No.270

GET MORE OUT OF YOUR WORKSHOP WITH MEW

MODEL ENGINEERS' WORKSHOP

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

AUGUST 2018

A Click Spring Jig for Clockmakers

INSIDE

- Repetition Machining on a Myford
- John Ashton's Sine Bar Setting Jig
- A Unimat Dividing Head
- Ajax Horizontal Mill

£4.99

mytimemedia ENGINEERING GROUP

9 770959 690133 70

2018, THE YEAR OF ENGINEERING SUPPORTER

COVER STORY

Workholding in the Lathe

YOUR FAVOURITE WORKSHOP MAGAZINE

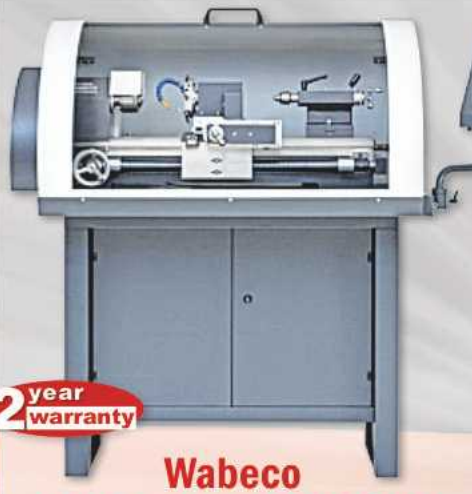
PRO MACHINE TOOLS LIMITED

Tel: 01780 740956
Int: +44 1780 740956

Up to 5 year warranty on selected WABECO Machines!

1885 WABECO 1885

Precision machines made in Germany for the discerning engineer!



2 year warranty

Wabeco CNC Lathe CC-D6000

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1215 x 500 x 605mm
- Weight – 150Kg
- NCCAD/ NCCAD Pro

1885 WABECO 1885

Wabeco produce quality rather than eastern quantity

CNC machines are offered with a variety of CNC control and software systems, and still be used as manual machines.

Wabeco produce precision made machines by rigorous quality control and accuracy testing.

All lathes and mills are backed by an extensive range of tools and accessories

5 year warranty

Wabeco Mill F1210

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW
- Size – 900 x 610 x 960mm
- Weight – 101Kg

Wabeco Lathe D6000

- Centre Distance – 600 mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1230 x 500 x 470mm
- Weight – 150kg

5 year warranty

Wabeco Lathe D4000

- Centre Distance – 350mm
- Centre Height – 100mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 860 x 400 x 380mm
- Weight – 71kg

5 year warranty

Wabeco CNC Mill CC-F1410

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW

- Size – 950 x 600 x 950mm
- Weight – 122Kg
- NCCAD/NCCAD Pro

2 year warranty

EMCO · WABECO · CERIANI · swiss tec · TECO · GOLmatic Maschinenbau · PROXXON · EMCO Hobbymaschinen

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • int: +44 1780 740956
email: sales@emcomachinetools.co.uk

MODEL ENGINEERS' WORKSHOP

Published by MyTimeMedia Ltd.
Suite 25, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
+44 (0)1689 869840
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

MODEL ENGINEERING PLANS
Contact: www.myhobbystore.co.uk/contact
Website: www.myhobbystore.co.uk/me-plans

EDITORIAL
Editor: Neil Wyatt
Tel: +44 (0)1689 869 912
Email: neil.wyatt@mytimemedia.com

PRODUCTION
Designer: Andrew Tompkins
Illustrator: Grahame Chambers
Retouching: Andrew Tompkins
Ad Production: Andrew Tompkins

ADVERTISING
Business Development Manager: David Holden
Email: david.holden@mytimemedia.com
Tel: +44 (0) 7718 64 86 89

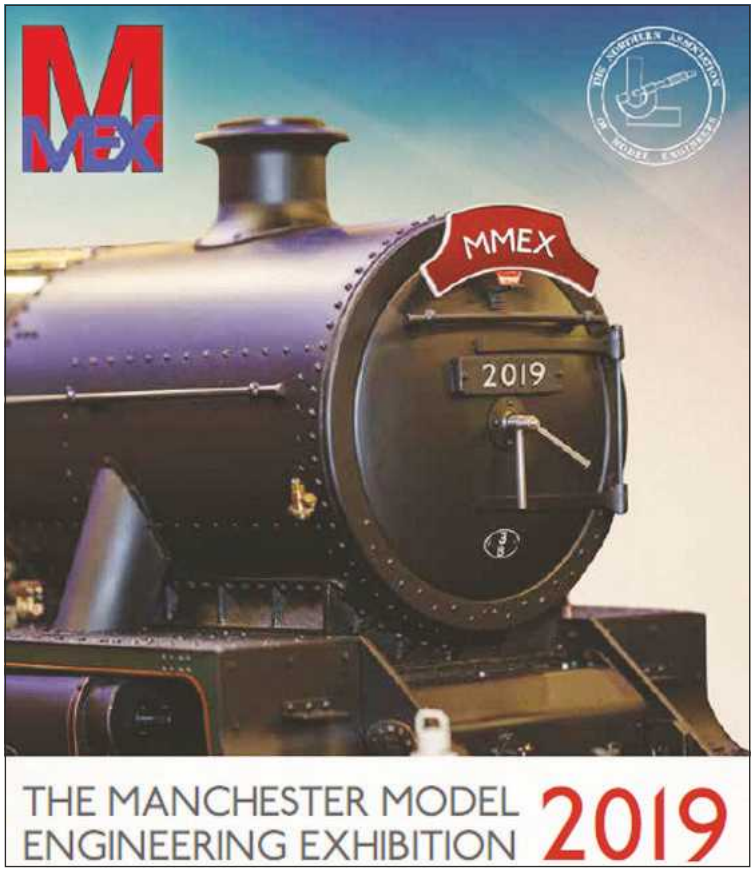
MARKETING & SUBSCRIPTIONS
Subscription Manager: Louisa Coleman

MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

mytimemedia
print & digital media publishers

Model Engineers' Workshop, ISSN 0959-6909, is published monthly with an additional issue in August by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 52.95GBP (equivalent to approximately 88USD). Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineers' Workshop, Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at dsb.net 3 Queensbridge, The Lakes, Northampton, NN4 7BF.
Air Business Ltd is acting as our mailing agent.

On the Editor's Bench



Manchester Exhibition on for 2019

The Manchester Model Engineering Exhibition, MMEX, is a biennial event next scheduled for February 23rd and 24th 2019. MMEX is sponsored by NAME, the Northern Association of Model Engineers and is a non-commercial undertaking run by model engineers for model engineers. A booking has been made to run MMEX 2019 at the Queen Elizabeth Hall Oldham, the same venue as used in 2017. Detailed planning has started, and an augmented organising group is being recruited. As before the exhibition will feature a mix of clubs and traders representing the best in model engineering.

It is also unusual in being run by an organising group, no committee there! The group is currently looking for a few more people to join the group and take on activities at the exhibition. This is not onerous at the moment but does mean being at the exhibition for free from setup on the Friday to pull down on the Sunday. Potential volunteers should contact Bob Hayter, the organising group chairman **hayterbob@googlemail.com**.

For further details of the exhibition visit **www.mmex.co.uk**.

Griptru Chuck Servicing

I've just had a call from a new subscriber who was complimentary about Pete Barker's article on three-jaw chuck servicing in issue 269. He has a Burnerd Grip-Tru chuck, which is rather more complex than an ordinary 3-jaw as it has an additional mechanism, for adjusting its runout.

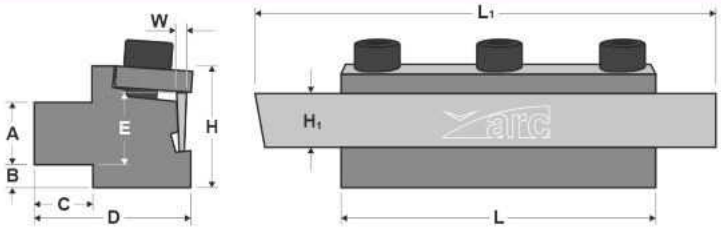
He asks if there is a reader who would be able to write up an article on the servicing and correct adjustment of a Grip-Tru? If you think you could do this, please get in touch.

arceurotrade.co.uk

UNBEATABLE VALUE ENGINEERING PRODUCTS

Parting Off Blocks with M42 HSS-Co8 Blade

Hex Key included



Code	A	B	C	D	E	H	L	W	H1	L1	Included Blade	Price
060-320-01006	6mm	10mm	10mm	27mm	6.5mm	22mm	56mm	1.5mm	10mm	80mm	M42 HSS-Co Blade 1.5x10x80mm	£23.08
060-320-01008	8mm	8.5mm			8.5mm							£23.08
060-320-01010	10mm	6.5mm			10mm							£24.22
060-320-01012	12mm	4.5mm	12mm	29mm	12.5mm							£24.22
060-320-01016	16mm	4mm	16mm	34mm	16.5mm	26mm	76mm	2mm	13mm	110mm	M42 HSS-Co Blade 2x13x110mm	£28.85

Spare M42 HSS-Co8 Parting Off Blades for Parting Off Blocks

Code	Grade	Section	Size	Price
060-320-01115	M42 HSS-Co8	Tapered	1.5 x 10 x 80mm	£8.04
060-320-01120			2.0 x 13 x 110mm	£10.96

8pc HSS Turning Tool Sets

Code	Size †	Price	Code	Size †	Price
060-320-10004	4mm	£21.52	060-320-10010	10mm	£35.64
060-320-10006	6mm	£23.62	060-320-10012	12mm	£43.86
060-320-10008	8mm	£30.49			

† Sizes are nominal and can vary - some may be oversize.

Centre Squares

Code	Max. Work Diameter	Price
100-090-01100	60mm (2.36")	£8.66
100-090-01200	100mm (4")	£13.80

Spring Tapping Guides

	Code	Type	Shank	Guide Pin	Length	Price
A	060-250-03100	Micro Spring Tapping Guide	12.7mm (1/2")	ø4.75mm (3/16")	83mm (3.1/4")	£5.21
B	060-250-03200	Spring Tapping Guide		ø9.5mm (3/8")	81mm (3.1/4")	£7.86

Sliding Tailstock Die Holder Sets

Our versatile Sliding Tailstock Die Holder will help you cut accurately aligned threads on your lathe using standard dies.

Button Die Holders are used to hold different diameter dies and are held in the front of the knurled sleeve of the tool. The sleeve is free to slide on a fixed arbor which is attached to the tailstock with a Morse Taper shank.

Code	Shank	Button Die Holder Sizes Included	Price
060-260-25200	MT2	Metric: 16x5mm, 20x5mm, 20x7mm, 25x9mm, 30x11mm, 38x14mm	£51.92
060-260-25300		Imperial: 13/16", 1", 1.5/16" & 1.1/2"	£48.46
060-260-25400		Metric: 16x5mm, 20x5mm, 20x7mm, 25x9mm, 30x11mm, 38x14mm, Imperial: 13/16", 1", 1.5/16" & 1.1/2"	£65.20
060-260-25500	MT3	Metric: 16x5mm, 20x5mm, 20x7mm, 25x9mm, 30x11mm, 38x14mm	£51.92
060-260-25600		Imperial: 13/16", 1", 1.5/16" & 1.1/2"	£48.46
060-260-25700		Metric: 16x5mm, 20x5mm, 20x7mm, 25x9mm, 30x11mm, 38x14mm, Imperial: 13/16", 1", 1.5/16" & 1.1/2"	£65.20

Button Die Holders

Code	Description	Sizes Included	Price
060-260-25103	Metric Button Die Holders - 6pc Set	16x5mm, 20x5mm, 20x7mm, 25x9mm, 30x11mm, 38x14mm	£23.65
060-260-25104	Imperial Button Die Holders - 4pc Set	13/16", 1", 1.5/16", 1.1/2"	£20.20

Use promotion code MEW-2707 on our website checkout to get 10% off the products shown above.

Offer valid until 31st July for orders placed on our website only (excludes telephone orders). Subject to availability.

Arc Euro Trade Ltd.
10 Archdale Street, Syston, Leicester, LE7 1NA.
Web: www.arceurotrade.co.uk Phone: 0116 269 5693.

Handling and carriage rates to most UK mainland destinations are based on order value:
£0-£10 = £1.40, £10-£25 = £2.45, £25-£60 = £3.50, Over £60 = Free (unless otherwise stated)

ALL PRICES INCLUDE VAT E. & O. E.

Contents

Coming up...

in our next issue

Coming up in our next issue, MEW 271 another great read.

Regulars

ON THE COVER

This month's cover shows an aluminium tube, threaded onto a temporary mandrel and being turned at high speed. For more information on different approaches to workholding, see Neil Wyatt's Lathework for Beginners on page 27.

HOME FEATURES WORKSHOP EVENTS FORUMS ALBUMS

Visit our Website

www.model-engineer.co.uk

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

THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

This month you can download Chris Gill's two great workshop apps Geometry and MetalBender for your phone from www.model-engineer/apps. See page 58 for details of how to install and use the two programs.

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

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

Body Filler on Brass

- How can you make sure body filler sticks to brass – or a should you consider using coachmakers' lead?

All Things Beaver Mill

- Do you have one of these machines? Come and tell the other Beaver fans about your experiences of using it.

Home Made Anvil

- Have you made your own workshop anvil? Share your design!

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

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

Ex- display items now for sale. Check our End of Line

Visit Our Aylesford Show Room!

Open Monday-Friday 10am-4:30pm & 1st Saturday of the month 11am-4pm

Garden Railways

Request your FREE Catalogue today!

Collect Loyalty Points Online

01622 793 700

www.dream-steam.com

PayPal VISA JCB Maestro MasterCard

Locomotives | Rolling Stock | Track | Accessories | Upgrades | Fixing kits & Washers | Chuffers | G Scale Figures | Curve Setters

BRAND OF THE MONTH: DSW

Dream Steam Works manufacturers a range of upgrades and enhancements for old Mamod,MSS, IP Jane &PPS Janet locos.

Upgrade Cylinders	DSUPCYL	£72.00
Ceramic Gas Burner Set	DSUPGBS	£90.00
Three Wick Meths Burner	DSUP3WMB	£45.00
Dead Leg Lubricator	DSUPDLDL	£29.00
Steam Regulator Kit	DSUPSRK	£35.00
Small Brass Chimney Cowl	DSENSMCWL	£4.00
Brass Cab Hand Rails	DSENCH	£4.20
Brass Side Tank Hand Rails	DSENSTHR	£5.20
Brass Smoke Box Hand Rails	DSENSBXHR	£3.10
Cylinder Covers	DSENCYCV	£12.00
Brass Sand Boxes	DSENSBX	£12.50
Brass Tank Tops	DSENWTT	£9.40
Lubricating Oil	SWLUB30	£3.00
Meths Burner Wick	DSWWK6	£1.90
Curve Tipped Syringe	DSWCTS	£2.10
460 Steam Oil 500ml	DSW460SO500	£5.50
220 Steam oil 500ml	DSW220SO500	£5.50
Solid Fuel Tablets	980001	£3.50
Water Filler Bottle	DSWWFB	£4.00
Meths Filler Bottle	DSWMFB	£3.00

*In stock as of 19/06/18, please note these loco's may no longer be available, check stocks online or call. Please note basic range takes 4 weeks from inital order and other locomotives are in batches. Batch dates will be in product description. Locomotives in stock will state instant dispatch available.

PECO

32mm (SM32) Track

Flexi Track - 12 Pack	SL600x12	£110.00
Flexi Track - 4 Pack	SL600x4	£38.00
Flexi Track - Single	SL600x1	£10.00
Setrack Curve - 6 Pack	ST605x6	£44.00
Setrack Curve - Single	ST605x1	£6.90
Setrack 38 Radius Curve - Single	ST607	£8.50
Setrack 38 Radius Curve - Six Pack	ST607x6	£48.00
Right Hand Point	SLE695	£45.00
Left Hand Point	SLE696	£45.00
Y Point	SLE697	£45.00
Small Radius Right Hand Turnout	SLE691	£45.00
Small Radius Left Hand Turnout	SLE692	£45.00
Wagon Turntable and Crossing	SL627	£20.00
Rail Joiners - 24 Pack	SL810	£3.50

45mm (G45) Track

Flexi Track - Six Pack	SL900x6	£79.00
Flexi Track - Single	SL900x1	£15.00
Setrack Curve - Six Pack	ST905x6	£40.00
Setrack Curve - Single	ST905x1	£8.00
Setrack Straight - Six Pack	ST902x6	£40.00
Setrack Straight - Single	ST902x1	£8.00
Right Hand Point	SL995	£54.00
Left Hand Point	SL996	£54.00
Point Motor Mounting Plate	PL8	£3.60
Metal Rail Joiners - 18 Pack	SL910	£6.00
Insulating Rail Joiners - 12 Pack	SL911	£3.10
Dual Rail Joiners - 6 Pack	SL912	£6.00

SLATERS

Festiniog Railway Ashbury First Class 4-Wheel Carriage Kit	16C01	£73.50
Festiniog Railway Third Class Ashbury 4-Wheel Carriage Kit	16C02	£73.50
Dinorwic Slate Wagon Kit	16W01	£20.00
Festiniog Railway 2 Ton Braked Slate Wagon Kit	16W03	£26.60
Festiniog Railway 2 Ton Unbraked Slate Wagon Kit	16W04	£25.40
War Department Light Railways K Class Skip Wagon Kit	16W06	£20.00
Dinorwic Quarry Slab Wagon Kit	16W08	£25.50
Dinorwic Quarry "rubbish" Wagon Kit	16W09	£25.50
Slaster's Mek-Pak	0502	£5.00
Slaster's Mek-Pak Brush	0505	£3.70

ROUNDHOUSE

In Stock Now*

Millie	Black, 32mm	£650
Millie	Victorian Maroon, 32mm	£650
Sammie	32mm & 45mm	£650
Bertie	Blue, 32mm	£650
Bertie	Yellow ,32mm	£650
Bertie	Maroon , 32mm	£650
Bertie	Deep Brunswick Green, 32mm	£650
Bertie	Maroon , 45mm	£650
Bulldog	Victorian Maroon, chevrons	£634

On Order

Bulldog	Due June 2018
Little John	Due Sept 2018
Bulldog	Due Oct 2018
Lady Anne	Due Nov 2018
Katie	Due Jan 2019
Russell	Due Jan 2019
Lilla	Due Feb 2019
Billy	Due March 2019

Many Home Builder parts and kits available to order online!*

Set-a-Curve

Available in 32mm and 45mm with a wide range of Radii

£15

BACHMANN

Percy and the Troublesome Trucks Set	90069	£390.00
Thomas with Annie & Clarabel Set	90068	£390.00
Thomas' Christmas Delivery	90087	£410.00
Toby the Tram	91405	£250.00
Thomas the Tank Engine	91401	£225.00
James the Red Engine	91403	£230.00
Annie Coach	97001	£80.00
Clarabel Coach	97002	£80.00
Emily's Coach	97003	£58.00
Emily's Brake Coach	97004	£58.00
Troublesome Truck1	98001	£59.50
Troublesome Truck 2	98001	£59.50
Ice Cream Wagon	98015	£56.00
Tidmouth Milk Tank	98005	£39.00
S.C Ruffey	98010	£70.00
Explosives Box Van	98017	£56.00
Open Wagon Blue	98012	£56.00
Open Wagon Red	98013	£56.00
Sodor Fruit & Vegetable Co. Box Van	98016	£56.00
Sodor Fuel Tank	98004	£56.00
V Dump Car (Oxide Red)	92504	£46.00
G' Flat Wagon with Logs	98470	£79.00
"LS" Skeleton Log Car	98490	£79.00
"LS" Speeder Orange	96253	£90.00
"LS" Speeder PRR	96251	£90.00
"LS" Speeder Santa Fe	96252	£90.00
16mm Scale Fireman and Driver	16-703	£19.95
16mm Scale Sitting Man and Woman	16-704	£19.95
16mm Scale Standing Man and Woman	16-705	£19.95
G Scale Grazing Cows	22-199	£24.95
G Scale Horses Standing and Grazing	22-201	£24.95

MSS

Side Tank Locomotive (32mm/45mm)	909003	£200.00
Saddle Tank Locomotive (32mm/45mm)	909013	£230.00
Side Tank Locomotive Kit (32mm/45mm)	909011	£190.00
Maroon Tender (32mm/45mm)	911403	£53.00
Green Tender (32mm/45mm)	911405	£53.00
Black Tender (32mm/45mm)	911401-BL	£53.00
Blue Tender (32mm/45mm)	911402-BL	£53.00
Maroon Passenger Coach (32mm/45mm)	911201	£53.00
Blue Passenger Coch (32mm/45mm)	911201BL	£53.00
Log Wagon (32mm/45mm)	911501	£53.00
Goods Van (32mm/45mm)	911101	£53.00
Guards Van (32mm/45mm)	911001	£53.00
Coal Wagon Grey (32mm/45mm)	911505	£53.00
Coal Wagon Unpainted (32mm/45mm)	911505-1	£53.00
Pair of Flat Bed Wagons (32mm/45mm)	911301	£57.00
Straight Track	910003	£34.00
Curved Track	910005	£34.00
Left Hand Point	910001	£24.40
Right Hand Point	910002	£24.40

WE HOLD A FULL RANGE OF MSS SPARES AND UPGRADES FOR OLD MAMOD & MSS LOCOS

MAMOD

Telford	MTELG0	£452.00
MKIII	MK3 From	£336.00
Saddle Tank	MST From	£336.00
Brunel	MBrunelOG	£440.00
Brunel Goods Set	BGS-CC-N	£520.00
Tender	MTDR	£39.00
Tanker	MTNK	£39.00
Goods Wagon	MGWN	£44.00
Guards Van	MGVAN	£50.00
Telford Tender	MTDR-T	£45.00

SUMMERLANDS CHUFFER

These highly developed and precision engineered chuff pipes that can bring the real sound of a working steam loco

A wide range always in stock!

