No.259

FITTING AN INVERTER - WHAT YOU NEED TO KNOW

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On the Editor's Bench

REMAP

More observant readers may have noticed that in the back pages of MEW we now have a new advertisement for REMAP. REMAP is a charity that uses the engineering talents of its many volunteers with panels across the UK to produce bespoke solutions to help disabled people with challenging tasks. A few people asked me for the story behind the athlete featured in the old ad, here it is:

Derek Derenalgi, a Fijian serving with the British Army, lost his legs in 2007 when the Landrover he was travelling in in Afghanistan was blown up by an anti-tank mine. But 15 months later he was picked as one of six members of the British armed forces to develop their sporting potential at a training camp in California. Derek was chosen not only for his sporting potential but for his strong mental attitude.

In 2011 Remap were asked by Battle Back to make a throwing frame for Derek to assist him in throwing the discus. The project was taken on by the South Bucks panel. Working with Derek's trainer, Alison O'Riordan, the panel designed a frame to comply with the rules and at the same time maximise his throwing potential. A key feature was footplates so that Derek's prosthetic legs could be anchored. The frame was made of aluminium for strength and lightness, weight being important for Derek because he was by now regularly competing abroad, and needed to be able to transport the frame easily.

The frame has worked very well for Derek, who is delighted with it and its impact on the distance he can throw. In June 2012 he competed in the European Games in Holland, and, using his Remap frame, won the gold medal. He went on to represent Great Britain at the 2012 Paralympics where he reached the final. Since this project for Derek, Remap has tackled many more sports projects, especially for throwers of discus, javelin, shot and clubs, with great success.

Some of the authors who write for MEW donate their fees to REMAP. If you would like to support or volunteer for REMAP, see their advert in the back of this issue, or **visit www.remap.org.uk**

Readers'Tips

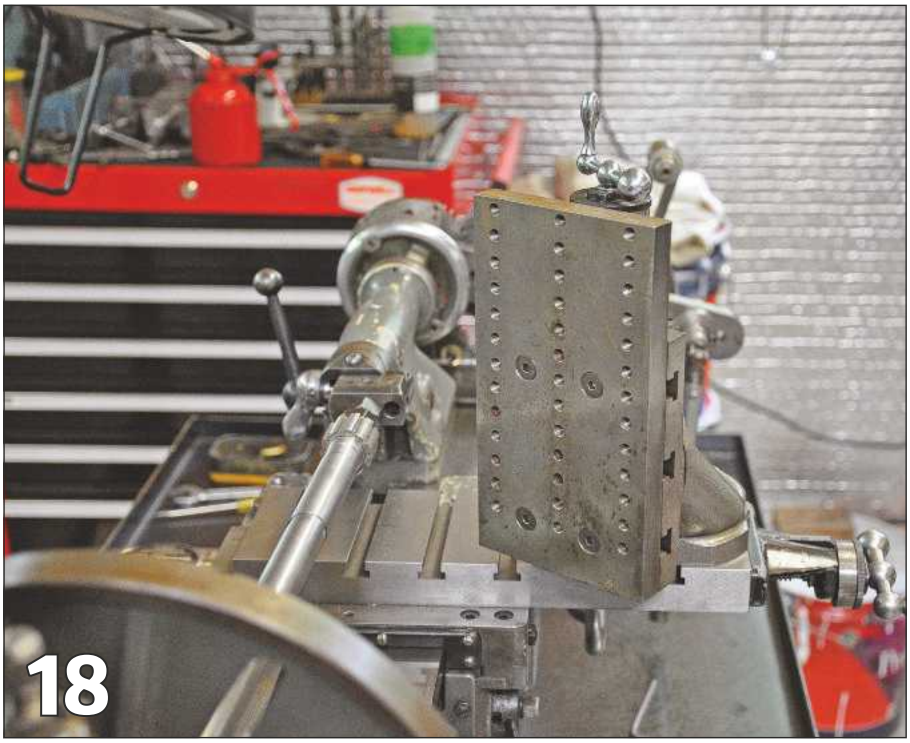
I've noticed over the last year that a greater and greater proportion of entries for the Readers' Tips in MEW have been coming from the same, relatively small, group of people! To encourage more entries from other readers the rules have changed so that "we reserve the the right not to award repeat prizes to the same person in order to encourage new entrants".

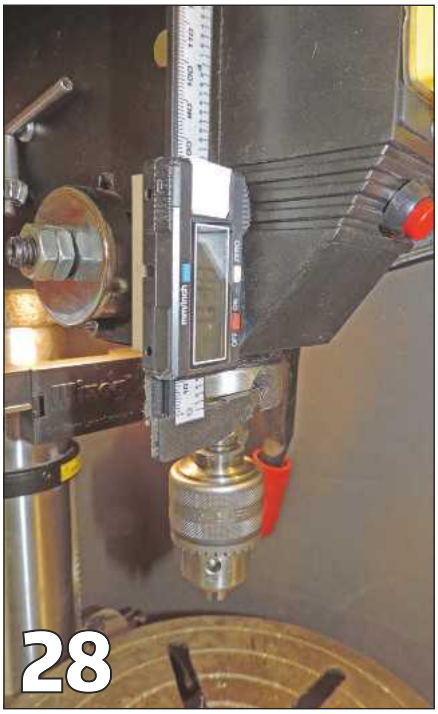
This doesn't mean past winners can't enter again, but we will be trying to choose winning tips from readers who haven't entered or won before.

So, if you haven't sent in a tip before, please consider doing so, because you have never had a better chance to win!

Ideally write me a couple of hundred words to describe your tip and include two or three photos.

Contents





See page 32 for details.

Coming up...

in our next issue

Coming up in our next issue, MEW 260 another rewarding read.

John Ashton makes a grinding head for the Acute Tool System.

Regulars

ON THE COVER »»

This month's cover features the readout fitted to Tony Bird's Myford lathe. Full details on page 9..

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THIS MONTH'S BONUS CONTENT

You can also visit our website for extra content and join in our online forum

See Jeff Thyer's Myford ML7 Gear Hobbing Attachment
Launch your favourite browser and enter www.model-engineer.co.uk/ hobber to see this device in action and also the results it produces.

Come and join one of the busiest and friendliest model engineering forums on the web at www.model-engineer.co.uk!

Effect of Tensioning a Boring Bar?

- Here's a debate that's still raging - is a boring bar with a tensioning rod up the centre really stiffer, or is it just less likely to chatter?

Electric Cars

- Are you a sceptic or do you already travel up and down the M1 in a Tesla roadster? Join the debate on the future of electric cars.

.Alba 2S NC Shaper

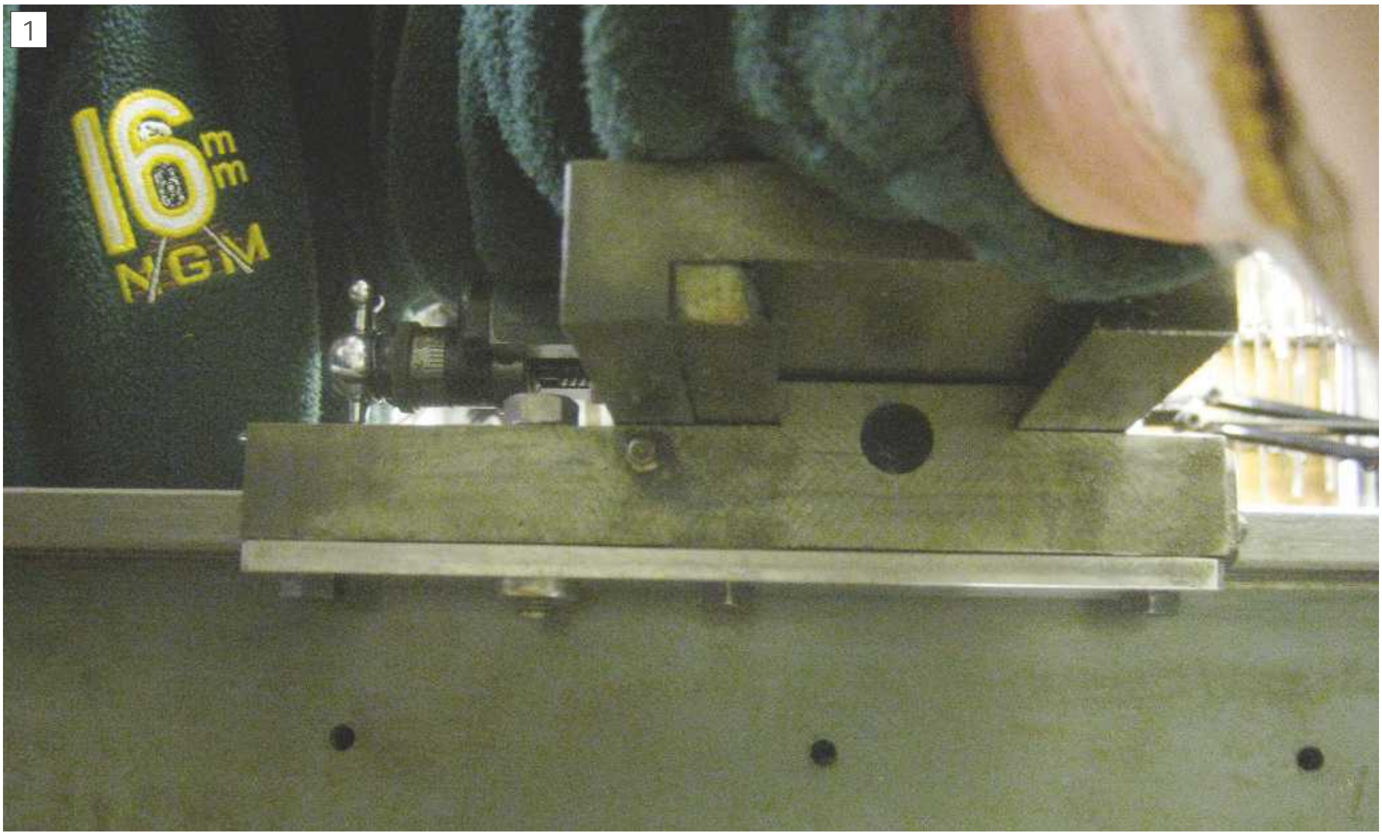
- You won't believe the speed with which Joseph Noci in Namibia has resurrected this rusty, battered machine and turned it into a workshop gem with full electronic control.

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

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

Digital Read Outs for a Myford Super 7

Tony Bird explains how he fitted a DRO to his lathe without having to drill holes in it.

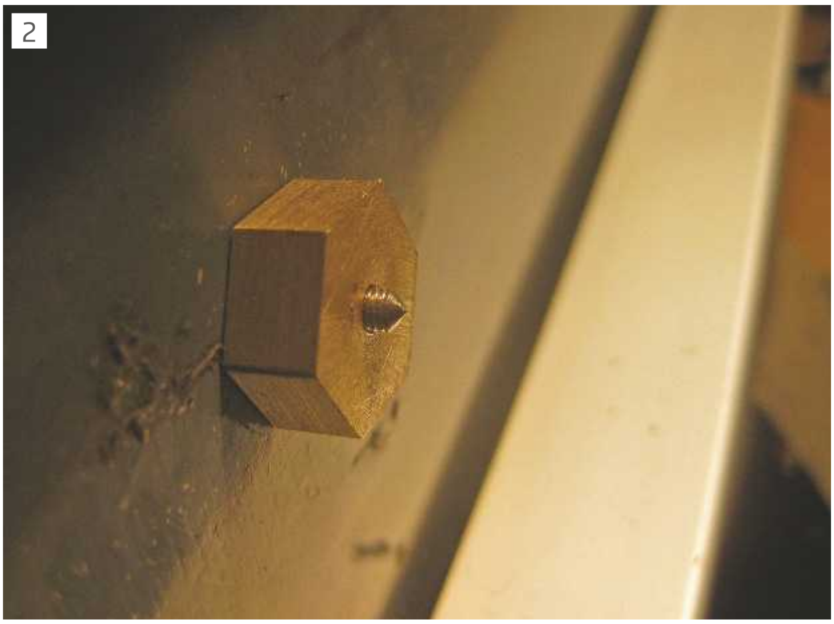


Threaded holes on the back of the lathe bed.

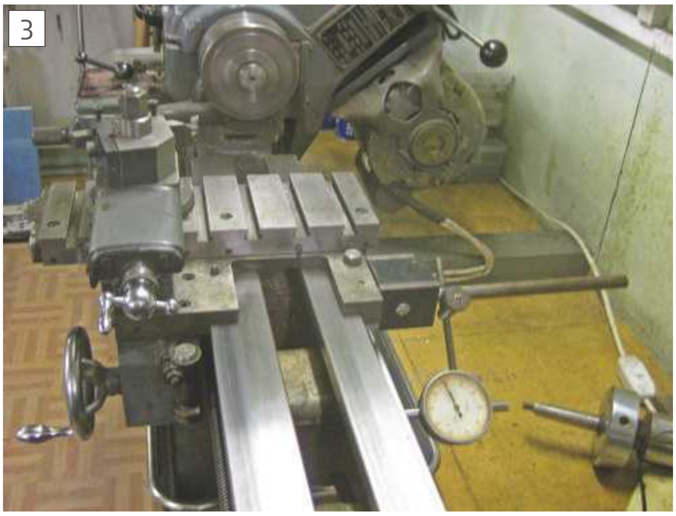
For some years, thought had been given to fitting a DRO to a Myford S7B lathe. The reason for the delay was that the linear scales then available, when fitted to the cross-slide, projected above it and covered the 'T' slot entrances on one side. Also, it did not allow any work piece mounted on the cross slide to overlap the side fitted with the scale. These older scales were of a fixed length so the nearest available stock length had to be bought which meant that unless the supplier already knew, you had to decide which size was suitable for your machine.

While visiting a model engineering exhibition in 2016 a new (to the author) DRO system was seen whose scales could be cut to length. These scales, an aluminium angle with a magnetic tape fitted, were lower in height than the cross slide of a S7B so wouldn't have the problem of projecting above it. A three axis DRO kit was purchased which consisted of a Digital Readout, 3 linear scales, 3 magnet encoders and a mounting kit.

The Digital Readout was fitted by its bracket to the wall behind the lathe. The fitting of the saddle's linear scale to lathe bed was fairly straight forward



Pointed screw for locating holes.



Checking alignment.

Clamping the scale for drilling.

using the threaded holes on the back of the lathe intended for mounting a taper turning attachment, **photo 1**. To hold the scale in place two ¼" BSF bolts drilled and tapped M3 were made. These bolts were screwed into the lathe bed and at one end of the scale a 3-mm securing hole was drilled. The other bolt screwed into the bed had a pointed threaded rod in it, the scale while being held in place by the other bolt was moved across the point to scribe the line for its other fixing point, **photo 2**. With the scale fitted a dial test indicator mounted on the saddle was used to check the scale was parallel in both planes to the bed, **photo 3**. Adjustments were made by facing off the higher of the two bolts for the one plane or elongating one of the securing holes in the scale for the other.

Initially it was thought that the linear scale fitted to the cross slide would be fitted level with it and cover the 'T' slots, however it was found that it could be mounted below the slots. The cross slide was taken off the lathe and its adjustment screws removed. It was found that a 3/8" HSS tool was a snug fit in the 'T' slots, so two were used with clamps to hold the scale in position while drilling its securing holes, **photo 4**. Unlike the saddle scale, because of the adjustment screws,clearance holes needed drilling and these were marked out using the pointed threaded rod system. After drilling, the scales height was reduced from 22-mm to 14-mm, **photo 5**. At this point the magnetic tapes with their protective covers were stuck to the scales and screws used to secure their ends, **photo 6**. The magnetic tape and its encoder have to be correctly orientated or they will not work, so the encoder was connected to the Digital Readout, then offered to the magnetic tape, if the LED fitted in the encoder is green it is correct, if red it isn't.

A start was made on fitting the encoder brackets, two of the three bolts that hold the rear saddle keep in place were used to hold some 2 x 2 x 1/8" aluminium angle that would support both encoder brackets. The mounting kit supplied consisted of two

Scale fitted.

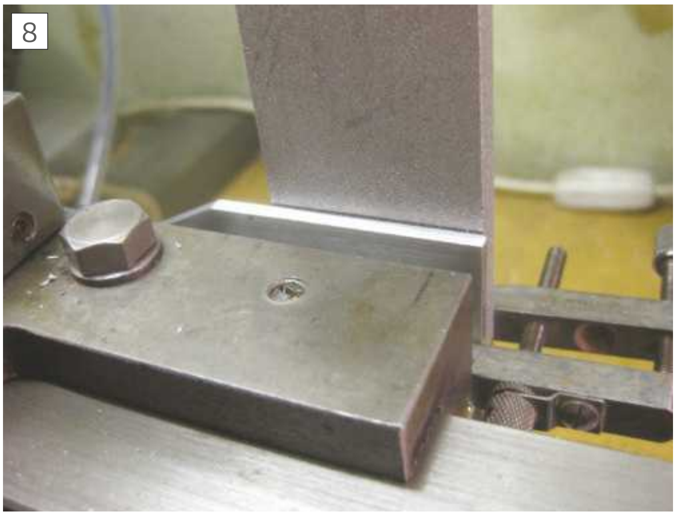
Magnetic tape clamped in place.

pieces of aluminium angle for the encoders, a long and short flat aluminium bracket and a range of M3 and M4 fixings. It was difficult to manipulate the encoders with their cables even when they were coiled, so some dummy encoders were made. One encoder angle was screwed to the end of the long flat bracket and a dummy encoder fitted to it, but it was found that the encoder would not line up with the magnetic strip of the linear scale, so some spacers were made.

The encoder assembly with its adjustments set in their mid-position was clamped with a piece of plastic for clearance to the saddles linear scale, **photo 7**. The long bracket of the assembly projected above and away from the rear of the saddle, this allowed two measurements to be made: the height of the bracket and the width of the aluminium angle which would support it, **photo 8**. The long bracket was cut level to the top of the saddle. Some 2" aluminium angle was cut to the width of the space between the bracket and the saddle plus the width of the saddle keep, the other side of it was cut so when in position it was also level with the top of the saddle. The saddle keep was removed and used as a drilling jig for securing holes in the aluminium angle, **photo 9**.

Encoder offered up to the scale.

The original saddle keep screws were used to hold the angle in place but it was found that because the saddle linear scale was so close to the saddle keep it wasn't possible to fit the angle with the scale in place. Because of this it was decided to make it possible to remove both the encoder brackets in one piece from the angle.



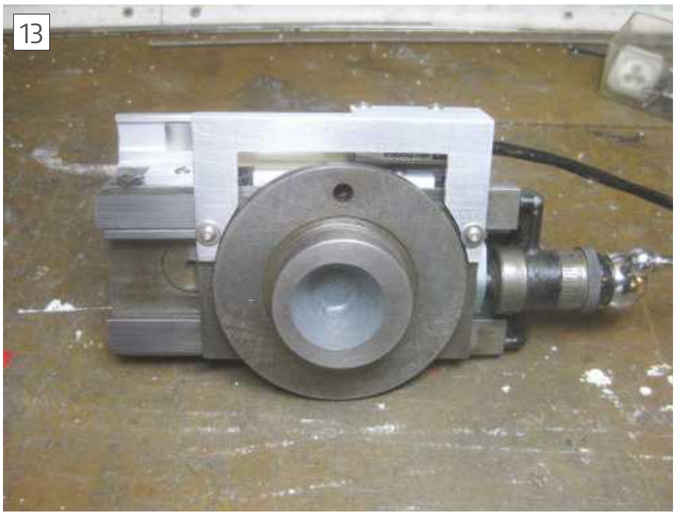
Fitting bracket.

Using saddle keep as a drilling jig.

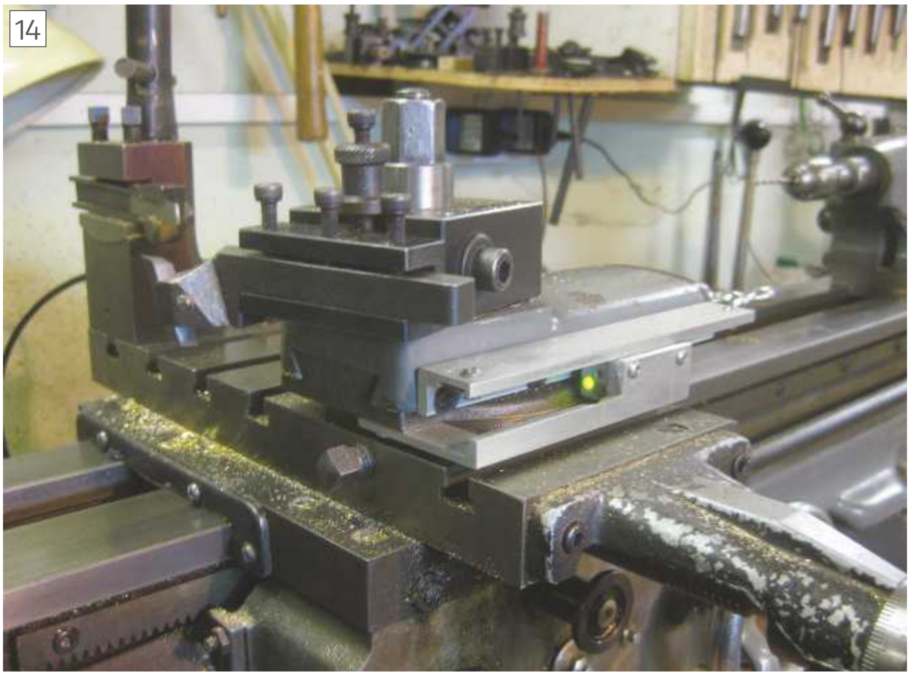
Aligning scale with cross-slide.

First two axes fitted.

Scale secured using aluminium blocks in t-slots.



Bracket for top slide scale.



Top slide scale fitted.

The whole system ready to go.

As long it was at the correct height it didn't matter where on the saddle keep angle the saddle encoder bracket was fitted however the cross-slide encoder had to line up with its linear scale. With the saddle encoder bracket removed the cross-slide encoder with its fittings was held against the saddle keep angle so that it lined up with the linear scale of the cross-slide above it, it was then held in place with screws, **photo 10**. With the cross-slide encoder removed the saddle encoder bracket was secured by screws symmetrically above the threaded holes that had held the cross-slide angle in position.

The saddle bracket and the saddle encoder bracket was removed from the saddle in one piece and the holes in the angle drilled to hold the cross-slide encoder were drilled through the saddle encoder bracket which allowed the cross-slide encoder angle to be fitted directly to it. The threads in aluminium angle which had been to hold the cross-slide encoder were removed.

Fitted with working encoders and the cables tidied up the DRO could now be used as a two-axis machine, **photo 11**. Before the fitting of the third axis a friend had asked 'as the fitting of the encoder brackets and the saddle linear scale hadn't needed holes drilled in the lathe would it be possible to fit the scale to the cross slide without drilling?' After some thought the idea of using two pieces of aluminium angle secured in the cross-slide 'T' slots by screws was decided on. The fitting of the linear scale being much the same as when it was fitted directly to the cross-slide, only countersunk screws had to be used to clear the saddle locking nut. This system also allowed the overhang of a work piece on the cross-slide the only down side being the loss of access to two of the 'T' slots, **photo 12**.

The fitting of the third encoder and linear scale to the top slide was similar to that of the cross-slide other than holes had to be drilled in the lathe for the screw fixings, **photos 13** & **14**. This DRO system works very well and the third axis fitted to the top slide has proved more useful than it was first thought, **photo 15**.

The DRO system used was supplied by EMS (International) Ltd. www.ems-i.co.uk. Other than the kit as supplied, for a two-axis system some 2 x 2 x 1/8" aluminium angle and some extra screws were needed, for the three-axis system a piece of 3 x 3 x 1/8" aluminium angle was also required. The author is not familiar with other suppliers' DRO products but some of the ideas used might be applied to them and possibly other lathes as well. ■

Readers' Tips

Keeping Your Cool(ant)

TIP OF THE MONTH WINNER!

Geoff Walker wins this month's Chester Vouchers with a tip for stopping coolant tipping.

This is my small coolant vessel for a lathe cross slide.

I would expect that most home workshop enthusiasts will have recycled used soft drink cans at some time or other. One use for the sides is shim stock and another for the base is a small coolant vessel. The latter will retain a small amount of coolant for brush application, such as in a parting off operation.

The vessel will often need to be as close to the workpiece as possible, with the end of the cross slide a favoured spot. A problem here is the base of the can is very light and even when filled with a small amount of coolant it is inclined slip around, which in the process of a machining operation is often annoying.

My solution was to drill a small hole in the centre of the base. The size of the hole is the root diameter of the threads on a small tee bolt. The tee bolt is "screwed" into the base of the vessel and then slid into a tee slot in the cross slide. The base can then be rotated to tighten it very lightly and secure it in place. As the base is domed on the inside there is an ample reservoir around the outer edges for the coolant.

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

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

Installing a Variable Speed Inverter

Fitting an inverter and motor package to a machine tool is one of those areas where expert advice never goes amiss. Joe Jordan from Transwave Converters gives a step by step guide to the process.

At Transwave we believe that a product should be just as easy to set up as it is to use so with that in mind we're going to walk through setting up an inverter, wiring the motor and the remote and finally running through some of the inverter settings so you can customise it to work how YOU want it to. The inverter package we'll be using here is our most popular package featuring the IMO Jaguar CUB inverter, a metric motor and an RCS remote control station.

So, after unpacking the contents you'll have an inverter, **photo 1**, (complete with intimidating million page manual), a motor, **photo 2**, (complete with unintimidating 4 page manual), and a remote, **photo 3**, (complete with intimidating wire with not-a-lot on the end of it). You'll also find some 4-core screened cable as well, **photo 4**. This is to connect the motor to the inverter which we'll get to soon. It looks like your mug is empty, so get some tea in there and let's get started.

The first step to fitting your shiny new motor to your machine is obviously to remove your old one. This will vary from machine to machine so take your time and be careful not to damage either the motor or the machine. Take a moment to reminisce on the good times you and the old motor shared and remember – cry not for what you lost, but smile for what you had.

The motor you have purchased should (if measured correctly prior to ordering) fit right in the space left by the old motor but before we do that we need to ensure that the motor terminals have been reconfigured. Your new motor is a dual voltage 3-phase motor wired for 415 volts, however the inverter outputs 240 volts so to get around this we need to change the wiring connections from 'star 415V' to 'delta 240V'. Now despite sounding like settings on an x-wings laser cannons – changing this configuration couldn't be easier. Simply unscrew the terminal block and you'll see 6 terminals with metal 'bridges' connecting the top 3, **photo 5**. Undo the nut on each and remove each metal link, then rearrange them to go straight down to the terminal below them, **fig. 1**, **photo 6**.

Now we can attach the screened cable to the other 3 terminals (U, V & W and earth) and then put it all back together. Now fit the motor in the motor-less void left by the original (gone but not forgotten) and that's the motor installation complete. More tea.

The next part of this adventure (I don't get out much) is installing the inverter itself. The inverter needs to be placed somewhere dry and relatively clean from swarf etc. The keypad should be accessible for programming and adjusting settings but the remote will be used for the bulk of operation so it can be placed safely out of harm's way.

The first part of installing the inverter (after deciding on its placement) is to connect the wires from the motor and the wires from the single phase supply, for this package you can use an ordinary 13A plug.

- Connect the wires from the motor to U, V, W and G (earth) coinciding with placement

1

IMO Jaguar Cub Inverter.

2

TEC three-phase motor.

on the motor terminals (e.g. U goes to U and so on)
- Connect the wires from the single phase supply Live, Neutral and Earth to L1(Live), L2(Neutral) and Earth/Ground(G)
- DO NOT CONNECT TO TERMINAL MARKED N- Seriously, don't!
- ENSURE NO CONNECTIONS ARE MADE TO THE TERMINALS MARKED "P+" and "N-". THESE TERMINALS ARE FOR BRAKING RESISTOR CONNECTION ONLY AND WILL CAUSE MAJOR DAMAGE TO THE DRIVE ... Seriously!

Now we can move on to testing (which is what my wife says I am). Using the keypad on the inverter test the start/stop feature and the variable speed potentiometer to ensure they're functioning. The buttons and the potentiometer are quite small and fiddly (which is what my wife...nevermind) but worry not – that's what the remote is for!

The inverter has many factory default settings which can be adjusted later but for now it's set up to run at a maximum frequency of 50Hz and a minimum of 0Hz with an acceleration and deceleration time of 6 seconds. All of these can be adjusted independently of each other later on but for now let's invite that lonely looking remote to the party.

