiece in the correct position, and in reasonable balance.

Figure 1 shows the various names of parts of a self centering three jaw chuck, and also shows the correct and incorrect means of holding work in the jaws of a chuck.

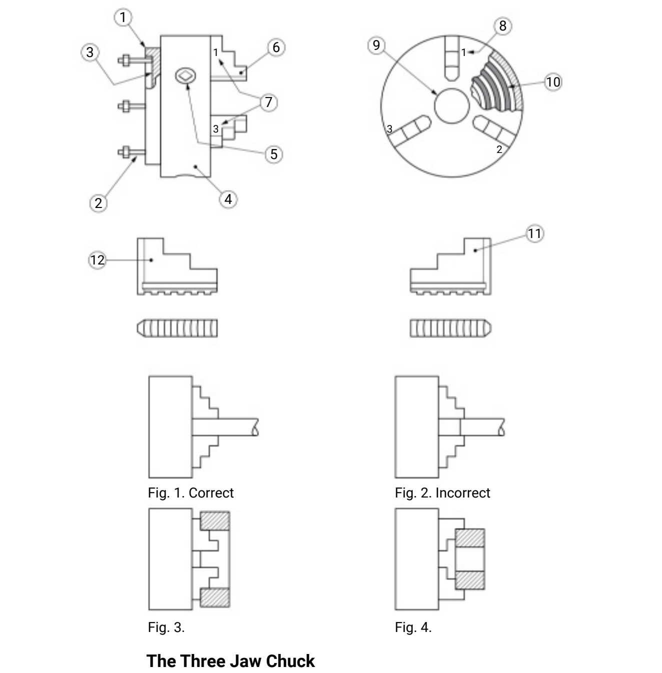


Figure 1. 3 jaw self centring chuck

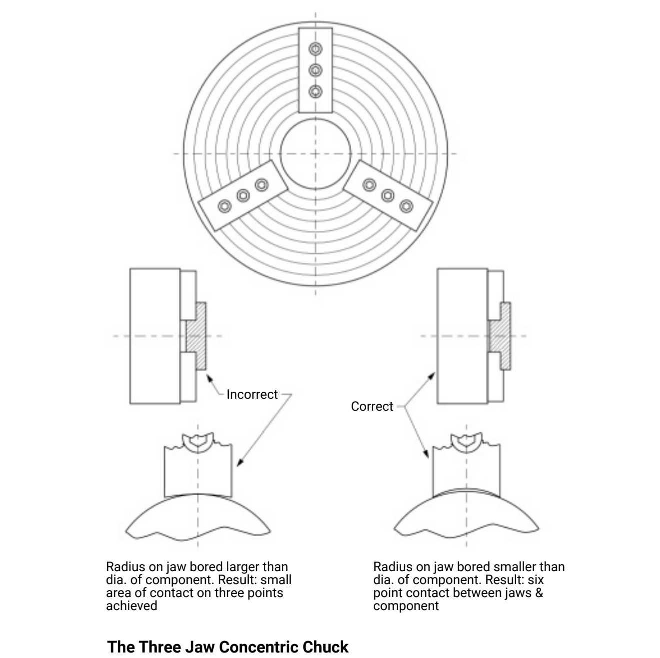


Figure 2. Work holding in a 3 jaw chuck

1 – Adaptor (or Backplate); 2 - -Securing studs; 3 - Locating Spigot (or Register); 4 – Body; 5 – Square for Chuck Key; 6 – Jaw; 7 – Jaw number (Jaw); 8 – Jaw Number (Body); 9 – Hollow centre; 10- Scroll; 11 – External Jaws; 12 – Internal Jaws.

Figure 2 illustrates work holding in the chuck. The bore of the chuck limits the size of material that can be passed through into the bore of the mandrel. (The spindle passing through the headstock to carry the chuck is also known as the mandrel).

A chuck which has been abused may have jaws which are now "bell mouthed". This is caused by using excessive force to hold work gripped in the outer extremities of the jaws.

There are various means of fixing a chuck to a lathe. On some lathes the chuck screws on, but different makes use different size and /or pitch threads and locations, (known as the register).

Unless a screw on chuck has some other means of retention, if the lathe is run in reverse (clockwise when viewing the chuck from the front) there is a risk that the chuck might unscrew and become detached. In such a case, the least that will happen is that the work, and the tool will be damaged. The worst-case scenario is that the chuck will detach completely, causing damage to the lathe bed, and possibly injury to the operator.