Specials can be ordered on request

£25

inc. P&P

BACHMANN EUROPE Plc | DSW DREAM STEAM WORKS | Mamod | MSS | ROUNDHOUSE | SUMMERLANDS CHUFFER | PECO

facebook twitter

Dream Steam Ltd, Ground Floor Suite, Vanguard House,Mills Road, Aylesford, Kent, ME20 7NA

Call us: 01622 793 700 or send an email to sales@dream-steam.com

www.dream-steam.com | sales@dream-steam.com | @dreamsteamworks | facebook.com/dreamsteamworks

Metric Thread Overlays for a Myford Imperial Quick Change Gearbox.

Mike Philpotts follows up discussion on the Model Engineer Forum regarding cutting metric threads using an imperial gearbox.

This article presents some graphics for paper overlay nameplate labels for the Myford Imperial QC gearbox for cutting metric threads, **photo 1**, as well as some helpful tables. I would like to acknowledge many helpful comments about the subject from Brian Wood, the late John Stevenson and others made on the various forum threads.

Murphy's Law prevails! I was about to try screw-cutting on my old imperial Myford Super 7 fitted with an imperial Quick Change Gearbox and found that the first requirement was for a metric thread!

There are long and convoluted threads (pun intended) on the subject on the forum at www.model-engineer.co.uk. In an effort understand those comments I went through what must be a well- trodden, but maybe not so well documented process.

Firstly, however I needed a new chart for my imperial gearbox to establish a clear starting point. Mine has been used as a tool tray by previous owners, it is scratched, almost illegible and needs replacing! See **photo 2**.

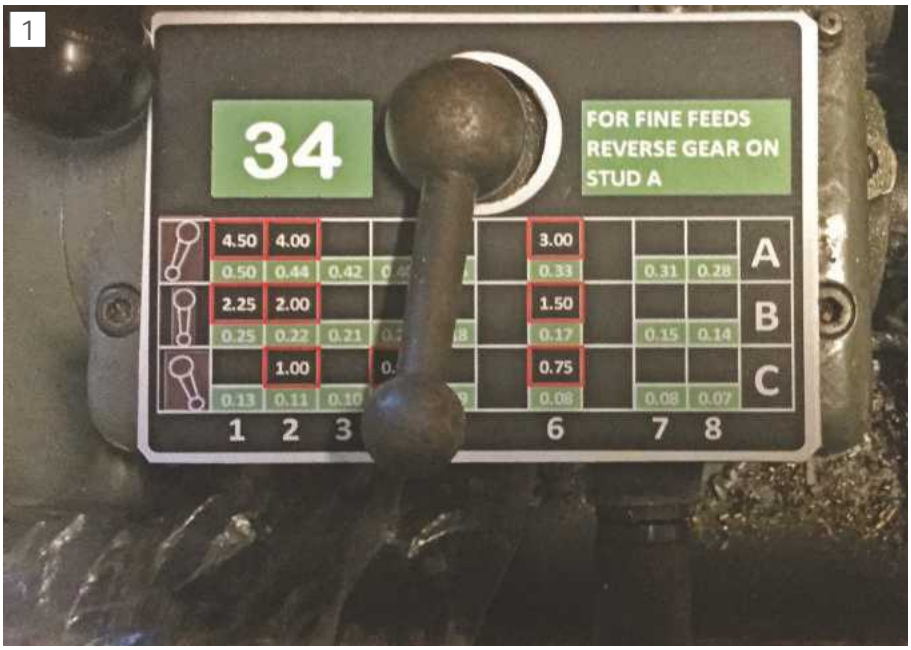
As a mean and miserly person, I looked at what could be done coughing up for a replacement plate.

The large tabulated numbers on the black background are for screw-cutting in threads per inch (TPI). The 19T/57T "Gear A" on the quadrant is reversed for normal turning to obtain the fine feed rates per revolution shown on the table on a red background.

Gear A is held in place by a little gate, so tools are not needed to reverse it, see **photo 3**.

The replacement chart was reproduced in a spreadsheet, coloured as per the original, and cut and paste as an image to a graphics software package. See **photo 4** and compare with photo 2.

This chart can be printed and laminated if a replacement imperial thread cutting chart / label is needed.



1

Metric overlay in place

The chart could be glued to a piece of aluminium and coated in polyurethane for a more durable solution.

The metric chart is derived from the imperial one in the same spreadsheet, and also cut and pasted as an image, **photo5**.


2

The tatty old plate

Similar to the imperial chart, the tabulated numbers on the black background, outlined in red, are for cutting threads with a metric pitch in millimetres. The non-relevant pitches have been blacked out on the spreadsheet.

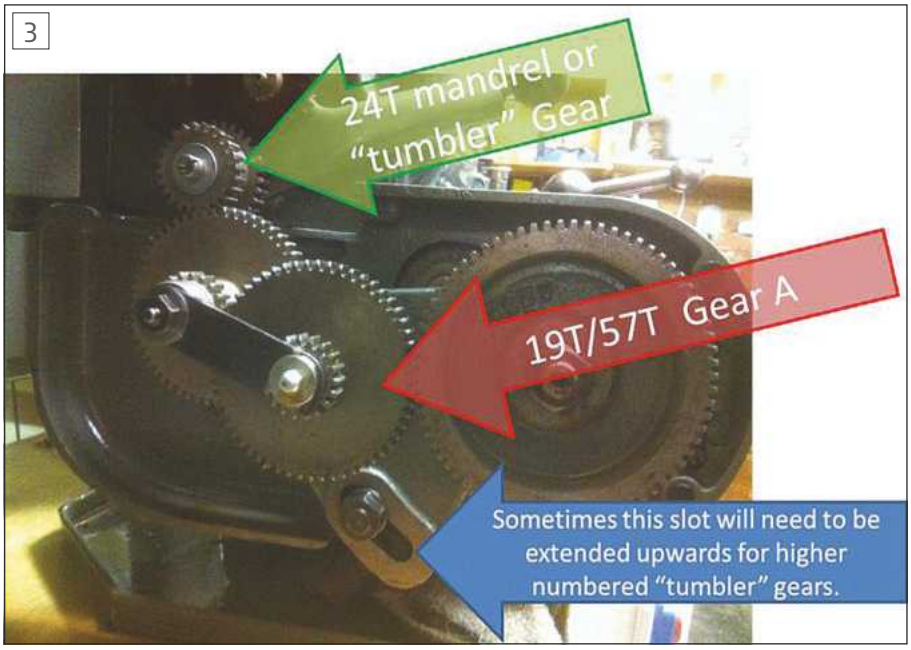
The 19T/57T "Gear A" on the quadrant / banjo is reversed for normal turning to obtain the fine feed rates shown on the table on the green background.

The chart can be printed and laminated and used as an overlay when the imperial gearbox is used for cutting metric threads by changing the mandrel or "tumbler" gear from the standard 24 Teeth to the appropriate numbered tooth gear. In this case we have 34 Teeth.

The 28mm hole in the label is big enough to slip over the 1.00" diameter of the ball

›

3



Gearbox change wheels

end range changing lever. Without an overlay, it may be best to standardise the thread cutting set-up nomenclature like this and read from a table:

1.00mm pitch = 34T 2C.

Which reads as 34 tooth mandrel gear, slider lever set to position 2, and the range selection lever set to position "C". Note: the numbers were derived by calculation from the imperial figures on the Myford label similar to the images of John Stevenson's much talked-about spreadsheet. However, if there are errors and approximations on the Myford chart they will be compounded and exaggerated by this method.

For complete accuracy the whole gear train needs calculating. The errors on the 33T label for 3.5mm (3.49) [**33T 4A**] and 2.5mm (2.49) [**33T 8A**] pitches may be too great for some applications.

Arithmetic

The general calculation for deriving metric pitches (Pmm) is as shown below where

Ts = Number of teeth on mandrel gear (usually 24).
Tn = Number of teeth on new gear on mandrel (most commonly 20, 33, 24)
TPI = threads per inch
Pin = pitch in inches = 1 / TPI (eg 8TPI = 1/8 = 0.125")
Pmm = pitch in millimetres
Cf = conversion factor inches to millimetres (25.4)
Pmm = (Tn / Ts) * (Cf / TPI)

Example Calculations

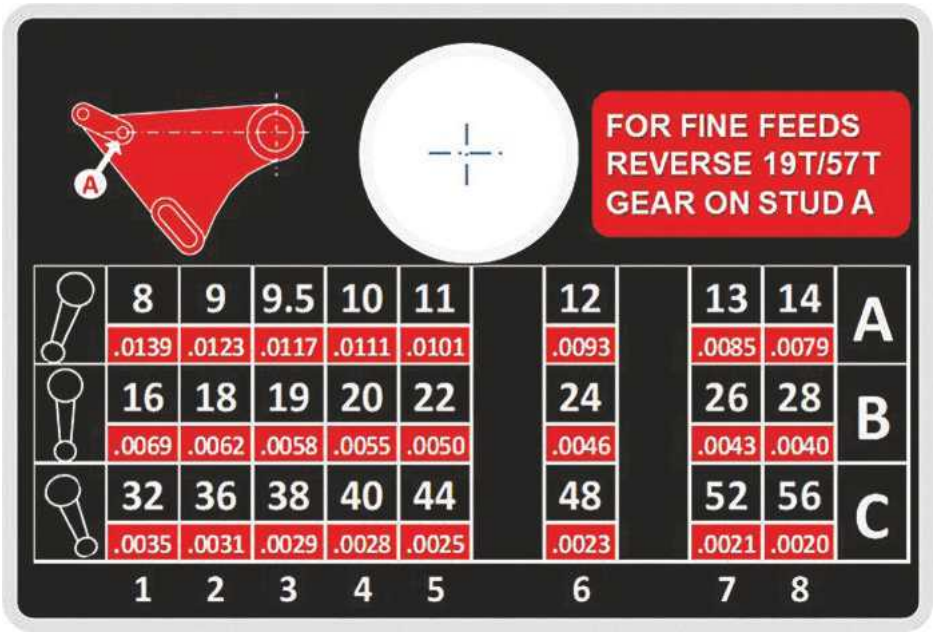
Example 1: 34 tooth mandrel gear with levers at position 2C (36 TPI on original label) we get
Pmm = (34 / 24) * (25.4 / 36) = 0.9995 millimetres (call it 1.00mm)
1.00mm pitch = 34T 2C - using our proposed nomenclature

Example 2: 33 tooth mandrel gear with levers at position 4A (10 TPI on original label) we get
Pmm = (33 /24) * (25.4 / 10) = 3.4925 millimetres
(call it 3.50mm with a .0075mm (0.2%) pitch error?)
3.50mm pitch = 33T 4A

Overlays are given for the 33 and 34 tooth metric setups as well as for various BA threads.

The overlays can be printed and used as temporary labels, hooked over the lever. Alternatively, they can be used on a semi-permanent basis by either lamination or by sticking them to some stiff sheet material such as aluminium.

4



Imperial overlay

The money saved on the replacement label can now be put towards the 33T and 34T gears needed for cutting those metric threads. Other overlays and tables are shown on the next few pages.

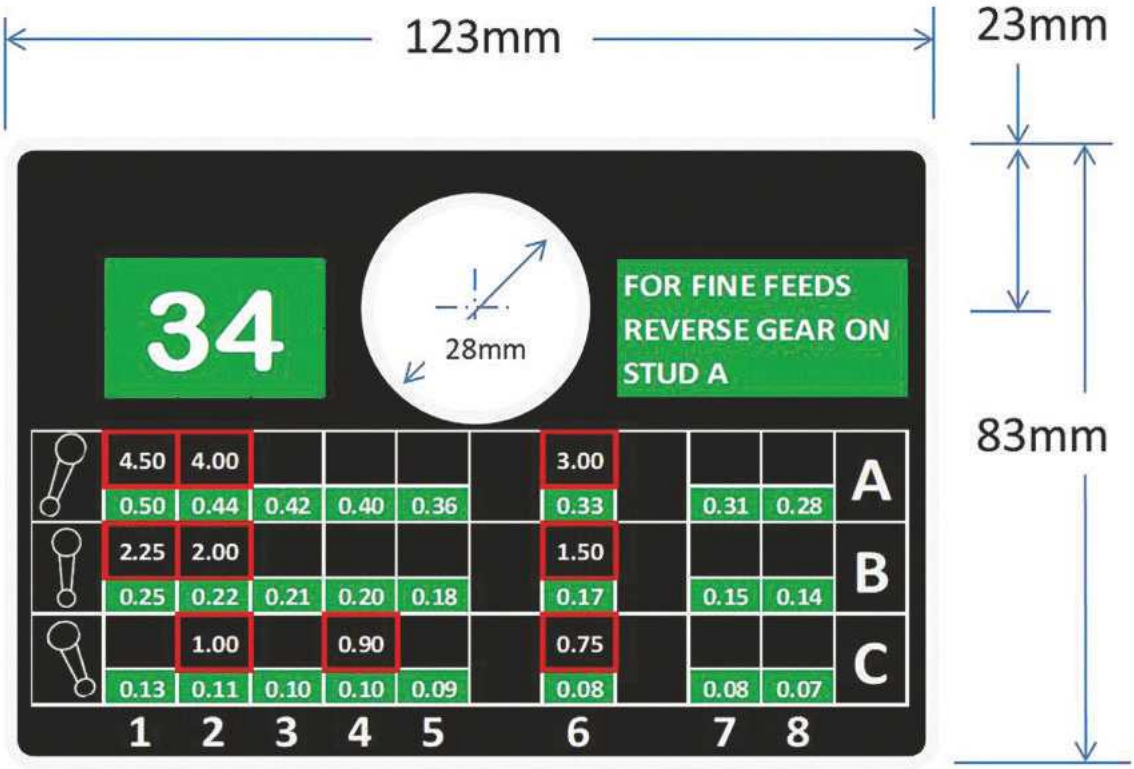
Conclusion

As an introduction to thread-cutting this has been a worthwhile exercise for me. I hope others found my documented deliberations helpful. The Metric Pitches chart inside the gearbox cover is inaccessible and the same chart in the Quick Change gearbox manual is also virtually unreadable! Presentation graphics and service manual standards have moved on since the fifties and sixties. Therefore, the chart is produced as a full page back to back with the charts for the simpler method described previously, **tables 1, 2** and **3**. Hopefully, it will improve the clarity of these methods making things a little less mysterious for beginners in home or model engineering.

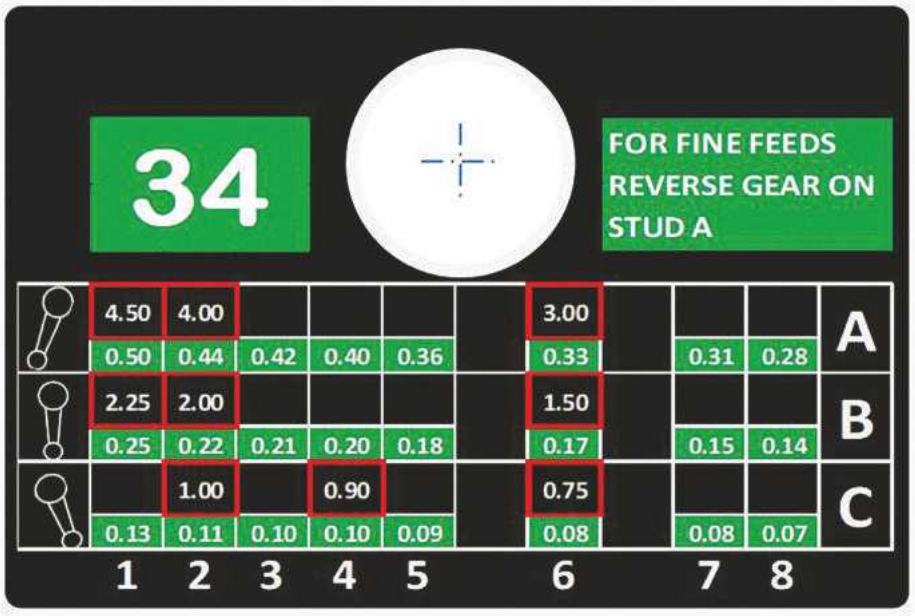
To quote LBSC, "Inspector Meticulous" may not be happy with the precision of the threads cut by these methods, however, it must be remembered that most of us are probably not sending rockets to the moon. That said, any suggestions for improving what is presented here would be most welcome. A complementary article on CNC, engraving or silk screening would be interesting.