Surprisingly the remote requires the most set-up, and is best worded as a list.
- On the inverter keypad - Press PRG/RESET
- Press FUNC/DATA
- Move up/down using the arrow buttons until F01 is displayed
- Press FUNC/DATA
- Move up/down using the arrow buttons until 1 is displayed
- Press FUNC/DATA – the display flashes SAVE and then shows F02
- Press FUNC/DATA
- Move up/down using the arrow buttons until 1 is displayed
- Press FUNC/DATA - The display flashes SAVE, and then shows F03
- Press PRG/RESET twice
- Turn off the power and wait for the display to go blank
- Connect the seven wires from the remote and the earth screen as shown below:

- Turn on the Power
- Press the start button on the remote
- The remote can now be used to start, stop, speed up, slow down, change direction, run, jog and make tea!
- Actually,- it can't make tea. Off you go then.
- Note – Should you need to incorporate a guard switch/limit switch so that the unit will not run unless this is closed then remove the pink wire from the PLC terminal and connect to one side of the switch, then from the other side connect the switch to terminal PLC. Easy really.

We're almost there now. The motor, inverter and remote are all connected and functioning as they should! The last part is to program and customise the inverter based on your machine and motor. This includes inputting information from the motor plate, the minimum and maximum frequency and the acceleration and deceleration times. All of these are of course explained in detail in the million page manual that was included with the inverter – however, to summarise:

We suggest that you set parameters P02, P03 and F11 to match the data from the motor rating plate
- Parameter P02 - This is where you input the kW rating of the motor
- Parameter P03 – This is where you input the full load current of the motor at 220-240V (usually the higher of the two current ratings on the motor plate)
- Parameter F11 - This sets the thermal overload to operate at between 20% and 135% of the inverter current rating. This again should be set to the full load current of the motor at 220-240V (usually the higher of the two current ratings on the motor plate)
- Parameter F37 – This should be set to 2 to ensure that the above three parameters function correctly.
- Parameter F01 - Drive Input for Frequency. This tells the drive what input to expect. The factory default is 4 and for Keypad/Potentiometer control this is the required value. If the drive does not respond to pressing keys on the keypad, check that this value is 4.
- Parameter F02 - Drive Input for Direction. This tells the drive in which direction to run. The factory default is 2. Should the motor be running in the wrong direction instead of swapping cables over you can change this setting to 3.
- Parameter F03 - Maximum Output Frequency. This parameter sets the maximum frequency. The factory default is 50Hz. Customers can change this to any value from 0 to 400Hz. Note that most motors are only designed to operate at a maximum of 60Hz. Note also that parameter F15 will also need amending if the factory default is changed.
- Parameter F07 - Acceleration Time. This setting determines the time taken for the motor to attain the frequency selected by the potentiometer in a controlled "acceleration ramp". The factory default is 6 seconds. If set to the drive defaults to 0.01.
- Parameter F08 - Deceleration Time. This setting determines the time taken for the motor to stop in a controlled "deceleration ramp". The factory default is 6 seconds. If set to 0.00 the drive defaults to 0.01 – DC Injection braking is available by setting parameter F22 - please consult IMO instruction manual.

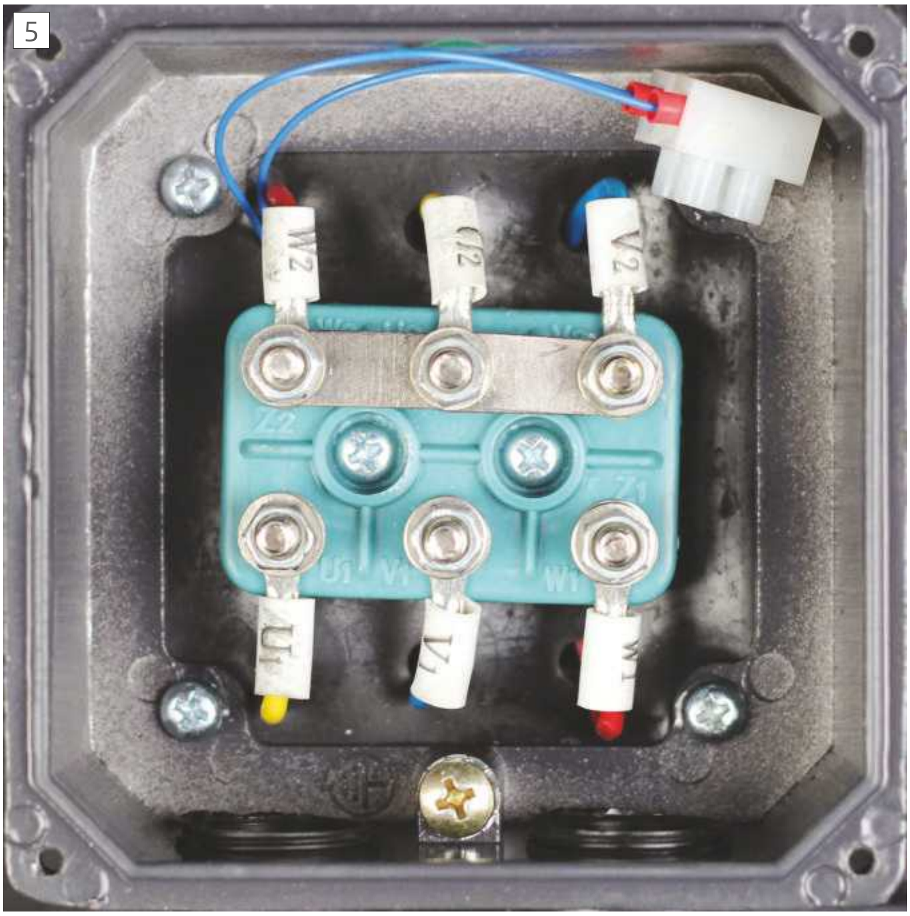
3

Transwave Remote Handset.

4

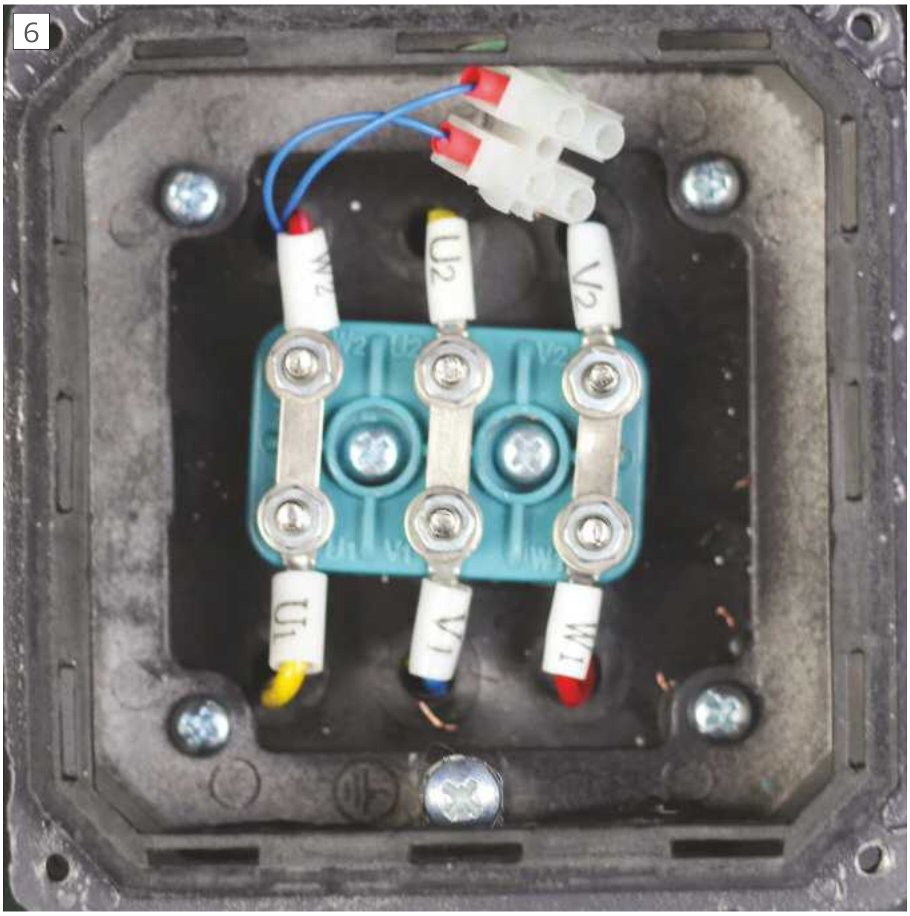
Shielded cable.

5



Motor in star configuration.

6



Motor changed to delta configuration.

- Parameter F15 - Maximum Frequency Limit. This sets the maximum upper limit the potentiometer will turn to. The factory default is 70Hz. If this is set higher than the value in parameter F03, parameter F03 takes precedent.
- Parameter F18 – Frequency Bias (Minimum Frequency). This sets the lower limit the potentiometer will turn to. The factory default is 0Hz. The value to be set here is the percentage of the maximum frequency set via F03/F15. For example, if the maximum frequency is set at 50Hz and you wish the minimum frequency to be 10Hz, Parameter F18 should be set at 20%. If, using the same example, the maximum frequency is set at 60Hz; the F18 parameter would be set at 16.67% to achieve a minimum frequency of 10Hz.

Run through all of those settings above to get the inverter just how you like it and then have a play around with it. Test it out and tweak as necessary. Of course, things might not always go to plan. Sometimes you'll change a setting and the inverter will act different to how you expect and you'll perhaps struggle to get it back to how it was before. If only there was a way to restore the factory default settings! Before that though, I spy an empty mug again.

Restoring the factory settings is so straightforward that even a baby (with a background in electrical and/or mechanical engineering) could do it. It simply involves using the keypad on the inverter. Such is the nature of a factory reset however that afterwards you'll need to input the settings for the motor, acceleration time, frequency etc. again.

- Disconnect all external remote control cables
- Turn on the power to the drive without running the motor.
- Press PRG/RESET
- Move the up/down arrow buttons until 1.H _ _ is displayed
- Press FUNC/DATA
- Move the up/down arrow buttons until H 03 is displayed
- Press FUNC/DATA (display shows 0)
- Press & hold the Stop button while pressing the up button until the display shows 1
- Press FUNC/DATA (display flashes SAVE)

And that's it. Your inverter package is all up and running with minimal explosions. Further details are included with your purchased package and Transwave are always available on the phone or email if you require any assistance or if you have any questions.

The package mentioned here is a Jaguar CUB5A-1 inverter with remote and a metric 0.75kW/1.00HP motor. This is available ex-stock from our Birmingham factory for £409 including VAT and Delivery to UK mainland. The Inverter includes a 5-year warranty, the remote and motor include a 12 month warranty. Why not give us a call on 0121-7084522 or email us at transwave@powercapacitors.co.uk. We're always more than happy to help. ■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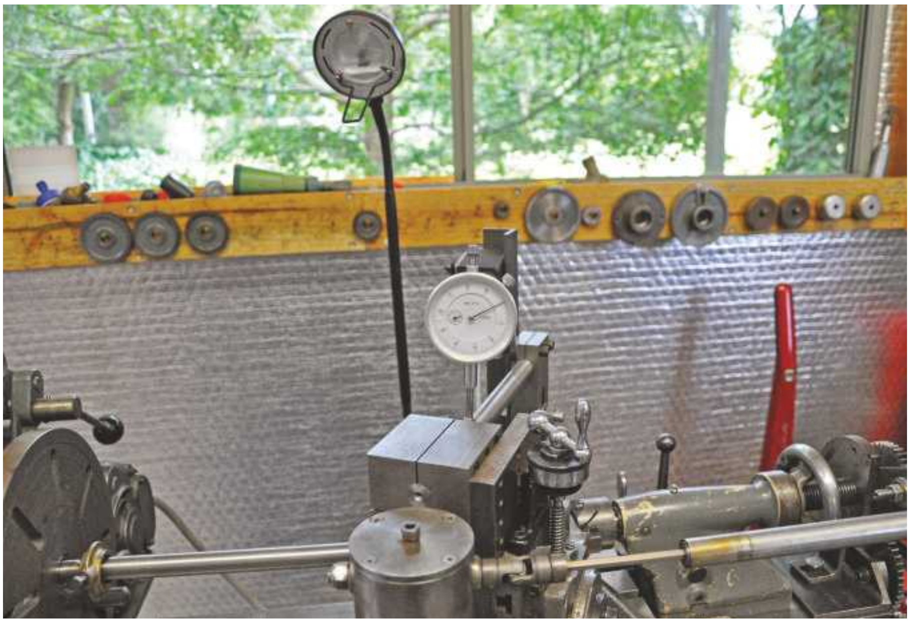
Making Gears on a Myford Lathe

Jeff Thyer, in Australia, describes his Involute Gear Hobbing Attachment for The Myford Ml7. Please note that for practical reasons, we have had to split the figures for this article across two issues of the magazine – Part Two.

Figures 1 to 3 show how the motion of the headstock is transmitted through the tumbler-reverse and the headstock change-gears, via the lead-screw to the 'transfer-gears' that have a fixed 1:1 ratio. The motion then proceeds via the 'tailstock change-gears' to the cardan shaft which transmits the motion of the final tailstock change-gear to the first mitre gear of the worm drive. Provided the relationship of the two universal joints is correct, and the input and output cardan shafts are set parallel, constant angular velocity will be preserved as the feed progresses. The ability to swivel the first mitre gear about the axis of the second mitre gear, and then lock it with a grub screw in a position where the input and output shafts are parallel, permits the vertical slide to be set to any left or right 'oblique angle' up to 45 degrees. Together the mitre gears with a 1:1 ratio transmit the motion to the two-start worm that drives the 20-tooth worm-wheel, which results in a 10:1 reduction in the motion. The worm-wheel then drives the spindle that drives the gear-blank arbour through an ER20 collet. The configuration of the 'swivelling worm-drive' and the 'spindle block' is shown in **fig. 4**. To achieve the flexibility necessary for the production of gears of various helix angles and diameters, and to allow the setup shown in fig. 3, the 'swivelling worm-drive' can be attached to the 'spindle block' in four different locations around the worm-wheel (see Photo Gallery).

The Hob Arbour

The arbour for the 32DP hob is 14.25 inches long and for approximately half its length is 1/2" in diameter to accommodate the bore of the hob, and there is a key way cut along this length. The other end of the arbour is 3/4" in diameter, the same as the boss on each end of the hob. By fitting a number of 3/4" collars with a 1/2" bore, the hob can be located at virtually any position along the half length of the arbour. It can then be locked in position against the 3/4" shoulder by the collars and the 1/2" nuts at the end of the arbour. Rotating the arbour and the hob end-for-end, allows the hob to be positioned at any point between the centres of the lathe and tailstock.



Setting the Depth of Cut (DOC).

Offsetting The Hob Arbour To The Hob Helix Angle

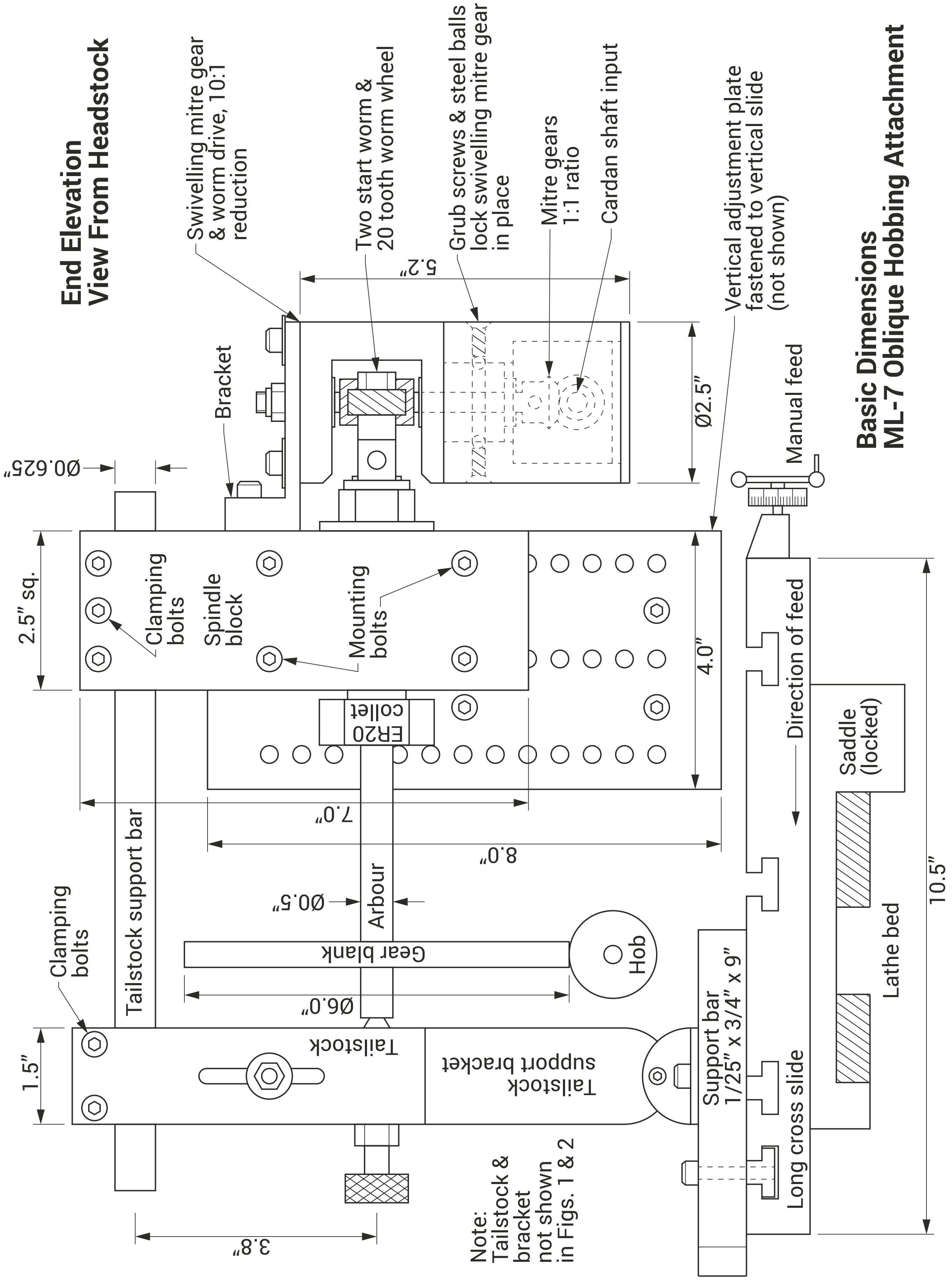
The hob arbour must be offset by the hob helix angle in a manner similar to the method used when turning a taper. To achieve this, rather than setting-over the tailstock, a boring head fitted with a hardened dead-centre was used. The helix angle of the 32DP hob seen in the photos is only 1.717degrees and to accurately set such a small angle it is necessary to resort to trigonometry and a Dial Test Indicator (DTI). Note that the boring head dovetails must first be accurately set to horizontal when it is locked into position with the draw-bar.

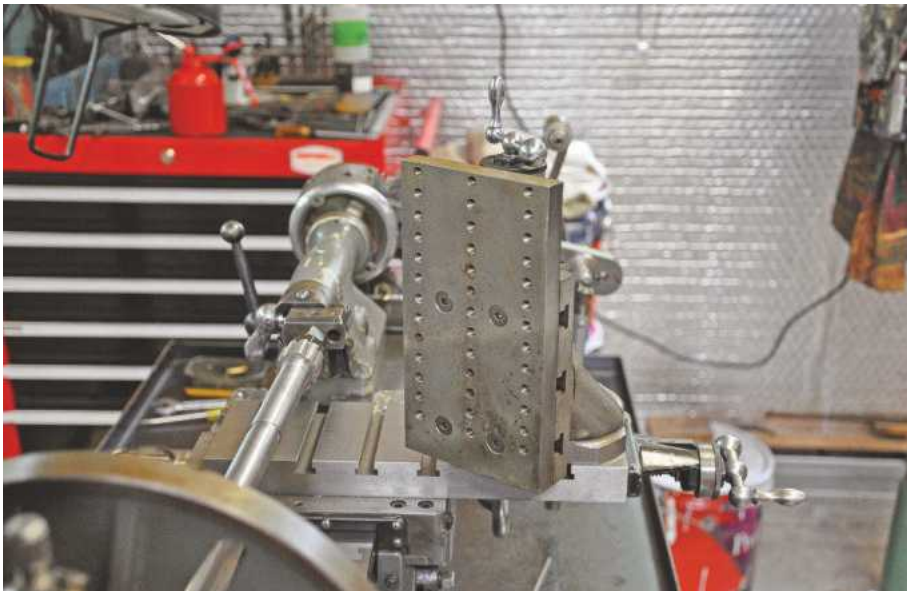
With reference to **Figure 5**, if the physical length of the hob arbour is 'L', and the helix angle of the hob is 'B', then the offset 'O' required to be set into the boring head is given by the equation O = L. sin(B). Therefore, the offset required for the 32DP hob is O=14. 25 x Sin(1. 717)=0.4269 inches. Once the calculated offset is set into the boring head using a DTI, the angle achieved can be checked by mounting a DTI horizontally on the lathe saddle and accurately measuring the displacement of the arbour over an accurate distance measured by the lead screw. If the travel of the saddle measured by the lead-screw is 'T', and the displacement measured by the DTI is 'D', then the achieved offset angle 'A' is given by the equation A=arctan(D/T). When this check has been applied, the achieved angle has usually been within two decimal places of the helix angle. If there is any significant difference between 'A' and 'B', trial and error and persistence will yield an accuracy to two decimal places (see fig. 5).

Although the same result could be achieved by setting-over the tailstock, in practice, the micrometer adjustment on the boring head, in conjunction with a DTI, greatly facilitates setting and fine tuning of the offset. In figs 1 to 3, and fig. 5, note that the respective hob helix angles of 4 degrees and 10 degrees were used for illustrative purposes only, and that the maximum helix angle likely to be encountered on a hob used in this attachment would be approximately 2 degrees.

Because the hob arbour is offset at the helix angle of the hob, the drive imparted by the faceplate and driving-dog does not result in a constant angular velocity for the hob. The relationship between the angular velocities of the headstock and the hob varies cyclically throughout each revolution

Fig.4


End Elevation
View From Headstock
Swivelling mitre gear & worm drive, 10:1 reduction
Two start worm & 20 tooth worm wheel
Grub screws & steel balls lock swivelling mitre gear in place
Mitre gears 1:1 ratio
Cardan shaft input
Vertical adjustment plate fastened to vertical slide (not shown)
Basic Dimensions
ML-7 Oblique Hobbing Attachment
Bracket
5.2"
Ø2.5"
Ø0.625"
2.5" sq.
Clamping bolts
Spindle block
Mounting bolts
4.0"
Manual feed
Direction of feed
ER20 collet
7.0"
8.0"
Saddle (locked)
Arbour
Ø0.5"
Gear blank
Hob
Ø6.0"
Clamping bolts
Tailstock support bar
1.5"
Tailstock
Tailstock support bracket
Support bar 1/25" x 3/4" x 9"
Lathe bed
10.5"
Long cross slide
Note: Tailstock & bracket not shown in Figs. 1 & 2
3.8"



The Vertical Adjustment Plate.

and is governed by the following equation (ref. 2):

$\omega_2/\omega_1 = \cos\beta/(1 - \sin^2\beta . \cos^2\gamma_1)$

Where:

ω_1= Angular Velocity of Headstock

ω_2= Angular Velocity of Hob

β = Offset Angle (equal to hob helix angle) (see Fig5)

γ_1 = Angle of the driving-dog passed 12 o'clock (see Figure 5 Insert)

From this equation it can be shown that when the offset angle is less than or equal to 2 degrees, at its maximum, the variation between the two angular velocities is less than +/- 0.06%. Put simply, this means that if the headstock was rotating at 500 rpm, the hob rotation would vary each revolution between 500. 3 and 499. 7 rpm. Because the helix angles of the hobs used in this attachment do not exceed 2 degrees, the error introduced into the gears produced can be considered to be negligible, and well within the limits required for model engineering.

Methods for Indexing the Gear Blanks

Indexing Method 1. As previously stated, using 'oblique feed' with a single-start hob producing 'N' teeth, on either a spur gear or on a helical gear, for 'N' rotations of the hob the blank must rotate once. The schematics in figs 1 to 3 show the attachment hobbing 25 teeth so there must be a 25:1 reduction between the rotation of the headstock and the rotation of the blank. If the headstock change-gears are set according to the Myford Chart for 25 threads to the inch, when the headstock (and hence the hob) makes 25 revolutions, the lead screw of eight threads per inch will make eight revolutions. If the tailstock change gears were set to a 1:1 ratio, then because of the 10:1 reduction of the swivelling worm-drive, the gear-blank arbour would make only 8/10 or 0.8 of a revolution instead of the one full revolution required. Therefore, the tailstock change-gears must be set to give a 5:4 or 10:8 ratio increase (i. e. Drivers/ Driven = (8/10) x (5/4) = 1). The required 5:4 tailstock change-gear ratio can be achieved using Myford gears with a ratio of 25:20, 50:40, or 75:60. So, with only access to the standard set of Myford change gears, if any of these combinations are available after the headstock change-gears have been set for the desired threads/inch, then the required number of teeth can be hobbed using this method.

Indexing Method 2. Alternatively, the required reduction ratio between hob and blank can also usually be achieved by mounting a compound or simple gear train in any combination of the available Myford change-gears, on either the headstock and/ or tailstock change-gear banjos. In fact, using this method, almost any number of teeth can be produced (except prime numbers). Careful selection of the worm and worm-wheel ratio will aid in the mounting of change gears. For example, a 10:1worm-gear reduction when producing say 39 teeth (not available on Myford chart) would require change gears giving an additional reduction ratio of 3.9:1, this could be solved in the following manner:

3.9/1 = 39/10 = (13X3)/(5X2) = (65X30)/(25X20)

One solution for this example gives change gears on the headstock banjo of 25 driving 65, and on the tailstock banjo of 20 driving 30, of course with the inclusion of suitable idle gears. So a worm-wheel that introduced certain prime numbers to this equation could complicate the mathematics.

Prime Numbers. Of course, no indexing will permit the hobbing of prime numbers of teeth unless a differential is introduced into the gear train on the tailstock banjo, or unless an additional change-gear with the required prime number of teeth is available.

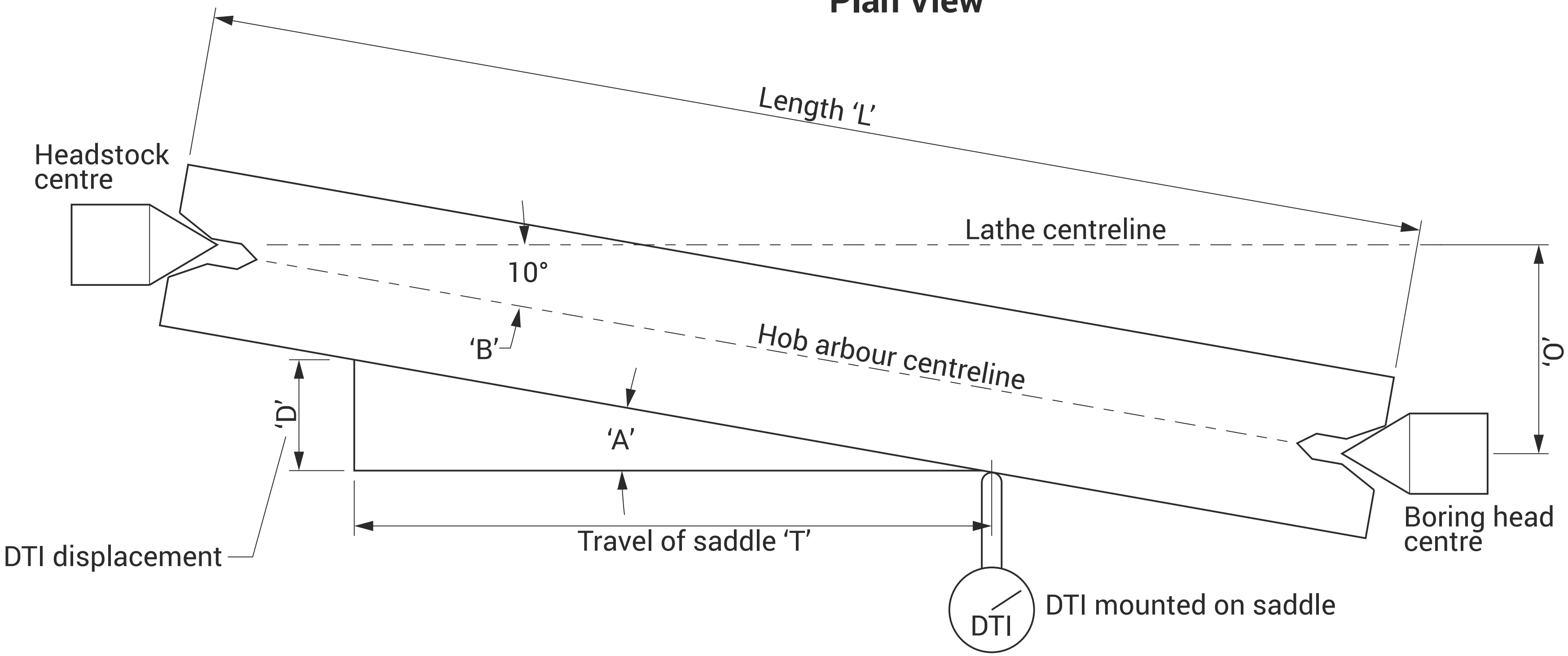
Gear-Blank Driving-Spindle and Arbour

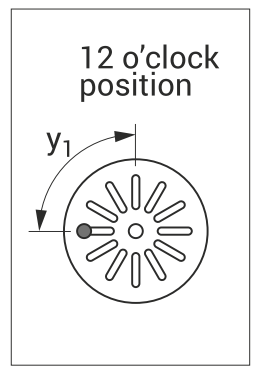
The gear-blank spindle must be driven by a worm and worm-wheel that permits no back-lash. In support of this requirement

Mounting options for the Swivelling Mitre-Gear Worm-Drive.