As examples, the Myford ML1, 2, 3 and 4 each started out with a 7/8" x 9 tpi (The standard 7/8 BSW) thread and a 7/8" register, but changed to 7/8" x 12 tpi, and the much later ones used 1 1/8" x 12 tpi with a 1 1/8" register. This thread is the same as used on the later Myford 7, (now generally referred to as "Myford" but this uses a 1 ¼" register). Imperial threads are usually quoted as diameter x tpi. Here, tpi means threads per inch.

Metric threads are usually referred to by their diameter and pitch. Pitch is the distance between the crest of one thread and the next. (For instance, M8 Coarse has a pitch of 1.25 mm)

Most standard threads come in coarse and fine pitches, such as British Standard Whitworth (BSW), British Standard Fine (BSF), Unified National Coarse (UNC), or Unified National Fine (UNF). For specific purposes, even finer threads, such as UNEF or Metric fine such as 10 x 1 can be used.

Nor will the thread form be the same. Whitworth form threads (BSW, BSF, BSP, British Standard Brass, Model Engineer etc.) are 55 degrees, while cycle, unified (UNC, UNF, SAE,) and Metric are 60-degree form. So a chuck that fits one make will not necessarily fit another, since thread diameters and pitches will be specific to a particular make or even model of machine. Where the chuck has a separate backplate this can be changed for one suit another make. Changing backplates is not used as means of having a chuck interchangeable between two machines in the same shop. You could end up having two machines each with less than desired accuracy!

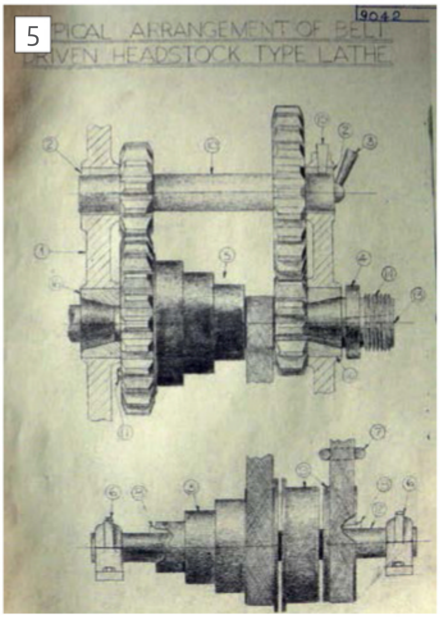
Sometimes, as in the case of the later Myford lathes, a thread may not have a pitch that is standard for that diameter. This may be to try to retain exclusivity in the market, or to provide a greater degree of precision for an adjuster, such as ½" x 40 tpi.

Some lathes, such as the current mini lathes, secure the chuck to a flange with studs and nuts; many would argue this is considerably superior to using a threaded fitting, as it is less likely to jam or to come unstuck if the lathe is ruin in reverse. Other larger lathes can use a system where the chuck is pulled onto a taper by a large nut on the mandrel. Others use what is known as cam locks to secure the chuck in place. These fittings can all vary in size from make to make, or even model to model.

Fitting an oversized chuck to a machine can, because of the weight and overhang, cause wear of the Headstock bearings.

headstock

This is the part of the lathe which conveys the power from the motor to the chuck. Many hobby lathes vary ›



Headstock and countershaft of a lathe

speeds by setting the drive belt in different grooves of a stepped pulley and the one on the motor. Some lathes have an intermediate countershaft between the motor and the mandrel. This allows the use of more stepped pulleys, allowing the number of speeds available can be increased.

In the simplest case the motor and the headstock will have stepped pulleys, and a belt, with which to vary the speed of the machine. The belt might be flat, vee, or poly-vee.

Many lathes are driven by an electric motor running on single phase alternating current (AC), and will run at a set speed. The motor speed will depend on the number of poles that it has. A four-pole motor fed with current at 50 Hz will run at about 1470 rpm, a two pole motor will be nearer to 3,000 rpm.

So assuming that the motor carries a stepped pulley with diameters of 2", 3" and 4" and drives to a similar stepped pulley, but facing the other way, it will provide three speeds. The 2" motor pulley will drive the 4" pulley on the headstock so that the lathe runs at half the motor speed. If the belt runs between the 3" motor and the 3" on the Headstock, the lathe speed will be that of the motor. If the 4" pulley on the motor drives the 2" pulley on the headstock, the lathe speed will be double that of the motor.