Other reference materials

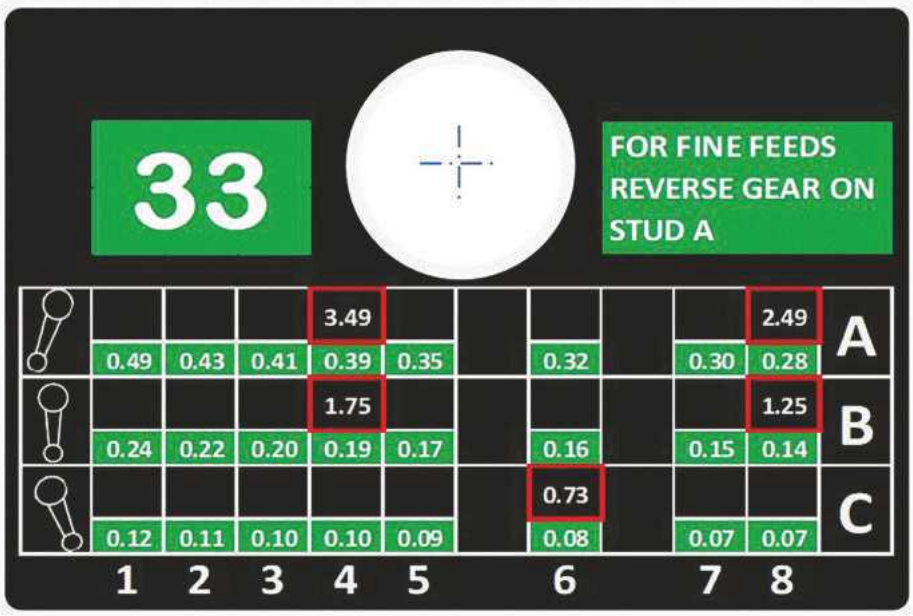
Gearing of Lathes for Screwcutting (Crowood Metalworking Guides) – Brian Wood ISBN-10: 1785002503
Instructions for Installation and Operation - Myford Quick Change GearBox
Gear Calculation software for lathes without gearbox can be found at Duncan's Metal Pages metal.duncanamps.com/software.php photo 12



5 *Dimensions for overlays*

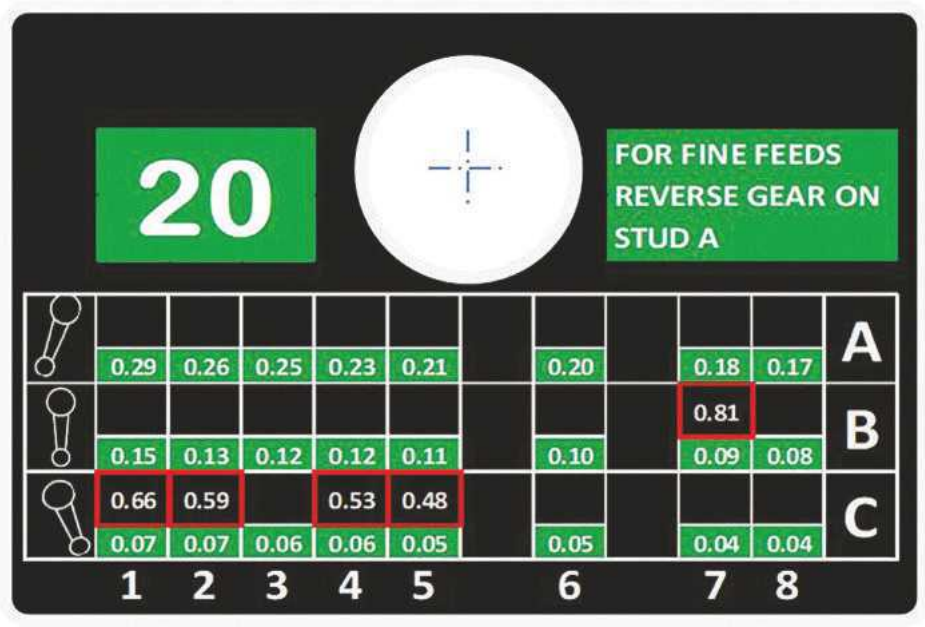


6 *Metric overlay for 34 tooth gear*



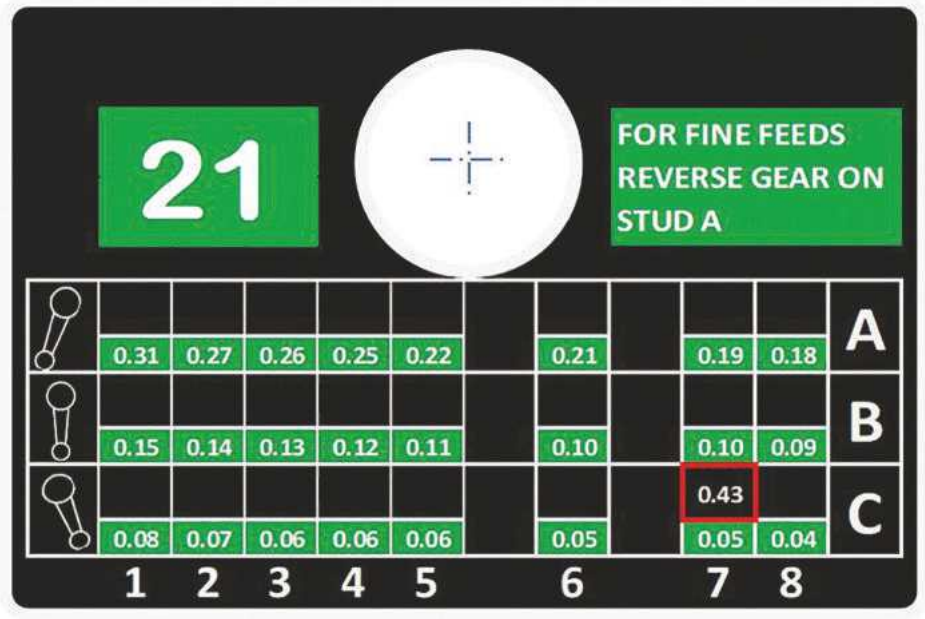
7 *Metric overlay for 33 tooth gear*

8



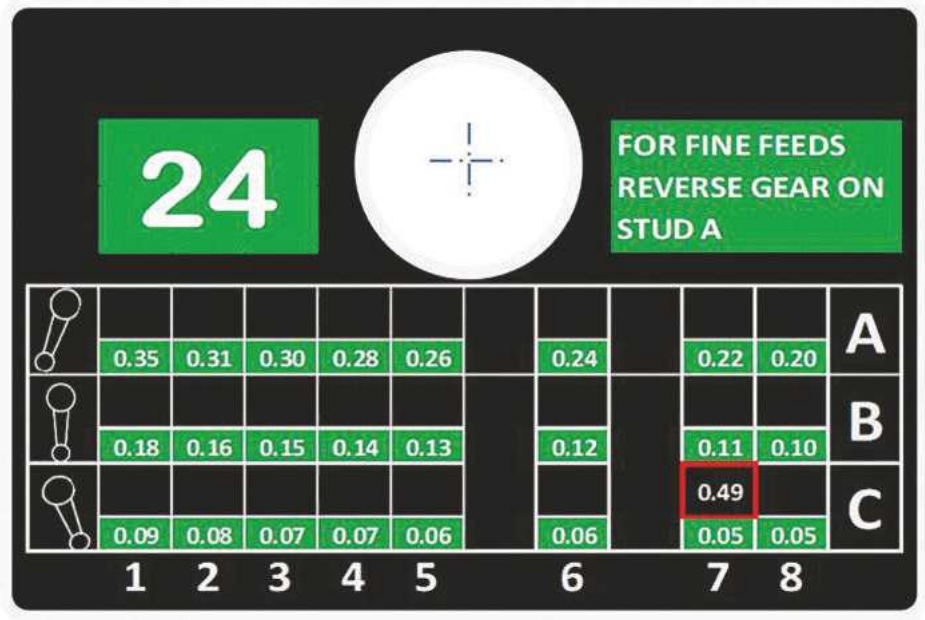
BA overlay for 20 tooth gear

9



BA overlay for 21 tooth gear

10



BA overlay for 24 tooth gear

Table 1

Metric Threads – setting references

Metric Coarse	Metric Fine	Pitch (mm)	TPI Setting	Tumbler Gear	Lever settings	Setting Reference
		4.50	8	34	1A	34T 1A
		4.00	9	34	2A	34T 2A
		3.50	10	33	4A	33T 4A
M24		3.00	12	34	6A	34T 6A
M20		2.50	14	33	8A	33T 8A
		2.25	16	34	1B	34T 1B
M14		2.00	18	34	2B	34T 2B
M12		1.75	20	33	4B	33T 4B
M10	M14	1.50	24	34	6B	34T 6B
M8	M12, M10	1.25	28	33	8B	33T 8B
M6	M10, M8	1.00	36	34	2C	34T 2C
M5		0.80	44	33	5C	34T 5C
M4.5	M7, M6	0.75	48	34	6C	34T 6C
M4		0.70	38	25	3C	25T 3C
M3.5		0.60	44	25	5C	25T 5C
M3	M5, M4.5, M4	0.50	44	21	5C	21T 5C
M2.5		0.45	56	24	8C	24T 8C
M2		0.40	56	21	8C	21T 8C
Reverse 19T / 57T Fine Feed	M3.5, M3, M2.5	0.35	10	30	4A	30T 4A
	M2.0	0.25	16	34	1B	34T 1B

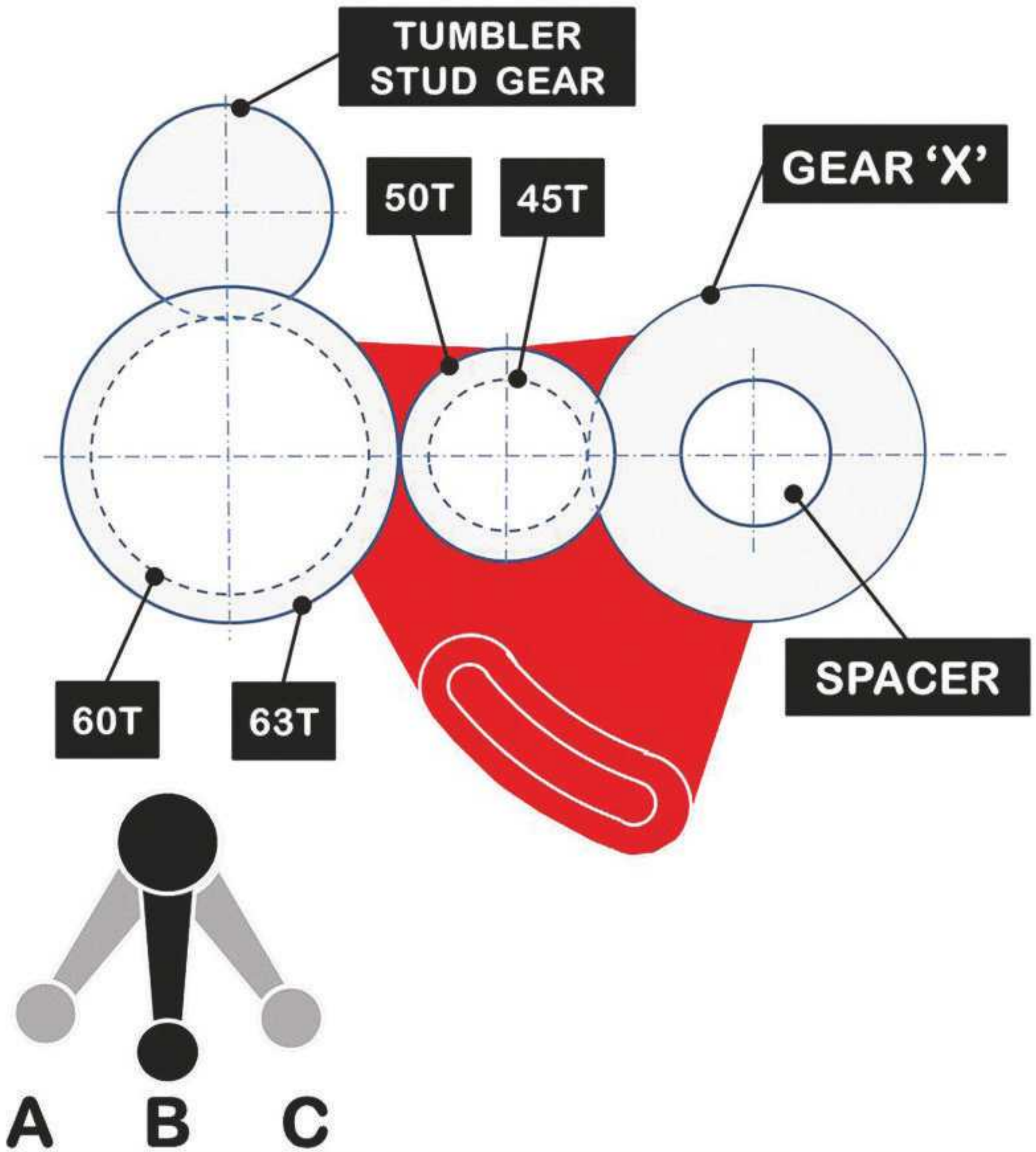
Table 2

BA Threads – setting references

BA	Pitch (in)	Pitch (mm)	TPI Imperial Label	Tumbler Gear	Lever Setting	Setting Reference
0	0.0394	1.00	36	34	2C	34T 2C
1	0.0354	0.90	40	34	4C	34T 4C
2	0.0319	0.81	26	20	7B	20T 7B
3	0.0287	0.73	48	33	6C	33T 6C
4	0.0260	0.66	32	20	1C	20T 1C
5	0.0232	0.59	36	20	2C	20T 2C
6	0.0209	0.53	40	20	4C	20T 4C
7	0.0189	0.48	44	20	5C	20T 5C
8	0.0169	0.43	52	21	7C	21T 7C

Table 3 *Metric Threads with gear diagram*

METRIC PITCHES



Pitch (mm)	Gear X	Tumbler Gear	Lever Settings	Setting Reference
0.20	60	28	8C	28T 8C
0.25	60	30	6C	30T 6C
0.30	60	30	4C	30T 4C
0.35	60	28	1C	28T 1C
0.40	60	28	8B	28T 8B
0.45	60	45	4C	45T 4C
0.50	60	30	6B	30T 6B
0.55	60	55	4C	55T 4C
0.60	60	30	4B	30T 4B
0.70	60	45	1B	45T 1B
0.75	60	45	6B	45T 6B
0.80	60	28	8A	28T 8A
0.90	60	45	4B	45T 4B
1.00	60	30	6A	30T 6A
1.10	60	55	4B	55T 4B
1.20	60	30	4A	30T 4A
1.25	60	30	1B	30T 1B
1.40	60	28	1A	28T 1A
1.50	60	45	6A	45T 6A
1.60	60	40	4A	40T 4A
1.75	60	35	1A	35T 1A
1.80	60	45	4A	45T 4A
2.00	60	40	1A	40T 1A
2.25	60	45	1A	45T 1A
2.50	60	50	1A	50T 1A
2.75	60	55	1A	55T 1A
3.00	30	45	6A	45T 6A
3.50	30	35	1A	35T 1A
4.00	30	40	1A	40T 1A

ALL NEW SUPER MINI LATHE

£599.00

Now fitted with metal leadscrew handwheel and calibrated dial at no extra cost. An accurate sensitive longitudinal feed.

Additional features:

- 100mm 3 jaw self centering chuck
- Steel gears fitted to headstock
- Steel change gears
- Brushless 450w motor
- Steel and aluminium handwheels

SPECIFICATION:

Centre height: 90mm
Distance between centres: 350mm
Speed range: 50-1100/120-2500 rpm with back gear for maximum torque. Hardened and ground slideways Weight: 39 kg
Wide range of accessories available including fixed and travelling steadies, 4 jaw chuck, vertical slide, quick change toolpost. Huge range of cutting tools.

WM12 VARIABLE SPEED MILL

£685.00

- Compact, versatile milling machine
- Infinitely variable speed control
- Dovetail column ensures positive head location
- Available in metric and imperial versions

SPECIFICATION:

Head tilts. Calibrated 45° - 45°. Very powerful 600w motor. Back gear for maximum torque in low range. All steel gears. Longitudunal traverse 250mm. Cross traverse 165mm. Digital rev counter. Weight 54kg

NEW DRO WM14 MILLING MACHINE

£1,095.00

Same features as our established WM14 milling machine, with 3 axis DRO fitted as standard.

- Magnetic scales
- X Y and Z traverses
- Switchable between metric and imperial
- Compact illuminated digital counter

SPECIFICATION:

Table size: 500 x 140mm
Longitudinal traverse: 330mm Distance spindle to table: 280mm
Speed range: 50 – 2,250rpm infinitely variable, with back gear for maximum torque Motor: 500w.

NEW DRO WM180 LATHE

- Fitted with 2 axis DRO
- Magnetic scales
- Supplied 3 and 4 jaw chucks, fixed and travelling steadies, face plate.

SPECIFICATION:

Centre height 90mm
Distance between centres: 300mm
Speed range 50 – 2,500rpm infinitely variable
Weight 70kg

£1,095.00

In addition to these new DRO versions, we will continue with our standard machines. All prices quoted include VAT and UK mainland delivery, excluding Highlands and Islands.

Our next exhibition is the Midlands Model Engineering Exhibition, Leamington Spa, 18th to 21st October 2018.

Our next **Open Day** is on Saturday, 21st July 2018, 9am to 1pm, at Warco House.

T: 01428 682929 Warco House, Fisher Lane, Chiddingfold, Surrey GU8 4TD
E: sales@warco.co.uk W: www.warco.co.uk

Making the Ratchet Click Spring of A Mechanical Clock

Bernard Zaegel, in the Netherlands, explains a tricky task faced by clockmakers.

A classical mechanical clock is wound up by turning a shaft called arbor. This arbor is maintained in position by a ratchet mechanism, composed by a ratchet wheel and a click. The click is pressed against the ratchet wheel by a spring, **photo 1**.

Traditionally, the spring is made by bending a long straight piece of brass, ("hammer hardened" brass).

My first click spring was functional but had an unpleasant irregular shape after bending by hand on a round object. Trying to correct this made it worse. A more sophisticated bending tool was desirable.

Background

My interest is in horology. I consider making a clock a wonderful hobby. Spending hours to make elegant, traditionally-shaped and polished small pieces of brass, put them together and bring them to life by a tick on a pendulum is a fascinating occupation when you are retired. A clock is also a scale 1 odourless family heirloom. My creations are accepted in house, and maybe later, I can expose a master piece in a modest place of the living room... Needless to say that a 2-metre-long model boat or a dirty steam engine are out of the question for me. I don't speak about "bigger than usual" projects, for example *Rebuilding the Medway Queen* MEW 227, April 2015.

In the 1970s, I saw some issues of the British Horological Journal, and Mr. John Wilding was describing his weight driven 8-day wall clock in several articles, later published in a book, **ref. 1**. I was very enthusiastic, but I had to postpone this for later. Thanks to the internet, I bought the old book few years ago, and it was a special

1

The click spring in place

2

The simple clock

3

My depthing tool

The runner with a flat

feeling to recognise many photos after so many years, and so I installed a workshop.

I understood quickly that I needed to read much more, and bought many other books from John Wilding, available today from RiteTime Publishing Ltd, advertising regularly in the magazine, **ref. 2**.

Reading the books, I understood also that I could never achieve his skills in marking out nor filing. But today things are different, it is possible to compensate those shortcomings with modern machines. I have a lathe, a milling machine with digital read outs, a rotary table, precision micrometers, commercial horological cutters... For example, with the rotary table placed horizontally in the mill, I was able to make the anchor of my first escapement without any marking out. But there are many more parts to make.

Actually, my first clock is not from Mr. John Wilding, but from Mr. Benjamin Franklin, yes the American politician playing with kites in thunderstorms, today politicians are more cautious. Besides his numerous other activities, Benjamin Franklin designed a clock, in the year 1756. The clock is described in a book by Colin Thorne, **ref. 3**. A perfect beginner's project because this clock has only 3 wheels. Despite, or thanks to, its simplicity, it is disconcerting, **photo 2**. I refer to the book if you want to know how simple it is – and thus attractive. It works surprisingly well, despite my questionable polish of pivots and pinions.

My First Click Spring

The clock is simple, but numerous, small parts must be made, including a click spring. Traditionally, the spring is made by sawing a tapered straight piece in a brass plate, usually 2 mm thick. The piece is then filed, polished, hammer hardened, polished, bent to form, and repolished. Although a beginner in the hobby, I obtained a decent "spring" before bending. But the bending, normally made with the fingers around a cylindrical object, caused unexpected problems. The piece is long and thin, i.e. fragile, and I obtained a functional, but irregular and ugly spring. I was also unable to bend the spring in a plane. John Wilding wrote "Round nose pliers are helpful in obtaining the shape of the spring". Well, each tentative try with pliers made it worse, nothing to do with "eye pleasant shapes" as he says. I have no photo of this spring, and magnifier glasses are taboo here. Nobody noticed, however, because my spring is cleverly hidden behind the dial, see photo 2.

Problem

The second clock I want to make is the "Brass Alarm Clock" of John Wilding, a nicely formed, simple skeleton clock, working with a "Foliot", oscillating bar) typical of the 16th century, **ref. 4**. "Skeleton" means that the spring is much more visible and must be better made. In this book, photo 76 shows the spring perfectly fitted on the main wheel. I don't understand how the master was able to make this photography if he bent the spring by hand. Also, according to the book, the "spoon" of the spring is filed before bending. But for me, it is then impossible to have a nice curvature of the spring blended smoothly with that of the spoon, I have always a break between 2 curves at this place, no photo available!

Jigs or guides to bend are well known, and *MEW* has published numerous articles on bending tubes. I was happy with ref. 5. I found that my spring was something like a tube with a square section, and the figure 3, single wheel bender, of this article inspired me. There are differences however, the formers must be adapted to the square section, and the section of my spring is not constant, due to the taper. This means that the distance between inside and outside formers should ideally be adjustable to meet this tapered form. I imagined a screw to adjust this distance during the bending, something like the adjusting screw of my depthing tool. This screw could also allow to make click springs of different sizes.

My depthing tool

If you seriously consider making a clock, you know what a depthing tool is. It is used to determine the precise distance of two arbors and to mark this distance on the plates, (the frame). By modifying the distance between the arbors (runners) on the tool, you feel by hand the resistance of the meshing pinion – wheel pair when turning the wheel, and when this resistance is minimal, "smooth running", you transfer this distance to the plates. You do this for

Horology has something magic...

›

each pinion – wheel pair, and you bore the holes according the markings, to "plant the train". This is the theory. One can notice that some errors can be added...

An official depthing tool is a specialized precision instrument. Obviously expensive, unless you make it yourself, like Mr Glenn Bunt, **ref. 6**. I was so impressed by his depthing tool that I concluded that, as a beginner, I would not build it, at least yet.