Fig.5

Offsetting The Hob Arbour To The Helix Angle
Plan View



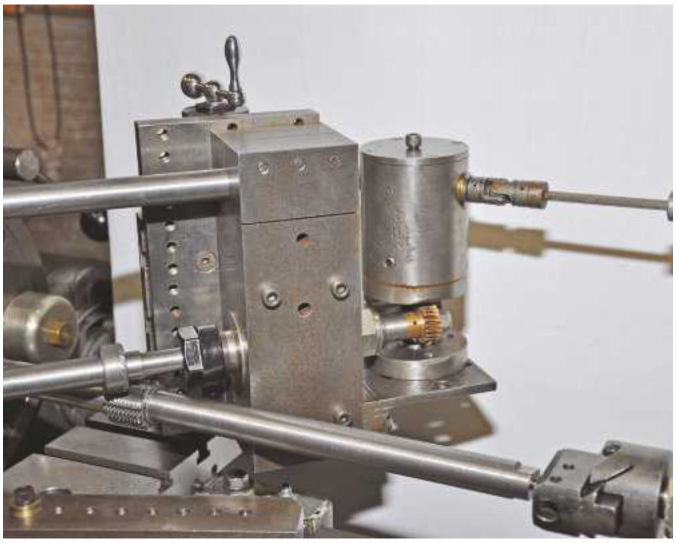


Faceplate & driving dog insert

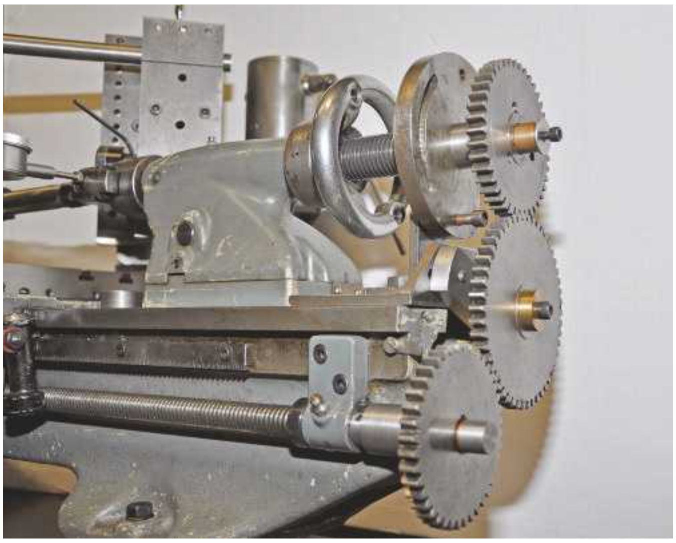
Stage 1 Offset 'O' calculated from equation O = L.Sin(B)
(where 'B' = helix angle of hob & 'L' = length of hob arbour)
Stage 2 Actual angle achieved 'A' calculated from the equation A = arctan(D/T)
(where 'D' = DTI displacement & 'T' - travel of the saddle)

If angle 'A' is not equal to 'B' use trial & error to achieve the correct angle.
With persistance, accuracy to two decimal places is possible.

Note 1: A procedure similar to Stage 2 is used to set the 'oblique angle' to the gear helix angle on the swivelling vertical slide when hobbing helical gears
Note 2: 10° used for illustration only. Usually <= 2°



Rear Set-Up, 22tooth, 32DP, 45deg RH helical gear.



Transfer Gears & Banjo-Arm Locking Plate.

the worm-wheel should have a diameter as large as can be accommodated, but if this results in a large number of teeth then a multi-start worm should be employed to reduce the resultant reduction ratio to a manageable level. Note that with a single start worm, to produce gears with less teeth than the number of teeth in the worm-wheel, the headstock and tailstock change-gears will have a combined ratio greater than 1:1, which is undesirable. The spindle is mounted in two automotive taper-roller axle-bearings that permit no end float. Each of these bearings can act as a thrust bearing, thus permitting the gear blank to be either pushed or pulled over the hob by the spindle.

The spindle is equipped with an ER20 collet that can accommodate gear-blank arbours up to 1/2" in diameter. To support the arbour the spindle-block also has provision for an overhead tailstock, the outer end of which can also be supported by a substantial bracket mounted on the rear of the cross slide (see figs 3 & 4). This results in excellent rigidity along the axis of rotation of the gear blank. Of course, when producing worm wheels using a radial feed, the supporting bracket cannot be used, so a short gear-blank arbour to reduce overhang is recommended.

The Vertical Adjustment Plate

The spindle-block is bolted to a 'vertical-adjustment plate' that is fastened to the vertical slide T-slots. The plate has a pattern of 39 threaded holes in three vertical columns (see fig. 4 & photos). This allows the spindle-block to be positioned vertically on the plate in order to produce larger diameter gears whilst, in the interest of rigidity, still having the full length of the vertical-slide dovetails engaged. The spindle block can also be mounted to the left or right of the centre column of holes in order to prevent the ER20 collet nut or the corner of the spindle block from coming into conflict with the hob arbour when swivelling the vertical slide to produce helical gears.

Setting the Vertical & Horizontal Axes of the Swivelling Vertical Slide

The Horizontal Axis. The Myford vertical slide swivels around a horizontal as well as a vertical axis, so to ensure that the setting for the DOC is accurate, the horizontal axis must be accurately set to zero with a DTI so that the 'Z' axis feed is vertical. To avoid disturbing the setting of the 'oblique' angle on the vertical axis, setting the horizontal axis to zero should be done first.

The Vertical Axis. An accurate helix angle on meshing helical gears is critical to shaft alignment, to minimising wear, and to quiet running. Therefore, the setting of the 'oblique' angle between the axis of the blank and the direction of feed is also critical. Initially, this can be set to a close approximation using the scale on the base of the swivelling vertical slide; however, for an accurate setting, once again trigonometry and a DTI is the best solution. With a DTI positioned horizontally against the gear-blank arbour, the cross-slide is fed an accurate distance and the displacement of the DTI noted. A trigonometric calculation will then reveal an accurate value for the angle set, and this must then be adjusted to the correct value. Unfortunately, because of the spatial relationship between the axis of rotation of the swivelling vertical slide and the axis of the gear-blank arbour, trial-and-error seems to be the only method that can be employed. With persistence, accuracy to two decimal places is possible.

Setting The Depth of Cut (DOC)

After the gear blank is fitted to its arbour, and the arbour tightened into the ER20 collet and then mated with the supporting tailstock, the vertical feed that sets the DOC can be set to zero. This is accomplished by lowering the blank until it just comes into contact with the teeth of the rotating hob. Then, with the blank withdrawn from contact with the hob using the cross slide, a DTI positioned vertically over a suitable reference point allows the DOC to be set.

Once set, the vertical slide can be locked and the tailstock support bracket fitted and tightened, ensuring that during these two operations the DTI reading is monitored to confirm that the DOC setting is not disturbed. Note that the required DOC can be found inscribed on the hob (sometimes labelled D+f), or knowing the DP, it can be calculated for spur and normal-helical gears using the following formula:

DOC = (2.2/DP)+0.002 (inches)

The Tailstock Banjo Arm and Change Gears

The tailstock banjo arm and the final transfer-gear, which is compounded with the first change-gear, are all mounted on the outer end of the lathe tailstock, concentric with the spindle axis, on a specially designed draw-bar that also secures the boring-head. The long banjo arm, in conjunction with its supplementary arm, permits a large number of simple, compound, and/or idle-gear combinations to be mounted. The geometry of this arrangement allows the banjo arm to be rotated into any position around the tailstock axis so that, if the tailstock change-gears include suitable idle-gears, the cardan shaft can remain virtually linear regardless of the diameter or helix angle of the gear being produced. The banjo arm can also be rotated to the rear of the lathe and the attachment operated in the configuration shown in fig 3. This is safer because it keeps the rotating cardan shaft and tailstock change-gears gears away from the operating position, and it can be used for the production of most gears.

The Tumbler Reverse

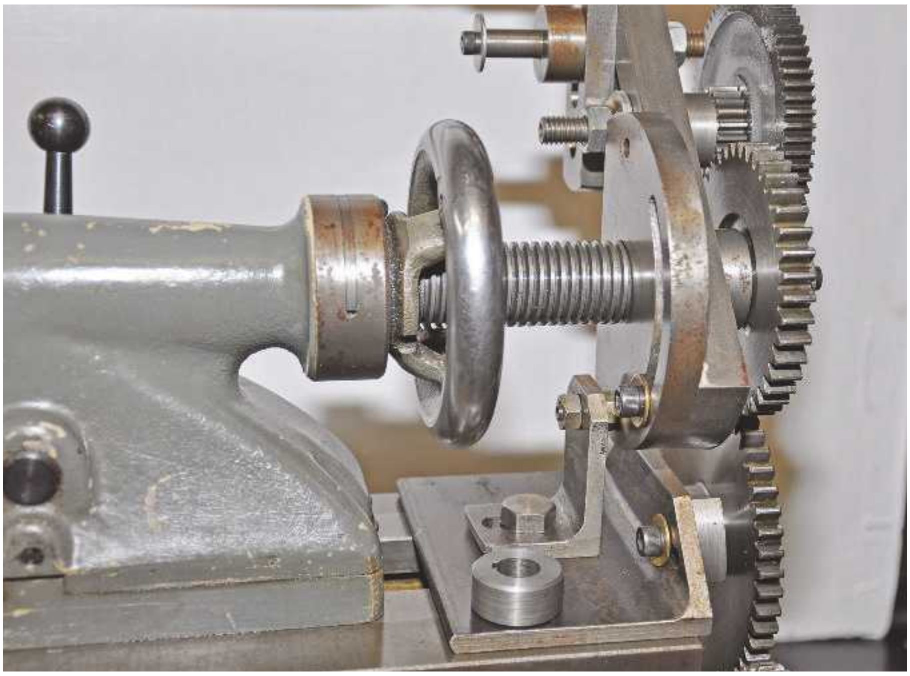
Once all the required change-gears (headstock & tailstock) have been mounted, the rotation of the gear blank relative to the hob may need to be corrected with the tumbler reverse of the lathe. With reference again to figs 1 to 3, with the lathe running forward the hob will rotate anticlockwise when viewed from the lathe tailstock. Therefore, with a right-hand hob the blank must rotate clockwise when viewed from the feed dial of the cross slide. In simpler terms, if the hob and blank are considered as a worm and worm-wheel in mesh, the required relative motion becomes obvious once the lathe is set in motion. Note that the bottom of the blank is fed across the top of the hob.

Positioning the Lathe Saddle

Within the limitations of the spline of the cardan shaft, the saddle can be moved along the lathe bed to bring the gear blank into the desired position above the hob; accordingly, the limitations of the spline must be considered when positioning the hob on its arbour. In simple terms, the centre of the axis of the blank should be positioned above the centre of the hob. However, when attempting to spread the wear along the length of the hob, care must be taken to ensure that the truncated teeth at each end of the hob are not engaged in the generation process. Once positioned, the saddle should be locked and precautions taken to ensure the half-nuts are not accidentally engaged during the hobbing operation when the lead screw will be rotating.

Gear Blank Dimensions

Because the Myford ML7 is calibrated in Imperial units, and because some Diametral Pitch (DP) hobs were available, DP logically became the method for dimensioning gears. However, all that is required to produce module gears, with either a 'metric' or 'imperial' lathe, is a module hob, the gear blanks to be turned to the correct metric dimensions, and if necessary, the DOC converted from millimetres to inches.



Transfer Gears, Banjo-Arm, and Locking Plate.

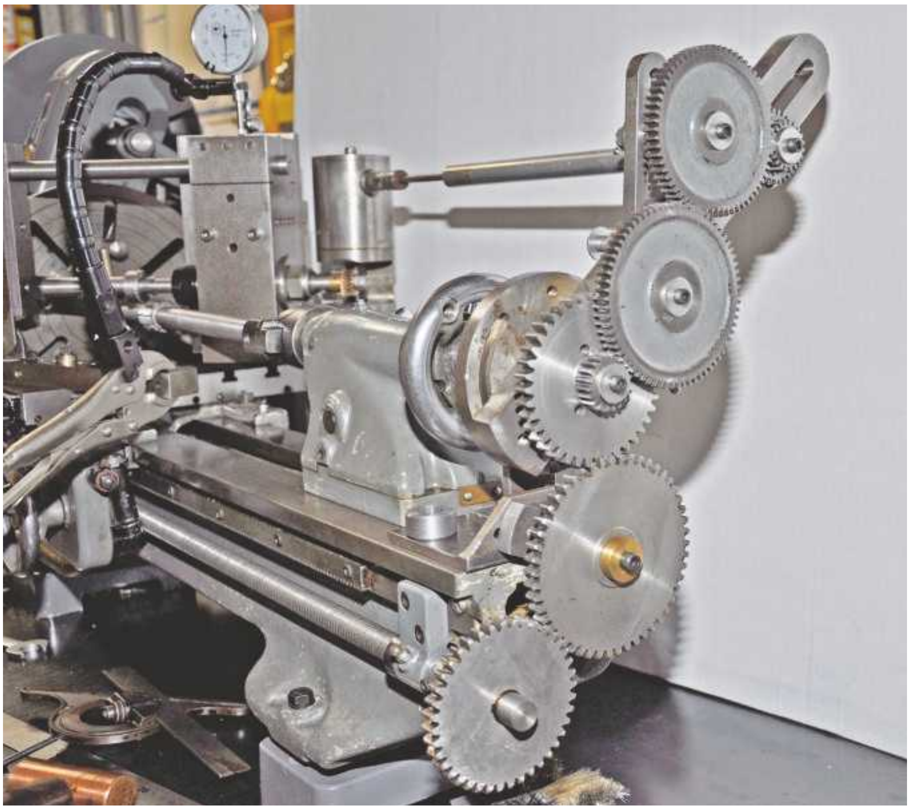
For those interested, ref. 3 provides a reasonable explanation of the differences between 'Transverse DP' and 'Normal DP' helical gears. Suffice to say that helical gears produced with the same hob that is used to produce spur gears are considered to be 'Normal DP' Helical Gears, and they have a larger diameter than a spur gear of the same DP with the same number of teeth. Equations for the dimensioning of DP gears are available from many references, but as a starting point, the relevant equations are as follows:

Spur Gear Outside Diameter (inches) = (N+2)/DP

Helical Gear Outside Diameter (inches) = ((N/cosH)+2)/DP

Where:

N=number of teeth, DP=Diametral Pitch of Hob, H=Helix Angle of Gear.



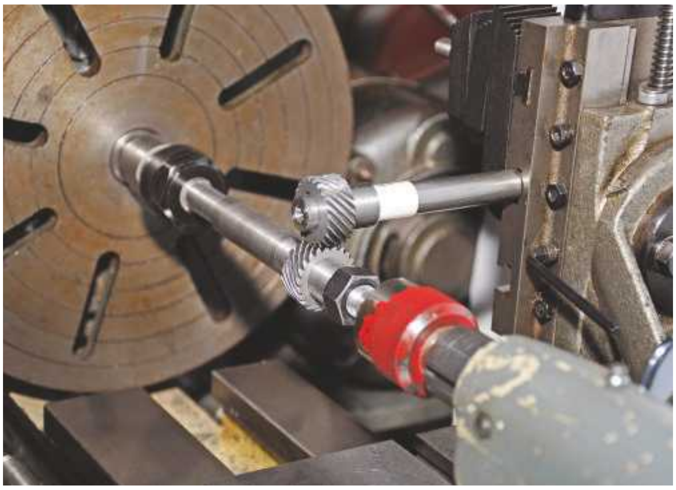
Tailstock Change Gears set for hobbing 22 teeth (rear set-up).

Cutting Speed, Feed, Feed Rate and Depth of Cut

Most authoritative references state that hob wear is reduced, but surface finish suffers, if a 'climb-milling' feed is employed. Although climb milling could be undertaken by reversing the feed direction shown in Figures 1 to 4, the limited rigidity in the attachment, and the backlash in the cross-slide feed screw, both favour 'conventional-milling'. Using conventional milling, in order to avoid chatter, it has not been necessary to reduce the DOC to less than the full depth required - this reduces hob wear and production time because multiple cutting passes are not required.

The 25 tooth, 32DP, 25 degree helical gears in the photographs were made from 1214 free-turning mild steel that permits very high cutting speeds. In practice, the feed was conducted at the full DOC of 0.071", with the lathe run in the lowest back-gear setting of approximately 50 rpm, and the feed restricted to 0. 015" per revolution of the blank. The 22 tooth, 32DP, 45 degree helical (spiral) gears in the photographs were made from 1020 mild steel, and were hobbed at speeds from 70 to 130 RPM with a reduced feed of 0. 010" per revolution of the blank. The rigidity of the attachment coped very well with these parameters and produced no noticeable chatter and a good finish.

With the Hob running at 50 rpm the blank was rotating at 2 rpm which, with a feed of 0.015" per revolution, resulted in a feed rate of 0. 030" per minute. Therefore,



Two 22tooth, 32DP, 45deg RH helical gears meshed in a 90deg drive.

Two 25tooth, 32DP, 25deg LH & RH helical gears, and one 22tooth, 32DP spur gear all in mesh.

32DP gears of 25 teeth with 1/2" face width, in theory, would take approximately 17 minutes to produce. In practice, it took a little longer because the swarf had to be removed with a bronze-wire tooth brush and cutting oil applied, so the feed was not advanced after each and every rotation of the blank. Obviously, production would be quicker, and probably finish would be improved with a good suds system to flush and lubricate the process.

Shortcomings of the Attachment

The principle shortcoming of the attachment is the limited rigidity of two components. First, the length of the hob arbour permits a certain amount of flexing that can lead to chatter. Second, there is an unavoidable degree of overhang in the mounting of the vertical adjustment plate and the spindle block on the vertical-slide, and the mounting of the vertical-slide on the cross-slide. This results in rotational flexing about the feed axis of the cross-slide, and this can only be minimised by tightening the cross-slide gib-strip. This overhang is most pronounced when producing spur gears, but with careful consideration of the setup for helical gears, the blank can be positioned closer to the centreline of the cross-slide thus reducing the overhang. Note that the heavy construction of the spindle block, the vertical adjusting plate, the swivelling worm-drive, and the Myford vertical-slide, together probably serves to dampen some of the tendency to chatter. The chatter resulting from these shortcomings can be reduced to an unobservable level if the feed rate and cutting speed are restricted, although this leads to longer production times. Note that feed rate has a greater adverse effect on chatter than cutting speed.

Assembling the attachment can be laborious because there are no accurate setting scales, so all settings must be done with a DTI, and the accuracy of some must be checked with trigonometric calculations. This lengthy process exacerbates another shortcoming that was learned from experience. Fitting this attachment renders the lathe unusable for its primary purpose so, to avoid duplication of effort, it is important to ensure that all gear blanks, arbours, key-ways, and fittings that require the use of the lathe have been produced before the attachment is setup.

Finally, the oblique feed process is inherently inflexible and is used industrially principally to produce large quantities of just one gear where the machine can be designed accordingly. This shortcoming is evident in the difficulty (impossibility) of setting up the attachment for both left and right helical gears of greater than 45 degree helix angle. Also, on this attachment it would be difficult to eliminate the varying angular velocity of the hob without considerable effort in designing and making a constant velocity joint to drive the hob arbour.

Design Improvements

The most effective design improvement would be to mount the attachment on a lathe that is more robust than an ML7, particularly one with significantly wider spaced cross-slide dovetails. Unfortunately, despite considerable thought, no means of bracing the ML7 cross-slide against rotational flexing has come to mind. However, the length of the hob arbour could be reduced by moving the tailstock closer to the headstock and mounting the tailstock banjo arm and change-gears on an extension of the tailstock spindle. With the extension locked in place by a lengthened draw-bar, the spindle-extension could be supported by the lathe fixed-steady locked to the outer end of the lathe bed. How much the arbour could be shortened is governed by the need to keep the full length of the saddle engaged on the lathe bed when positioning it as close as possible to the headstock, but a reduction of at least four inches is possible. A shortened hob arbour would also result in greater engagement of the boring head dove-tails when offsetting to the hob helix angle, thus resulting in slightly less overhang with a consequent minor improvement in rigidity. Of course, a longer cardan shaft might also be necessary.

For those with the necessary skills, all the change gears, banjo arms, mitre gears, and cardan shafts could be eliminated by driving the worm with a stepper motor controlled by a suitable computer program referenced to the rotation of the hob. Not only would this simplify construction, but it would also permit prime numbers to be hobbed with relative ease.

Conclusion

There is nothing original in the design of this attachment. The oblique feed process has been in existence since the earliest hobbing machines, and the basic configuration of the attachment was inspired by an article in a 1990's Australian model engineering magazine that has unfortunately been lost. Of course, the best attribute of the attachment is that, without the need for a dividing head, it can produce almost any number of teeth with just one hob while using only the standard set of Myford change-gears. Finally, with the exception of the transfer gears (found in a bargain box), the worm and worm wheel, the universal joints, some nuts and bolts, and a number of bearings, all of which can be obtained quite cheaply on eBay, the rest of the attachment was made on the ML-7.

In truth, much of the design was just an interesting project for a newly acquired CAD capability, and its construction was the first major foray into model engineering, and the first serious project for a newly acquired ML7. Since the design of this attachment could be adapted to any lathe, a 'construction series' is inappropriate, but to give some idea of scale some basic dimensions have been included in fig. 4 which was adapted from a design drawing. ■

References:

1. DYNAMIC ANALYSIS OF THE CUTTING FORCES IN GEAR HOBBING by Ali M. Abood, BSc. School of Mechanical and Systems Engineering University of Newcastle upon Tyne, UK, December 2002. PhD Thesis. 'Methods of Hobbing', p11-20. http://hdl. handle. net/10443/983

2. Wikipedia. Universal Joint. 'not a constant velocity joint'. Equation of Motion. https:// en. wikipedia. org/wiki/Universal_joint

3. KHK Stock Gears. Transverse versus Normal DP Helical Gears. http://khkgears. net/product-category/helical-gears/ and,
http://khkgears. net/product-category/ helical-gears/technical-information-of- helical-gears/

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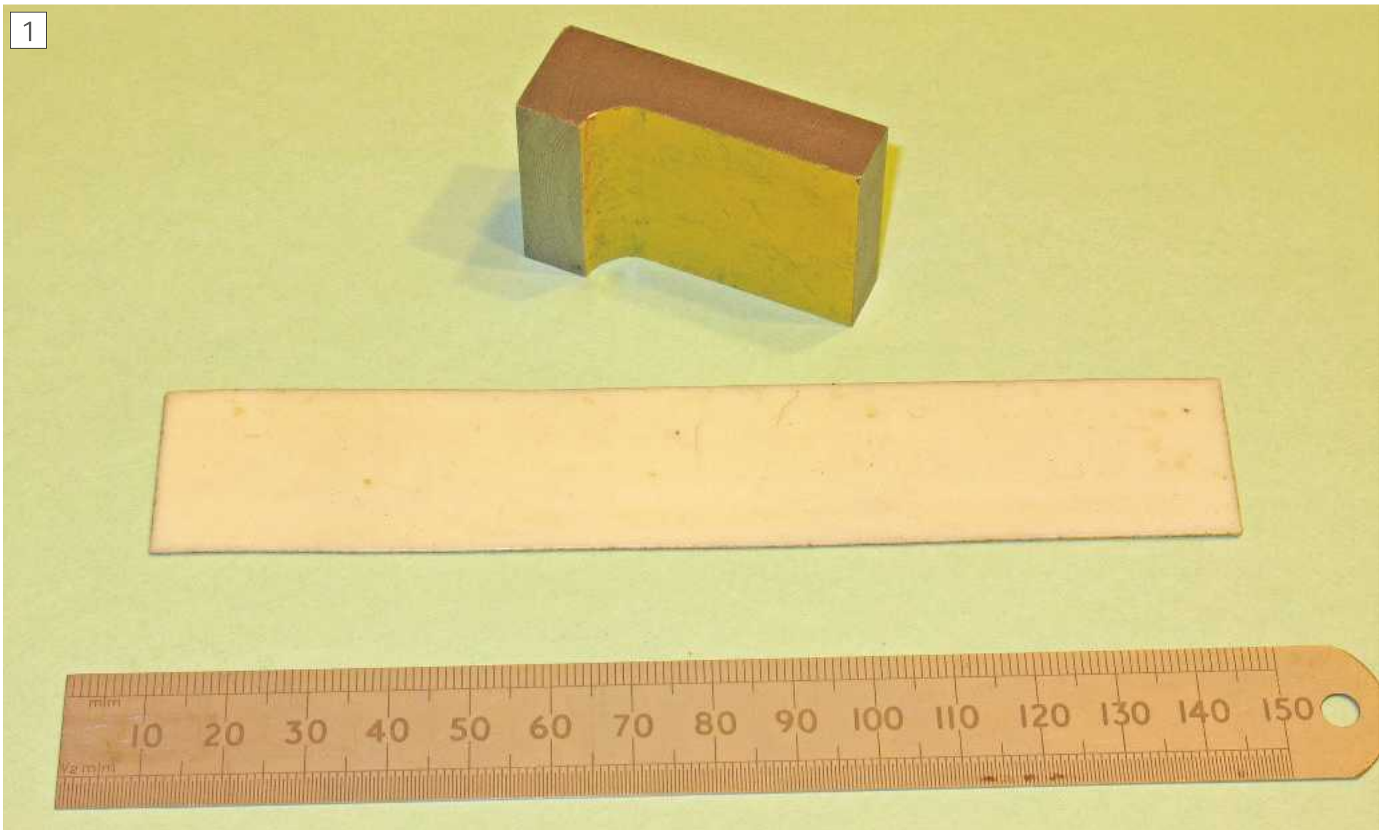
Little Goodies

Peter Shaw raids the bits box to make some useful doodads...

1



Square and plastic

Microsquare

Photograph 1 shows my homemade 'microsquare' made from a piece of angle iron which was probably about 4in each side and about 3/8 inch (9.5mm) thick. My piece after cutting and flycutting square on all sides ended up 45.5mm x 31.5mm x 15.5mm x 9.3mm although sizing doesn't really matter.

In use it is useful for procedures such as tapping work held in the vice where it is necessary to ensure that the tap is at right angles to the work. The micro square can be stood on the vice jaws and used to provide a guide to tap squareness.

Another situation is setting up my parting off tool where the narrow part of the square can be used to gauge the setting of the parting off tool blade.

Little bit of plastic.

Also in photo 1 is my little bit of 25mm x 140mm white plastic which I use when setting up cutting tools on the lathe. Again, sizing doesn't really matter.

What I do is place it below the work and tool, move the work light down so that its light is also below the work but shining on the plastic. I can then easily see the tool tip as it approaches the work - the tool/work gap appears dark against the illuminated white/cream plastic.