Some lathes vary the speed by changing gears rather than belts. Modern lathes, can also vary the motor speed electronically. Sometimes this referred to as variable frequency drive (VFD) This usually means that the motor is a three-phase unit, but runs from a 240 volt single phase socket.

To prevent damage, gears should never be changed with the motor or lathe rotating. Sometimes, it may be necessary to "rock" the chuck to and fro by hand to allow gears to engage.

(Industrial lathes very often have three phase motors running on 450 volts, and are not interchangeable with those for VFDs). Take no chances with electrics. A mistake could be fatal. If in any doubt take advice from a professional.

Photograph 5 shows the Countershaft and Headstock for an older lathe driven by flat belts, with the Back Gear engaged.

1 – Main casting; 2 - Eccentric bushes (which move the Layshaft gears into or out of mesh with those on the mandrel; 3 – Handle for engaging or disengaging back gear; 4 – Main spindle (mandrel); 5 – Stepped pulleys; 6 to 9 refer to overhead lineshaft drive, so have been ignored; 10 Layshaft; 11 – Bolt for engaging direct or indirect drive to Spindle; 12 Countershaft; 13 – Morse taper, inside the mandrel; 14 – Mandrel Thread; 15 Taper peg to retain back gear in engaged or disengaged position; 16 – Taper bearings for mandrel.

Back gear is a means of reducing the speed of the Mandrel when on larger work, with heavier cuts are being taken. Under normal circumstances the back gear is disengaged, and the pulley is locked to the gear by the pin, Item 11. When back gear is engaged, Item 11 is pulled outwards, so that the pulley, Item 5 and the small gear run free on the mandrel to drive the large gear on the layshaft, (Item 10) reducing the speed. The speed of the mandrel is further reduced by the second stage reduction of the small layshaft gear driving the large gear which is fixed to the mandrel.

The lathe cannot be operated with both Item 11 and back gear engaged. It will lock because effectively two different ratios are engaged, and machine cannot run at two different speeds at the same time. Where a lathe has a screw on chuck, it is bad practice to engage back gear to lock the Headstock to unscrew the chuck. If a shock loads are applied to loosen the chuck, it is possible to damage the gears, possibly breaking off teeth.

The bore of the mandrel usually has an internal taper, most often a Morse taper, but not always! Morse tapers are self-gripping tapers, and come in a number of sizes, which one will depend on the size of lathe. The angle of the Morse taper varies very slightly from size to size. You could come across sizes varying from 0 to 6. The most common will be the smaller sizes, such as the 2MT found on the Myford ML7. The mini lathe has a 3MT in the mandrel, and a 2MT in the bore of the tailstock barrel. A 5MT, found on some of the larger hobby and small industrial lathes, will allow work up to over 30 mm diameter to pass through the mandrel.

The ability to pass longer material through the hollow mandrel can be very useful, and save the waste caused by having to cut material into short lengths.

Saddle

The saddle carries the cross slide, and is moved along the bed, manually by a handwheel. If moved under power, depending on the machine, it will either be by the leadscrew or by a separate power shaft. The control for this is by one or more levers on the apron. The arrangement will be such that longitudinal and cross feeds cannot be engaged at the same time.

On the top of the saddle is mounted the cross slide. This is moved to and fro across the lathe by a handle or Handwheel. Old machines do not have the graduated dials which indicate the distance moved.

The graduations on the dial vary, in that some indicate the movement, which means that an advance of say 1 mm will result in the work diameter being reduced by 2 mm. (What you take off this side, will be also removed when the far side comes round to the tool!) On other lathes, the dial will indicate what will be taken off the diameter.

Depending on the machine, the graduations may be in Imperial units, or metric. Some machines have dials which are graduated in both systems. Referred to as "dual dialled". Often these are actually metric machines so that a dial carrying graduations totalling 3 mm will also carry 118 marks each representing a thousandth of an Imperial inch.

Plunger clock on a magnetic base

Finger clock on a magnetic base

Usually on the cross slide will be mounted the top or compound slide. This can be swivelled around on the cross slide. For most work it is set parallel to the axis of the lathe, indicated by a zero mark on the graduations. It can be used in more than one way.