A less sophisticated one is the "John Wilding depthing tool", described earlier in 1970, ref. 1. It was designed with adjusting the anchor escapement in mind but can also be used to "depth" wheel and pinions – if the pinion is not mounted on an arbor. It consists of a plate with 2 runners, one being movable, by hand). The runners have a hardened taper, to scribe on the plates of the clock.

W.R. Smith improved this simple design, **ref. 7**, page 50, by adding a screw to move one of the runners with precision. This is what I wanted, with an M3 metric screw, to give a pitch of 0.5 mm.

I made the depthing tool of Mr. Smith, **photo 3**, but my moving runner has a flat to allow fastening it with one hand. If you turn the nut, the runner does not turn, **photo 4**. My runners have also no hardened point, and I compensate this by measuring the distance with a micrometer, the distance at the outside of the silver steel runners, minus the average diameter of the 2 runners is the distance between the axes. I know that you add the errors by making such an indirect measure, but the precision of my micrometer is 0.001 mm, a micro – meter! The idea is to plant the train into the plates in one go: all the holes bored with the milling machine controlled by the digital read outs, avoiding reported errors.

Actually, with a wheel-pinion pair in place in my depthing tool, I feel no change in resistance when turning my wheel if I modify the distance of the axes for an amount of say plus / minus 0.1 mm, **photo 5**. I suspect that, in contrary of the official depthing tool, the resistance due to the bearings is bigger than the resistance of the pinion-wheel pair, and I think that this imprecision is undesirable if you want to plant the train.


6

The inside former, the pin for the click spring, and the outer roller

Some theoretical knowledge of gears is desirable, and I found what I wanted in ref 8. Using commercial – and thus perfect - horological cutters, **ref 9**, the blanks of the wheels and pinions having precisely the theoretical diameter, measured with a micrometer, the best distance between arbors must be the theoretical one, and that can be computed with any precision and transferred to the plates with the precision of the digital readouts. This is 0,01 mm in my case, much better than what I could achieve by marking out. Horological cutters can be made at home, **refs 10** and **11**, but, if I am ambitious, I want also to avoid overestimating myself!


7

With the depthing tool upside down, we can bend click springs

This worked very well, because my first clock is now running for more than one year, better than one minute a week, with a healthy action. With the specified driving weight, but since I added a double fall with a pulley that is not described in the original design, the force applied to the train is precisely the half of the specified one. So, was it useless, my depthing tool? No, because it was essential to build the anchor escapement.

One could argue that the Brass Alarm Clock I am building has a "strob" escapement, described by Richard of Wallingford, who died in 1336, more than 680 years ago), that does not need a depthing tool to build.

My solution:

At this stage, I realised that I was considering making a second depthing tool to make my bending tool, including the M3 adjusting screw. But making the same thing twice was not necessary, the depthing tool could be used directly without any modification. An inside former was turned in a brass sheet of the same thickness as the spring (2 mm in my case) and to the diameter of the bent spring (52 mm). A small indentation was made in the mill, with a rotary table – it can also be filed! – to accommodate the spoon, photo 6. It was mounted on a base comprising a pin to fasten the spring, and a clamping bar was screwed under the base to fix the whole in the vice. The depthing tool is mounted upside down on the inside former. A roller was turned to be used as outside former and adapted to turn on the moving runner of the depthing tool, the one controlled by the adjusting screw. This roller is made from 2 parts, to avoid any chamfer within the square opening obtained between the 2 formers, **photo 7**. Traditionally, horological parts have sharp edges, and

the click spring is no exception.

An embryo spring was made, with an unformed spoon, **photo 8**. I was unable to obtain a pleasant curve between the spoon and the spring, **photo 9**, but using the depthing tool as a handle, while turning the adjusting screw to compensate for the taper of the click spring and squeezing it gently between the 2 formers, I bent the spring in a nice curve, **photo 10**)

I had a disappointment, however, because the spring being springy, and substantially thinner at the end than close to the spoon, the thin part was not remaining close to the inside former, the correct curve and had a radius that was too big. A second inside former was made, with a smaller diameter (47 mm), and only the end of the spring was formed again; this was enough to obtain a satisfactory spring. Only then the spoon was correctly marked out, and filed flush with the curvature of the spring, and the spring mounted in place, photo 1.

Conclusion

I am pleased with the result in photo 1, the same as to be found in the book of J. Wilding, ref 4, but now in colour. Without a simple guide, I would have been unable to obtain this result. ■

References:

Ref 1: A weight driven 8-day wall clock, by John Wilding, Brant Wright Associates Ltd.

Ref 2: www.ritetimepublishing.com, promotes the books written by John Wilding and sells horological materials, it advertises regularly in the magazine but the site itself is here:
www.clockmaking-brass.co.uk
www.iantcobb.co.uk

Ref 3: Clockmaking for the Model Engineer, by Colin Thorne, Camden

Ref 4: The construction of a weight driven brass alarm clock, John Wilding, Rite Time publishing Ltd

Ref 5: A review of pipe bending options, Stuart Walker, MEW 237, January 2016, page 27

Ref 6: Making a Clock Depthing Tool, Glenn Bunt, MEW 227, April 2015, page 42 and MEW 228, May 2015, page 58

Ref 7: Clockmaking & Model-making Tools and Techniques, by W.R. Smith, supplied by Rite Time publishing Ltd

Ref 8: Wheel and pinion cutting in Horology, by Malcolm Wild , The Crowood Press Ltd

Ref 9: P.P Thornton, (successors) epicycloidal cutters,
http://www.ppthornton.com

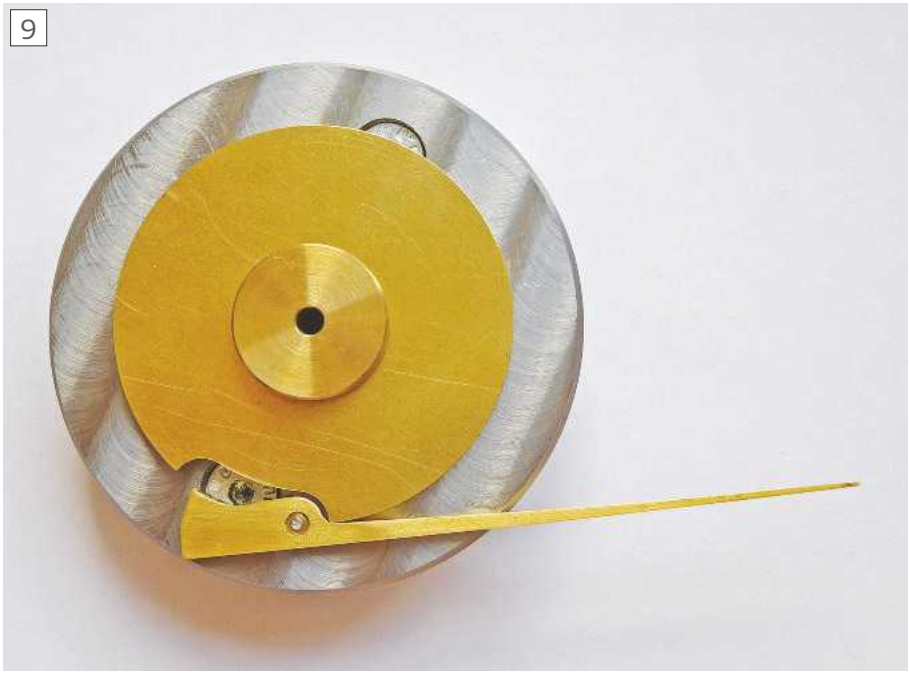
Ref 10: Adventures in clock wheel cutting, Glenn Bunt, MEW 235, November 2017, page 26

Ref 11: Simple cutters for clock pinions and wheels, Ted Knight, MEW 262, December 2017, page 13

8

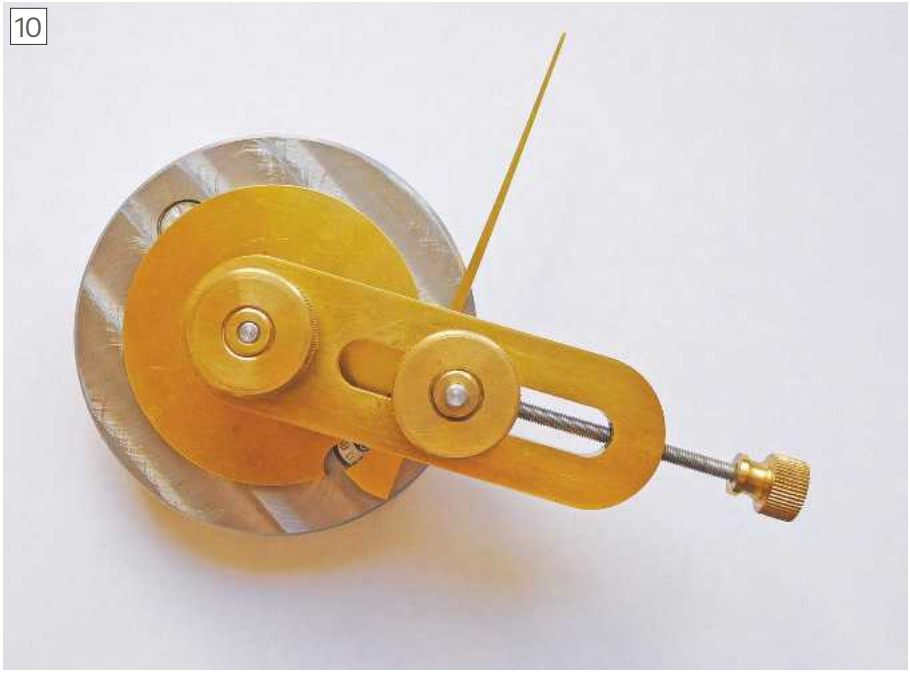
The embryo click spring

9



The embryo click spring in the bending tool

10

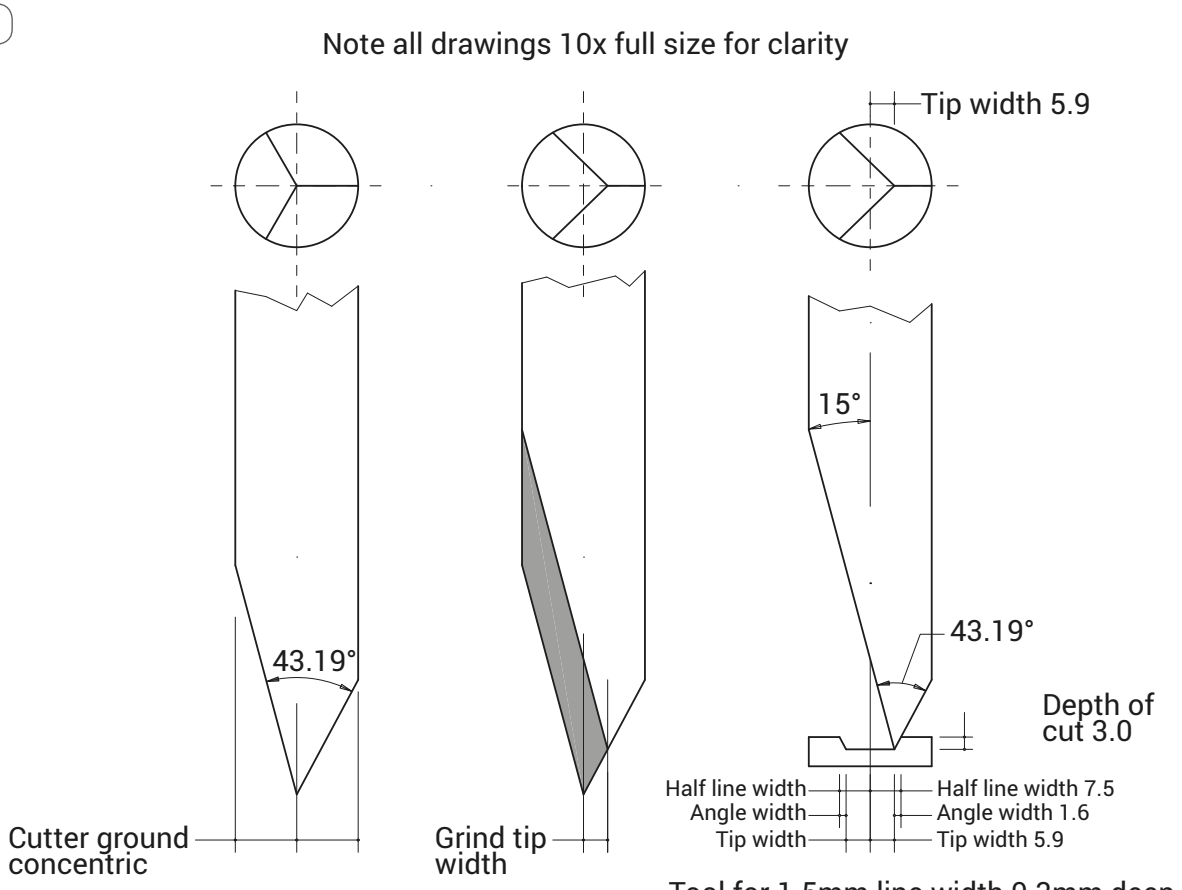


The tool ready to bend the click spring

A High Speed Engraving Attachment

Keith Johnson made this device to fit his CNC Wabeco 1210 Vertical Milling Machine, but it would suit most other CNC mills of similar capacity. Part 4

Fig.10



Tool And Tip Width

Tool and Tip Width – fig. 10

Line width 12/8 = 1.5 divide by 2 for half line width = 0.75
Half line width 0.75 minus 0.16 = 0.59
Tip Width 0.59 is Required
To Check - angle width 0.16 + 0.59 tip width + 0.59 tip width + 0.16 angle width = **1.5mm finished line width.**

A typical set of numbers to true type engrave the same 12mm high at 0.30 deep as above example.
Line width 12/8 = 1.5 divide by 2 for half line width = 0.75 divide by 2 again = 0.375
Half line width 0.375 minus 0.16 = 0.215
Tip Width 0.215 is Required

To Check - angle width 0.16 + 0.215 tip width + 0.215 tip width + 0.16 angle width = **0.75mm finished line width.**

Always check engraving, figures, spelling etc. as this operation once committed to metal is final and permanent. This is definitely a case for the old expression measure twice, cut once.

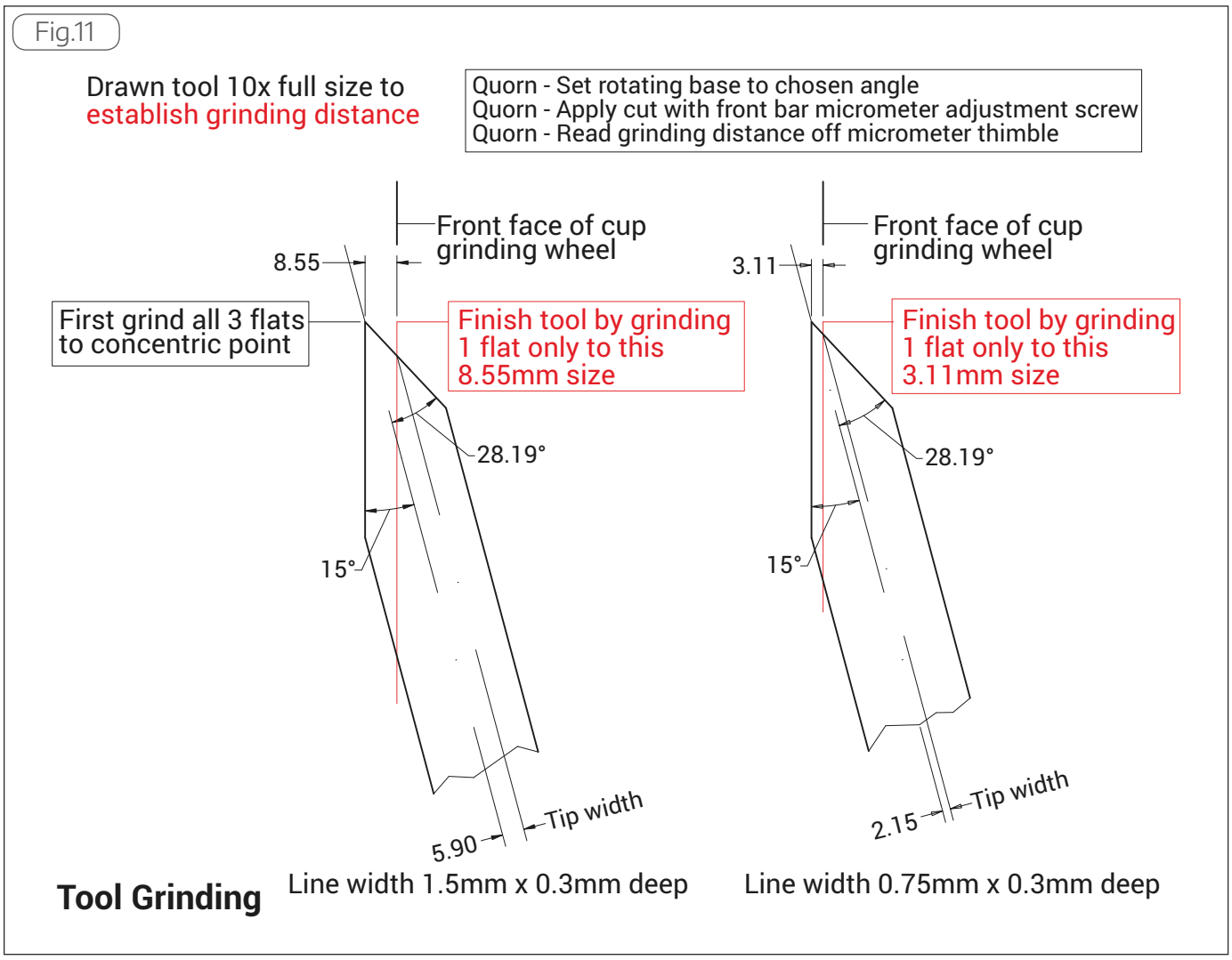
Tool Grinding fig. 11

All my tool and cutter grinding is done using a look alike Quorn type machine I made about 30 years ago, all machined and fabricated from steel without using any castings.

To grind an engraving cutter the 3mm diameter HSS blank is held in an ER25 collet work spindle, this spindle is free to rotate within the machine workhead, a 12 hole index plate and pin, control the division points. The spindle is clamped in the

›

Fig.11



workhead during grinding. The machine is fitted with a cup or flared cup wheel, with all grinding being done on its front face.

Grinding Distance – Fig11

The rotating base is set to the desired tool angle, (15 degrees in the above example).

However due to this tool angle, the tip width dimension we have figured out as above needs to be expressed as a "grinding distance" that can be directly read from the front bar micrometer thimble.

The quickest way is to draw the tool at 10 x full size for clarity and measure directly the grinding distance, in this example the drawing dimension is 8.55mm. Dividing by 10 the distance soon becomes 0.855mm.