Useful in other situations also, indeed anywhere where one needs to see an adjustable and decreasing gap.

Cross-slide leadscrew guard.

On my lathe, as the cross-slide is withdrawn from the lathe, the under part of the dovetail becomes exposed to swarf etc. By adding a piece of flexible plastic as shown, the dovetail becomes protected against the swarf. I used a piece of plastic damp proof course material but almost any flexible plastic could be used. The material is attached to the cross-slide by the (scrap metal) bracket shown using two existing screw holes and which also forces the material to bend down the sides of the cross-slide, **photo 2**. Being flexible, as the cross-slide moves inwards, the plastic can bend and slide up the splashback.

Although mine works well, I think that it could benefit from being slightly longer, and wider thus covering more of the splashback. ■

2

Cross-slide guard

Some Upgrades for a Drill Press

Stub Mandrel returns with some simple upgrades to that most essential of machine tools, the pillar drill

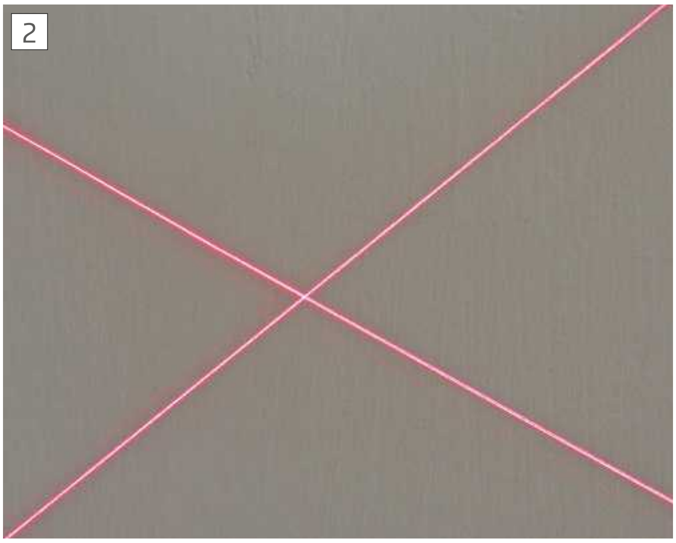
I've had my new Pillar Drill for some time now and have got used to the much bigger and better specced machine. I rarely use the big 16mm capacity chuck that came with it, preferring top use a smaller Rohm 13mm chuck that has the advantage of holding drills down to well under a millimetre in diameter. The chuck is one of a pair I normally use with my lathe and is mounted on a 2MT arbor, so it fits directly into the pillar drill's quill, but despite being easy to change over, it has become a virtually permanent fixture.

Some features of the drill I find really useful are the circular rotating table and the handle operated height adjustment. Between these two adjustments I find it quick and convenient to set up work ready for drilling, using an old and battered drilling vice that is (often) bolted to the table. The fitted work light is also a blessing, although the original filament bulb didn't last long I found that an LED globe light was an excellent alternative.

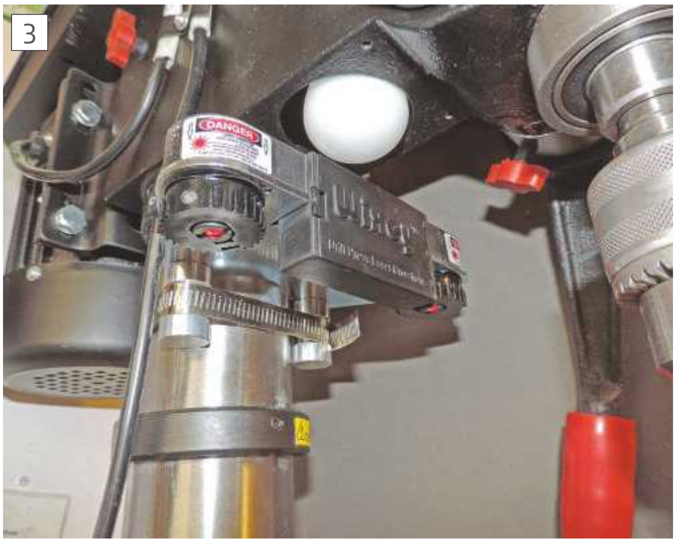
I was recently asked to try out the Wixey Pillar Drill laser, **photo 1**, from Machine-DRO/the Allendale Group. This is a device that mounts on the pillar of almost any drill press and shines a pair of cross hairs on the work to facilitate easy alignment. Out of the box, the unit is very solid, being based around a hefty steel plate with two steel posts that are used to align it with the drill pillar. A quick test showed that the laser cross hair was bright and very clear, **photo 2**.

Laser unit in its packaging.

The pillar drill is fitted to the pillar using a very long 'jubilee-clip-cum-strap' which fits in two recesses on the posts. It's a bit of a mission winding up such a long strap, but once done it make the laser unit very secure, **photo 3**. There are a few simple adjustments to be made before you can use the laser. The first task is to align the lasers vertically, it's suggested to use a square, but I used a medium-sized angle plate as it



Laser cross hairs.



Laser unit fitted to pillar.

is more stable. Resting on the drill table set the angle plate so one laser shines along the upright corner of the angle plate. Adjust a small grub screw in the laser mount to make the beam accurately vertical. Repeat for the second laser head.

Now you need to align the lasers to the drill spindle. I used a very small drill to make a tiny hole in a piece of hardwood. The laser heads can then be carefully rotated so that the two beams cross exactly on the hole and you are good to go! I did find the laser heads a bit stiff, so this took a few attempts to get right, but it was still only a one minute job.

In use, the lasers give a clear cross on the work, **photo 4**. The only problem I have is that, because I don't want to block the worklight, I have the unit a little low down, meaning that the lasers don't cross with the table wound all the way up. Like most Wixey devices the pillar drill laser is aimed at woodworkers, but I have found it a great boon for metalworking, especially as the 'crossing point' is just the right size for aligning a small centre punch mark. While it's a nice thought., it probably isn't fine enough to use on a milling machine, and you would probably need to devise a different way of mounting it.

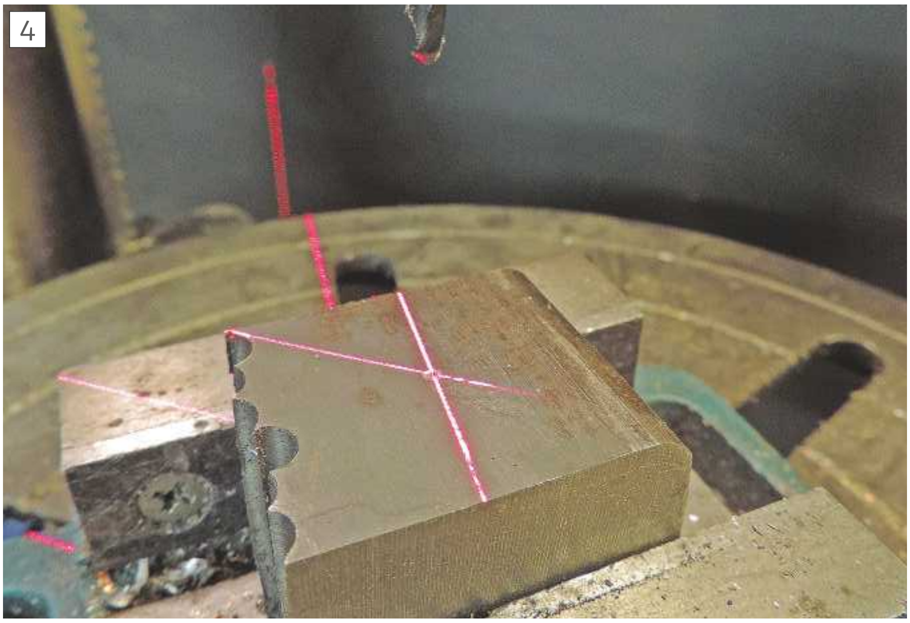
The second improvement I've made to the pillar drill is to add a simple depth read out, **photo 5**. While the dial on the feed lever works, it is a bit fiddly to set and zero. I had a cheap carbon fibre digital caliper – it turned out that the reason it was cheap was that it only reads to 0.1mm or 0.01", but that's fine for drilling holes.

The advantage of it being a plastic unit was that I could cut it short and also chop off most of the unwanted bits to make sure it didn't get in the way. To attach it to the body of the drill I used a small plastic block glued to the drill with silicone based glue, **photo 6**. Once set, I attached the caliper with double sided tape. It was a challenge to think of a simple, slightly flexible way of attaching the tip of the caliper to the quill, my solution was a small blob of another kind of silicone adhesive, **photo 7**.

For anyone who worries that I have rendered it impossible to fit the supplied guard to the drill, well yes, I have. I find the supplied fold-down guards difficult to use and ineffective -they guard the chuck but do nothing to stop whirling swarf! Instead I far prefer to use a simple guard made from a large square of polycarbonate attached to a magnetic stand, I can reposition this with ease and use it with any workshop machine – so it gets used, and the safest guards are those that get used.

I hope these ideas come in useful to you, the Wixey Pillar Drill Laser is available from **www.machine-dro.co.uk** for £32.54, they also sell plastic calipers, but you might prefer to butcher a cheap and nasty one rather than one of their good quality Baty or Moore and Wright ones! ■

4



Cross hairs on a trial piece.

5

Caliper fitted to drill.

6

Mounting block was a 3D print test piece!

7

Tip of caliper glued to quill.

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Wider Interests

Dear Neil, I am responding to your editorial in MEW no.258 in which you invited contributions from readers having hobbies other than model engineering.

I suspect that I am one of many with an interest in old "full size" machinery of all kinds who find MEW an invaluable source of knowledge.

My introduction to MEW began with issue no.15 in 1993 which featured Albert Wallis, the inspiring restorer and collector of Brough Superior motorcycles. Whilst I do not place myself on a par with his high level of skill, I am nevertheless a restorer with a particular interest in old cars.

My latest long term restoration is that of a 1916 American La France which began in 1998 and took 15 years to complete. It was purchased as a pile of pieces, with many parts damaged or missing. These parts had to be made using a flat bed Colchester Mascot and a Harrison L6 together with an Adcock and Shipley no.1 horizontal mill.

A number of devices were made from scrap, such as a rotary table, dividing head and auxiliary milling spindle in order to make items such as piston rings, bronze and iron spur gears and a helical pump drive. Brass castings were made from scrap brass melted by charcoal harvested from the wood stove. A few photos are attached.

Many thanks for a truly useful and interesting magazine.

Terry Cleife, by email

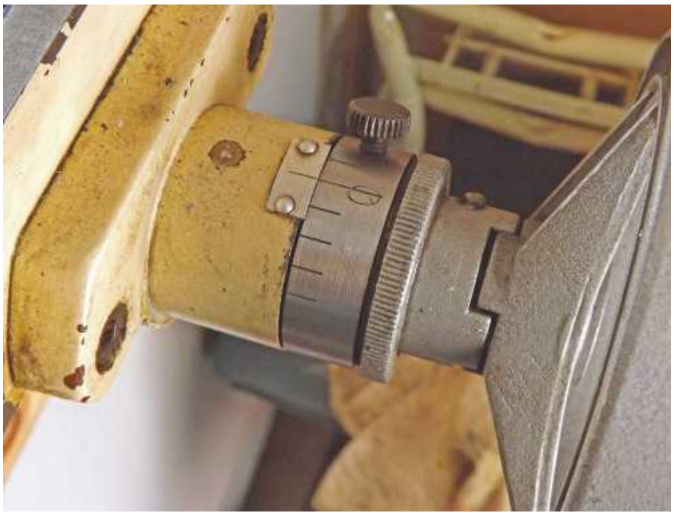
Thanks for some great photos, Terry. I have included a few here, but you might wish to offer Diane Carney a detailed article for Model Engineer – Neil.

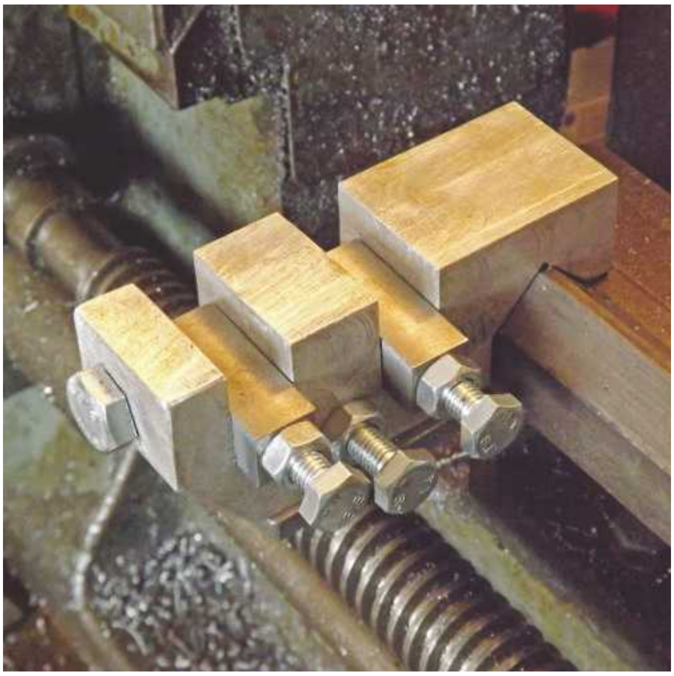
Tooling system

Dear Neil, issue no. 255 finally arrived in New Zealand a couple of days back and I was very interested in the further article on Richard Smiths tooling system. I wasn't disappointed, and found the article brilliant . I wondered if the next part will include perhaps a drawing or a plan as I got a little confused on page 11 when it mentioned a couple of flats filed onto the M10 cap screw. Does the vertical pillar have a recess in it to go over these flats and is there a nut on it ? A plan or cross section will clear the matter up for me. It's such a neat idea that I am very keen to make one. It appears Richards carbides need 7 degrees positive front tool clearance and I would be keen to find out the part number of the insert he used.

Other than that, just wanted to say how much I enjoyed reading no. 255 as the article on the drill chucks, ball turning etc was superb and a credit to both the authors and your production team. Sadly I will need to wait another whole month before no.256 arrives in New Zealand.

Bryce Clifford, New Zealand





Slide Transplant

Dear Neil, I read this article, in MEW No 258, with interest, especially when Howard Lewis described the calibration of the vertical slide. Something struck a chord!

Last year I bought a used pillar mill/drill but found I was experiencing trouble when using the graduated scale - in fact it gave me a lot of puzzling to do until I worked out the problem. The machine was metric and 10 tuns of any of the 3 handles gave 25mm of movement. The leadscrew was of 2.5mm pitch. However, the graduated scales read from 0 the 12.5mm! That is 5 times the movement that turning each handle gave. In my simple-minded thinking if a leadscrew is of 2.5mm pitch then the scale should be calibrated from 0 to 2.5mm too - or am I being naive?

set about making 3 new calibrated scales. They don't look too pretty but at least they tell me what degree of movement I am getting. I intend to eventually replace them with more polished versions but will continue to use them for now.

Unfortunately, before I could calibrate any of the scales I first had to make a triple stop for on my lathe bed plus devise a way to use a 50 tooth change wheel for indexing the calibration. My amateur attempt worked well but, like the finished product, isn't overly pretty. The actual graduating process went well too but I need to improve on the number stamping technique!

Geoff Garrett, by email.

Underground, Overground.

Dear Neil, I was intrigued by the Chief Wombler's revelations. Van der Waals force calculations can become quite time consuming. I would suggest more suitable scales would be Angstrom Units, or more modern "Napoleonic" dimensions of Barns and Ponds (and yes, they do exist), or just Reynolds Numbers.

On a visit to Llanberis Slate Museum they have a truly Victorian workshop, where everything for the quarry was made in-house. Before electrification in 1918 power was by overhead shafting – putting a cut on was done by ringing a bell – the old lad up on the mountain would then open the sluice gate, "motoring up" the water-wheel.

Perhaps he has found a new use for the Laxey wheel?

Brian Howett, by email.

PS: Angstrom units are used to calibrate slip gauges against the wavelength of light. Not easy in a blacksmiths shop? (Too dark?)

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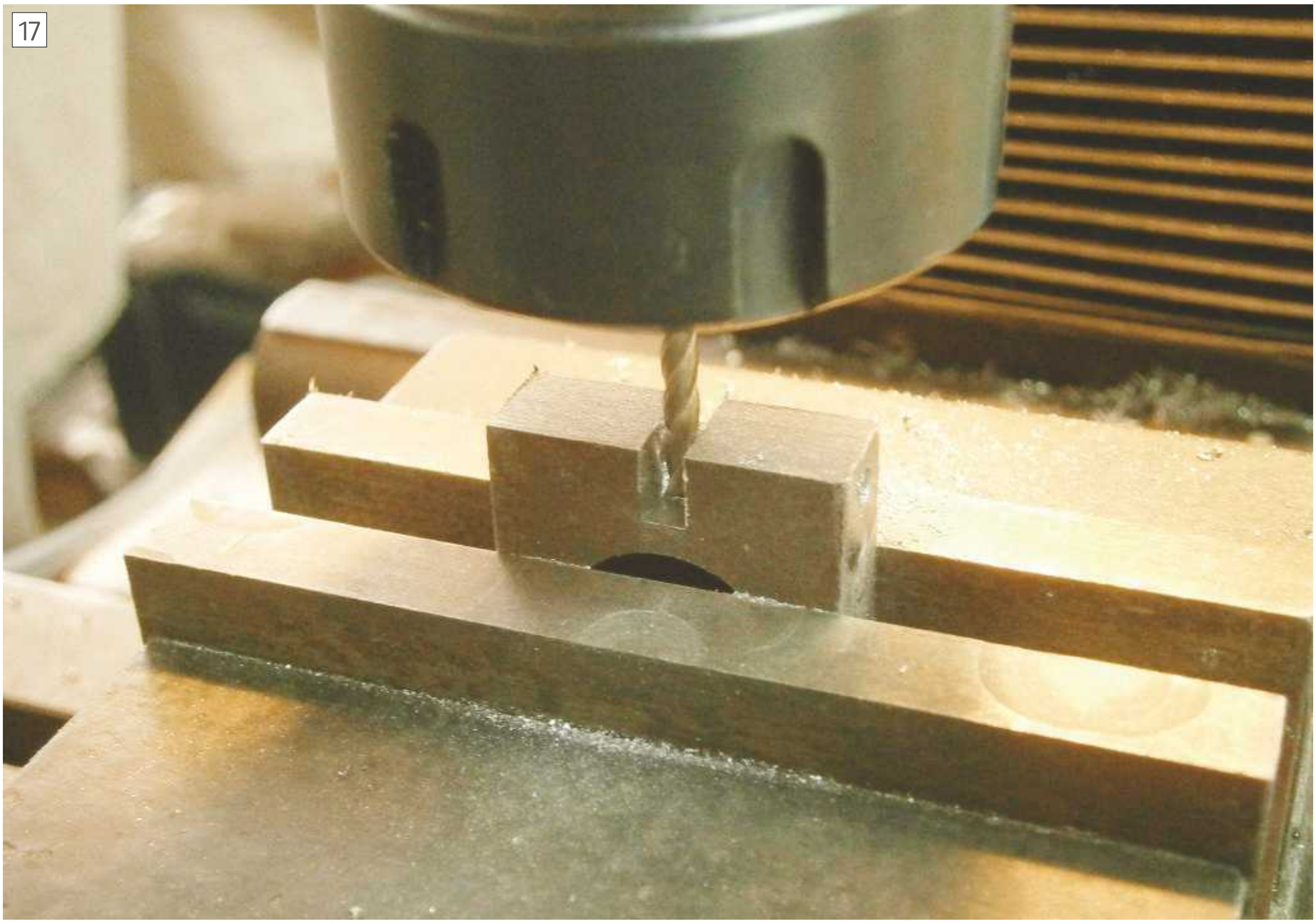


17

Mill small slot

Before slitting into the hole with a hacksaw I drilled the tapping holes for the 6 mm clamping screw and 3 mm pin. The slit can be made with a hacksaw as it is scarcely worth the trouble of setting up a slitting saw. The slot for the link could I suppose be done with a warding file for want of anything easier or could be made by two saw cuts into a hole, but I recently bought a new milling head for my vertical milling machine and so was keen to try it out. I used a long series end mill and this was not wise, as, with any worthwhile depth of cut, the slender cutter deflected into the cut on the way in, so that the slot ended up not square and over-size, **photo 17**.

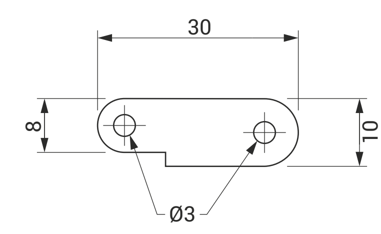
I had to finish the slot with a warding file and use a piece of 1/8 inch (3.17 mm) plate for the link rather than the planned 3 mm plate. I finished by opening out the near sides of the slot to 3 mm and tapped the far side M3 for the pin and did the same for the M6 clamping screw.

The link was a simple drilling, reaming and filing exercise. It was not worth the trouble of machining the curves on the end and I simply filed them to shape. Because of the limited depth of the slot in the base, I reduced one end to 8 mm width (**fig. 5 b**).

When it came to the stirrup (**fig. 5 c**), I had learned my lesson and brought out one of my two large slitting saws, photo 18). My new milling head made light work of driving this 1.5 mm wide saw through the stirrup in two cuts, to produce a slot with parallel sides of the correct width, **photo 18**.

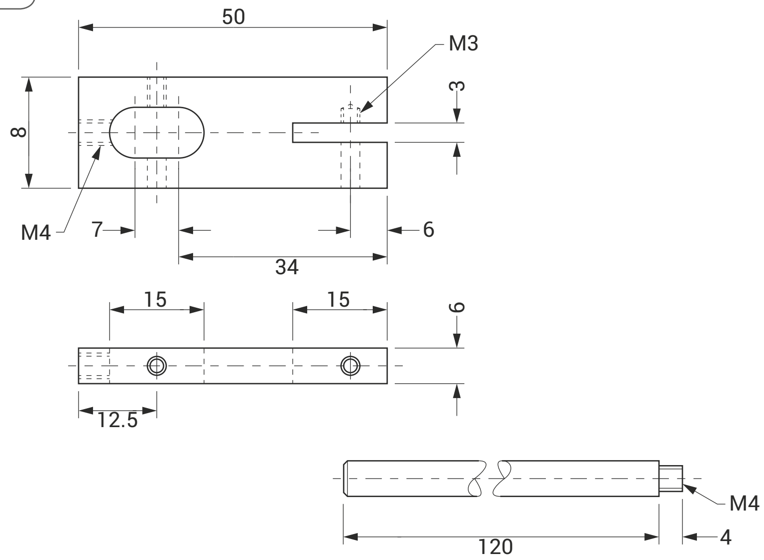
The 8 mm slot for the 7 mm diameter quill of course could not be cut with a slitting saw and I used a straight fluted slotting cutter with which my new machine coped admirably, provided I kept it well supplied with soluble oil and free from

Fig.5b



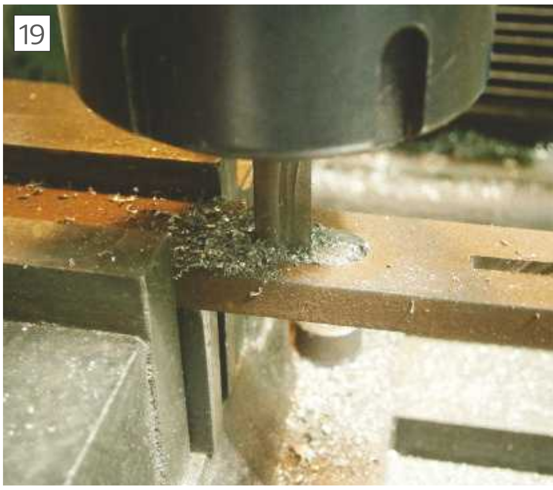
Drill Feed Plate
Mat'l: 1/8" steel plate

Fig.5c



Drill Feed Stirrup And Handle
Mat'l: Steel or brass

Saw large slot



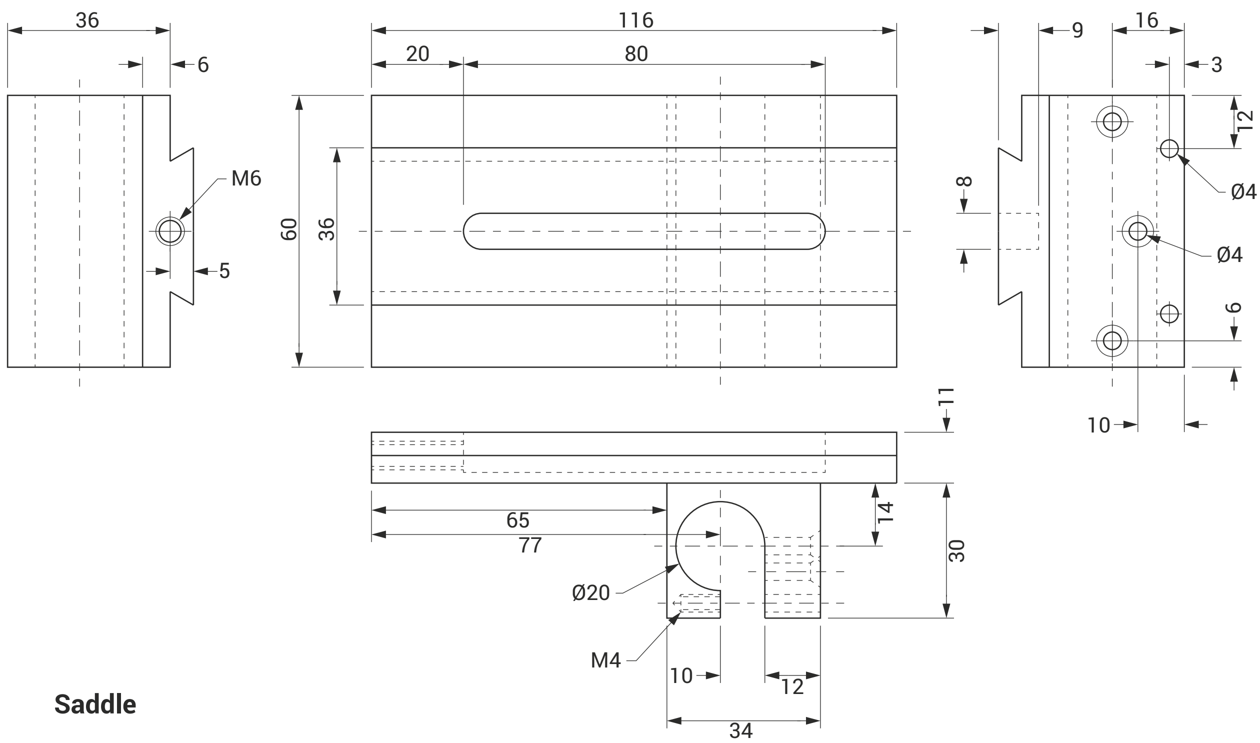
Mill stirrup slot

accumulations of chips, **photo 19**. All that remained was to drill and tap the holes for the pin and the handle. The latter was a simple exercise with stocks and die. I could not match the shiny finish of the rest of the lathe and contented myself with a coat of Black Zinc spray paint, which gives a good, corrosion-resistant finish as well as concealing small imperfections of finish.

The slides

Whereas in an engineer's lathe, the saddle is moved along the bed by the lead screw, cut is put on by the cross slide and angular feed by the top slide, in the watchmaker's lathe, the saddle is clamped to the bed, the cut put on by the cross slide and the top slide is used to traverse the tool parallel to the lathe's axis, though it can also be set over for angular cuts. Since in clocks and watches there is no need for long longitudinal (sliding) cuts, there is no need for the saddle to move during cuts. I will nevertheless continue to call the part that

Fig.6



Saddle

remains at rest on the bed the saddle.

To get an idea of the size of the slides I looked at several photographs of watchmaker's lathes that had them and tried to make mine to the same scale. They may look oversized, but there are practical limits to how thin the slides can be made, and any extra width and length allows for future fitting of other accessories.

Saddle

This began as a large chunk of cast iron that had once formed part of a tilting X-ray table and it had first to be roughed out to shape by sawing and then by shaping (**fig. 6**), **photo 20**. A milling machine might have been quicker, but harder on the nerves, as milling cutters are expensive, and machines likely to be owned by an amateur are lightly built and vibrate a lot, so heavy cuts cannot be taken.