If the saddle is not moved along the bed, preferably clamped in place, the graduated dial on the top slide can be used to turn to a set length.

If the top slide is set at an angle, it can be used to turn a short Taper. The length of the taper will be limited by the length of travel of the Top Slide. This will be illustrated later in the subject of using centres.

Depending on the machine, the Cross Slide may be moved under power, as well as the Saddle being moved along the bed. But not at the same time!

The toolpost is mounted the top slide and can be of different types. The simplest is merely a clamp which holds the cutting tool in position, a slightly more sophisticated version uses what is often referred to as a "boat" type holder. The tool sits on a pad with a convex radiused bottom which engages with a similar concave radius on the lower part of the assembly. This aids setting the tool to centre height, but has the disadvantage of changing the geometry of the tool in the process, by changing the effective top rake. Another toolpost is the American type where the tool pokes through a slot in a vertical post, and is clamped in place, again giving the facility to vary the angle at which the tool is set. I have to admit to disliking both these latter types!

More often a fourway toolpost is used. This is a square block of metal with a grove along each side, into which tools can be clamped by the screws along the top of each side. The toolpost is usually clamped by a lever on the top, and when slackened can be rotated, often to bring it against a stop in the Cross Slide so that it is at right angles to the lathe axis. There are times when the toolpost can be clamped at angle away from 90 degrees to the axis, for a particular task. Not everyone likes them, because of the risk of cutting oneself on the tools if the toolpost is close to the work whilst measuring the workpiece.

There also other multiway toolposts in use, such as the three-sided Lammas one. These are often shop made rather than commercial items, to the design of a particular model maker.

Increasingly used, now, are quick change Toolposts. These were originally used in industry where time is money, and the tools are already set, without the need to use shims. (The use of shims is discussed, later, when dealing with cutting tools). These come in different, but similar forms, consisting of a toolpost to which tool holders can be clamped. Each tool holder has an adjuster to set the tool to the correct height.

It should be noted that toolholders for one marque are very rarely interchangeable with those of a different one, because of dimensional differences, which may not be distinguishable by eye.

The saddle can be moved along the bed by different means. The obvious one is by the handwheel on the apron. This drives a small gear which engages with a rack fixed tom the front of the lathe bed. Less frequently, some lathes move the saddle by means of a Handle fixed to the end of the leadscrew In this instance, the Leadscrew may be the only means of moving the saddle. There are times when this method of positioning the saddle can advantageous if the handwheel is graduated.

If the Saddle carries half nuts. These are literally two halves of a nut, which can be clamped, when required, around the leadscrew, so that when it rotates the Saddle is moved along the lathe bed. Some smaller lathes only have one half nut.

On some lathes the leadscrew is used to provide the sliding traverse for turning along the work. Another variation of this is to have a key way along the leadscrew, and a key within the apron is permanently engaged, so that, when required the drive can be engaged to provide power cross feed. On other more sophisticated lathes, there is a separate shaft to provide the drive for Sliding traverse or cross feed.

The direction in which the saddle and cross slide moves is usually determined by what is known as the tumbler reverse within the headstock. This consists of two gears, carried on a bracket which can be rocked and set in three positions, refer back to photo 4. In one position one gear carries the drive from the mandrel onto the geartrain driving the leadscrew or the powershaft. in the centre position, neither gear is engaged. In the third position, the second gear is used as an Idler to reverse the direction of the drive.

Where a lathe has a powershaft, as well as a leadscrew, because the two often rotate at different speeds things are arranged so that only one can be driven at a time. If the lathe has a Norton selective gearbox, this can be used to select a suitable feed rate for the job in hand.

It is also possible to select what thread pitches can be screw cut. Many times it is more convenient to use taps and dies to cut smaller diameter threads. When cutting threads, a suitable lubricant, such as Trefolex or Rocol STD should be used.

● To be continued

Readers' Tips

TIP OF THE MONTH WINNER!