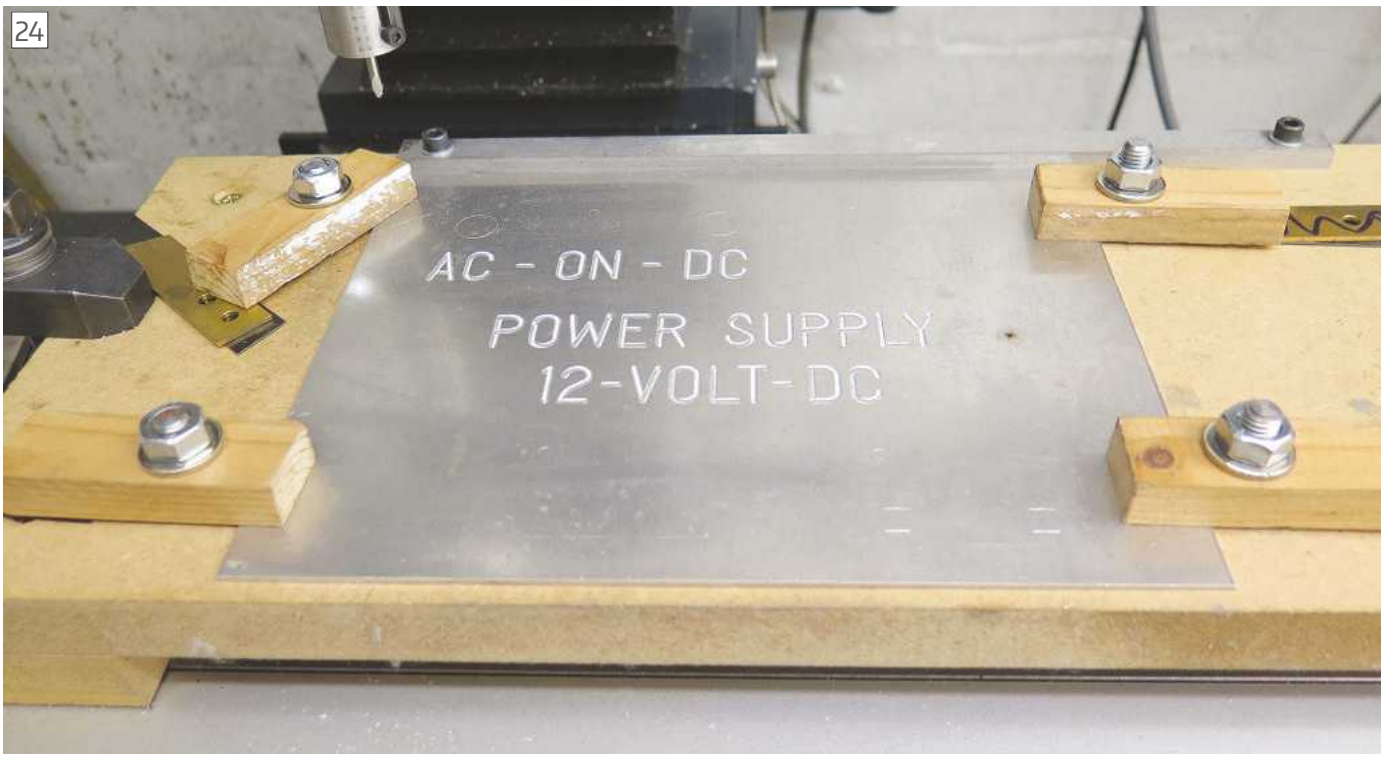
We have now figured the triangular tool tip will have two faces ground to the same dimension, lets call this Zero and the remaining face will have a further 0.59mm removed to create the tip width. However as already described the "grinding distance" to produce this last flat is 0.855. At this stage I convert this dimension of to Imperial measurement = 0.034", this suits my machine construction and calibration. Incidentally when planning and making this grinder I never intended stamping numbers onto the scales, but to neatly do all the engraving at a later date. However, all the calibration lines were fully completed during manufacture of the parts, the machine was assembled and tested using felt tip marks applied before grinding. Yes, you have guessed, not yet stripped it down to engrave any numbers. I have never missed them.

So back to the job in hand try my method - with a felt tip pen put a total of 3 dot marks on the plain periphery of the graduated thimble. First put 2 dots to indicate zero, a space of (0.855mm = 0.034") put 1 dot.

A further 5 dots in total are put on the plain periphery of the Index plate, this quickly identifies the 3 positions used spaced at 120 degree intervals.

Put 2 dots at each of 2 positions and 1 dot

Setting Z Height



Engraving Completed

on the final index position. It is now quick and easy to grind and index glancing at either set of dots.

I have used this method of felt tip dots for years on all types of machines with or without numbers, it is just a case of thinking once to mark up the scales correctly before starting production. Once you get into the routine just follow the dots, no more numbers on the fly, its almost like working to stops. Only put dots where they can be easily cleaned off, with a rub from a grubby thumb, never into line graduations.

Safety

Before fitting this attachment to any machine for any purpose remove the power supply to the machine spindle motor by either pulling out the mains plug or click out the emergency stop switch. Doing both gives total peace of mind, its a bit like wearing belt and braces, being double safe so your pants don't fall down.

Fitting Attachment to the Wabeco Mill

The Wabeco mill is designed with a threaded drawbar/cutter extract mechanism integral with the workspindle. This system requires toolholders to be screwed up into engagement with the draw bar. I therefore use the following sequence to fit my attachment to the machine.

1 - Fit attachment spindle holder, into Wabeco spindle secure using machine draw bar.
2 - Fit remainder of attachment to mounting collar using 4 x M6 cap screws.
3 - Fit Anti - Rotation mount screw with large washer - M5 cap screw with washer through 6mm wide slot in mounting plate and into 12mm diameter bar, clamped in the original guard mounting bracket.
4 - Fit engraving machine spindle into holder and clamp with jubilee clip to secure.
5 - Fit drive belt for chosen speed and adjust for tension.
6 - Plug motor flying lead into power supply noting polarity, safely routing lead clear of any rotating items. My power supply sits on a shelf near to the mill, requiring a 1metre long figure of eight supply lead. Importantly this location also allows easy access to the power supplies on/off switches when operating the machine.
7 - Switch on the power supply AC switch first
8 - Use DC switch on power supply to control motor, throughout engraving sequence.
9 - Switch off AC at shutdown.

> Working to numbers is one way of total repeatability of character size, very important in the event of a tool needing to be changed or reground

New Front Panel for Power Supply

Having described the attachment in detail its now time to produce an engraved item with it. I required a new front cover panel for the already constructed power supply, so decided to use a piece of aluminium sheet from the stock box.

The size required is 200 x 160 x 1.5mm, I was lucky to find a piece that only needed one edge milling off to complete and bring to size.

Because the engraving attachment was already fitted to the Wabeco machine I did the engraving first, then milled to finished size and drilled all the holes.

The panel was drawn to size and all lettering details positioned as required using V - Carve Desktop from Vectric the chosen font was Railway, single line, setting the character height at 12mm.

Incidentally the 12mm refers to the toolpath dimension, or put another way, it is the centre line of any engraved character. In this example and as previously illustrated the line is to be 1.5mm wide x 0.3mm deep. When engraved to the correct depth overall character height will be 13.5mm.

This overall height dimension together with line width, is another easy check to make with a digital caliper gauge, thus ensuring the engraving is at the correct designed depth. Working to numbers is one way of total repeatability of character size, very important in the event of a tool needing to be changed or reground, as sometimes unfortunately happens.

The piece of aluminium selected to use, was of unknown machinability together with an engraving line width of 1.5mm, so I treated it with respect for feeds and speeds. Before opening the software a few input details needed to be decided.
Engraving Spindle Speed 9,000 RPM (Low Range on Pulleys)
9,000 RPM x 0.003142 x 1.5mm Diameter = 42.42 M /Minute
Table Traverse Rate, X and Y - 50mm /

Minute
9,000 RPM x 1-Tooth Cutter x 0.0055mm Chip Load/Rev = 49.5mm/Minute
Plunge Rate, Z - 25mm/Minute
9,000 RPM x 0.0027mm Chip Load/Rev = 24. 3mm/Minute

Returning to the software and the completed drawing of the panel layout, the engraving details were contained in three separate lines. I like to split work into sections so created three individual G Code files to complete this panel.

A few clicks on the mouse soon selected all the characters in the first line, a few more clicks to selected various program options, at this point
I programmed for:
Z Axis to start at + 25. 00mm
Z Axis safe height moves at + 3. 00mm
Only one cutting pass, with the Z Axis at 0 cutting depth

When toolpath had been calculated, a few more clicks created a "G Code" ready for Mach 3 to save to a file, with name of choice.

I called this, FP First Line.

Move to Second line and repeat all the various clicks etc. I called this, FP Second Line. Move to Third line and repeat ditto etc.

At the machine, I clamped the panel blank against sub table guide bar and in line with left hand edge this is the origin X0 Y0 position. To set the Z Axis starting height I use an aluminium spacer with a piece of flat plastic that slides on the top, used as a thick feeler gauge, **photo 23**. The accurately measured height of these two items = 25.20mm.

I positioned the engraving tool over the height gauge and jogged down, until sliding the plastic feeler under the point of the engraving tool produced a very fine scratch on the shiny surface of the plastic.

I then positioned the tool above starting point at X0 Y0, zero all axis of Machine Digital Readout. Now I set Mach 3 Screen to read X0000 Y0000 Z +25. 0000 and loaded the first file FP First Line.
The actual test cutting process was:

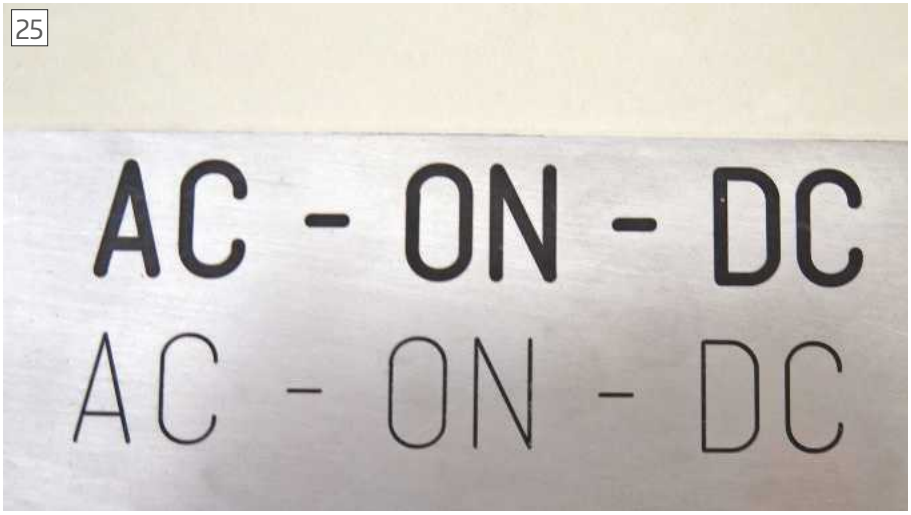
- Switch on power supply and switch on DC Motor to drive spindle.
- A wipe with a turpentine covered brush across the panel in engraving position.
- A click of the mouse in Mach 3 sets it all in motion.
- When the machine has completed this 1 pass and returned to Origin X0 Y0 Z25
- Switch off spindle motor, check the panel may be entirely blank, or just traces of letters, or maybe full letters, it all depends on set up accuracy etc.
- Vacuum off any swarf Close this file
- Repeat for second and third files.

Now I brought out the Mach 3 Jog Panel. I set jog distance to 0.1000 mm and jog Z Axis down by 0.1000 (or less). Then I reset Z Axis Only on Mach 3 Screen to read Z +25.0000.

Finally, I switched on spindle motor and reran G Codes again for all 3 lines, continuing until all engraving is at the correct size, **photo 24**. Measuring line width and character height with a digital caliper gauge, maybe using a magnifying glass, is always easier with good lighting.

Any Panel, Dial or Component that requires engraving, will be closely looked at for a long time to come so, I always aim for perfection.

25



Line Width Comparision

Comparing Line Widths

Having completed my new front panel and while the machine was still set up for engraving. I clamped another piece of aluminium sheet to the sub table. Using the 1.5mm line width tool and first line G Code file, I engraved as before. This is the top line in **photo 25**. A new cutter was ground to produce a line width of 0.25mm then engraved as before, this is the bottom line in the photo.

Finishing Panels

All engraving shown here has been filled with black acrylic paint.

Start by scrubbing the panel thoroughly with a nailbrush in a bowl of hot water plus a few drops of washing up liquid. Rinse under the hot tap and allow to air dry. With a small soft art brush paint in all letters overlapping the outer edges edges, wash brush under running cold water. Every hour, keep applying further coats until paint builds up to fully fill engraving. Leave in a warm room to totally harden for a several days.

Now its back to a bowl of cold / just warm water with a few drops of washing up liquid. With a piece of 240 grade wet and dry fixed to a waterproof flatting block ,carefully flat down panel to remove raised paint, leaving the engraving fully filled. Rinse under the cold tap and allow to air dry.

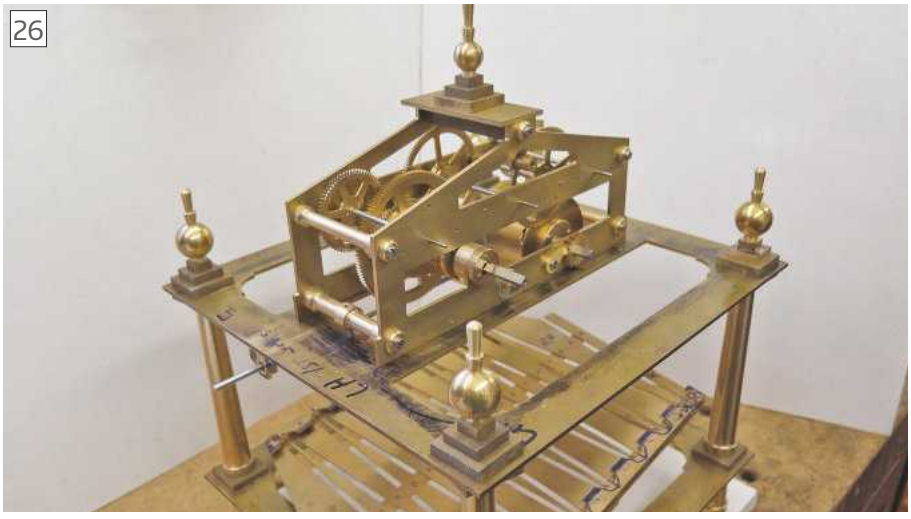
All lettering should be matt finish from flatting down, any shiny bits on the paint indicate it needs another few coats to fill. Repeat as above until you are satisfied with panel appearance.

My completed attachment now has a long list of jobs i wish to accurately engrave dials / keytop / case parts etc. the list goes on, but top of it is completing the Congreve Clock, **photo 26**. ■

Specialist Supplies

12 Volt DC Motor Pt No 457RE850 - MFA/ Como drills Ltd - **mfacomodrills.co.uk**
Green 4mm Round Belting - Stationary Engine Parts Ltd - **stationaryengineparts.com**

26



Congreve Clock

Try any title for £3*

Save up to 85%!

The summer should be about sunshine and relaxing, so this year why not treat yourself to any of our magazines for just £3 with no obligation to continue! You could even treat someone else...

3 ISSUES FOR £3
THEN £9.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.99
EVERY 3 MONTHS

- Range of great titles to choose from
- No obligation to continue
- Great future savings
- Delivered conveniently to your door

3 ISSUES FOR £3
THEN £10.70
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.25
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.99
EVERY 3 MONTHS

5 ISSUES FOR £3
THEN £14.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £11.25
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.25
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £9.65
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £10.80
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £9.99
EVERY 3 MONTHS

3 ISSUES FOR £3
THEN £9.99
EVERY 3 MONTHS

Prefer a Digital or Bundle Sub?
Offers available online at:
www.mytimemedia.co.uk/SS18P

SUBSCRIBE SECURELY ONLINE:
WWW.MYTIMEMEDIA.CO.UK/SS18P
CALL 0344 243 9023** AND QUOTE SS18P

*UK only Direct Debit/Continuous Credit Card offer only
**Calls are charged at the same rate as standard UK landlines and are included as part of any inclusive or free minutes allowances. There are no additional charges with this number. Overseas calls will cost more.

TERMS & CONDITIONS: Offer ends 30th September 2018. Subscriptions will begin with the next available issue when order is placed. You can cancel your subscription before the third issue and pay no more money than the £3 already debited. Otherwise your subscription will automatically continue at the low rate selected above. This is a UK offer only. The prices above relate to trial print subscriptions. Digital and Bundle trial subscriptions are also available online at www.mytimemedia.co.uk/SS18P.
MyTime Media collects your data so that we can fulfil your subscription. We may also, from time to time, send you details of MyTime Media offers, events and competitions but you always have a choice and can opt out by emailing us at unsubscribe@mytimemedia.com
We do not share or sell your data with/to third parties. Details you share with us will be managed as outlined in our Privacy Policy here http://www.mytimemedia.co.uk/privacy-policy.
Please visit www.mytimemedia.co.uk/terms for full terms & conditions.

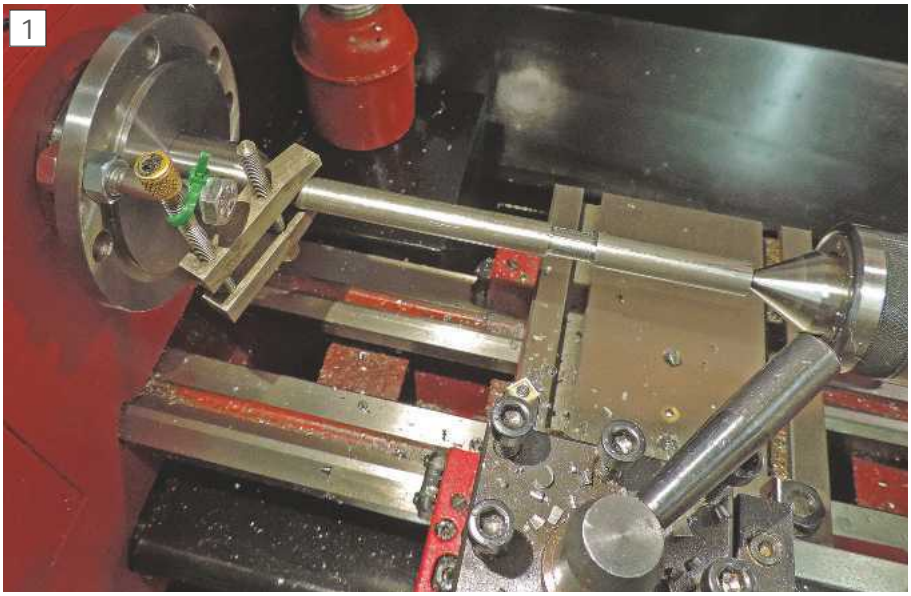
Lathework for Beginners

PART 6 - WORKHOLDING

This ongoing series will build into a complete guide to using an engineering lathe. This month Neil Wyatt returns to the subject of workholding.

Last time we looked at various types of chuck, including the self centring three-jaw and independent four-jaw chucks that are the staples of most lathe work. This month I will look at some other approaches, and also delve into the subject of steadies.

Given this month's content, it might be worth starting with a safety reminder – always do your setting up work with the lathe switched off at the wall and turn the lathe by hand before switching on to ensure that everything is safely secured and there are no clashes. Start the lathe slowly and gently increase speed, and if dealing with work that is irregular and out of balance, keep the speed slow enough not to cause vibration.



1 Improvised setup for turning between centres. The zip tie is not under any load, it is just to stop rattles.

Turning Between Centres

Turning between centres is one of the oldest turning techniques, in fact the earliest lathes did not a have a rotating spindle in the headstock and just had two 'dead centres' between which the work was mounted. The watchmaker's turns and the bodger's pole lathe both work on this principle, using a cord around the work to spin it back and forth. Well adjusted, a pair of dead centres will give you as accurately round work as you may want (although they don't guarantee the work won't be tapered!)

On our more sophisticated metal lathes, the usual approach is to mount the work between Morse taper centres fitted in the headstock and tailstock and drive the work with a 'lathe dog', **photo 1**. On older lathes it was typical for them to be supplied only with the centres and a 'drive plate', **photo 2**, with chucks being expensive accessories.

To use such a setup, it is best to start by using a three-jaw chuck to face and centre each end of the work, **photo 3**. The use of a centre drill, provides a 60-degree cone to match the centres, together with a central hole that ensures the centre fully engages, **photo 4**, this hole also acts as an oil reservoir if you are using dead centres. You can also use the technique of using a centre square to find the centre of the bar, **photo 5**, and drilling a centre hole by hand or in a drill press.

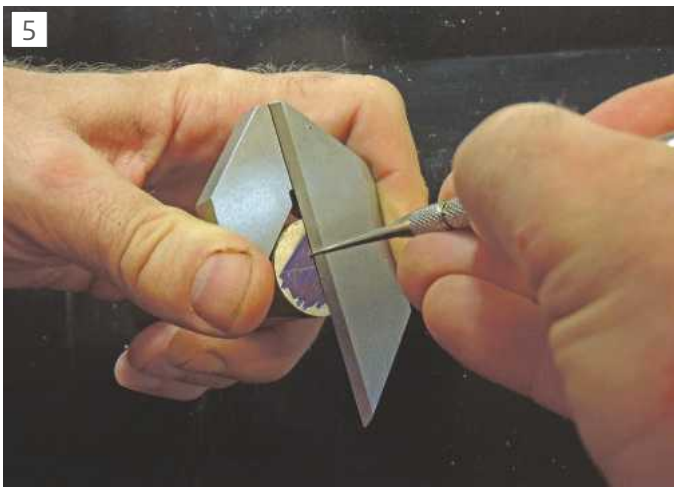
As our metal lathes have a rotating spindle, a 'live centre' is fitted in the headstock taper. Make sure the bore is scrupulously clean first – pushing a few sheets kitchen roll right through from the front to the rear is the most reliable way. These days such centres should be more than accurate enough, but if ultimate accuracy is needed or an old lathe is suspect,

The catchplate from an old Super Adept lathe.