20

Roughing saddle

21

Cleaning saddle end

However, I used a stout end mill in my mill drill to clean up the surfaces of the casting, **photo 21**, as the part would not otherwise have fit in my shaping machine to do the ends.

Once cleaned up, the part could be marked out for the various holes. The only really critical one is the one for the bed of the lathe and this needs to be a nice sliding fit over the bed. Centring it in a four jaw chuck leaves the part out of balance, and the speed at which you drill and bore out-of-balance parts will depend on the size and rigidity of your lathe, **photo 22**.

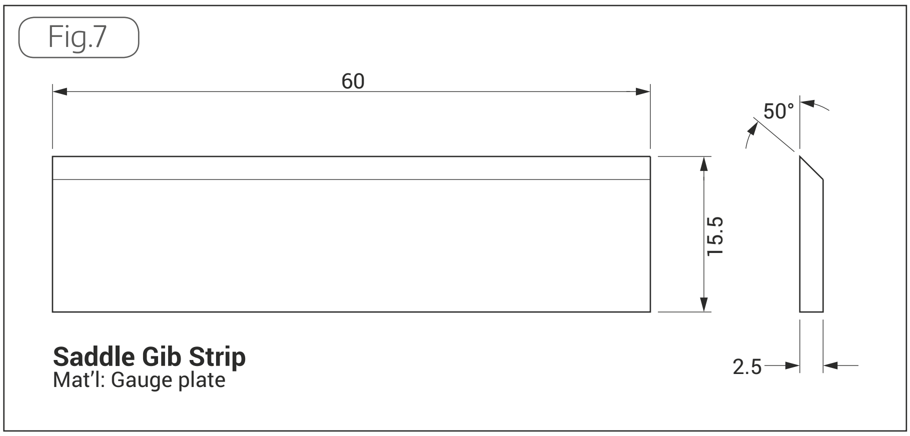
I finished the bore using an expanding reamer. If you are tempted to run a large reamer through a hole under power, while

22

Boring saddle

Reaming saddle

Grippers on gib

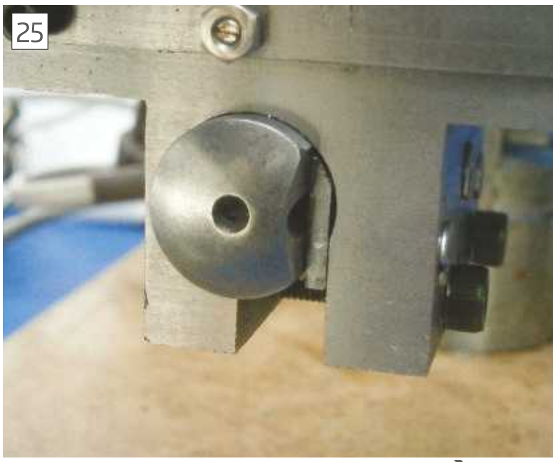


holding the reamer in your hand, you may get away with it, but sooner or later it will wrench the reamer out of your hand with probably painful consequences. **Photograph 23** was taken with the spindle of the lathe locked, the power switch off and the power plug removed for good measure.

The 10 mm wide slot is best cut out using an end mill and the 2.5 mm thick gib strip that prevents the saddle from rotating on the bed needs careful fitting. Reducing a piece of 3 mm gauge plate or ground flat stock to 2.5 mm needs a little ingenuity to hold it while it is being machined. In the July/August 1994 issue of MEW (More Strokes with the Shaper) I described how to make a pair of "grippers" as an exercise in the use of the shaping machine and photo 24 shows them in use to hold the thin piece firmly down on a pair of parallels in the machine vice of my shaping machine. One edge of a gripper is machined at an angle of about 8 degrees and the other at about 30 degrees in the opposite sense. It is not easy single-handedly to get them into place so that they grip, so help from a second pair of hands can save a lot of frustration, but once in place they force the part down on to the parallels and grip securely, **photo 24**. An angle of about 50 degrees filed or machined on one edge of the strip (**fig. 7**) was a good starting point for fitting.

Once I had my piece of plate, I fitted it carefully to the saddle, by adjusting the chamfer on one edge with a file until it fitted snuggly, and then spotted through for the three M4 screws that attach it to the saddle, prior to drilling and tapping the plate, **photo 25**. The ends of the screws must not of course project beyond the interior surface of the plate or they would foul the flat of the bed. A little rocking is permissible, as the saddle is always locked to the bed in use, but as Mr Lorch could fit it without it rocking, I found that with a little patience I could too.

Whether one cuts the slides using a shaping machine or a milling machine involves balancing the cost of the dovetail cutter against that of two single edge tools, but there is also a consideration of



Saddle fitted to bed

›


Rough saddle dovetail


Finishing saddle dovetail

precision. If the shaping machine ram is worn or poorly adjusted, the two sides of the dovetail may turn out to be slightly out of parallel. In the female half of the slide, this can be adjusted out with the gib strip, but it is not possible with the male side. On balance, I think that while roughing out can be done with a shaping machine, the final cutting of the angular ways is best done with a milling machine and dovetail cutter.

In the event, since I have a Quorn tool and cutter grinder and can sharpen milling cutters, I roughed out and finished the slides on the milling machine. Roughing out is shown in **photo 26** and the formation of the dovetail in **photo 27**. The dovetails should be cut in several passes so that the cutter cuts on the full height of the dovetail face only for light finishing cuts.

Milling the clearance slot for the feed screw takes us back to the 8 mm slotting cutter, though if started from a hole, an end mill can be used to cut the slot, **photo 28**.


Milling screw slot

This then leaves the threaded hole that forms the feed screw nut. Rather than fit a bronze nut in the rather restricted space, I elected to cut it straight into the cast iron of the saddle, as mild steel and cast iron run very well together, and if unacceptable wear should take place, I can fit a nut later. It is important that the axis of the "nut" should be parallel to the axis of the dovetail ways, and as holes drilled from the tailstock of the lathe are less likely to go astray, I set up the saddle in the four jaw chuck, **photo 29**, checking with a square off the face of the chuck that all was perpendicular.


Centring saddle for screw

To be continued

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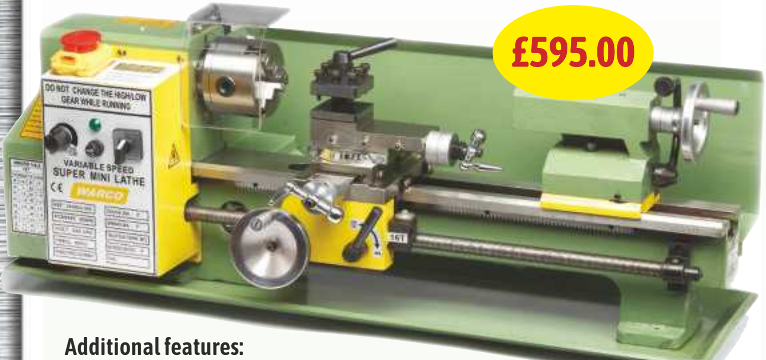

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Models of my Workshop Machinery

William Slow posted some photographs of his models of workshop machinery on the Model Engineer forum, we just had to ask for more!

When I am about to embark on another scratch build model I begin by looking at the real thing, and then dividing it up in to the simplest shapes it is made up out of. In most cases this will be a simple box, (everything when simplified down is a box!) when the boxes have been identified measurements are taken from the full-size original and applied to a quick sketch on an old cereal packet/ scrap of paper (whichever is closer to hand!) Then because the machinery is in the shed I have to run back in side and up to my room to relay the measurements to the material to begin. My room is my secondary workshop and is where I carry out most of my model making.

Photographs 2 & **3** show my first machinery model I made which was begun in early December 2015, when I was 15. The full-size original is an old Warco pillar drill that was retrieved out from a skip at a school where it had been totally dismantled, hung from a staircase for a student's photography project and then discarded. The motor and mount were lost so one was fabricated up and this has been replicated on my model. The process in the previous paragraph was used to get all the measurements and the first thing I made was the actual head casting. It took me 3 attempts to get the final product, as I found out that the real one tapers from front to back. I was up and down like a yoyo taking measurements and then relaying them back to my room. To get the scale of 1/10 each measurement is divided by 10 to get the final measurement (e.g. something 300mm long is going to be 30mm long in 1/10 scale. This can be applied to other scales 1/8= dividing by 8).

Each part is made up one by one and assembled together to achieve the finished article. All of my models are made out of vary thicknesses of plasticard (styrene) sheet and plasticard shapes (angle, tube, etc.) Brass was used on the pillar drill for the column and brass wire for handles and such like. The motor and drill chuck are turned out of some paxolin rod that happened to

The overall collection of my models with appropriate 1 pence piece for scale purposes.

My first model, note the scale plug with real brass pins!

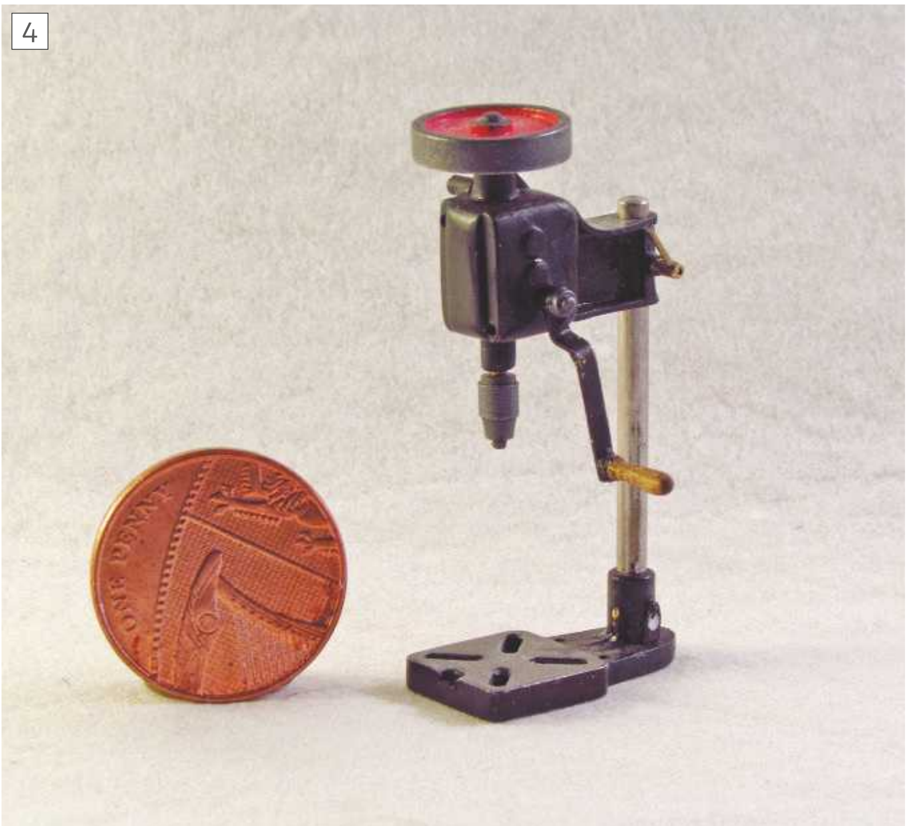
Note the 0.3mm drill bit, made from a piece of fine wire, flattened and then twisted.

be the right diameter. The pillar drill was completed in late February 2016 and is the tallest model in my set.

A Seig/Axminster mini lathe and milling machine were used in the construction of all the following models as well as all other machinery in the workshop. Paint used on all the models are Humbrol enamels and Hammerite, sprayed with a vintage Humbrol airbrush. The metal effect paint is Humbrol metalcote.

Photograph 4 is of the little Metabo hand crank pillar drill that resides in my room. This one took considerably less time to make as I didn't have to run back and forth to work something out, all in all it took 2 weeks (March 2016). It is my smallest machine model I have made. It was made in the same way as the large pillar drill; visually divided up in to boxes, measurements taken, made up in plasticard and then machined on the mill to get some of the square features and then assembled. The column is made out of a piece of steel rod and little brass collars were turned to fix it to the plasticard. Fine brass wire make up the handles and other fine bits.

Photograph 5 shows my third model I made, a Wilmac disc sander. The real one again was pulled from a skip and has had another custom motor mount made which has again been replicated on my model. The same process was used to build up this

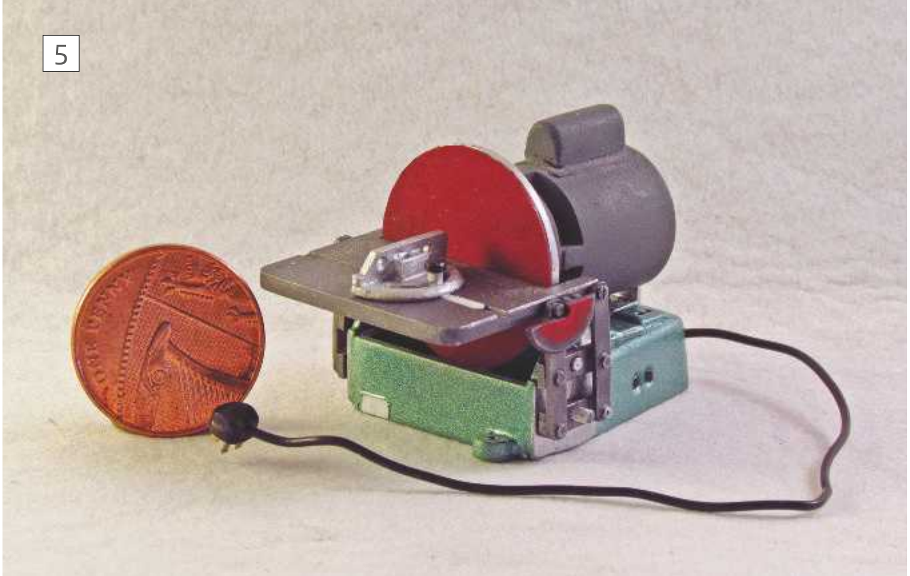


The metabo drill next to a 1 pence piece.

model like all my others. Only this one had a slightly more complicated main casting to replicate. The motor again is a piece of the paxolin rod and the disc is a piece of aluminium that I turned down, it has then had a piece of 800 grit fine sand paper stuck on the front (I think it is around 80 grit if I was to scale it up! Bit coarse I think!).

Photographs 6,**7** & **8** show the RJH belt sander, this was probably the fiddliest model to make as I put all the lettering on the front. The letters stand 1.5mm tall and are from the Slater's range. This was fine for the bandfacer name along the bottom but it didn't help with the triangle RJH logo. This was achieved by taking a pencil rubbing of the full-size logo, and then photocopying it down to achieve the scale height. That was the easy bit as I now had to cut out and shape some letters that are less than 10mm tall and around 3 to 4mm wide. The cams for the belt adjustment were also sized down with this method. This took quite a bit of time but I'm pleased with the result. The belt is also made out of 800 grit sand paper and the 2 rollers are made from a piece of steel rod. The casters on the bottom were tuned out from an offcut of nylon cutting board and aluminium sheet was cut-out to form the caster's metal frame work.

Photograph 9 is my current machinery model (not yet finished). It is of the Seig

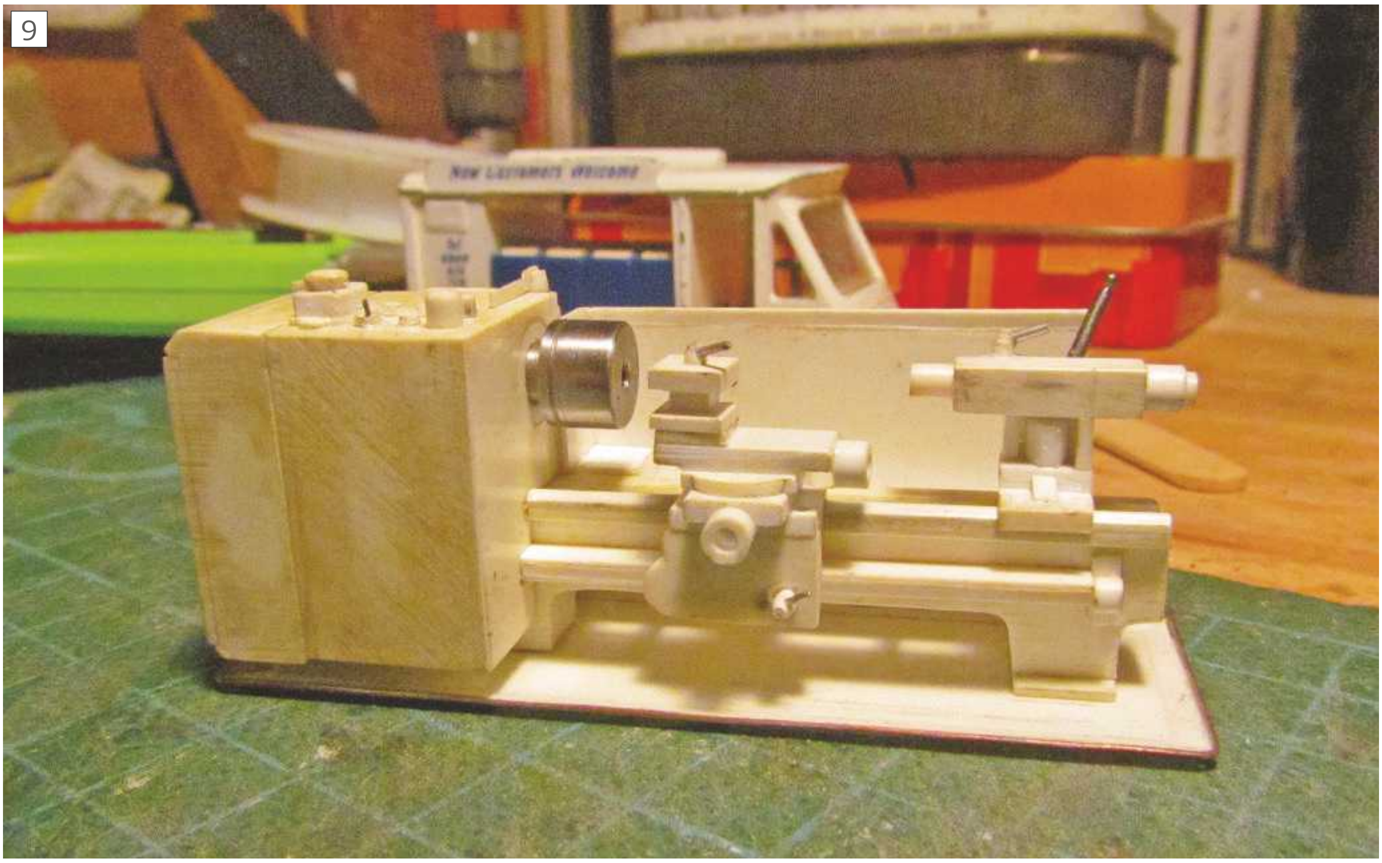


The disc sander with appropriate plug.

The RJH belt sander with lead and plug.

The logo and micro lettering.

Unfinished at this stage clearly showing the lettering and safety switch.



Currently unfinished the Seig sc2 lathe, just the details and paint now.

The chainsaw showing the iconic lettering reproduced in miniature

The embossed grid on the chainsaw.

SC2 lathe that I have, it really only needs paint and the hand wheels making for it. This again is made up in the same way as all the others.

Photographs 10,**11** & **12** show my most recent model only this one isn't for me it was a commission for a sculptor who wanted a chainsaw for one of her pieces. This is the most challenging model I have made as it isn't just boxes, it has curves and angles in all directions. Firstly, as it is a relatively mobile full size piece I had it in my room just for ease of accessibility. I had partially dismantled it to build a model as close to scale as I could. It was built up as boxes and then shaped with needle files, sanding sticks, etc. To get the mesh/grid on the side of the model I had to make up a punch to emboss the piece. This was done with the milling machine using slitting saws and hand filling points on to the tool. This worked surprisingly well and gave the right effect. The cylinder head was machined on the mill again, with slitting saws to cut the fins. The model is entirely made from plasticard the only pieces that aren't is the handle which is a piece of aluminium tube with heat shrink on it and the chain which is from a toy BMX bike which has a moulded rubber chain, which just happened to be the perfect size. The letters are from the slater's range which have been turned italic by softening them with the glue and pushing them with a toothpick to get the desired effect. I have subsequently been asked to make two more, I wish I had taken moulds of the parts to take resin copies. I'm going to do that now by making another chainsaw from plasticard and moulding the various pieces to then make two resin chainsaws, I'll then keep the plasticard original.

The weathering effect was achieved by spraying Humbrol metalcote over the main casting then applying some special fluid which allows the top coat to be chipped off. The top coat was sprayed on and chipped off in areas to get the desired effect. It was then "dirtied" by using the oily sawdust from the real thing to colour it down. The writing on the side was applied with a fine permanent marker, the same process will

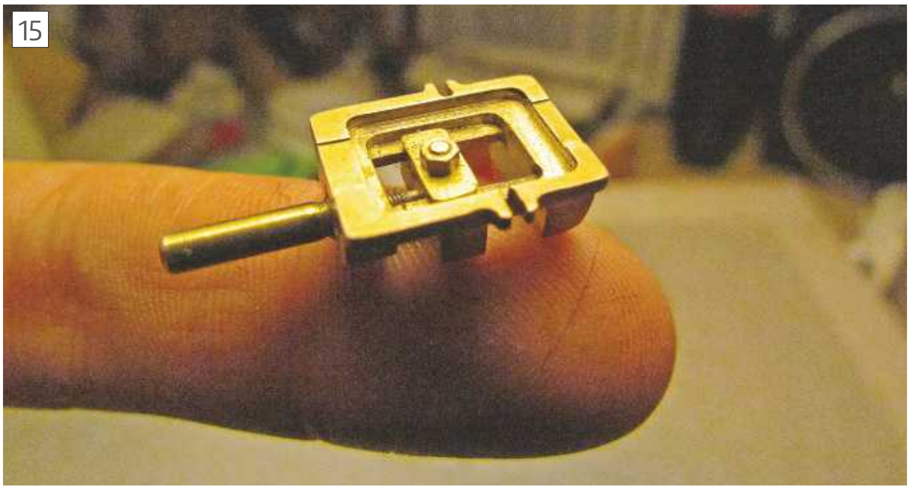
The model being dwarfed by the full size counterpart behind.

The brass pillar drill vice balanced on my finger.

The vice holding a 1 pence piece.

be used on the next 2 when it comes to it. This is the first model I have ever really weathered down and I'm very pleased with the overall effect.

Photographs 13, **14** & **15** show a little pillar drill vice I machined from a piece of brass. It is based on one I use in the shed and it works. I used a 12BA nut and bolt for the mechanism with the nut pressed in to the handle and the bolt soldered into the moving jaw this was totally machined on the milling machine and a bit on the lathe. I now need to find a knurling wheel that does a knurl that fine! ■



Underside of the vice showing the 12BA nut holding the moving jaw to the main casting.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Morse Taper arbors the simple way

Inchanga, in South Africa, explains the making of tapers, a valuable skill for beginners and experienced hands alike.

Often, we need to make a piece of tooling for the lathe or milling machine that has a Morse Taper on one end. Whereas you can buy a blank end arbor from various suppliers they are expensive and one has to wait for the postman to deliver it. However, I have had some right lemons when buying items such as these. Some suppliers do not seem to appreciate the subtleties of different length Morse Taper or the correct length and end finishing. For example, on my Myford Super 7 of 1970s vintage the headstock internal taper is not a full length as per the standards, the tailstock is a full depth type. So an MT2 drill bit or Jacobs chuck does not fully seat correctly in the headstock as the hole through the spindle is a smaller diameter than the tang on the end of these two items. For the tailstock end the tool must have a tang or similar smaller diameter portion to allow the self ejecting barrel to release the tool.

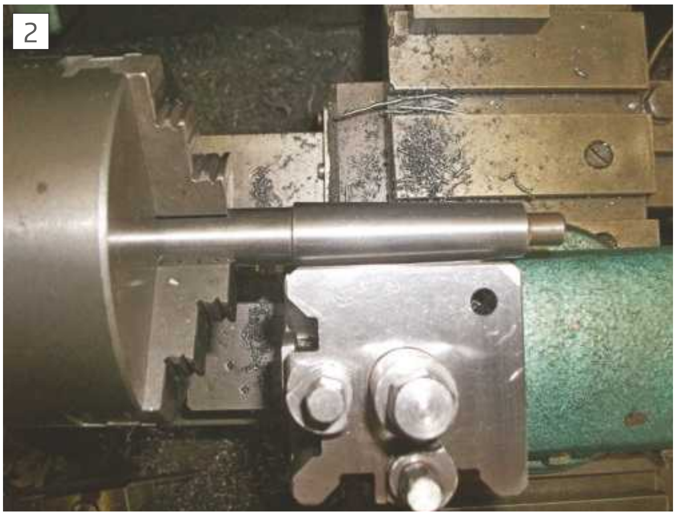
On one occasion, I purchased a MT3 blank end arbor for my milling machine, from a company who I believed had a good reputation, to make a gear cutter adapter (at great expense and I had to wait several frustrating weeks for it to arrive here in South Africa due to the local postal service being somewhat backwards). I especially asked at the time of placing the order if the arbor would definitely fit my milling machine, details of which were given, I was assured that it would fit perfectly by the sales person. When the arbor finally arrived I tried it in the milling machine spindle and found to my disgust that the non-machined large end fouled on the end of the spindle preventing it from seating correctly. On measuring the taper portion I found the diameter at the larger end was almost 60-thou undersize, so the taper was trying to go much deeper in the spindle socket. Comparing it to an MT3-MT2 adapter sleeve it was plainly visible the supplied item was way undersize! To return it and get a replacement would have taken a few more weeks and I was needing to get on with the job, which was now many weeks overdue, so it went into the scrap-box. That company does not get my patronage any more. A fly cutter I purchased from another supplier also had the same problem. I had to do some careful work to machine away the fouling portion before I could use it as intended. That arbor was as least salvageable. So having incurred considerable expense and then found the arbor was useless for its purpose I have now given up buying such items and make my own from standard round bar. I can make one or more in an afternoon without raising a sweat and if it doesn't work as intended then it is purely my fault, but knowing the special requirements one can modify the way we make the arbor to ensure it will fit as intended!

Setting the tool-post body square to the lathe spindle

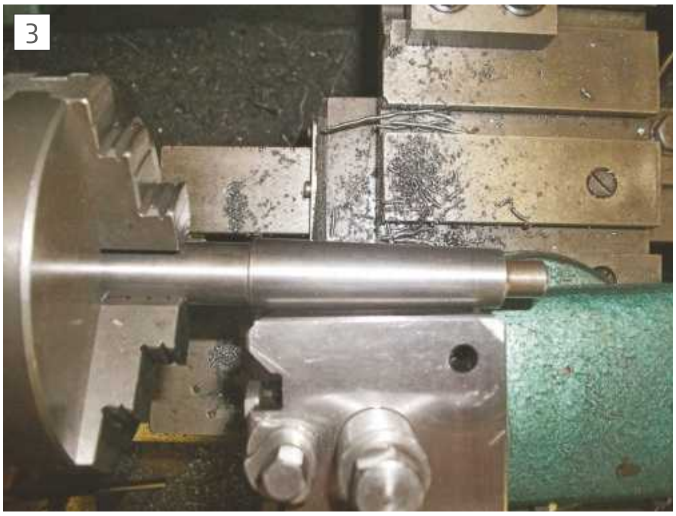
History

The Morse Taper was invented by an American engineer - Stephen A. Morse - in the mid 1860s as a way to accurately locate and hold tools and it quickly became an industry standard. Being a very shallow taper, it has considerable torque abilities. Tapers that have much steeper tapers are not able to transmit much torque before they slip. Even today it is a fully recognised item with both ISO and DIN standards covering the dimensions. Of course, Stephen Morse at the time had never heard of metrication so his dimensions were all imperial. The various standard documents either give both the metric and imperial values or sometimes just the metric values. However, it isn't essential to have copies of the standards for our applications, we are not making super precision parts, as long as it does the job then we are happy. Most of the salient information is readily available on the Internet on various useful web-sites.

The Morse Taper is available in 8 different sizes, starting at Morse Taper 0 (the smallest) and going up to Morse Taper 7 (9 including the curious MT4.5 taper - Ed). For most amateur small lathes and milling machines it is rare to find anything bigger than a MT3. If you need the exact dimensions and taper angle then the standards cover these in great detail. Fortunately, we don't often need all this information to make the odd Morse Taper arbor for the home workshop. The taper on all the different sizes was originally set at 5/8th inch per foot, (1 in 19.2), but over the years this has been slightly changed as standards became normalised. Knowing the taper per unit length we can calculate the angle of the taper. A word of caution here,



Tool-post body only touching the large end of the taper



Top-slide swung so the tool-post body touches the taper all along its length

the angle given in the standards is the "full included angle", for making one we need to know the "half-angle" value as we will be setting over the lathe top slide to cut the taper. An example is the headstock or tailstock centre that has an included angle of 60°, where we need to set the top-slide over by 30°.