A marshalling area for stray drills and Allen keys

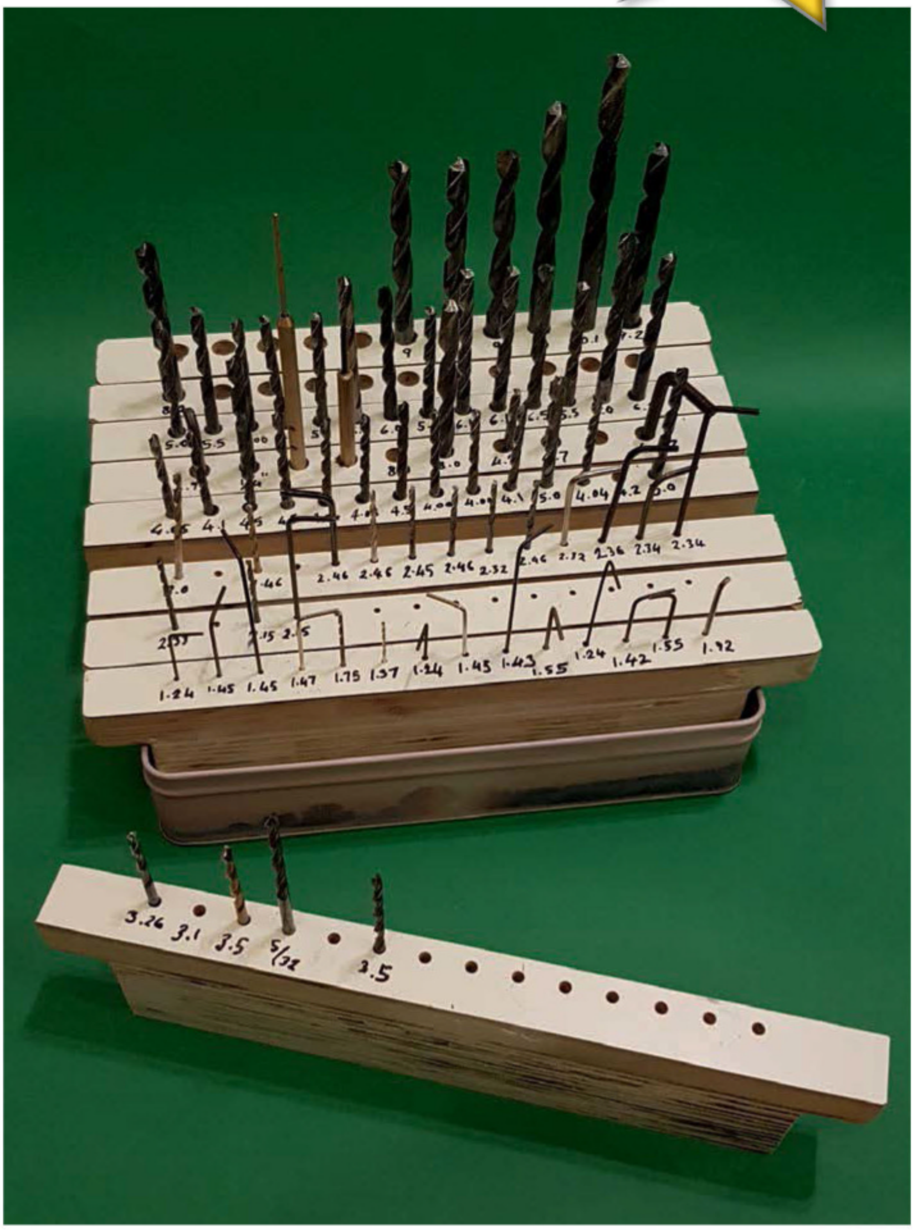
This month's winner is Bard Amos from Cambridge, with a handy idea for keeping things organised.

If you are as disorganized as me, you will have found small caches of stray drills and Allen keys littered around the house, and not had time to identify them and put them back in the right place, so a good handful have accumulated in a pile.

Even when you find time to identify it, an orphan drill may find its rightful place in a set usurped by a shiny new one that you bought to replace it. The purpose of the device in the photo is to provide a place where such orphans can be stored temporarily and, crucially, labelled and used.

My device consists of a shallow biscuit tin housing wooden sections that are each equipped with lugs on each side so that any one can be lifted out and handled individually. I made mine from scrap wood (entirely collected from skips). First, I filled the tin to the brim with rectangles of plywood and then glued them all together. Next I cut a piece of blockboard that had white laminate on one side to a size slightly larger in width than the plywood and glued it on top . I then sliced the timber with a circular saw into the T-shaped sections, each about 18mm wide. The last step was to clamp each wooden section under the pillar drill and drill the holes ranging in size from 1mm to 12 mm. Most of the cost of the device was for a tube of wood filler to fill the gaps in the cheap blockboard.