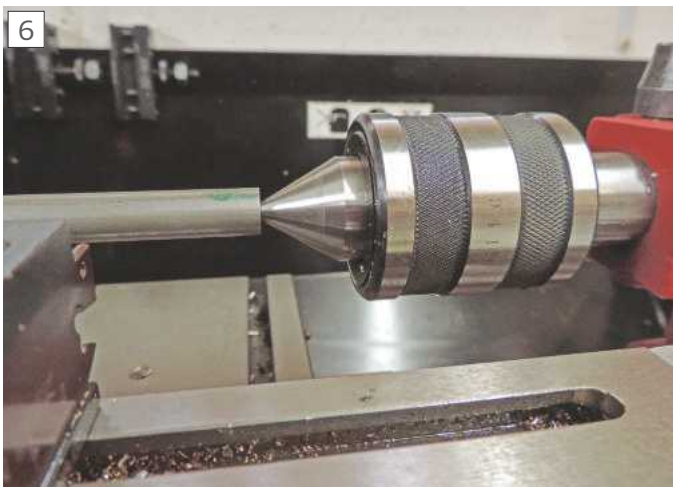
Preparing a bar by facing and centring.

The centre, note the central hole inside the cone.

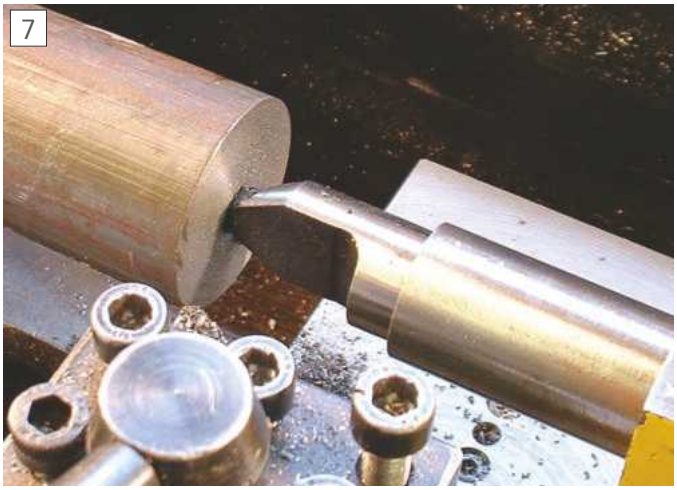
›



Using a centre square, a blue sharpie works as well as marking out blue.



Rolling centre in the tail of the work.



A half centre allows you better access.

A set of lathe dogs.

a 'soft centre' can be used and turned in place, just a light skim being all that is needed. If you have no suitable centre, a bar held in a 3-jaw chuck and turned to a 60-degree point can be used.

In the tailstock it would be traditional to use a 'dead' centre which needs regular lubrication and constant adjustment for dimensional changes caused by heating. It is best to use a 'rolling' or 'rotating' centre, **photo 6**, unless you need to work very close to the end of a small bar, when it can be useful to use a half-centre, **photo 7**.

The work is mounted between these two centres, simply by advancing the tailstock to hold it firmly, without shake. Before doing this, it is necessary to fit a driving dog, **photo 8**. Ideally if there is a flat on the work, use that, but otherwise it is a good idea to use a slip of soft metal to protect any existing turned finish. With a backplate lathe like the SC4, you will probably find the easiest way to drive the dog is with a bolt fitted to the backplate, although a notched driving plate also works well. If you don't have a driving dog, it is possible to use a toolmaker's clamp.

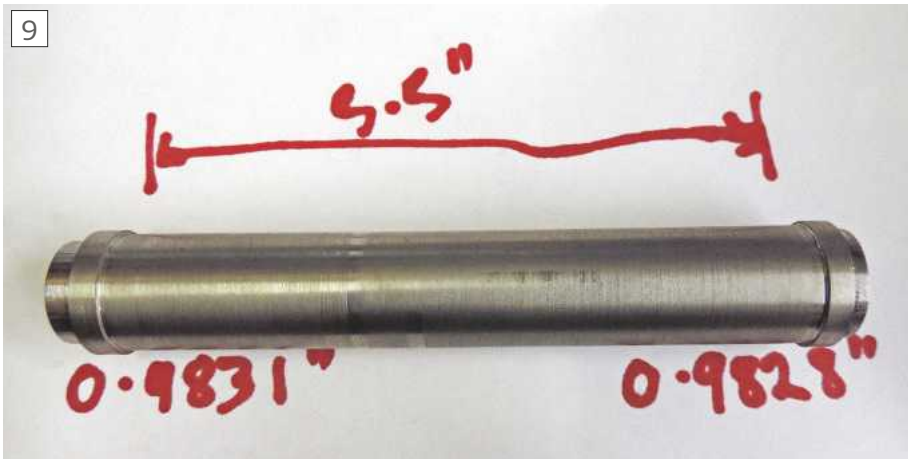
Whatever you use to drive the work, be aware that it introduces a significant hazard should your clothing, hair, fingers or anything else be caught by it. Keep your concentration on the job in hand and as always when using the lathe, make sure there are no distractions. Turn off your phone!

You will note that the presence of the dog means it is impossible to turn along the full length of the work, the usual solution is the remove the work and reverse it end for end. Unlike most approaches to turning, this should not lead to any loss of accuracy.

This retained accuracy is the typical reason for turning between centres, it is often advised for turning crankshafts, and was used for turning the test bar in **photo 9**. As it was reversed to turn the raised portion at each end, its accuracy was not affected by any small error in tailstock adjustment. This finished bar is used with a dial indicator for accurately setting the tailstock for other turning methods.

Faceplate

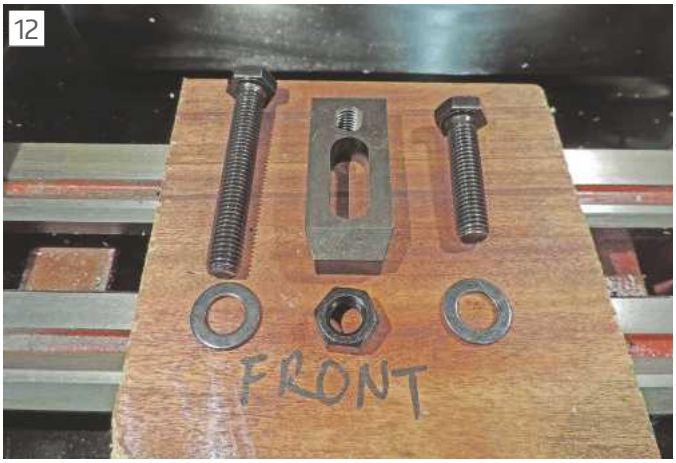
The other 'classic' way of mounting work from the days before chucks is the faceplate, and when you need to securely fix some irregular object with great accuracy the faceplate will earn its keep, even if it otherwise goes unused for long periods.



This test bar was turned between centres and is used to align the lathe tailstock.

Every Good Lathe Deserves Faceplates.

Care is needed to ensure balance and avoid clashes with the lathe bed.



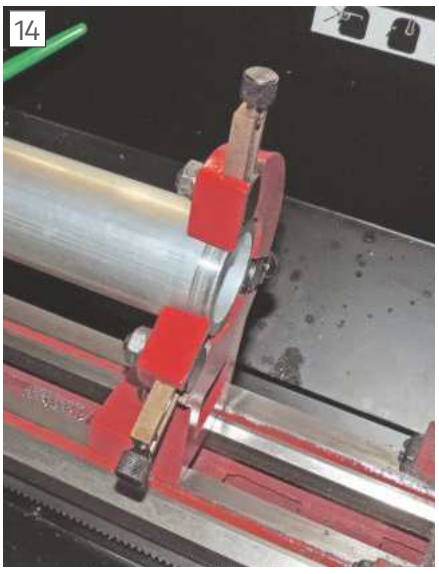
One of four clamps in the standard SC4 set, these should always be set up so they are angled down to the 'toe' that grips the work.

This setup pushed my mini-lathe to its limit.

The faceplate is a simple device, **photo 10**, just a large, round disc, fitted just like a chuck, and with slots, t-slots or even threaded holes to provide flexibility in mounting different workpieces. It may show the additional sophistication of concentric circles to aid alignment, but in practice final alignment is always a matter of careful tapping and adjustment.

The principle of the faceplate is simple, the practice is less so. There are several areas to think about:

- Security of the work, it must be held so that the forces applied during turning cannot shift it.
- Keeping clear of the bed. It's easy for work or clamps to end up outside the rim of the faceplate. Take care doing this as if anything strikes the bed the damage could be woeful.
- Faceplates are much larger than chucks, and it is not unusual to need to remove the chuck guard to fit them. Do this with care, as in a conflict between you and faceplate mounted work, you will lose. Restore the guard as soon as faceplate work is complete.
- Access to the work – it is equally important to make sure your tool can reach the work to carry out necessary work without fouling anything.
- Balancing the load, faceplate work is rarely perfectly balanced, this means using extra weights clamped in place to achieve better balance and keeping speeds low. On the SC4 the large silver knob on the headstock can be turned to disengage the spindle, which makes balancing a little easier.



A typical use of a fixed steady.

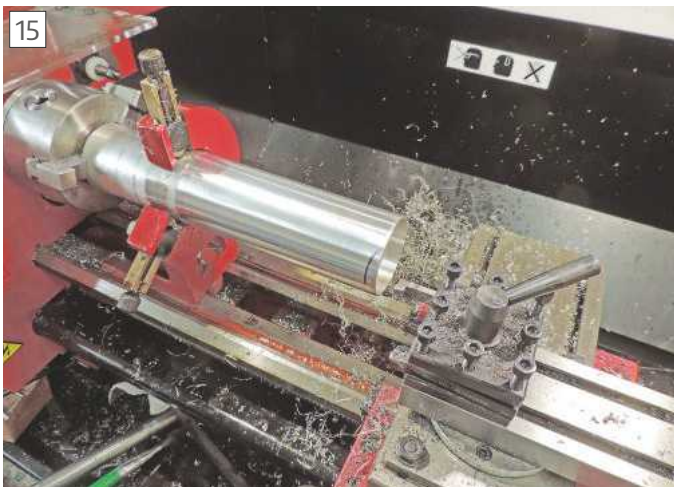
Almost inevitably the use the use of clamps, while allowing the secure fixing of the most peculiarly-shaped workpieces, can take up a lot of space, **photo 11**. While the dedicated clamp set in **photo 12** is ideal for securing very heavy work, it is worth gathering together various different sizes and styles of clamp. For SC3 and SC4 faceplates a set of milling clamps for 12mm t-slots also works well, for example. Bear in mind that any set of clamps is likely to have multiple uses, for example I have used clamp pieces as makeshift parallels and as counterweights for unbalanced work.

Be prepared to use your ingenuity, **photo 13** shows a large slab of cast iron mounted on the faceplate of a mini-lathe. The 'invisible' fixings are a pair of M6 bolts through stout plates on the inside of the faceplate. Needless to say, this setup required the lathe to be run quite slowly, despite the balance being quite good.

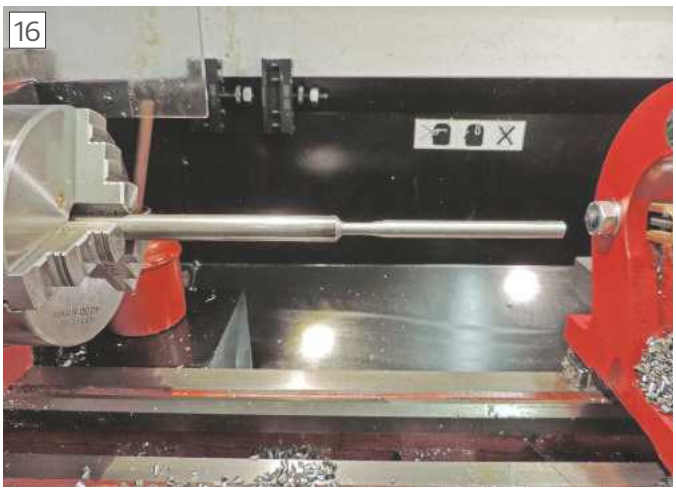
To sum up, the faceplate is remarkably flexible for workholding, but will stretch your ingenuity to the limit. Patience and attention to detail is needed to work safely and effectively with faceplate mounted work, please take extra care.

Fixed Steady

Us hobbyists are notorious for wanting to work beyond the capacity of our machinery, but the requirement to carry out turning operations on overhanging work that can only be held by one end is not unique to



The overhang in this example was more than ideal.



A machining challenge, with huge overhang.

Fixing points for the SC4 fixed steady.

Setting the steady close to the chuck.

The steady allows a 3mmm deep cut on an overhung, thin bar.

our workshops. In fact, the need to this was identified in the early days of turning and the fixed steady was invented to fill the need.

The typical pattern of a fixed steady is a frame that fits securely to the lathe bed, carrying three 'fingers' that are adjusted to constrain the work, **photo 14**. Typically, these fingers are of phosphor bronze for hardness and low wear when running on steel work, but they may be made of hardened steel or even have ball races fitted to their ends.

The best way to use a fixed steady is to mount the work as accurately as possible in the chuck, then move the steady as close to the (stationary) chuck as you can get. Adjust the fingers of the steady so they bear lightly on the work. Those supplied with the SC3 and SC4 type lathes have fine adjusters, instead of solely relying on the fixing bolts. If you have a Myford or similar pattern steady without fine adjustment, hold the fingers in place by hand while nipping them up.

Now move the steady along the lathe bed to where it needs to be, and lock it to the lathe bed. Add some lubrication to the fingers – cutting oil is fine – and you are ready to go but do keep the speed down and keep the cuts in proportion to the rigidity of the setup.

The rather demanding job shown in **photo 15** was the result of a poorly thought out machining sequence. I had finish turned the outside of the tube by fitting it with a 3D printed plug, supported on a rotating centre, but forgotten to counterbore the tube. I did not want to spoil the finish by running a steady on it, so I was forced to use the steady much closer to the chuck than was ideal. Eventually, with light cuts and a little patience the job was carried out without any mishaps.

Travelling Steady

The machining challenge in **photo 16** is perhaps a little contrived, but I wanted to demonstrate just how useful a travelling steady can be if you need to turn along the length of long, thin workpieces. The bar in the photo is 11mm in diameter (actually 7/16") with the section at right turned down to 7mm and the centre necked section is 5mm, and the total overhang is about 250mm. One way to do this would be to take several cuts, slowly extending the work from the chuck. This would be likely to leave a poor finish at the 'overlaps' leaving the challenge of putting a decent final finish. In fact, the pictured bar was turned in one cut, and the finish is suitable for finishing to a polish with a piece emery paper glued to a board (the HSE approved method).

A fixed steady could be used to do this, however, you would be stopping and starting continually, moving it along the bed to provide support where it was needed. The ability to take uninterrupted deep cuts in such a long bar is provided by the travelling steady as it can be set to support the work very close to the point of the cut. As the distance remains constant the finish can be very good.

The first step is to fix the steady in place, on the Arc SC4-500 (and most lathes) this means removing a couple of set screws (that stop the fixing holes filling with swarf), **photo 17**, and simply screwing the steady firmly in place. The phosphor bronze 'fingers' can then be retracted, and the work fitted in the chuck. As with the fixed steady the final

This 3D printed device was a solution to a one-off job too big for a standard steady.

Running down a TIG welding stick with an improvised steady.

Two of my large collection of stub mandrels.

More sophisticated expanding mandrels.

This large cylinder is screwed on to an arbour fitted to the lathe.

This simple jig is for turning elliptical glands.

adjustment is best carried out close to the chuck, **photo 18**.

Run the saddle to the tailstock end of the work, and set the tool to take a cut near, but not too near, the steady. The reason for leaving some space is to allow enough room for a couple of trial cuts to get the exact depth of cut needed but still allowing the steady to run on the work.

Lubricate the length of the work with cutting oil, to reduce the likelihood of overheating. This shouldn't cause issues with carbide tooling as the flow of coolant reaching the tip will be constant, if small. I used Maxsyn SLF chlorine free which has an advantage of not being too unpleasant if it starts to smoke! Of course, if you have pumped coolant, it pays to use it.

In the example in **photo 19**, a roughing/chamfering tool with a 90-degree point was used with depths of cut of 2mm and 3mm and a speed of 520rpm. It is wise not to run too fast when using a steady as hotter work can lead to inaccuracies, and more smoke when the oil hits the tool.

For more details on the use of steadies, John Stephenson wrote a detailed 'Treatise on Steadies' that appeared in MEW issue 259.

Custom steadies

If you are stuck with a job that doesn't suit the equipment you have to hand, there is along tradition of making makeshift steadies to suit the job in hand. A wooden bracket with a bored hole has got may a hobbyist with an oversize workpiece out of difficulty, although it is essential to work slowly and with light cuts. A more modern alternative is the 3D printed steady, with three ball races in **photo 20**. Obviously, this isn't as rigid as a metal steady, or even a wooden one, but in the example shown it was sufficient to enable the lightly-held tube to be bored out without it 'walking' out of the chuck.

At the other extreme are steadies for very small diameter work. That shown in **photo 21** was bored in place using a drill in the 3-jaw, and by carefully clamping it alongside a tool, it was possible to turn down quite soft, flexible TIG welding rod to a diameter suitable for threading 10BA!

Specialist Mandrels

A mandrel is a tool that is designed to fit inside a workpiece to hold it accurately for turning. Most often encountered is the 'stub mandrel', typically a short, slightly tapered, cylinder turned in place for accuracy. The workpiece, which should be a force fit on the mandrel is then fitted (perhaps tapping it on with a nylon-faced hammer), and gently pressed off. A typical use of a stub mandrel is to true up the outer diameter of a flywheel or locomotive wheel. Cuts are best kept light, as if the work spins on the mandrel its accuracy and fit will be lost, and the bore may be spoilt.

An alternative to a force fit is to drill and tap the mandrel, but only with the 'nose' of a second tap. If it is then slit with a hacksaw a screw fitted into the end can be used to expand the mandrel to fit the work. Other alternatives are threaded holes or screwed extensions for screw or nuts that hold the work in place. I have a small collection of such mandrels, many from hex stock, all with a centre pop mark to help align them with 'jaw one' for a reasonable level of accuracy, **photo 22**.

It is possible to buy expanding mandrels, these work rather like an ER collet in reverse, expanding to cover a modest range, typically 1mm for the screw adjusted MT fit ones in **photo 23**, or 0.5mm for 'quick release' ones.

If the work to be turned has an internal thread, it can be run onto a mandrel in the lathe, **photo 24**. This month's cover photo shows an unusual example, a telescope drawtube which needed to be turned accurately all over and was internally threaded at one end. To ensue concentricity with the thread it was mounted on a large diameter threaded mandrel for final finishing.