The half angle for a MT2 is 1.4307° and you might wonder how we are going to set this with sufficient accuracy. My Myford Super 7 has the normal graduated top slide protractor but it only has 1° increments, so a 30° set over is simple, but trying to guess where 0.4307 is on the tiny legend is very difficult, if not impossible! But where there is a will there is a way!

Method of setting top-slide

Here is the way I set the top slide to cut a Morse Taper with excellent accuracy. You need very little in the way of measuring instruments, just the normal vernier callipers is perfectly adequate. We do however need a Morse Taper shank to copy from, this can be an adapter sleeve or a known accurate Morse Taper drill shank. As cutting the taper is purely using the top-slide movement to move the tool along the bar it needs to be set-over by the correct angle. The cross-slide gives inward tool movement to reduce the diameter but the top-slide must follow the correct path to get the correct taper.

Step 1

Fit the faceplate onto the headstock spindle and apply an engineers square between the faceplate and the tool-post block. This is shown in **photo 1**. Slacken off the tool-post body clamping bolt and swing the tool-post body so that it is exactly square to the faceplate. Lock the tool-post body. (We will later be able to reposition the tool-post once the other setting up has been done).

Step 2

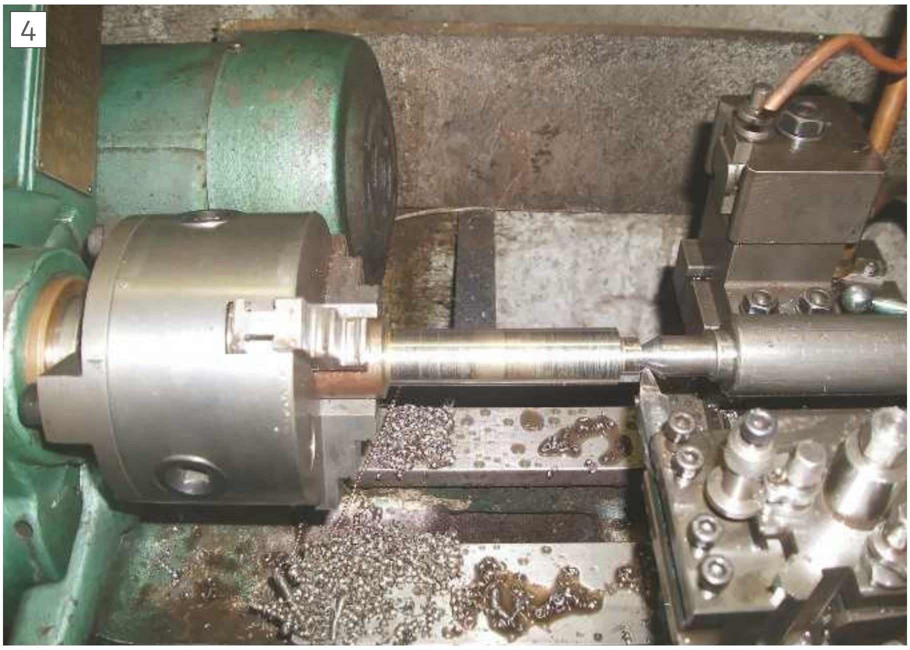
Replace the faceplate with the normal chuck and grip the plain end of the tool with the Morse Taper end pointing towards the tailstock. There must be sufficient of the taper exposed to be able to run the tool tip all the way along the taper without hitting the chuck jaws. Now move the cross-slide in so the tool-post body is just touching the large end of the taper, **photo 2**.

Slacken off the top-slide locking bolts so that it can rotate a little stiffly. Move the cross-slide in further so the larger end of the taper is just touching the tool-post body and slowly move the cross-slide a little bit more. The top-slide should swing and line up with the taper, photo 3. If you want you can back off the cross-slide a little and poke a thin feeler gauge between the taper and the tool-post body to check there is a constant gap all the way along the taper. I generally just feel for any slight rocking and allow the cross-slide movement to twist the top-slide around the required amount. Once you are happy then lock the top-slide clamp bolts so it can't move.

Having set over the top-slide correctly then we can now reposition the tool-post body to suit the cutting tool we are going to use. If you have a DTI and want to check the alignment is correct then go ahead and use it, but a simple test is to fit a round nose tool into the tool-post and a use the tip to grip a feeler gauge between it and the taper. If the top-slide is run along its full length then the feeler gauge should show identical readings anywhere along the taper. Set the tool tip so it just grips the feeler gauge and then wind the top-slide through its full travel and keep moving the feeler gauge up and down to feel for how tight it is being gripped. Hence, why feeler gauges are called feeler gauges, as we are using the incredibly powerful human senses to detect minute differences in tightness. The same senses allow the fingertips to detect minute surface roughness which only very precise measuring instruments can actually measure correctly. Even my wife, who has absolutely no engineering skills, can feel how smooth or rough a surface is.

Step 3

Having set the top-slide angle correctly we can now begin turning the selected bar to the correct diameter. For the MT2

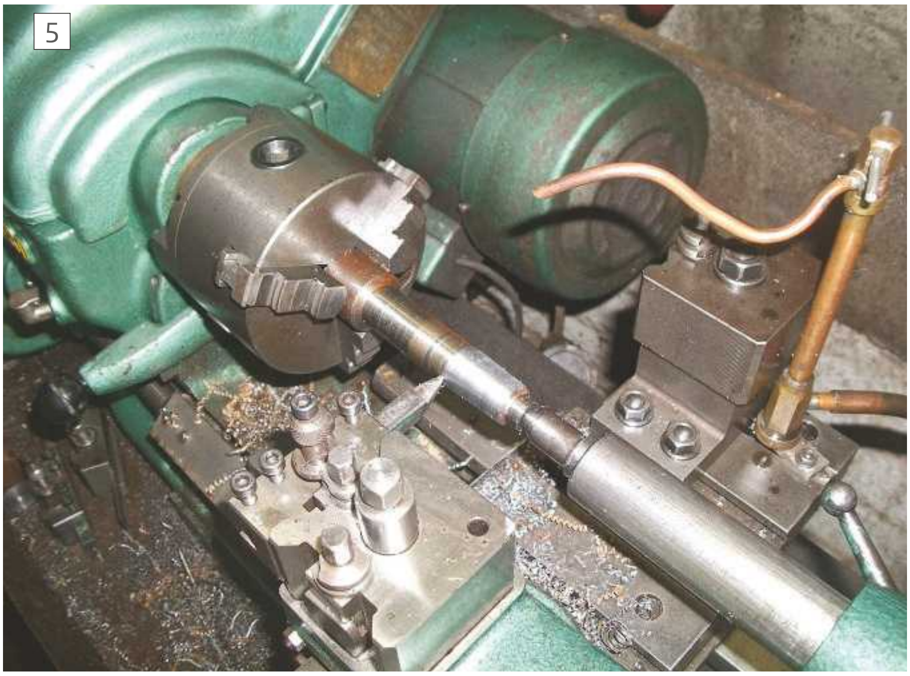


Roughed out arbor ready for the final taper machining.

arbor the maximum diameter is generally 0.7-inch, (17.8mm) but the standards allow up to 18.6mm for non-aligned depth in some applications. I have never actually come across a machine that will swallow a full-size MT arbor; there is always a fair bit of the larger tapered end sticking out. (If the tailstock barrel has been reamed out to correct scarring then you might need a little bit more on the diameter, so check first with a standard drill or other item to see if this is necessary). For an MT2 taper I normally turn the bar to 3/4 inch (≈19mm) so the taper will run out into the parallel portion as I get to the finished size. If the bar on the non-tapered end needs to be larger than 3/4-inch then there needs to be sufficient length to prevent bottoming on the tailstock or milling spindle. I generally allow ½-inch or so, but you can judge that from the job. The arbor blank should be roughed out to slightly larger in diameter in all dimensions before machining the taper section. Drill a centre hole in the end so the tailstock can support the slender piece. Turn the ejection tang or the drawbar stub to suit your application. Drill and tap the end for your favourite drawbar thread and use a larger centre drill to put a decent size countersunk chamfer for the tailstock centre. **Photograph 4** shows a roughed out blank ready for cutting the taper. This bar is 28mm in diameter and I was making two items, one is a conventional live centre with two miniature thrust ball bearings, the second item is also a live centre using ball bearings but it is an "external centre" similar to a travelling steady. Details will feature in a separate article at a later date.

Now for the finishing cuts, **photo 5**. Lock the saddle solidly to the bed so it cannot move. The only movement we want is the top-slide moving along the correct angle and the cross-slide to set the depth of cut. Start at the tailstock end and don't be greedy with too much depth of cut. You might question why we have to start at the tailstock end? Well you will discover if you start at that end and put on a cut of say, 20-thou, it will gradually decrease the depth of cut as you move the top-slide towards the headstock until the tool stops touching the bar. If you started at the headstock end and put on 20-thou of in-feed with the cross slide by the time you are at the other end you will have about 120-thou of effective in-feed and you will probably break the tool!

5



Starting to cut the taper

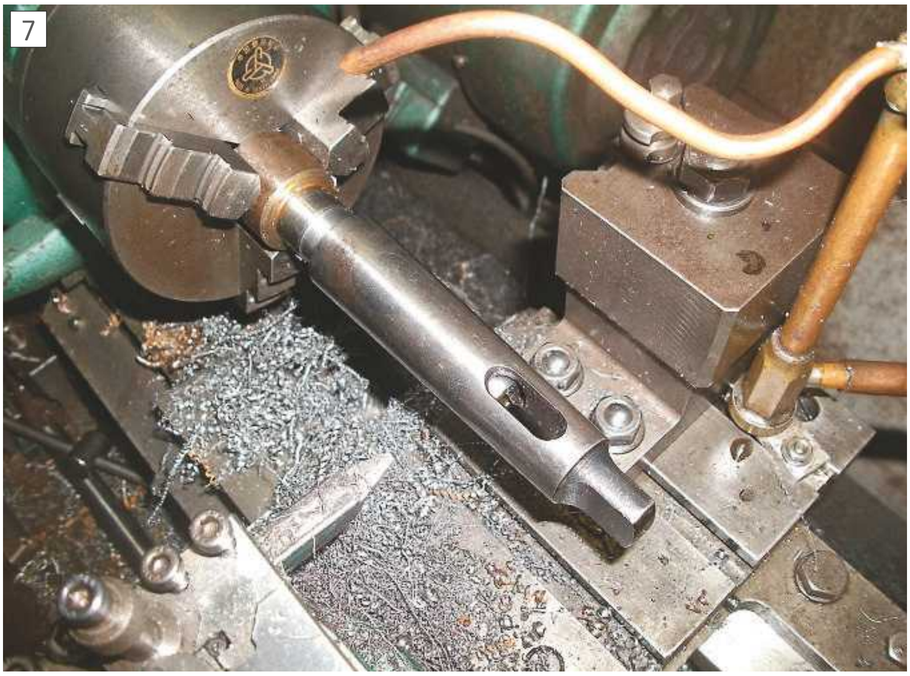
About 20-thou (0.5mm) in-feed on the cross-slide is all we can normally take at one pass. The tool overhang is quite a lot as the tailstock gets in the way of the angled top-slide even with the barrel almost fully extended, so the tool has to stick out a lot more than desired. As the in-feed gets deeper then the cut will extend further along the work piece. When the cut is almost along the full length then we are getting very close to the final size. A cut of 20-thou is about right for the initial roughing cuts but as the taper extends further along the bar reduce it to 10-thou and then 5-thou and for the final finishing cuts as little as 2-thou in-feed to get a good finish.

It is essential to have a gauge to see how close you are to the finished size, it being difficult to measure a tapered item accurately. A drill sleeve is an excellent gauge as they are made to high precision and often fully ground on the internal and external surfaces. Stop the lathe and withdraw the tailstock support and try the adapter sleeve onto the work to see how far it enters. Keep trying the gauge as you approach the finished size. One thing you will learn about shallow tapers - often the hard way - is the adage "A little off the diameter is a lot in the depth it fits into the socket". So take care you don't "overshoot the platform" as LBSC often used to say, or you might have to start again with a new piece of material! With the nominal 5/8th inch per foot taper a 1-thou decrease in diameter along the whole length is about 20-thou more the taper sits into the socket. So an error of, say, 25-thou undersize along the length is almost 1/2-inch deeper in the socket.

When approaching the final size concentrate on obtaining as good a finish as possible. Although some polishing with a smooth file and emery cloth is acceptable it won't remove torn portions well enough. For the final cuts the lathe should be run slowly and the shavings coming off the tool should be like dust, as the finishing cut will be about 2-thou at maximum, **photo 6**.

6

Finished taper before polishing



An adapter sleeve to gauge the depth of engagement

To check the insertion depth an adapter sleeve is a good gauge. By looking through the two ejector slots in the side you can see the bottom of the internal taper and the recess to accept the tang. **Photograph 7** shows the finished taper almost fully bottomed in the sleeve, there is about 95% full engagement, which is more than adequate for most purposes. If you should be unlucky and go too far, all is not lost. Simply unlock the saddle and turn back the smaller end using the saddle traverse and make it the same diameter as the tang diameter. If the tang portion is now too long then reduce the length a little to compensate.

For finishing the blank end, it is plugged into the headstock to ensure concentricity. A draw bar-tapped hole may be required in some applications, especially for milling machines where the cut is intermittent. Shock loads can cause an otherwise perfect taper to rattle loose and a draw bar is an essential item for this type of adapter.

Morse Taper adapter sleeves and tailstock centre with short taper

Top-slide movement

Ensure your top-slide has no shake, adjust the gib screws so it is a little tight but moves easily. Any wobble in the top-slide will mess up the taper angle! On my Myford Super 7 the total top-slide travel is just enough to machine a full length MT2 taper. For my milling machine that has an MT3 taper it is not enough travel. Although it is possible with a great deal of care to move the saddle along the lathe bed and pick up the portion of taper already machined it isn't always satisfactory. For this problem, I normally undercut the bar midway along the taper to make the taper into two distinct sections with a gap of about 8mm between them. Having cut the smaller diameter end I move the saddle along the bed and lock it again and then cut the larger diameter end. Using a 6-inch steel rule placed along the tapers it shows how far the larger end needs to be reduced to get the two tapers in line.

Tool height setting

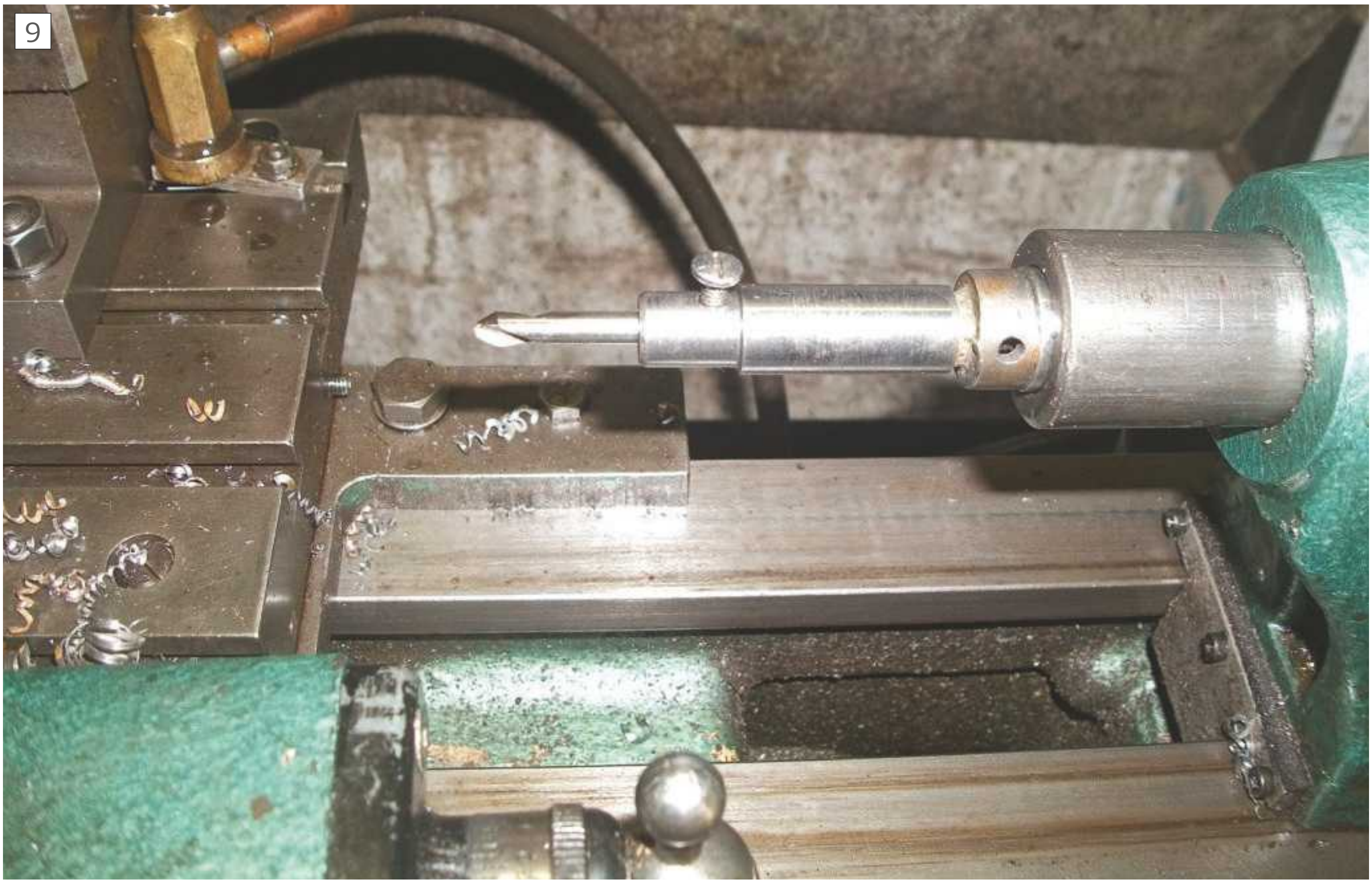
This is something I didn't originally think about. It goes without saying that one would normally aim to have the tool at exactly centre height. But what effect does a tool that is a little low have? I happened to mention this to a knowledgeable friend and he pointed to an illuminating article that appeared in MEW in April 2002 by Peter McQueen that gives us the complete facts. My thanks to Russell Flagg for a scanned copy of the article. It seems even a gross error in a tool being much too low doesn't significantly alter the end result. It is often better to have the tool a little below the exact centre height rather than being above the centre height as a minor dig-in tends to deflect the tool tip away from the work. Being above causes the dig-in to become more severe, so when parting off with a front parting tool we normally set it a tiny bit lower and when using a rear tool-post parting tool we set it a little higher.

Taper length

We often don't need a full-length taper and something quite a bit shorter will often suffice. It is common on larger taper shank twist drills to find the taper end split into two portions with a distinct gap between the larger end and the smaller end for easier ejection. Even a taper of as little as 25% of the full length can transmit a huge amount of torque if the taper is accurate. **photo 8** shows two Morse Taper adapter sleeves and a home-made tailstock centre made from a worn-out drill shank. (The screw in the back is for the tailstock ejector mechanism). The smaller sleeve is an MT2-MT1 adapter, the larger is an MT3-MT2 type. The tailstock centre has a taper length of only ≈50% of the standard length and it grips perfectly in the tailstock barrel.

Choice of material

For non-critical applications normal free cutting mild steel is fine as it machines



Extended centre drill for awkward places

easily and it is simple to get a good finish with normal lathe tools. For a better job I normally use a higher grade of special steel called V-155 which is a very tough steel to machine but with carbide tooling gives a superb finish and it will last forever. (V-155 is made by Bohler Steel and is used for crankshafts and axle shafts in automotive manufacture. It is one of the toughest steels made). Taper shank ends on the larger drills are not high- speed steel; they are a less expensive softer steel friction welded onto the spirally cut portion. This machines quite easily with normal HSS tools. Some of the tooling I have made over the years uses broken or discarded HSS drills that I obtained for nothing, saving a lot of effort to cut a taper. But they are usually very battered and scarred by the time I get them and need a minor skim to clean up. The tailstock taper shown in photo 8 was a badly abused MT2 ½-inch drill that had the tang end bent and twisted and it was cut off as it was beyond reclaiming. What is not visible is the joint between the HSS and the softer shank end, the joint is just in front of the taper and the 60° point had to be ground as the HSS material was too hard to cut with normal lathe tools, even carbide tipped types. I used a diamond-loaded cut off disc to liberate the remains of the HSS twist drill and my friendly tool grinder at work finished the pointed end one lunchtime for a packet of cigarettes! All this has ever needed in over 20 years of use is a gentle stoning with a slip-stone to remove minor scarring.

Over the years I have made many little items of tooling to make life easier. One of my favourites is an extended centre drill holder. This is shown in **photo 9**. It started life as another discarded MT2 drill and I cut off the broken drill end and silver soldered in an extension made from 10mm stainless round bar socketed in a reamed hole for accuracy. In the other end I drilled and reamed a hole for a BS2 centre drill. I use half a BS2 centre drill, easily snapped in half by grinding a shallow V shaped groove all round it in the middle with a handheld 12V dc drill and a cutting disc whilst holding it in the bench vice with half of it sticking upwards. I then place a piece of tight fitting aluminium tube over the end and give it a sharp pull sideways or give it a sharp tap with a 1/4-pound toffee hammer, and spend the next ten minutes trying to find the bit where it flew across the workshop. (I must remember to wrap a piece of rag around the drill before whacking it with the'ammer!) Then grind a flat on the side for the screw to bear against. This little tool allows me to get into tight places that even my smallest Jacob's chuck will not venture. The observant readers will see I broke the tip off my last BS2, so another trip to the tool stores is needed. I also have a selection of different length centre inserts made from silver steel rod that can be used instead of the BS2 drill for supporting very slender shafts. The smallest normal tailstock centre is just too large for delicate work and the tailstock gets in the way with some jobs. I never could fathom out why Myford made the tailstock such a bulky item as it prevents the top-slide working too close when facing a piece held with the tailstock centre. I have sometimes considered slewing the top-slide through 180° so the feed handle is nearest the headstock, but this causes problems when working close to the chuck. You can't win! My very first lathe, bought when I was a young apprentice for £10, was a decrepit Drummond 4-inch round bed model of 1909 vintage with the treadle disconnected and a huge dc motor cobbled onto the flat belt drive. (Starting the motor was like a pre-flight checklist in an aircraft as it had two switches and a manual commutator lever you had to operate in the correct sequence or else it tripped the mains. And no clutch, so frequent starting and stopping of the motor). Turning long tapers on that was a piece of cake as the tailstock rotated around the bed and the work was turned between centres. Some of my original Morse Taper tooling I still have was made on that old monster. I disposed of that one and bought a more modern version for £20 a few years later. This was ex Royal Navy from a destroyer and had a date of 1917, but it was virtually identical and had been very well cared for and was almost like new, and it had all the change-wheels and the added Dore-Westbury back-gear adaption was complete and working. I rather stupidly disposed of it to a friend at work in the 1980s when I came to South Africa. He still has it and uses it all the time. I have been looking for another one ever since. ■

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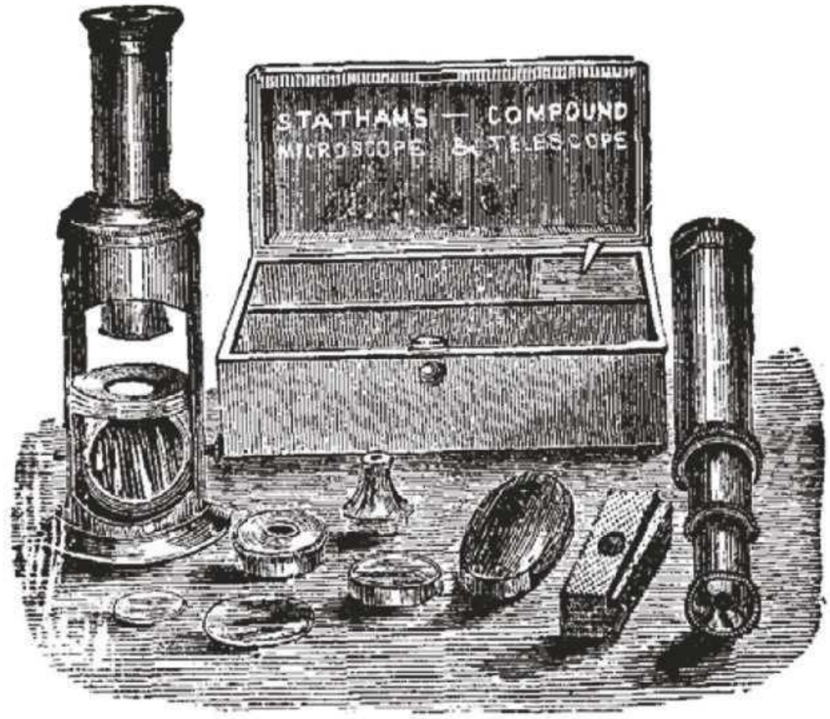

Parts and Materials

■ Copper tube, sheet, bar and other non-ferrous metals for sale. **T. 01684 661081. Holmfirth.**

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■ Set of detail drawings, part-built or complete Tender, for 8 wheel Gresley A3 Pacific, in 71/4" gauge, ideally to the design of Henry Greenly. **T. 01642 723641. Middlesbrough.**

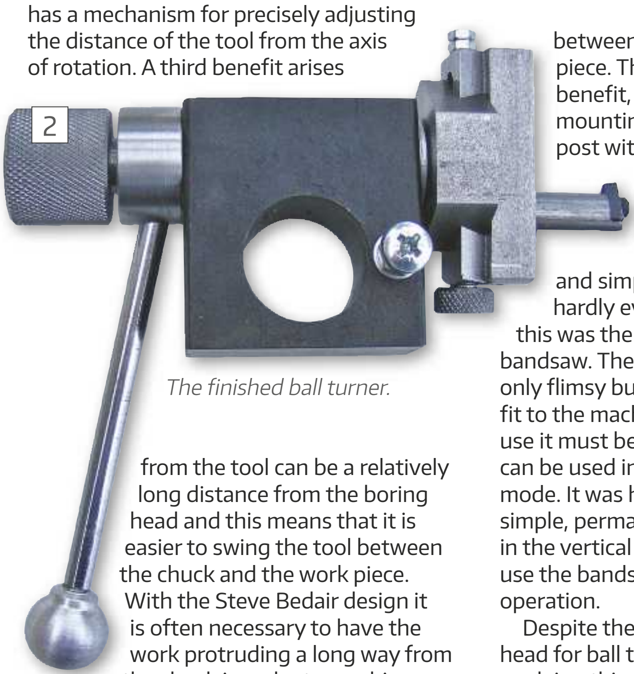
Mike's Workshop

Mini-lathe Ball Turner

From Mike's Workshop comes this ball turning tool with mini-lathes in mind.

There are many designs of ball turners that have been built for the asian mini-lathe. Most are based on the design of Steve Bedair where the tool swings around the work piece in the horizontal plane. The Sieg ball turner is a little different because it swings around the work piece in the vertical plane. However, all these designs require the removal of the top slide so that the ball turner can be fitted on the lathe. I made a ball turner to Steve Bedair's design many years ago. It works very well and I have used it many times over the years but it is always a chore to remove the top slide in order to use it.

On larger lathes many have made an adaptor so that a standard boring head can be fitted onto the tool post with the axis in the horizontal plane. With a suitable tool in the boring head it can then be swung around the work piece in the vertical plane to machine balls and cut radii. There are a number of benefits to this approach. Firstly, the boring head is probably already available in most workshops so it is relatively simple to make a holder that fits on the tool post. Secondly, the boring head has a mechanism for precisely adjusting the distance of the tool from the axis of rotation. A third benefit arises from the tool can be a relatively long distance from the boring head and this means that it is easier to swing the tool between the chuck and the work piece. With the Steve Bedair design it is often necessary to have the work protruding a long way from the chuck in order to machine between the chuck and the work piece. The final, and perhaps the best benefit, is that the boring head and mounting can just slide onto the tool post without having to remove the top slide.