As shown in **photo 1**, each item can be labelled with a Sharpie- type marker and the label can be erased with a tissue damped with methylated spirits when the tool is moved to a permanent home.



We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'.
Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 600 words and a picture or drawing. Don't forget to include your address! Every month I'll choose a selection for publication and the one chosen as Tip of the Month will win **£30 in gift vouchers from Chester Machine Tools**. Visit **www.chesterhobbystore.com** to plan how to spend yours!

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

Planning your Workshop

Here's some useful advice for anyone setting up a dedicated workshop for their hobby.

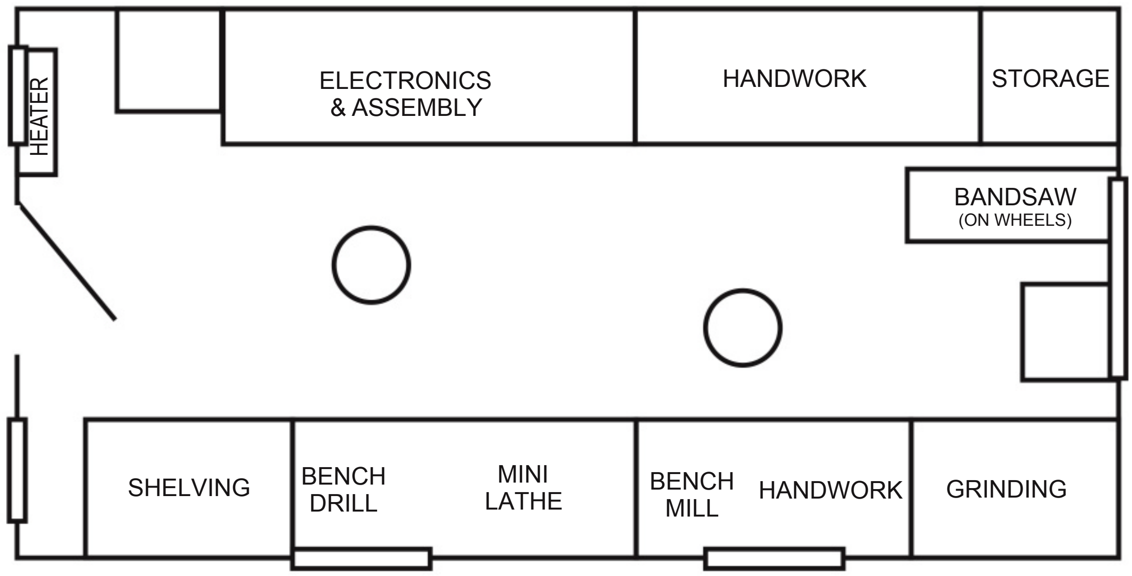


Figure 1. An example workshop plan – they don't have to be complicated to be useful.

When planning your workshop think about the main activities you will be carrying out. Even if you only have a small space, it's worth dividing it up into an area for assembling, adjusting and carrying out fine handwork and another section for machines like the lathe and mill. To make the most of your space, draw your workshop out to scale on squared paper and cut out pieces of card to represent each bench or machine, **fig. 1**. Some people even make little card models or use a computer design package (CAD), but whichever way you do the planning a little thought before you start moving things into place will bring its rewards in the long run.

One way of organising a workshop is, starting near the door:

- A 'clean' area for assembling and painting
- The handwork bench, usually with a decent vice and a reasonable clear space.
- The main metalworking machines: lathe, mill, pillar drill.
- A 'dirty' area for grinding and linishing, bearing in mind that grinders can produce a lot of dust.
- Storage on shelves or cupboards – allowing for future acquisitions!

Naturally, you can divide your workshop into as many areas as you like. Many people combine an interest in electronics with metalworking. If this is the case, it helps to have a special area set aside, as metal swarf is the last thing you want around circuit boards!

If you are doing a lot of painting or using spray paint an area screened off with an extractor fan will help prevent dust settling on fresh paint and keep down levels of solvent fumes. For occasional small work a temporary spray-booth or dust cover made out of a cardboard box is effective.

If you intend to carry out welding or brazing regularly you might set aside an area, clear of flammable materials and actively ventilated – not only to get rid of any harmful fumes, but to stop the build up of hot air. An insulated hearth is ideal for brazing and a steel topped bench that you can connect to the ground lead is best for most types of welding. If you only carry out these operations occasionally, it may be better to wait for fine weather and work outside.