The options for workholding are uncountable, as the example in **photo 25** shows, if you use your ingenuity you can find a safe, secure and accurate answer to almost any workholding challenge. ■

Arc Euro Trade

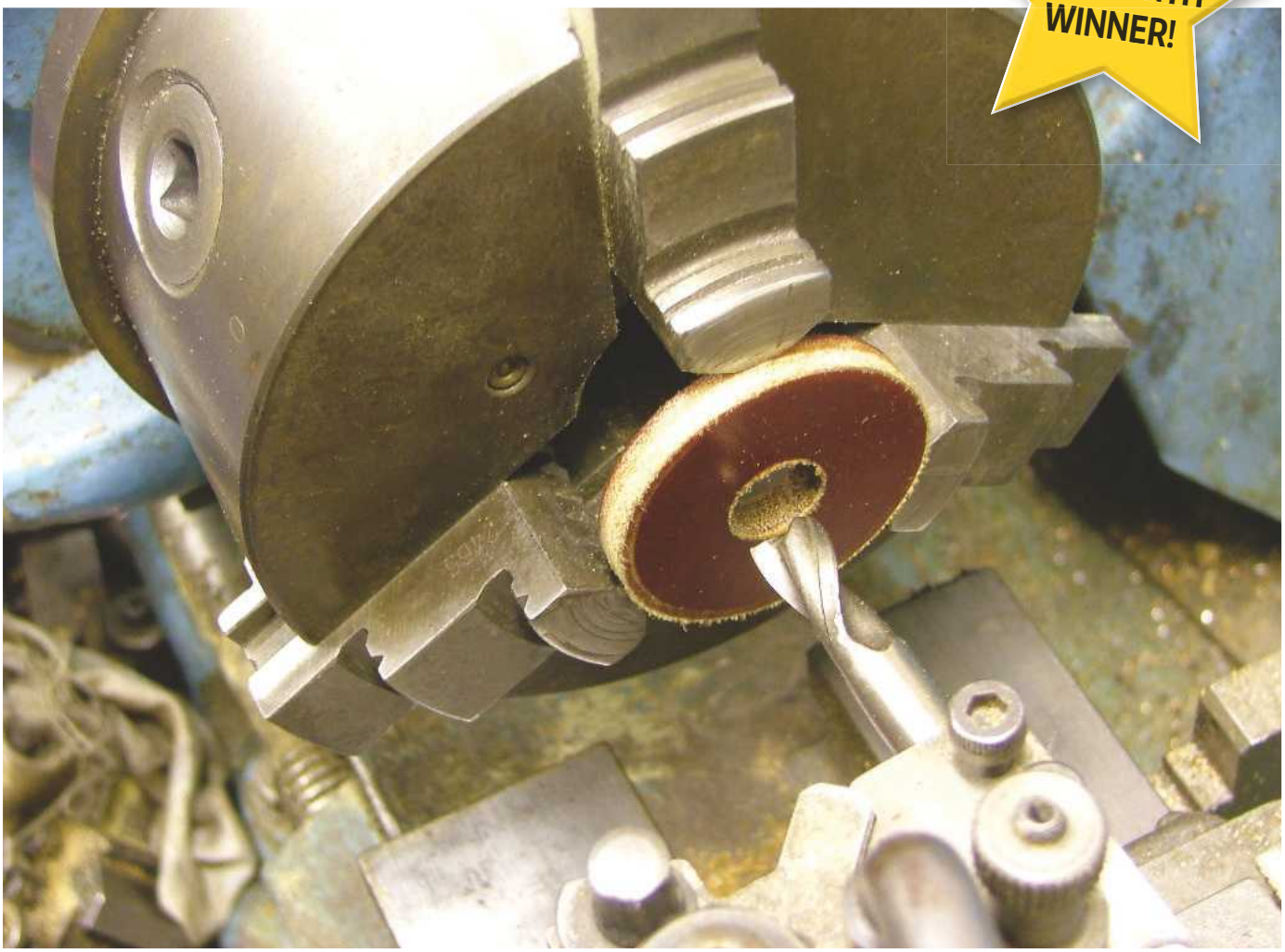
The various accessories featured in this series including dogs, faceplates, steadies and expanding mandrels, as well as the featured Arc SC4-500 lathe are available from Arc Euro Trade, together with Morse taper and ER collet systems as well as backplates and faceplates.

Readers' Tips

CHESTER MACHINE TOOLS

A Use for Old Endmills

TIP OF THE MONTH WINNER!



Clive Richens wins this month's Chester Vouchers with an idea for the use of old endmills.

I have received all issues of *Model Engineers' Workshop*, and I haven't seen this system mentioned before so I thought I would submit the idea. During machining in my workshop, I occasionally either break or blunt endmills of various sizes, as of course do others. However, I don't throw them away, I use them as internal boring bars in my lathe toolpost, as you only need one cutting point for this purpose, so missing broken off points are not needed.

An advantage of using an endmill in this way allows you to rotate it in the toolholder on the lathe for adjusting the cutting angle relative to the work.

If an endmill gets blunt and I don't own a cutter grinding machine, I can also just touch one point up on a grindstone by hand.

Also, the plastic lid from a can of spray paint can be used to hold cutting fluid on the cross slide or machine bed and a magnet inside it will prevent it from being knocked off.

This idea was one of your readers tips very recently using a tee bolt to attach it to the lathe, and therefore can only be fixed where there is a slot, and not able to be used on any machine in the workshop.

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.

THE MOST VERSATILE TOOL FOR TURNING & FACING

It's easy to see why our best selling turning tool is the SCLCR. It can turn and face a bar without altering the toolpost, and the 80° nose angle gives much more strength than a 60° (triangular) insert. The NJ17 insert cuts steel, stainless, cast iron, phosphor bronze, aluminium, copper, brass etc. Please state shank size required - 8, 10 or 12mm square. Spare inserts £6.86 each for 8-10mm tools, £7.99 for 12mm.

SPECIAL OFFER PRICE £39.20

USE THE OTHER 2 CORNERS FOR ECONOMY!

Our SCRCR rough turning tool uses the same inserts as the SCLCR tools above. The good news is that it uses the other two corners! These very strong 100° corners are rigid enough for rough or intermittent turning. The insert is mounted at 75° to the lathe axis. 10mm sq section (for CCMT06 insert) and 12mm section (for CCMT09 insert).

SPECIAL OFFER PRICE £39.90

PROFILING WHEELS or SHAPING AXLES & PILLARS?

If you need to create complex shapes, our SRDCN button tool is invaluable. The 10mm square shank holds a 5mm dia cutting insert, and gives great versatility, superb strength and excellent tool life. The late Mr D Hudson of Bromsgrove SME used these tools for many years to profile the special form of tyre treads for his self-steering wheel sets with great consistency. Spare inserts just £5.79 each.

SPECIAL OFFER PRICE £39.20

TURN SMALL DIAMETERS with LIVE CENTRE IN PLACE!

The SDJCR tool uses a 55° insert, allowing access to small diameter components when using a tailstock centre. It can also profile back-angles. The NJ17 insert cuts steel, stainless, cast iron, phosphor bronze, brass, copper, aluminium etc. Shank size 10mm square section. Spare inserts just £6.86 each.

SPECIAL OFFER PRICE £39.20

A TOP QUALITY BORING BAR FOR YOUR LATHE

Bar Dia.	Min Bore
8 mm	10 mm
10 mm	12 mm
12 mm	16 mm
16 mm	20 mm

Here's your chance to own a top quality boring bar which uses our standard CCMT06 insert. Steel shank bars can generally bore to a length of approx 5 times their diameter. Please state bar dia required - 8, 10, 12 or Spare inserts just £6.86 each.

SPECIAL OFFER PRICE £42.58

INTRODUCING THE GROUNDBREAKING NEW KIT-QD PARTING TOOL!

The new and innovative KIT-QD parting tool has a more secure insert location, stronger body and improved insert design compared to the original KIT-Q-CUT. It has an increased maximum reach of 23mm, giving over 1.3/4" parting capacity in solid bar. As previously, the tool fits the vast majority of ME lathes, including ML7 & ML10 machines, regardless of toolpost type. It comes complete with the key to locate and eject the tough, wear resistant insert. Cuts virtually all materials. Spare inserts just £10.75 each.

SPECIAL OFFER PRICE £69.50

EXTERNAL THREADCUTTING TOOL

These tools use the industry standard 16mm 'laydown' 3-edge inserts. With tough, tungsten carbide inserts, coated with TiAlN for wear resistance and smooth cutting, threads can be cut at very slow speeds if required. Tools are right hand as shown. 55° or 60° insert not included - order separately at £13.65. See our website for more info.

SPECIAL OFFER PRICE £43.80

INTERNAL THREADCUTTING TOOL

These tools use the industry standard 11mm 'laydown' 3-edge inserts. With tough, TiAlN coated tungsten carbide inserts, quality threads can be cut with ease. Tools are right hand as in picture. 10, 12 and 16mm dia's available. 55° or 60° insert not included - order separately at £11.37. See our website for more info.

SPECIAL OFFER PRICE £43.80

DORMER DRILL SETS AT 60% OFF LIST PRICE!

All our Dormer drill sets are on offer at 60% off list price. The Dormer A002 self-centring TiN coated drills are alco available to order individually in Metric and Imperial sizes. Please see our web site for details and to place your order.

TURNING, BORING & PARTING TOOLS COMPLETE WITH ONE INSERT.

Please add £3.00 for p&p, irrespective of order size or value

MasterCard VISA VISA Electron Maestro

MIDLANDS EXHIBITION 18-21 OCT '18

GREENWOOD TOOLS

Greenwood Tools Limited
2a Middlefield Road, Bromsgrove, Worcs. B60 2PW
Phone: 01527 877576 - Email: GreenwTool@aol.com

Buy securely online: www.greenwood-tools.co.uk

BRISTOL MODEL ENGINEERING & MODEL MAKING EXHIBITION 2018

AUGUST 17TH, 18TH & 19TH

THE LEISURE CENTRE—THORNBURY
NEAR BRISTOL - BS35 3JB

FRI 10AM - 5PM SAT 10AM - 5PM SUN 10AM - 4PM

ADULT £10.00, JUNIOR £4.00, FAMILY £23.00 (2+3)
3 DAY AND ADVANCE TICKETS ALSO AVAILABLE—SEE WEBSITE

MODEL & MINIATURE LOCOMOTIVES, MARINE EXHIBITS
BOATING POOL, WORKSHOP DEMONSTRATIONS
WOODTURNING

FREE PARKING

NEAR M4/M5 INTERCHANGE
5 MILES FROM M5 JUNCTIONS 14 OR 16

ACCOMPANIED CHILDREN UNDER 16 FREE

QUEUE HOPPER ADVANCE TICKETS AVAILABLE ON-LINE

CLOCKS
STATIONARY STEAM ENGINES
TRACTION ENGINES, HOT AIR ENGINES
MACHINE TOOLS, WORKSHOP EQUIPMENT, SHIPS
AEROPLANES & HELICOPTERS, RADIO CONTROLLED TRUCKS, IC ENGINES

FOR FURTHER INFORMATION PLEASE VISIT OUR WEBSITE:
www.bristolmodelengineers.co.uk **OR CALL 0117 405 8580**
ALL ATTRACTIONS CORRECT AT TIME OF GOING TO PRESS, BUT MAY BE SUBJECT TO CHANGE OR CANCELLATION

S.M.E.E. BRISTOL Est. 1909

ORGANISED BY THE BRISTOL SOCIETY OF MODEL & EXPERIMENTAL ENGINEERS
REGISTERED CHARITY NO. 1094274

A Stepper Motor Driven Toolchanger for a Small CNC Lathe

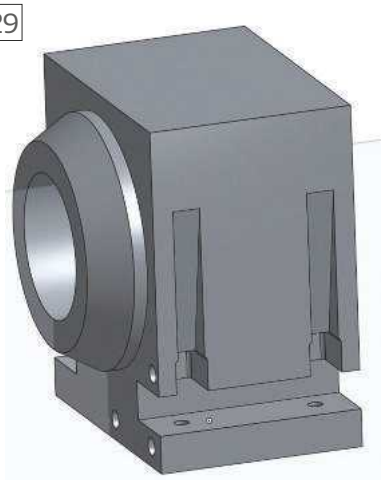
In this new series, Simon Davies describes the development and construction of a CNC toolchanger for his Emco lathe. Part 2

Main block

A 3D rendering of this component is shown in **photo 29**. This started life as another of the colossal lumps of XC38 steel, band-sawed to close dimensions including a big step out of the cone end of the block. A swift cleaning up on the sides was followed the setup shown in **photo 30** where the first few millimetres have been taken off the 4 corners of the block in preparation for another mighty swarf generating exercise. Note the entirely necessary live centre to stop 8kgs of steel embedding itself in the wall – or me.

Thanks to this support plus some support of a different nature from the *Model Engineer* website forum, I eventually plucked up the courage to run the block far faster than I had envisaged. This resulted in the blue and straw swarf travelling further, comments from the household about the vibrations coming through the floor, but a better surface finish and a much increased removal rate as can be seen in **photo 31**.

29



3D view of the block showing the cut away access to the hold down bolt heads

The topslide had not been disturbed since the cone was cut on the toolholder but the size of the objects and the different cone faces meant that I eventually ran the lathe in the normal direction of rotation but with a tool held upside-down machining from the rear as seen in **photos 32** and **33** to cut the corresponding cone. The centre hole was then drilled and part bored as seen in **photo 34**, which also shows the finished cone. The bored-out part of the cone is only clearance for the shaft to toolholder so neither the dimensions nor finish were required to be perfect. My 25mm drill was next inline for assaulting the block, **photo 35**, driving a hole through prior to a boring bar finishing the job to suit two Oilite bushes, **photo 36**.These were chosen to allow the shaft on which the toolholder sits to move axially as necessary whilst still ensuring that the cones of the block and toolholder remained in alignment. I could have also machined my own bushes but this in combination with 25mm Silver Steel allowed a simple and off-the-shelf solution and allowed me to focus on the more complex parts.

At about this point I realised that the chuck jaws lacked sufficient depth to allow me to grip the cone face of the block to finish machine the rear side. As a result, I machined up a tapered bar and held it between centres as seen in **photos 37** and **38**, truly a wild ride but fortunately only a cleaning cut was required.

An Oilite bush and the aluminium insertion device made especially for the purpose are seen in **photo 39** and the result after fitting in **photo 40**. At this point, the lathe operations on the main block were complete and it was over to the mill for the next phases.

One of the key parameters is the height of the tool and I proceeded to measure this by a method that I have not heard of before although doubtless it has been used

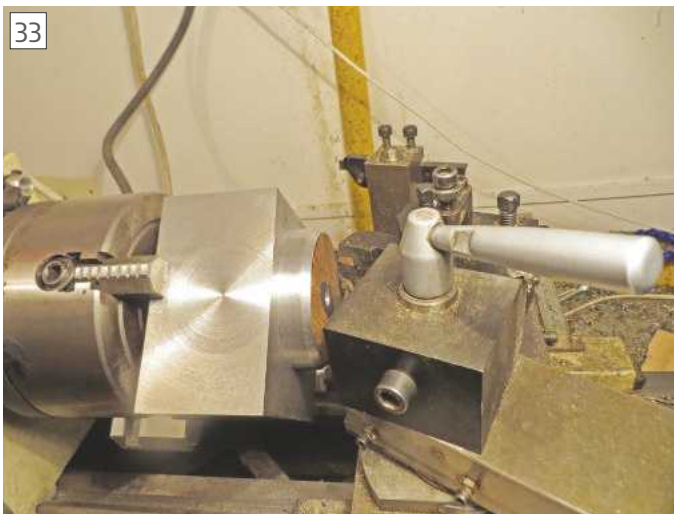
30

Starting to machine down the block ready for cutting the cone surface

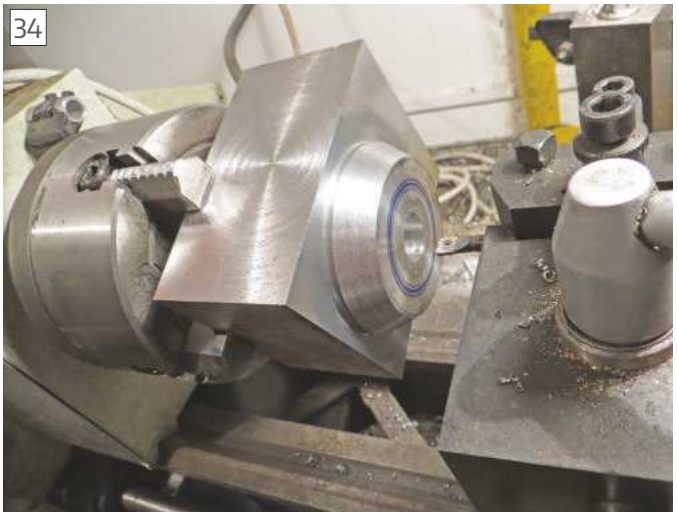
31

Lots of hot swarf later, the block is ready for the cone

Topslide still in the same position as for the plate cone, note the inverted tool cutting on the far side of the block



Viewed from a different angle, the very limited clearances are obvious



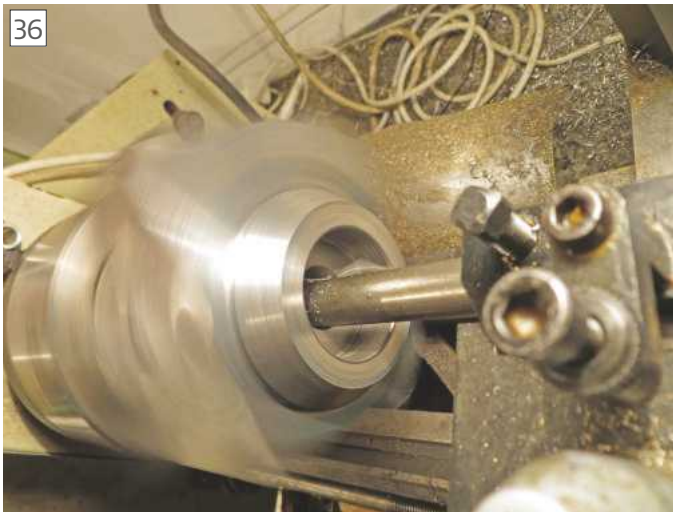
Boring the centre (clearance) portion of the block

Start the process with a 25mm drill

many times in the past. A tool was set to centre height and checked for accuracy by making facing cuts. A comparator gauge was then run across the (flat) top and the value noted **photo 41**. I then removed the comparator across to the surface table and built a set of gauge blocks until the indicator setting was the same **photo 42**.

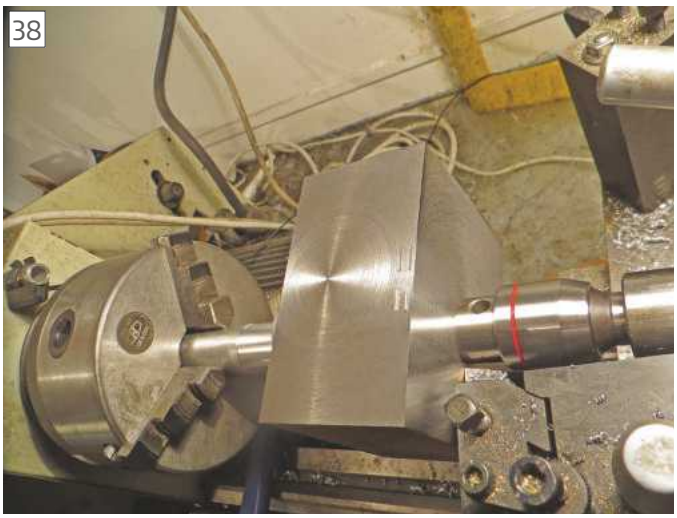
The comparator was returned to the lathe to ensure that the setting was the same and had not been moved. The gauge blocks now give the centre height above the saddle for use when machining the block base to size. Of course, there are other methods and I probably did not need to go to such lengths – but having recently acquired a set of gauge blocks, I could not resist an opportunity to use them!

The result was then used to define the cut depth for the bottom of the block – some complicated calculations linked the centre line of the bush to the bottom of the block and this was then flycut to size as seen in **photo 43**.



Biggest home brew boring tool in action

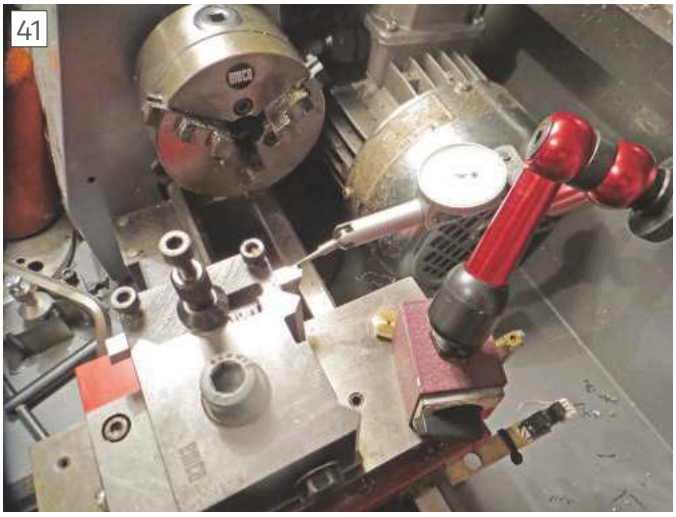
Scary stuff to clean the face - taper bar supported between centres



Eventually a good finish - even if the 4-jaw has marked another face

Oilite bush and press tool

Bush in place with press tool inserted. Several attempts were needed to get the fit right



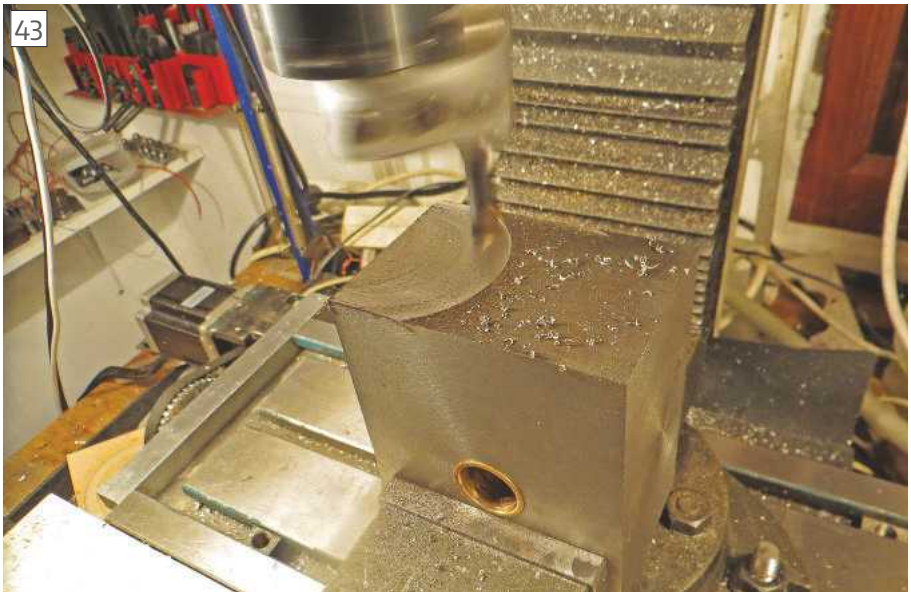
Measuring the tool tip height above the saddle with a flat tool

Mounting holes for the stepper motor supports were drilled and tapped resulting in another breakage and a brand-new set of HSS taps being purchased. The situation in **photo 44** was not easy to cure!