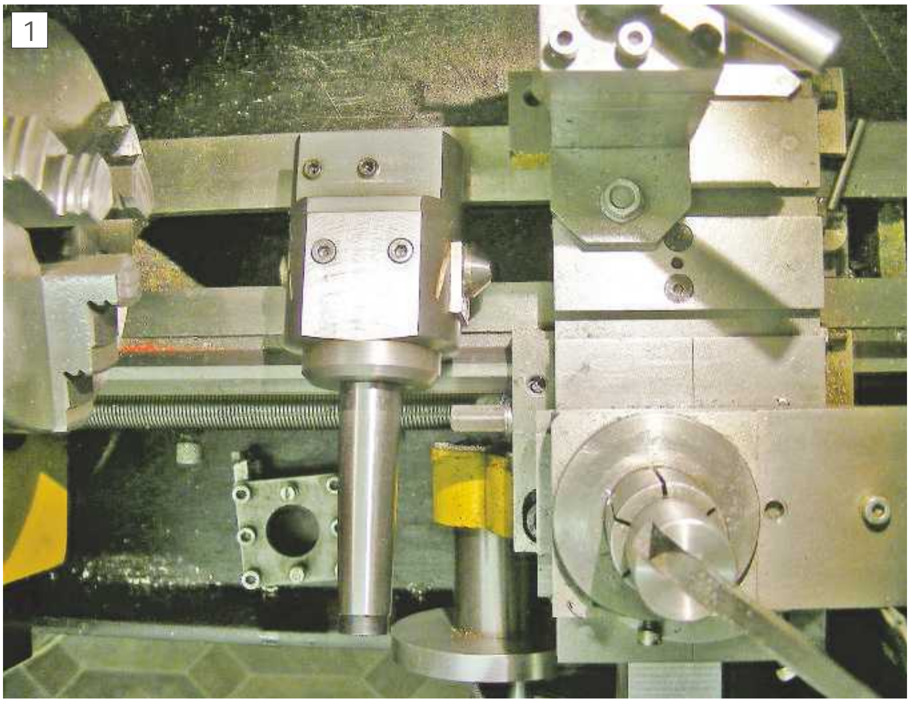


2

The finished ball turner.

My own experience with machine accessories is that unless they are quick and simple to set up then they are hardly ever used. A classic example of this was the vertical cutting table on my bandsaw. The factory supplied table is not only flimsy but it also takes quite a time to fit to the machine in order to use it. After use it must be taken off before the machine can be used in the more normal horizontal mode. It was hardly ever used. I made a simple, permanently attached table for use in the vertical mode and I now frequently use the bandsaw in the vertical mode of operation.

Despite the advantages of using a boring head for ball turning there is a problem applying this method on a mini-lathe.



1

My boring head laid on the lathe bed.

Photograph 1 shows my boring head laid on the bed of my lathe next to the tool post. As can be seen the boring head is extremely bulky and there is insufficient room to adapt it as a ball turner even with my extended travel cross slide.

The present project was started to look at the possibility of designing a simple compact boring bar type holder that could be used for turning balls with a diameter of 0-25mm on the mini-lathe.

The ball turner.

The completed ball turner is shown in **photo 2**. It is mounted directly onto the expanding tool post on my top slide. On the left is a knurled knob. Tightening this locks the position of the tool. The long handle rotates the tool around the work piece. On the right is the tool with an indexable carbide tip. This fits in a tool block that can slide in dovetails. The position of the block can be adjusted with the knurled knob on the holder. The screw on the top of the mounting block is used to adjust the height of the block on the tool post.

Photograph 3 shows the ball turner separated into its component parts. At the top is the mounting block. At the extreme left is the knurled locking screw that screws into the shaft. Next left is the lever that is used to swing the tool during ball turning. The component beneath the mounting block is the shaft which is fixed to a hexagonal block with a milled dovetail on the right-hand end. To the right of the shaft is the push rod. Note the small M3 tapped hole near the right-hand end for the feedscrew. To the right of the pushrod is the tool block. This has a matching dovetail to that on the shaft block and it is bored to accept a 10mm rod with a TCMT insert at the end. Beneath the tool block is the M3 feedscrew with a knurled knob and above are the two nuts and washer that lock on the end of the feedscrew after assembly.

The block.

The block was a 50mm length of 25 x 50 steel bar. This was marked out for the various holes as shown in **fig. 1**. The large hole was made after mounting the block in the 4-jaw chuck. Initially it was drilled out to 13mm and then it was bored out to 25mm to suit my expanding tool post.

The small hole for the height adjusting screw was drilled out 4.3mm and counter bored with a 5mm drill for a depth of 15mm. The remaining 10mm section of 4.3mm was tapped M5.

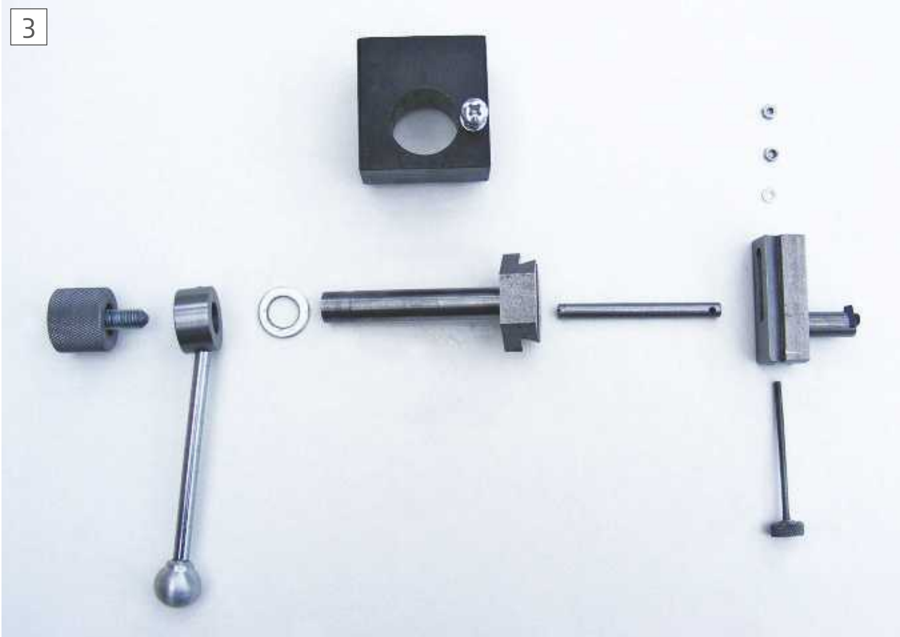
The hole for the shaft was initially drilled out on the milling machine to a diameter of 11.5mm and reamed to 12mm.

The locking screw.

The locking screw, **fig. 2**, was fabricated from a length of M8 studding and a knurled knob. The knob was tapped M8 and the stud was secured in place with epoxy resin.

The knob was made from a piece of 25mm bar. This was faced in the lathe. It was drilled out with a 6.8mm drill to a depth of 20mm. This hole was counterbored with an M12.5 drill to a depth of 5mm. An M8 tap was started in the hole. The end of the bar was parted off at 23mm from the end. The cut off piece was then clamped in the bench vice and the hole tapped until the tap bottomed.

3



Exploded view showing the various parts.

Fig.1

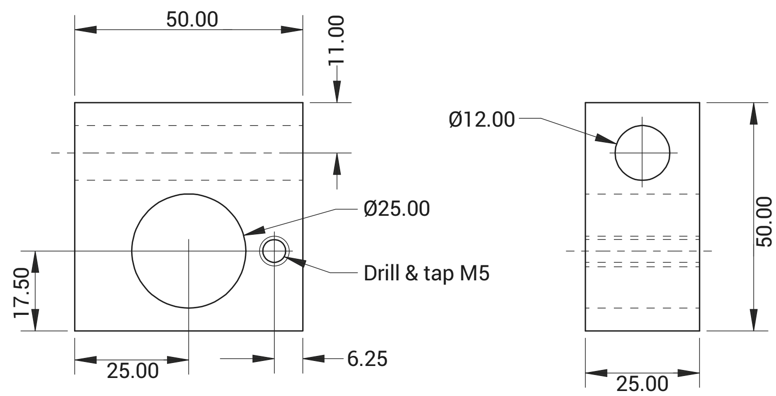


Fig 1. The Mounting Block

A length of M8 studding was screwed into the hole and then a washer and nut screwed onto the stud. The nut was tightened down firmly. The assembly was gripped in the lathe chuck by the nut and the outer diameter turned down to 24m and then knurled. The end of the bar was faced and chamfered. The assembly was removed from the chuck and the nut and stud unscrewed from the knob. The knob and stud were cleaned in white spirit and then lighter fluid. A little epoxy resin was smeared on both stud and in the threaded hole and the two were then screwed together and allowed to set.

The stud was cut off to leave 17mm protruding from the knob. The knob was then wrapped in 1 turn of cardboard and re-chucked in the lathe with the stud protruding and the knob was chamfered. The protruding stud was faced and then heavily chamfered, **photo 4**.

The lever.

The lever, **fig. 3**, was made from three components. The collar was machined from a 12mm length of 25mm diameter steel bar. This was faced both sides, chamfered and drilled out with a 12mm drill. The collar was mounted in the mill vice and cross drilled

Fig.2

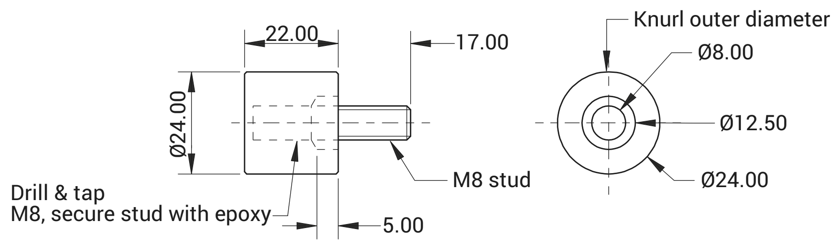


Fig 2. Locking Screw

The locking screw.

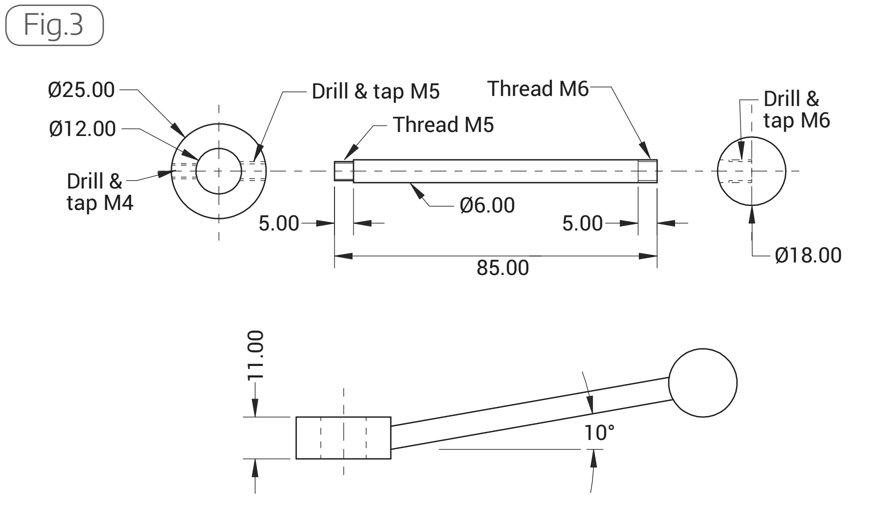


Fig 3. The Lever

with a 3.3mm drill and then tapped M4. The piece was turned around in the vice and the vice fixed at an angle of about 10 degrees using some suitable packing. A cross hole was drilled at this angle using a 4.3mm drill and this was slightly counterbored out to M6 and tapped M5. The handle was formed from a piece of 6mm round bar 85mm long. One end was reduced to 5mm diameter for a length of 5mm and threaded M5 using the tailstock die holder. The other end was threaded M6 for a length of 5mm. The M5 threaded end was then screwed into the angled cross hole of the collar and secured with a drop of Loctite.

The other end of the handle was finished with an 18mm aluminium ball. This was made once the ball turner was complete, **photo 5**.

The lever

The shaft and dovetail block.

The shaft and dovetail block, **fig. 4**, were made in two separate pieces and then pressed together using an epoxy adhesive to ensure a good bond. The reason for this form of construction was partly because of the material available and partly the difficulty in holding a tall thin object for milling.

The shaft was a piece of 12mm round bar. This was cut 75mm long and faced both ends. One end was lightly knurled for a distance of 6mm. Both ends were chamfered. The bar was drilled through 5mm for a distance of 40mm from each end. Drilling from both ends minimised drill wander. The un-knurled end was then drilled out 6.8mm for a length of 20mm and tapped M8 using a tap in the tailstock chuck to ensure that the tap was inline with the bore. The piece was turned around in the chuck and the hole was drilled out to 6mm. The piece was carefully cleaned with white spirit and then lighter fluid and left to dry.

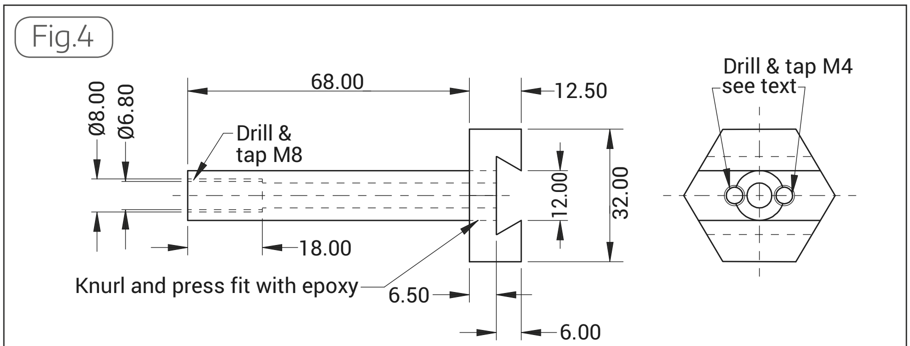


Fig 4. Shaft And Dovetail Block

The dovetail block was machined from a piece of 32mm hexagonal bar. This was chosen because it was available and because it is much easier to securely hold the hexagon bar for milling compared with a round bar. This was chucked in the lathe and faced off. A piece 13mm long was parted off. This was chucked in the lathe and the parted off face trued up to give a final thickness of the piece of about 12.5mm. The piece was mounted on parallels in the milling vice and a 12mm wide 6mm deep slot was milled in the centre of one face. The two dovetail faces were then cut using a 60-degree dovetail mill. The block was placed back in the lathe, dovetail side towards the chuck, and it was centre drilled and then drilled out to 12mm. A slight chamfer was made using a 90-degree countersink. The part was cleaned in white spirit and then with lighter fluid and left to dry.

The shaft and the block were ready to be assembled. The shaft was placed in the tailstock chuck with the knurled end protruding. The block was placed in the chuck with the dovetail side towards the chuck. A little epoxy resin was mixed and smeared into the hole in the block and on the end of the shaft. The two parts were pressed together using the tailstock ram. It was only possible to get about 1- 2mm of the assembly pressed in the lathe but starting it in this way ensures that the two parts are reasonably well lined up. The assembly was carefully removed and transferred to a bench vice that was then used to complete the pressing operation. The shaft should be pressed in but it must not protrude into the dovetail slot. The assembly was cleaned up with acetone to remove any excess epoxy resin and left for the resin to set, **photo 6**.

When the adhesive was set a line was marked along the centre of the dovetail section. The line was centre punched where it intersected the shaft in two places, see fig. 4. Two holes were drilled at the two centre punch marks 3.3mm diameter and 6mm deep. These blind holes were tapped M4. Two 4mm M4 grub screws were screwed in, **photo 7**. This ensures that the dovetail piece cannot move on the shaft.

The push rod.

The push rod, **fig. 5**, is simply a 63mm length of 6mm diameter round steel. Both ends were faced and lightly chamfered. The M3 tapped hole was not drilled until the ball turner was assembled.

The tool block.

The tool block, **fig. 6**, was made from a piece of 16 x 19 mild steel bar. This was found in the scrap box. It was about 50mm long with a 30mm radius on one end. The radiused end is not necessary and it could just as well have a square end.

The dovetail was cut first and as it approached finished size the fit with the dovetail block was frequently checked. The fit should be such that the dovetail slides freely with little play in the direction of the shaft axis. The slot was cut next. The work piece was turned over in the vice and the 10mm hole for the insert tool holder was drilled. The piece was re-mounted in the vice with the curved face uppermost taking care to ensure that it was accurately set at right angles to the mill table. The hole for the insert tool holder retaining screw was drilled 3.3mm and tapped M4. The position of the 3.5mm hole for the feedscrew was marked out and drilled 2.5mm. This hole will be opened out to 3.5mm during assembly. The finished block is shown in **photo 8**.

The feedscrew.

The feedscrew, **fig. 7**, was made from a length of M3 studding and a knurled knob.

The knurled knob was made from a length of 12mm round bar. This was faced in the lathe, drilled out 2.5mm for a depth of 6mm, knurled, tapped M3, chamfered and parted off. The knob was attached to the stud using epoxy adhesive, **photo 9**.

Assembly.

The two dovetails were slid together, the push rod inserted and the locking screw screwed into the end of the shaft. The dovetails should move freely but when the locking screw is tightened they should lock together. The locking screw was loosened and the tool block was slid across so that the hole for the insert tool holder is closest to the centre and the locking screw was tightened.

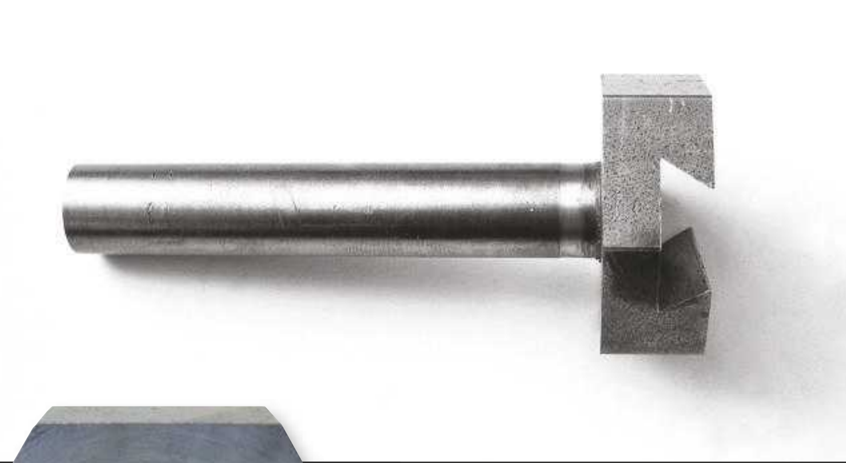
This sub assembly was mounted in the mill vice with the curved surface uppermost and ensuring that the dovetails are accurately vertical. Using a 2.5mm drill bit through the previously drilled 2.5mm hole in the tool block the push rod was drilled through. The sub assembly was removed from the vice and dismantled by removing the locking screw and tapping the end of the shaft sharply on a flat surface. This should cause the push rod to fall out. The 2.5mm hole in the push rod was threaded M3.

The tool block was mounted accurately vertical in the vice again. The 2.5mm hole was opened up to 3.5mm and the drilling continued until the drill emerged from the lower flat surface of the tool block.

The push rod was replaced in the shaft and the feedscrew, with a washer, screwed into the M3 hole in the push rod. This was screwed in until it emerges from the hole on the flat side of the tool block. A washer was placed over the end and two M3 nuts. These nuts were adjusted so that the feedscrew turns easily but there is no backlash. When adjusted the two nuts were locked together.

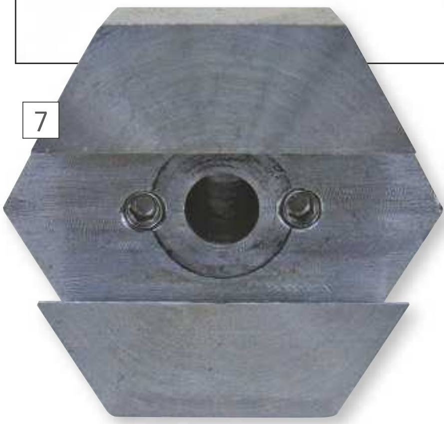
The shaft was inserted through the hole in the mounting block and the lever slipped over the end and secured in place with an M4 grub screw. The final operation was to screw in the locking screw.

6



The dovetail block and shaft.

7



The dovetail block showing the two grub screws

Fig.5

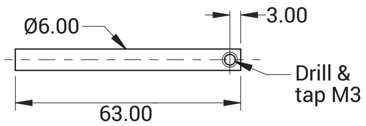


Fig 5. Push Rod

Fig.6

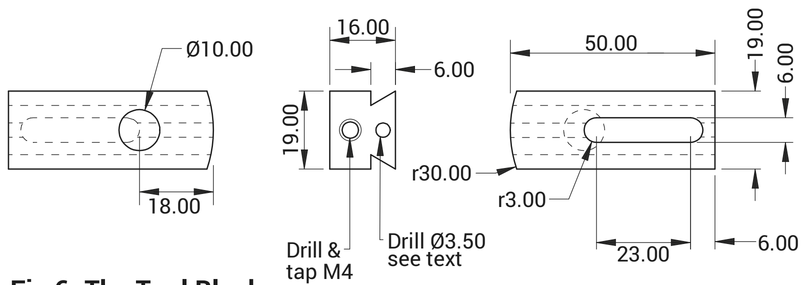


Fig 6. The Tool Block

The insert tool holder.

The tool block is designed to take a tool 10mm in diameter. This could be made from a piece of 10mm diameter HSS or silver steel but I had some 11mm TCMT inserts and so I made a simple tool holder, **fig. 8**, to hold one of these. After milling the end of the 10mm mild steel bar as shown in the drawing the end was cleaned and an insert was stuck in place using superglue. The hole position was spotted through using a 2.8mm drill. The insert was removed and a 2.1mm hole drilled and then tapped M2.5. The insert was clamped in place using an M2.5 cap screw, **photo 10**.

Final operation.

When everything was assembled the last remaining operation was to turn a ball to fit on the end of the lever.

The first thing to do was to set the rotation axis of the ball turner at the same height as the spindle axis. To do this the ball turner was slipped over the lathe tool post and then lifted and manoeuvred until the knurled locking nut could be gripped in the lathe chuck. The height adjust screw on the mounting block was then set. This sets the two axis in alignment and provided there are no changes to the tool post or the ball turner it will always go back on the tool post at the correct height. The ball turner was removed from the lathe.

8

The tool block showing the slot underneath.

Fig.7

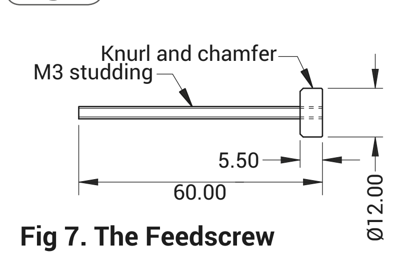
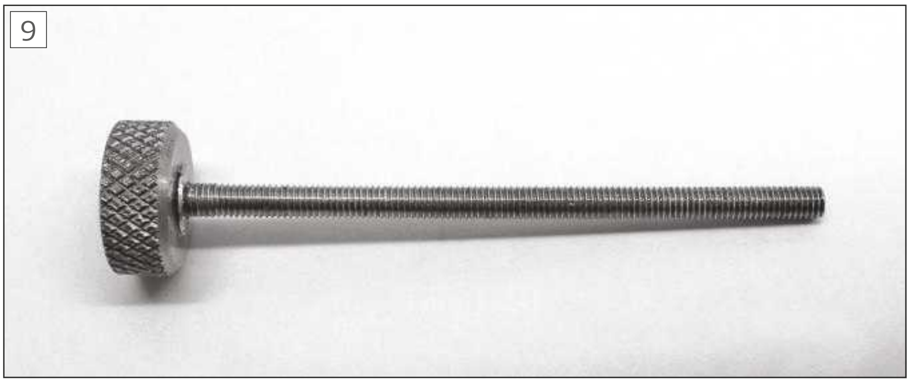


Fig 7. The Feedscrew

9



The feedscrew.

Fig.8

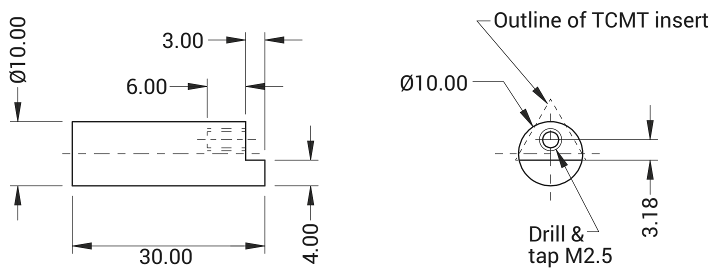


Fig 8. Insert Tool Holder.

10

The insert toolholder.

A piece of 12mm bar was taken and the end turned down to 6mm and threaded M6. The top slide was set over by 15 degrees and a shallow taper was put on the mandrel. The top slide was set at 45 degrees and a point was turned on the end of the screw thread, **photo 11.** The top slide was returned to zero set over afterwards.

A piece of 19mm diameter aluminium bar was faced at one end and drilled out 5mm for a depth of 9mm. The hole was then tapped M6. The piece was parted off 19mm from the end.

The ball turner was placed on the tool post and the tip of the insert tool aligned with the point on the end of the mandrel. The cross slide was then locked using the carriage lock.

The aluminium piece was screwed onto the end of the mandrel and with the ball turner set at maximum diameter the axis of rotation of the ball turner was centred on the work piece by eye. The lathe was started and the ball turner feedscrew adjusted until it just starts to cut on one edge of the work piece. It is important to lock the ball turner with the locking screw after each adjustment. Small adjustments to the top slide and the ball turner were made until the aluminium was being cut equally on both sides. Once this was achieved then the top slide is not adjusted any more, only the ball turner. The ball turner setting was slowly decreased and successive cuts made until a complete ball was formed.

Photographs 12, **13** and **14** show the development of the ball on the lathe.

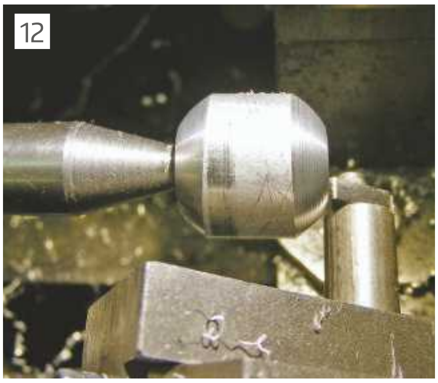
Once the ball was finished it was removed from the mandrel and screwed onto the lever completing the ball turner.

Conclusion.

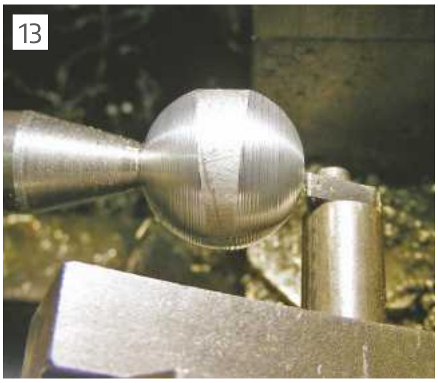
This ball turner works well and is ideal for making small knobs for machine accessories. It is very quick to set up.

The mounting block was designed to fit my expanding tool post but in principle it should be straightforward to make a suitable block for almost any other type of toolpost. ■

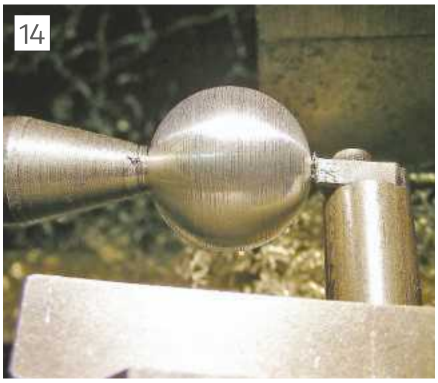
The ball turning mandrel.



The start of turning a ball.



The ball nearly formed.



The finished ball

In our Next Issue

Coming up in issue 260
On Sale 6th October 2017

Look out for the October issue, 260, of Model Engineers' Workshop, for some more fascinating workshop insight:


Make **Will Doggett's** Dividing Head.


Terr Gorin fits a Top Slide to a Unimat SL.

John Ashton makes a grinding head for the Acute Tool System.

A Treatise on Steadies

John Stevenson delves into the details of some lathe accessories that rarely get the attention they deserve.