Woodworking and metalworking can be uncomfortable bedfellows, particularly if you are serious woodworker who regularly uses routers, a wood lathe and other specialised equipment. Metalworking machines don't like sawdust, which gets oily and fills up places it shouldn't get to. Woodworking doesn't like oily swarf which spoils clean timber. If you can't find separate space for each activity, the alternative is to separate them in time, doing a good clean up whenever you go from one activity to teh other.

Things to Avoid

One of the biggest mistakes you can make is placing machines too close together. It's easy to forget how far the slides of a mill can move, for example, and you need to allow extra space on the side with the handle. Make sure that there is plenty of room for you to access all parts of each machine – even a mini-lathe can be an effort to move, but what if a half-tonne lathe is too close to the wall when you want to change a drive belt? Think ahead!

FREE PRIVATE ADVERTS

MODEL ENGINEER MODEL ENGINEERS' WORKSHOP

Save a stamp! You can now place your classified ads by email. Don't waste time scanning the form, just send the text of your ad, maximum 35 words, **meweditor@mortons.co.uk,** together with your full name and address, a telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses or website links to protect your and other readers' security security.

Tools and Machinery

- Myford Super 7 lathe mounted on the standard heavy duty base. Parker variable speed drive, 230V supply. Clutch poor on disengage. 4" chuck with int/ext. Jaws. Some extra parts. Collection only. £1000, ONO. **T. 01903 785968. Littlehampton.**

- VHM FV-320T universal milling machine. Imperial. 2MT spindle. High precision inclinable head. Table 24 ¾" x 6". Cabinet stand. Please phone for full details and photo. £400 or £450 with swivel vice. **T. 07989 212680. Southport.**

- Metalworker variable mini lathe spindle taper Morse 3, tailstock Morse 2 variable speed 100-300 rpm auto feed drive, also operators booklet various gears, £320 condition used, fully functional. **T. 01245 231812 Chelmsford.**

Myford ML7 on makers stand, 3 and 4 jaw chucks etc, £1325. **T. 01246 277357. Chesterfield.**

- Chester DB7V lathe circa 2013 with most of the original accessories. There is a bad connection or faulty switch, happened 3 or 4 times but a twiddle of the wiring inside solved it! £375 cash on collection. **01205 368276. Boston UK**

- Axminster c2a mini lathe, 300mm gap, 80mm 3 jaw, 100mm 4 jaw chucks. Axminster stand, fixed steady, 7 spare change wheels, carriage stop, eurotrade headstock bearing upgrade. £450. **T. 01304 614015. Sandwich, Kent.**

- 2" Whit taps, 2 of, £20 each. 1 ¼" End Mill Clarkson, new, £45. All plus p&p. **T. 02089 321093. N.W. London.**

- Inca Euro 260 bandsaw, 230V. 12 ½" x 12 ½" work plate. Stands 35" high. Fair condition. Collection only. £200 ONO. **T. 01903 785968. Littlehampton.**

Magazines, Books and Plans

- Model Engineer magazines from July 1948 to end 2022. Free to good home. Collection from Aylesbury. Years 199 to 2007 incomplete. **T. 07774 828328. Aylesbury.**

- Model Engineers numbers 4316-4471 (2008-2013, No. 4467 missing), free to good home, New owner collects from Gateshead area or arranges to pay for shipment. **T. 01914 140500. Gateshead.**

- Machinerys Handbook, Nineth Edition, £15. L.B.S.C 1000 County Class Drawings, £50, all plus p&p. **T. 02089 321093. N.W. London.**

YOUR FREE ADVERTISEMENT (Max 36 words plus phone & town - please write clearly)

❑ WANTED ❑ FOR SALE

Phone:		Date:		Town:	

Please use nearest well known town

Adverts will be published in Model Engineer and Model Engineers' Workshop.

The information below will not appear in the advert.

Name ....

Address ....

....

....

.... Postcode..............................

Mobile .... D.O.B..............................

Email address..

Do you subscribe to Model Engineer ❑ Model Engineers' Workshop ❑

Please post to:
ME/MEW FREE ADS, c/o Neil Wyatt, Mortons Media Centre, Morton Way, Horncastle, Lincolnshire, LN9 6JR
Or email to: meweditor@mortons.co.uk

Photocopies of this form are acceptable.