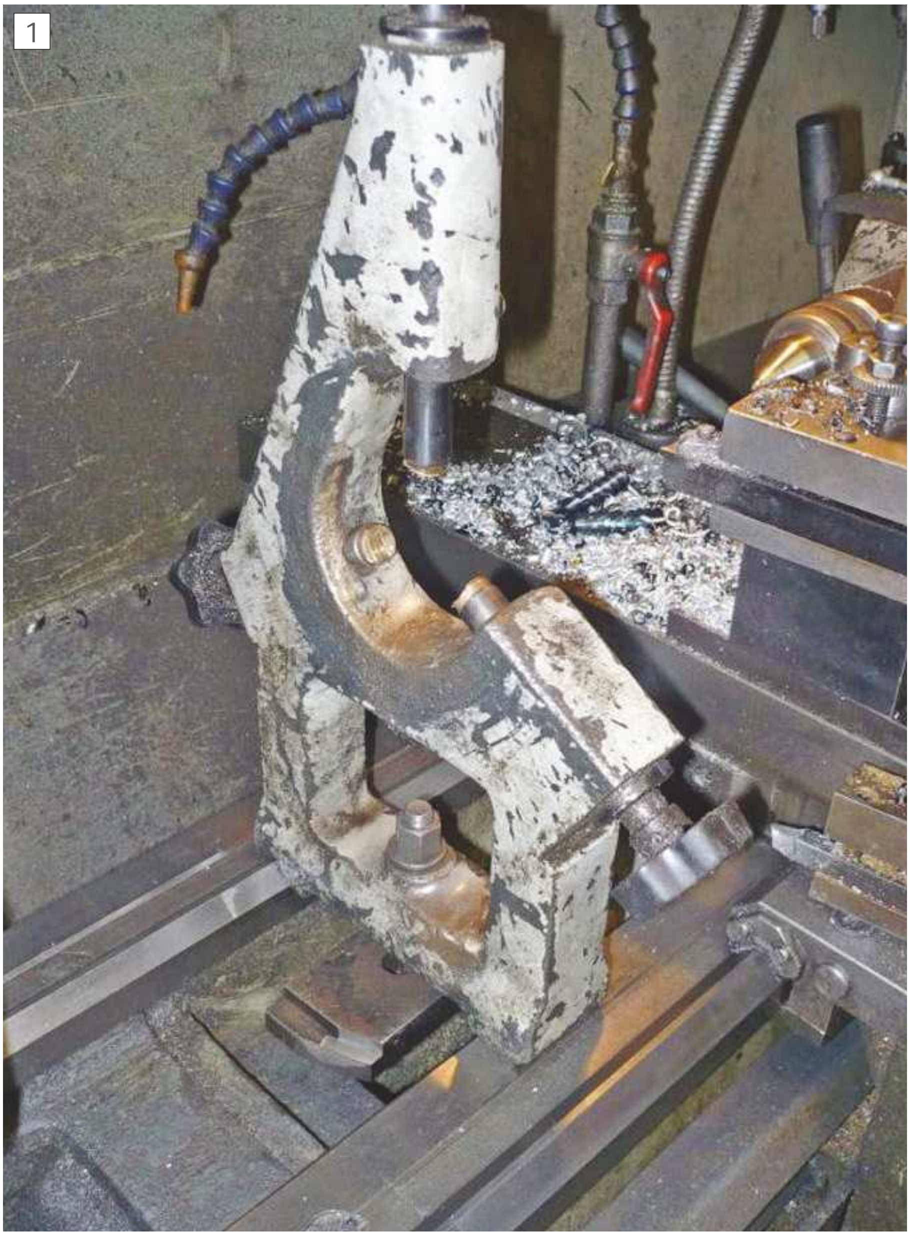
One of the most desirable of attachments for a lathe after the chucks and centres have been bought is probably a steady. These come in two flavours, fixed and travelling and it's the former that seems to get more general use.

With a second hand lathe, it's also the bit that's most likely missing and some of the genuine ones are like hens teeth to obtain.

Also, I have never read an article that looks at steadies on their own and not part of a machines accessories and this article tries to address this shortcoming.

The purpose of this article is to look at various types of steady to give an idea on what maybe a better approach to certain jobs and to take a general look instead of the blinkered "It was made for an Acme so I need a genuine Acme". When we look at them in detail it becomes apparent that certain designs that have run on for years and often been copied are not as good a design as first thought, when compared to other designs.

This isn't the be all and end all of steadies, there are many ways to achieve the same aims, this is just what I have to use at this moment in time and is posted just to further ideas. I make no apologies for the quality of the pictures or the state of the machines, these were all taken in a working environment that is my living.



1

A typical small steady.

2

A larger TOS steady.

I am of the opinion that there has never been a steady for all uses, this is further enhanced by the different ones I have to do different jobs, sometimes you can see from example pictures why a certain design just won't work. Again, I'm not forcing my views on anyone just offering an across the board idea on steadies.

A generic steady shown in **photo 1**, this was supplied with my small TOS lathe and is often copied, especially on the smaller Chinese lathes and works well for general work. It is of the generic design with the fingers centrally spaced and adjusted by threaded screws. One point to note is the keep plate that fastens it down has been chamfered on both ends so it can swing into position without having to remove the bolt and thread it up from underneath. This is a modification that can be adapted to many other designs.

The generic steady shown in **photo 2**, as supplied as standard on my large TOS, is a typical design with hinged top, popular on

Hardened steel pads.

older British and American lathes, again the keep plate has been reworked to save time fitting and removing.

This steady is fitted with hardened steel pads, shown close up in **photo 3**, as opposed to bronze. It sounds an unusual combination but it does work and actually marks the work less than brass or bronze pads, provided it is kept well lubricated. These are how they are at present after 30 years' work without being dressed or touched up, incidentally this lathe is a 11 x 84" centre lathe so it get some serious work, as does the steady. Supporting

Oversize prefabricated steady.

electric motor rotors in excess of 1/2 a tonne is normal.

Photograph 4 is a large prefabricated steady I made for the big TOS to take over from the standard one. Sorry the picture is a bit shaky as I was trying to hold the measure at the same time as take the photo. It's 22" side to side and will hold 16" diameter. Screws are 24mm all thread with nuts pinned to the top and brass pads screwed on. It was a bit of a rush job as I needed it for some large rollers.

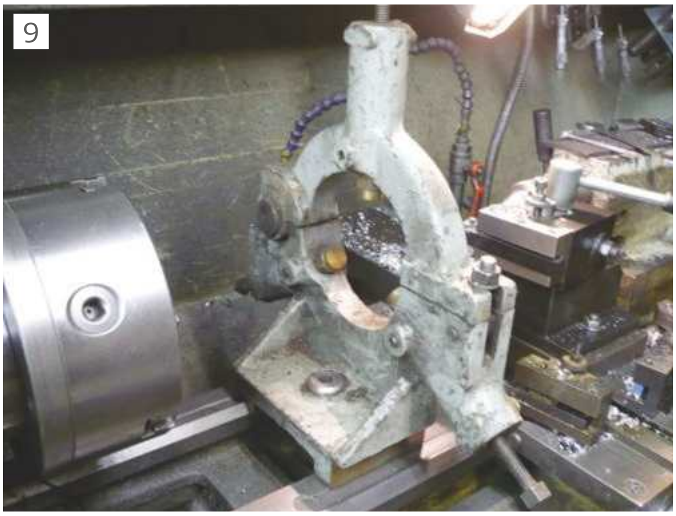
Details of one hinge are shown in **photo 5** and there are 8 plates, 4 top, 4 bottom

Hinge detail.

The opposite hinge.

Cathead steady.

Reverse of the cathead steady, note the large diameter ball race.



Repurposed Herbert steady.

Loose cathead.

Use of the loose cathead with a normal steady.

each set has been laser cut identically from 10mm steel plate, then 2 plates on each have had the ears cut off (ouch!) to form the hinges. The bed profile has also been laser cut and only needed dressing with a file to fit the bed correctly.

The opposite hinge point is shown in **photo 6** and the whole assembly is held together with a series of countersunk Allen screws. Now this steady is well outside the scope of most workshops and this magazine, but it's more about the method of construction than size. This one was done quickly, just over a day from drawings, to laser cutting, to assembly as it was needed urgently, but it proves a point that missing steadies can be reproduced quickly and easily, it's not all about casting or carving out of large plate. I will touch on this later in the article with something more relevant to readers.

Moving onto variations of steadies, **photo 7** is a cathead steady I made for both the small TOS and the CVA, it's in two parts and only requires a change of base to fit both machines. Cathead steadies vary in design and have been around for years, they probably saw light of day in the American oilfields to hold irregular pipe for machining. They get their name from the protruding bolts for centring looking like cats' whiskers. Since this picture was taken the sleeve has had two more holes drilled and tapped at 120 degrees to one of the existing screws. This allows it to hold square, hex octagonal and irregular shaped work.

Photograph 8 shows a view from the other side to show the mounting. The cathead can be secured either way depending on what it has to grip. To line up you slack the two cap head screws, grip the inner of the sleeve in the 3-jaw chuck and wind the jaws out to grip and ensure concentricity, then finally tighten the two caphead bolts.

This steady shown in **photo 9** came off an old Herbert lathe and had the vee moved over on the base on a packing block to line up with centre and it also has lumps milled off the side to allow the ears of the saddle to pass. It was an exercise to make a readily available steady fit a machine that never had one of this size as this takes over from the small generic standard steady in photo 1, that came with the lathe.

Photograph 10 shows a loose cathead similar to the one in photo 7 but having 2 sets of screws and no bearing. It's designed to be fitted to something like a welded shaft, or square and then run in a standard steady as such as shown in **photos 11** & **12**, again since this picture was taken it's had the two extra holes drilled at either end for hexagon work.

Another steady for the small TOS, this time off a Colchester, is shown in **photo 13**. Again, this was modified because it was available and **photo 14** shows a view of the rollers and the conversion plate needed to get it to centre height. I modified this as it's a roller steady and capable of higher speed than a normal steady but there is an inherent problem with roller steadies and that is that if chippings and turning get under the roller they can imbed themselves into soft materials or even lock the work up in harder materials. One dodge is to cut a stiff cardboard washer that is a tight fit on the shaft and have this between the tool and the steady to stop chips embedding. Many people fancy roller bearing steadies but to be honest they can be more trouble than they are worth.

Now the next four photos show what I mean about there never being a steady for all jobs. **Photograph 15** is the standard steady for my CVA lathe which is a clone of a 10EE holding a typical job, having to support a small armature to work on the drive end. **Photograph 16** shows the problem in that fan is on the steady but the fingers are not reaching the end of the shaft.

Even with centrally spaced fingers this isn't going to happen. In this case the steady can't turn around as it relies on one vee on the rear shear to locate it and that's common to many lathes.

The answer as shown in **photo 17** is to reverse the steady if possible, fine on something like a Myford with 2 flat shears but not on something like the 10EE, so what is needed is a second vee machined in the


12

Reverse view of the loose cathead.


13

Roller steady.


14

Close up showing how it was converted from a Colchester to fit the TOS.

Steady on CVA lathe.

But the fingers aren't engaging properly.

So reverse the steady.

opposite foot, **photo 18**. Still enough room to fit on the flat way but you get two bites of the cherry!

Purists will throw their arms up in the air milling a steady but purists don't have to earn a living doing this daily. Sometimes you have to do whatever is needed to complete a job.

Last, not exactly a steady but can be used as one, is the rotating chuck in the tailstock. In **photo 19**, shot from the back, one bearing sits in the back of the chuck and a second sits in the backplate. Front is shown in **photo 20**. By using an independent 4 jaw it can hold anything you throw at it and allow you to clock the parts up that need to run true and then machine enough to then get a conventional steady on the part.

This attachment was made so I could hold some shafts that had been completely rebuilt with weld, enough to machine a band on them to get a steady, then machine the end for a centre.

This is by no means all there is on steadies, it's only a small part but hopefully enough that you can see other ways to support work.

I propose at a later date to follow this up with a smaller steady to fit the Myford 7 series of machines using the laser cut approach. This will have a maximum support diameter of about 130mm or 5", far more than the standard ones and the readily available kits on the market.

The Myford steady, **photo 21** is not a good example of a steady given how many have been made and the high prices that they fetch. The limitation is in the finger adjustment, just relying on one bolt to locate the brass or bronze finger. In use, even with adequate lubrication work in a lathe expands with heat and this is why

But this means a bit of judicious butchery.

Rotating chuck mounted on MT arbor.

The rotating chuck in lathe tailstock.

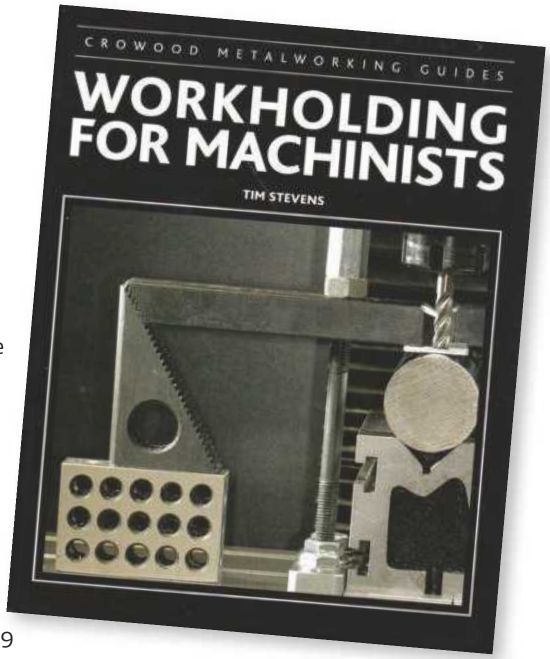
The standard Myford steady has no fine adjustment.

steadies are made with adjusting screws, as in use an experienced turner will be tweaking these screws to keep a constant pressure on the work. Too loose and you get chatter and too tight and it seizes.

As mentioned earlier the material for fingers is usually brass, bronze or hardened steel on larger commercial lathes. Brass isn't really suitable other than for light loaded use as it's too soft. Bronze is far better but aluminium bronze is even better as it's a very tough skiddy material much suited for wear pads in industry. ■

On the Wire NEWS from the World of Hobby Engineering

Workholding for Machinists, by Tim Stevens



Tim Stevens was apprenticed as a silversmith, and has worked in the jewellery trade, in car and motorcycle manufacture, and as a technical college lecturer. Now retired, he runs three vintage cars, and is busy in his home workshop repairing and making parts for his own machines and those of local colleagues.

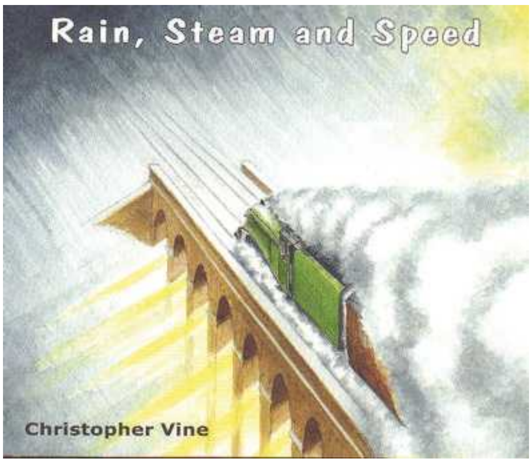
Tim's new book, Workholding for Machinists, is the latest title in the Crowood Metalworking Guides series. In this well-written and readable book, Tim targets the relative newcomer to metalworking although I must admit there are more than a few ideas and wrinkles that I haven't come across before. The book covers the various workholding options that are available to the metalworker, together with the principles behind them. In it he stresses the value that a little forethought can bring in making subsequent machining operations easier, while also maximising accuracy and security of the work. The book also contains a useful glossary of less familiar terms.

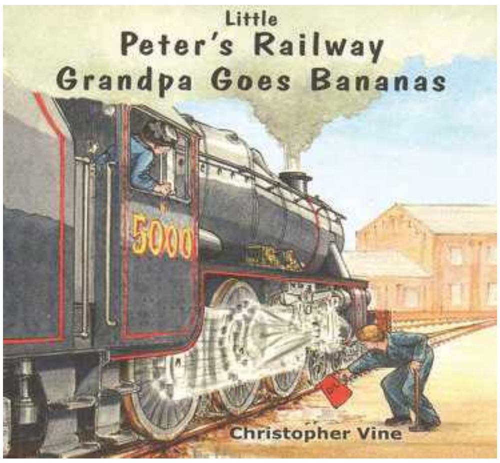
Topics covered include:

- Work holding on lathes and milling machines
- Collets and collect chucks
- Turning between centres
- Turning on a faceplate
- Tool holding

Workholding for Machinists is published by the Crowood press and retails at £14.99

Free Books for Schools





Author of the popular Peter's Railway books, Chris Vine, and businessman Nick Jarmany, CEO of Quixant PLC have teamed up to undertake an ambitious initiative to introduce engineering to more young people. Thanks to Nick's support packs containing three of Chris' books have been sent to the science co-ordinators of every primary school in the UK – that's 24,000 schools!

Many readers will be familiar with the Peter's railway books which introduce engineering ideas and concepts in an entertaining way with engaging stories and delightful illustrations. The books are backed up with free classroom resources which can be found at **www.petersrailway.com/schools**.

The books sent out are A Bit of Energy, Grandpa Goes Bananas and Rain, Steam and Speed. They certainly have fires the imaginations of many youngsters, lets hope this initiative encourages many more to develop an interest in engineering and technology.

A Benchtop Bandsaw

David George reviews the Clarke CBS190B 190mm bandsaw from Machine Mart.

1

The Clarke CBS190B.

2

The bed angles a full 45 degrees.

3

You can see the table clamping arrangement in this image.

I was not sure what to expect from a bandsaw which was priced at £155.98, but as I got to use it, **photo 1**, I found that it has quite a few useful attributes. Having unpacked and assembled it I went through some of the settings and found that the blade guides needed adjusting and the table levelling screw needed adjusting to get 90deg to the blade.

The back aluminium casting is quite sturdy but the front plastic cover is a little flexible and I found that on closing and bolting the cover up you need to press the cover near to the safety switch, which prevents it working with cover open, to make the switch operate. This only needs to be done if the cover has been opened. The cover is held closed by two hex head bolts but in the parts list it shows two thumb knobs and studs and as there isn't a spanner in the tools supplied, only Allen keys, it's a bit off-putting.

Having bolted down the saw I tried a cut or two in some plywood and was impressed with the ease in which it cut but found that the ripper guide was out of square and cut tapered. I found that the guide just needed slackening up and squaring with a square before tightening up and all was ok with the parallel cutting. Next, I tried the table tilt, **photo 2**, and found it fairly easy to set but it seems wobbly until you re clamp the table lock handle, **photo 3**. Using the


Fitting the coarser toothed blade.


Cutting aluminium angle.

mitre gauge, I cut some pieces of 1 inch thick wood and with a little adjustment found this acceptable in squareness and 90 degree angle. I then put the table back to flat and checked for squareness and it was again good.

I had thought to try it on other materials and bought another type of blade more suitable for cutting metal but of the correct length and width with 14 teeth per inch (TPI). Fitting the new blade tensioning and tracking it was quite easy with no problems, **photo 4**. The first material I tried was Perspex and it cut without burning and left a clean cut. The second was aluminium and the angle section 1 1/5" x 1 1/5" by 1/8" cut without any problem and square. The final piece was some 1/8" x 4" brass plate and again it cut well, **photos 5** & **6**. I did try a piece of steel bar but the blade speed is too fast so I wouldn't recommend cutting steel on this saw. The other little problem that I found was that the mitre gauge face was a plastic moulding with quite an amount of shrinkage and if you hold certain lengths of material to cut it may be out of square but I screwed a piece of aluminium to this using the slots already in it to smooth out the waves in the plastic.

Overall, I think that this is well worth considering if you need such a piece of equipment.

The Clarke CBS190B is available from Machine Mart stores nationwide, or from **www.machinemart.co.uk**.


Cutting brass sheet.

Fly Cutter

A simple piece of tooling that makes an ideal beginner's project

A fly cutter is a single point tool, usually used for machining plane surfaces. It is an inherently accurate tool when used in this way, and if the toolbit is a good one, rigidly held, it will produce smooth, flat surfaces with the most basic of set ups. It is also possible to flycut convex surfaces, but the lack of fine adjustment of the typical flycutter imposes limits on accuracy.

There are innumerable ways of making a fly cutter. The basic requirement is simply a toolbit holder, which is easy to attach to a rotary machine such as a lathe or a mill. Stan Bray has described another useful style, which bolts directly to the faceplate. Tubal Cain was unashamedly used a square-section boring bar held crosswise in a chuck!

The body of the cutter is just a piece of 1" mild steel bar, turned down to 1/2" to make a shank. When you hold the cutter in a chuck, the body can be held flush against the jaws, preventing any rearward movement. The thick end of the bar can be sawn and then filed to a 10° angle. This angle gives the toolbit its top relief.

For use with 1/4" HSS tool steel, a slot offset from the centre line of the body is needed. On my mini-lathe I was able to achieve this by holding the shank in the lathe's tool holder, suitably angled. I cut the slot with a 1/4" FC3 mini-mill, which gave a slot that was good fit for the tool steel. By using the same mill in a pillar drill and 'plunging' it into the thick side of the body, two recesses with 4BA tapped holes for the securing screws were easily made.

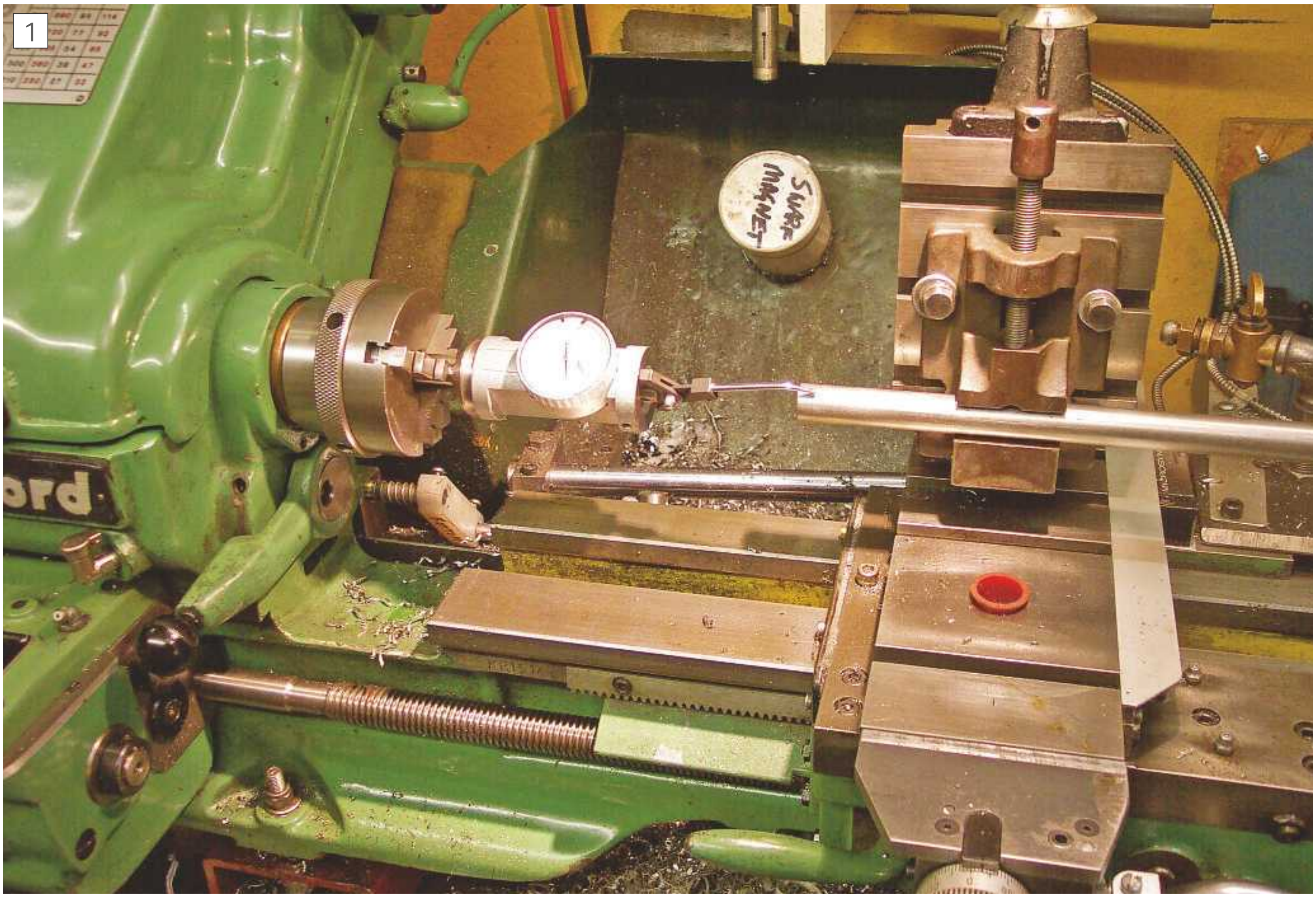
The tricky bit is making a good toolbit. You will need a roughly 2" long piece of 1/4" square HSS. If you need to shorten a longer piece, grind a shallow groove all round with a mini-drill and carborundum wheel. Hold the bar in a vice, covered with a cloth, then tap the end sharply with a hammer. To visualise the shape of the tool, think how it will contact the work as it rotates; with the bit in the holder identify the corner that will do the cutting. The angle of the holder provides one clearance angle, but you need to grind further clearance on the end, 'front' and 'top' of the bar. Aim for 5-10°, and a little more on the end of the bar. Effectively you need to create a left-handed knife tool.

In use, the cutter should be held firmly in a chuck. In the case of milling machines supplied with heavy-duty drill chucks, you can probably get away with holding the cutter in it, but don't try using the fly cutter in a pillar drill. Fly cutters need to be run slowly; this one has a maximum of a 3" cut and you should run it no faster than you would turn a 6" diameter cylinder - pretty slowly. The work should be moved past the cutter; on smaller lathes it can be a challenge to achieve a set-up where the whole area to be worked passes the cutter. The depth of cut and feedrate should be less than usual, because of the significant leverage between the end of the cutter and the shank. Be patient and keep your cutters sharp and you will get excellent results.

Finally, a version of this tool that is not angled can be used to hold form tools, such as those used for cutting gearteeth or special profiles. ■

Drilling Long Bars

Brian Wood faces up to the challenge posed by some long stainless steel bars.



The co-axial indicator in use

From time to time I get requests to supply items in stainless steel to a local bespoke manufacturer who specializes in making expensive mixed media furniture for discerning clients.

A little while ago he asked me to supply 16 off 16mm diameter stainless steel bars with M6 securing holes formed centrally in each end. The bars varied in length from 240mm to 740mm. The short bars would be easy to accommodate with a fixed steady, gripped in the lathe chuck in the usual way. The problem came with holding and working on the long bars, of which the longest set of four was well over the length of my Myford lathe.

As a Christmas present to myself the previous year, I had indulged in a co-axial centreing aid for use in my vertical milling machine; here was another chance to use it for this job.

Photograph 1 shows it centreing the end of a bar held in a vice fitted to a Myford vertical slide. Finding the centre with the device is disarmingly simple; the bar was moved both across and vertically to the lathe bed until the indicator was barely twitching. The beauty of these gadgets is that the indicator movement can be viewed continuously from a fixed position, avoiding completely all the gymnastics involved with mirrors using more traditional methods. At the point of minimum indicator movement, the cross slide and vertical slide controls were locked; the bar then being central.

Photograph 2 shows the view along the lathe bed where the distant end of the bar is supported centrally in the fixed steady at the tailstock end of the lathe bed. The steady had been preset on a short length of 16mm diameter material held in the lathe chuck before being moved and securely as seen in this photo. **Photograph 3** shows the degree of overhang of one of the longest bars

It just then remained to remove the co-axial indicator and fit the necessary tooling at the chuck end of the lathe to centre, drill and tap each mounting hole in turn, racking the apron along the bed to feed the work onto the tooling. The vice provided a secure and accurate two sided cradle to hold each bar end in turn before closing the moving jaw to grip the bar firmly. The shorter bars were also included in the work as it only took a short time to deal with them rather than break down the set up.

The alternative way of setting up the vice is of course to grip a length of matching bar in the lathe chuck with fag paper between the vice jaws and the bar and carefully adjust the cross and vertical alignment until the paper can just be removed before gripping the bar. Any errors will be trivial and can be ignored. ■

2

The view along the lathe bed

3

The overhang on the longest bars

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