Adverts will be placed as soon as space is available.

Terms and Conditions:
PLEASE NOTE: this page is for private advertisers only. Do not submit this form if you are a trade advertiser. If you wish to place a trade advert please email Angela Price at aprice@mortons.co.uk

By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from Mortons Ltd. and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from Mortons Ltd: Email ❑ Phone ❑ Post ❑
or other relevant 3rd parties: Email ❑ Phone ❑ Post ❑

SILVER CREST
models

MARKET LEADER IN LARGE SCALE, READY-TO-RUN, LIVE STEAM

25 MODELS ONLY
OVER 75% ALREADY SOLD!

LNER A3 CLASS FOR 5" GAUGE

Order in the name and livery of your choice

£14,995.00 + p&p

The LNER A3

The world famous **"Flying Scotsman"** is probably the name that most readily comes to mind out of the 78 A3's that saw service on Britain's railways.

All locomotives received double chimneys by 1960 and subsequently most were fitted with German style "trough" smoke deflectors following complaints from drivers in respect to poor visibility. 4472 was the first steam locomotive to be officially recorded at 100 mph.

Also available with double chimney and smoke deflectors, in the livery of your choice.

The A3's saw service over most parts of the LNER system. The final locomotive, 60052 was withdrawn in 1966. Before the war the A3's were painted in LNER green livery, but carried unlined black 1939-45. They were re-painted in LNER green following the war. A majority of locomotives then carried BR blue livery before all were re-painted in BR brunswick green with orange/black lining. Early, or later, lion crests were carried according to period.

Request your free brochure today

Request your free brochure today by e-mail, telephone, or by returning the coupon opposite.

Telephone: **01327 705 259**

E-mail: **info@silvercrestmodels.co.uk**

Find more information at
www.silvercrestmodels.co.uk

The Model

This coal-fired model features three cylinders and outside Walschaerts valve gear. The copper boiler is silver soldered and hydraulically tested to twice working pressure, CE and UKCA marked. The body casing is assembled using etched brass sheet.

This development of this model has been supervised by our award winning professional engineer Mike Pavie and the batch is being built by the same manufacturer who supplied our much acclaimed Coronation Class locomotive.

The A3 Class model is supplied fully built and ready-to-run, painted and lined in either LNER green, or BR lined green. We will supply your choice of nameplate. As testament to our confidence in the quality of this model each locomotive will be supplied with a full 12 months warranty. All models will be subject to a pre-delivery inspection and boiler test. Our after sales service is considered by customers to be second-to-none.

Summary Specification

- Coal-fired live steam
- Silver soldered copper boiler
- Reverser
- Working drain cocks
- Stainless steel motion
- Safety valves
- 3 cylinders
- Boiler feed by axle pump, injector, hand pump
- Bronze cylinders with stainless steel pistons and valves
- Sprung axle boxes with needle roller bearings
- Piston valves
- Mechanical lubricator
- Outside Walschaerts valve gear
- Multi-element superheater
- Etched brass bodywork
- Choice of liveries
- Choice of nameplate
- Fully painted and lined
- Ready-to-run

Approx Dimensions:

- Length 74"
  Width 9.5"
  Height 14"
- Weight 105 kg

Limited Availability

We have reserved factory capacity for the manufacture of just 25 models. We may be able to increase this a little, but cannot guarantee additional stock availability. Once the batch is completed it is unlikely we will commission further production of the A3 Class for a number of years, if at all. For orders received now the model is scheduled to complete its build in June 2023.

Free p&p worth £195.00 if you order early.

We will offer free p&p on any order placed within 28 days as a thank you for your early order.

Delivery and Payment

VISA MasterCard

The order book is now open and you can reserve your model now for a deposit of just £1,995.00. We will request an interim payment of £5,000 in March 2023 as the build of your model progresses, a further stage payment of £5,000 in May 2023 and a final payment of £3,000 on build completion.

FREE BROCHURE REQUEST FORM

Please send, without obligation, my free 5" gauge "A3 Class" brochure.

Name: ____________________

Address: ____________________

____

____________ Post Code: ____________

Please send to: Silver Crest Models Limited
18 Cottesbrooke Park, Heartlands Business Park,
Daventry, Northamptonshire NN11 8YL

MEW

Company registered number 7425348