The next stage was to cut the slots in the sides to allow the block to be bolted down onto the saddle. This can be seen during operations in **photo 45**, where the hold down bolt holes can also be seen. Slots to allow M6 Socket head screws to be inserted into the holes were then cut, **photo 46**, followed by rather crudely tilting the block at an angle for hex key access slots to be cut as seen in **photos 47** and **48**. Note the use of Mr. Stevenson's blocks! Photograph 49 shows the finished result, cut with a ball end mill.

The next stage was to test fit onto the

Comparing against a set of Gauge blocks

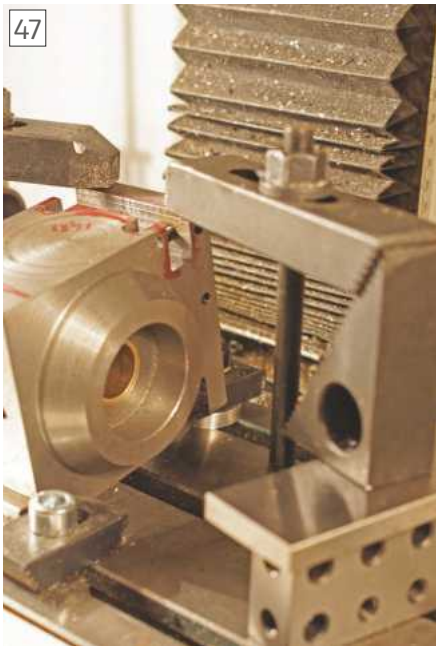


Fly cutting with a boring tool works surprisingly well

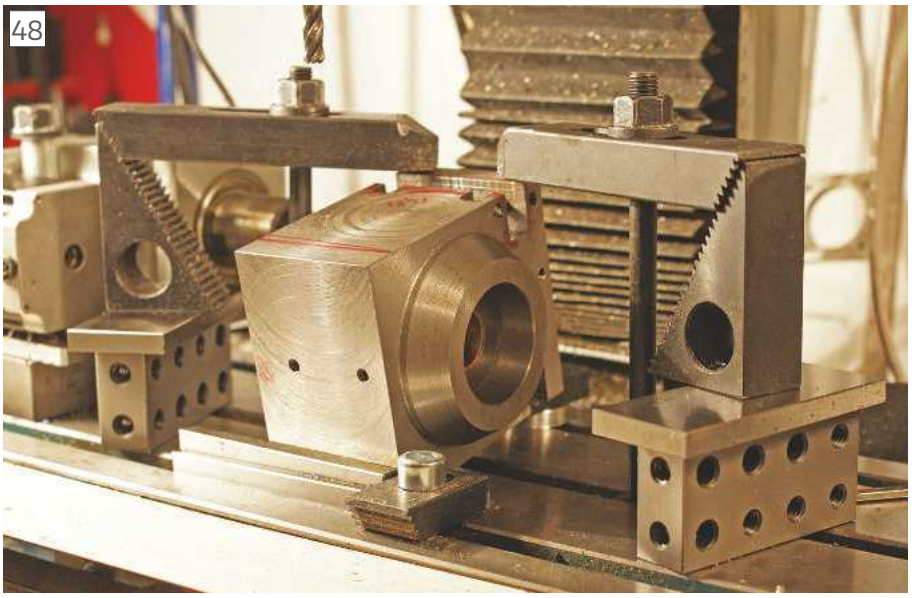
Not a good place to break a tap

The block gets some slots to access the hold down bolts

Test fit of a 6mm SCHS



Rather Heath-Robinson arrangement to set an angled cut. Maybe I should buy a tilting machine vice



Actually looks better from this angle. Note the parallels acting as a stop in the foreground

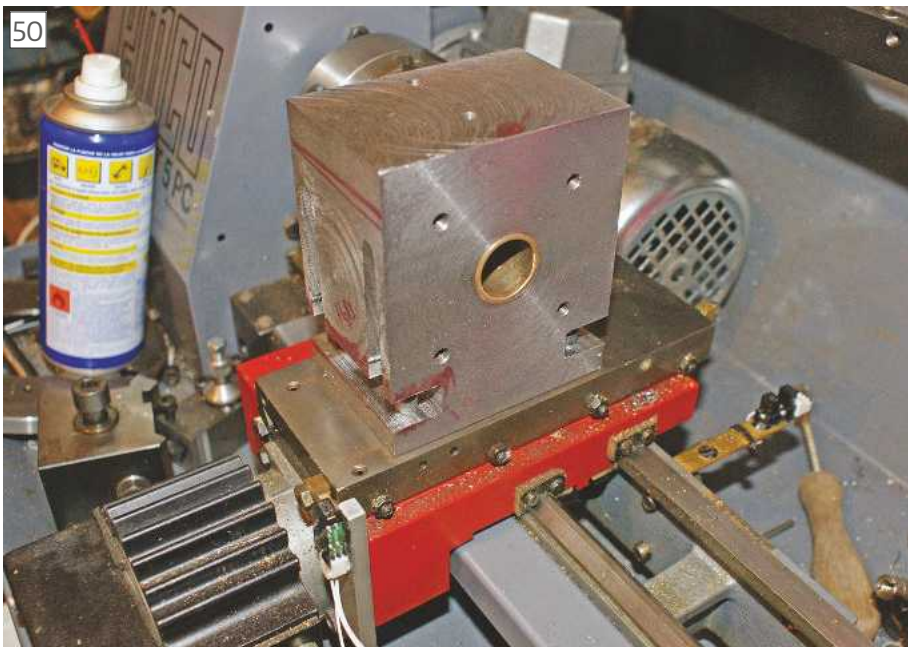
saddle and to ensure access was sufficient – although I am uncertain what I would have done if it was not, **photo 50** shows the result. Although a few further holes were cut, the block was effectively finished at this point.

Locking bolt assembly

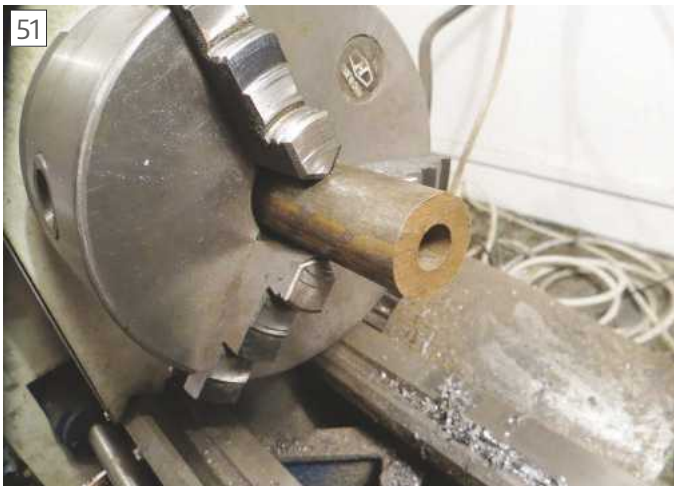
The locking bolt and nut lies at the heart of the toolchanger and is the key component that pulls the toolchanger cone onto the matching cone on the block. Unsurprisingly it went through several iterations before arriving at the current version illustrated here.

The bolt passes through the centre of the toolchanger shaft, held in place by a pair of caged needle roller bearings. At the toolchanger end there is a removable cap

The finished access chanels for ball head hex keys



First installation of the block and good to see it fits!



Cored bronze rod for the locking nut

Cleaned and bored to size

bearing allowing the shaft to be removed from the rear side of the block. Also, at the rear end there is a large fine LH thread permanently attached to the shaft.

Mated to this thread is a matching bronze nut surrounded by a toothed belt gear wheel.

Tightening the nut has the effect of pulling the cap at the one end towards the nut trapping the block and thus locking the cones together.

To minimise the friction in the tightening process, a thrust ball race and matching cup are also trapped between the block and nut.

The nut is driven by the larger of two stepper motors through a T5 toothed belt and a 15:68 set of toothed gears.

The original design had a direct drive stepper and a RH thread. The stepper motor was initially increased in size before I realised that it was never going to provide enough torque to lock everything tightly enough to work. As part of the improvements and in an effort to extract the maximum torque possible from the system, the thread was converted to LH

Parting off - 0.7mm pitch thread visible

and thus self locking as force was applied to the tool tip and the thread pitch decreased from 1mm to 0.7mm. The combination is now that well known metric thread 21.4 x 0.7mm, a perfect example of why "measure twice, cut once" should be rigorously applied, although even the intended 22 x 0.7mm is hardly standard.

The cap end now has a loosely locking system with the toolholder. Originally, I intended that a simple friction lock would suffice to allow the nut to tighten on the thread without spinning, whilst allowing the toolholder to then rotate without tightening the nut back up. I was sadly mistaken here and the positive locking method was chosen to fix that problem whilst loosening the nut several extra turns to ensure that there was no danger that it might self lock while selecting a new tool position. All part of the development process and not by a long way the only changes from the original design.

The nut started life as a piece of cored phosphor bronze, 'collected' some thirty years ago waiting for the right moment to be used. This was bored, threaded to the dimensions above, the outer dimension trued and then parted off as shown in the sequence **photos 51** to **53**.

● To be continued

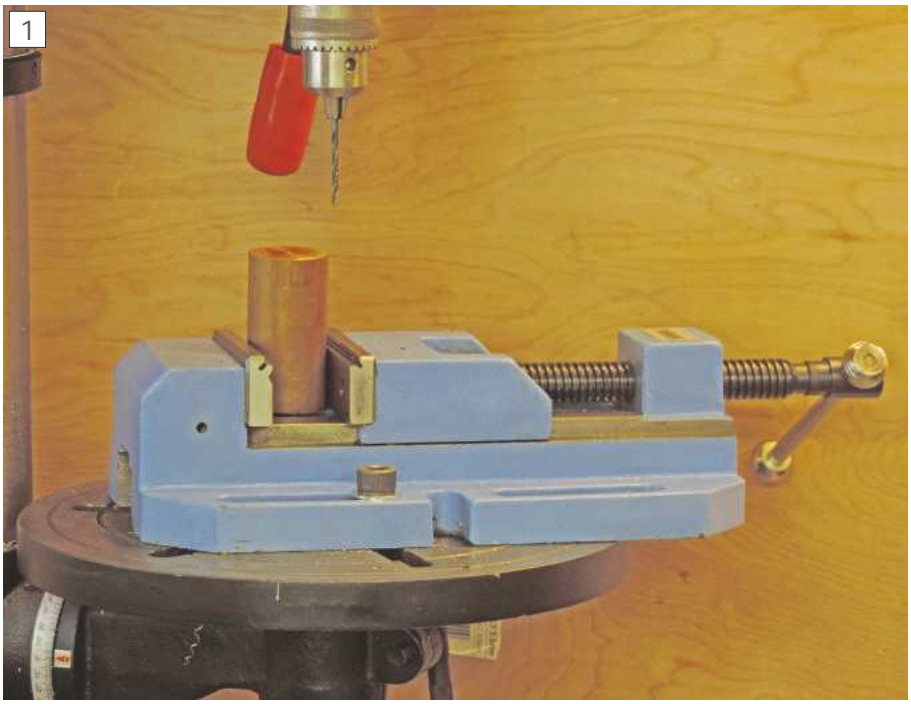
Axminster Engineer Series Drill Vices

Stub Mandrel reviews a vice from this new range.

Vices are essential tools in any workshop for obvious reasons, and there are many different types. The type that causes the greatest confusion (and debate) is the drill vice. While a milling vice needs to be both accurate and rigid, may people's requirements of a drill vice are simply that it grips the work well enough to stop it spinning when a hole is drilled. To this end there are a plethora of cheap, but not always cheerful, drill vices available. I must admit that for many years I have used one of these, with a sloppy jaw, poor support for the work near the fixed jaw (due to a deep groove). Working with greater accuracy or small parts has either involved borrowing a milling vice, clamping a small milling vice in the drill vice or simply resorting to drilling with the vertical mill.

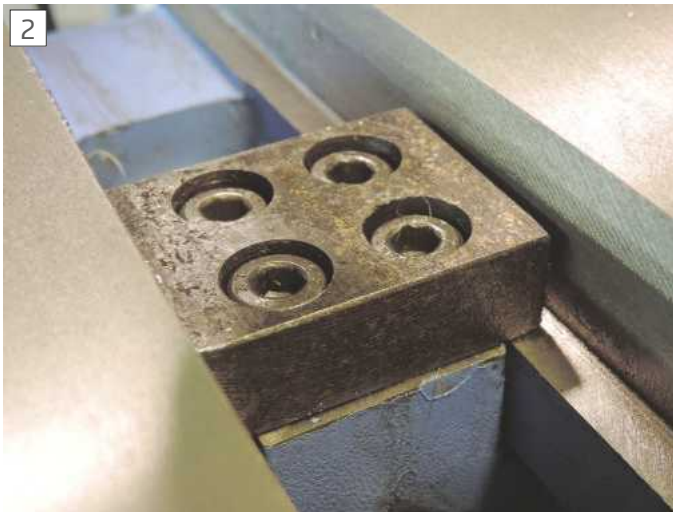
While this approach was possibly OK with my small bench press, moving up to a hefty 16-speed bench press highlighted the weakness of this approach. For productivity and accuracy with the drill press, you really need a robust and accurate vice with many of the features of a milling vice but with a faster jaw action.

The new Engineer Drill Vices from Axminster Tools and Machinery are intended to meet this need. Available in four sizes - 60, 100, 120 and 150mm I have been 'road testing' the 100mm version for a couple of weeks.

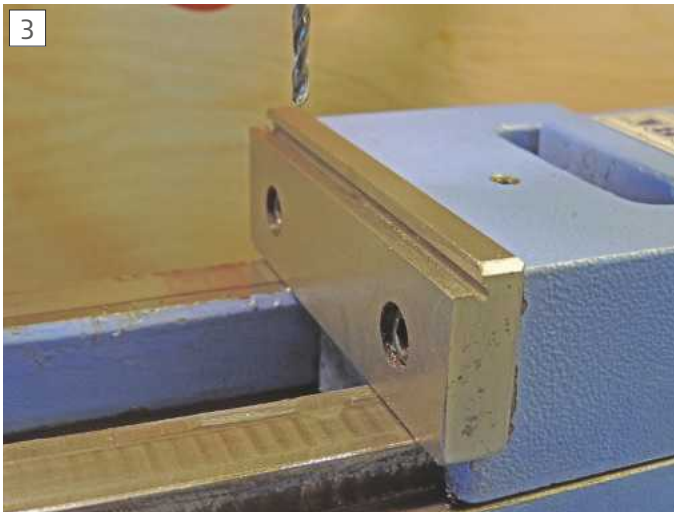


1 The 100mm version of the Engineer Series Drill Vice

The vice arrived well packed in a very large, very heavy box, which contained a large box and on finally reaching the vice in its sealed bag my initial reaction was concern that it could be too big and heavy for my drill press. The vice itself is a SOBA product, an Indian brand that has a generally good reputation



2 The robust keep plate



3 The moving jaw

›

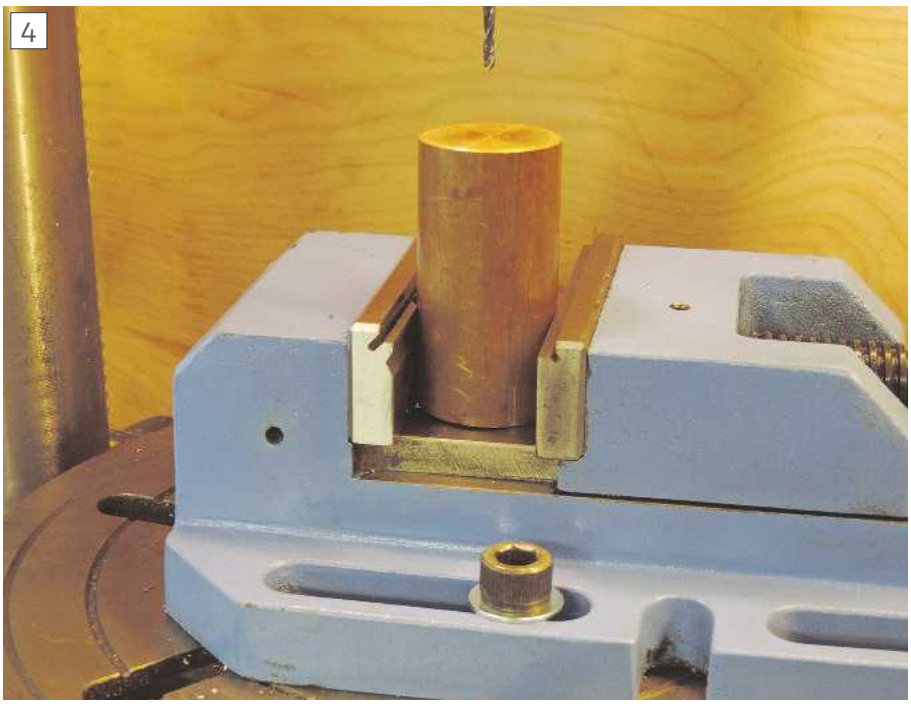
Although the vice completely dwarfs my old drill vice, it sits well on the 30cm table of my drill press, **photo 1**. The drill press is also solidly made so the table shows no sign of 'drooping' under the load, however, I could not recommend the 100mm version for anyone with a 'budget' benchtop drill press. The 60mm version is much lighter and would be more appropriate to these machines. The 120 and 150mm versions of these vices are very large and heavy and will suit those whose workshops are proportioned for seriously big work.

Axminster claim the vice has CNC machined slideways and a ground base to provide smooth travel of the moving jaw, keeping it accurately aligned and parallel too the base. This certainly seems to be the case, with the jaws moving smoothly through their full travel without noticeable shake or lift and meeting accurately when closed. The U-shaped moving jaw with it's roughly 1:1 width to length ratio meets the 'narrow guide' principle, unlike basic vices with shorter slides that need to have some play to avoid jamming. It also has a robust keep plate with four adjustment screws, **photo 2**.

Importantly, the dimensions of the 100mm vice and its ample fixing points allow it to be placed on my bench press with the spindle anywhere from the fixed jaw to the full opening, **photo 3**, allowing full use of the vice's capacity.

The best size of fixing bolt for the vice is M14, which is probably overkill for any drilling I do, but matches my drill table's slots. I had to make do with M12 and a washer which was OK for light work, but I will make up some M14 bolts for heavier duty work.

Looking at the vice in detail, it has some nice features. The jaws are finely ground and have horizontal and vertical v-grooves that allow the easy alignment of round stock, **photo 4**. I found that it could hold light alloy workpieces securely without marking them.



Three grooves allow easy holding of round work, and recesses hold thin work

There is also a recess at the top of the jaws to facilitate holding thin work, a particularly useful feature that takes advantage of the lack of jaw lift. The ground ways continue right under these removable jaw plates, this allows narrow work to be held accurately upright – a bugbear with my old vice.

There is also a tapped hole on the left side of the fixed jaw which may mystify some users, **photo 5**. This is for attaching a stop, to allow easy positioning of repeat jobs.

The leadscrew on the vice is a well-sized ACME thread and works freely with little backlash. The handle has two ball ends which are little roughly finished but nonetheless comfortable to use. Most importantly, the handle's proportions allow work to be clamped securely without undue effort.

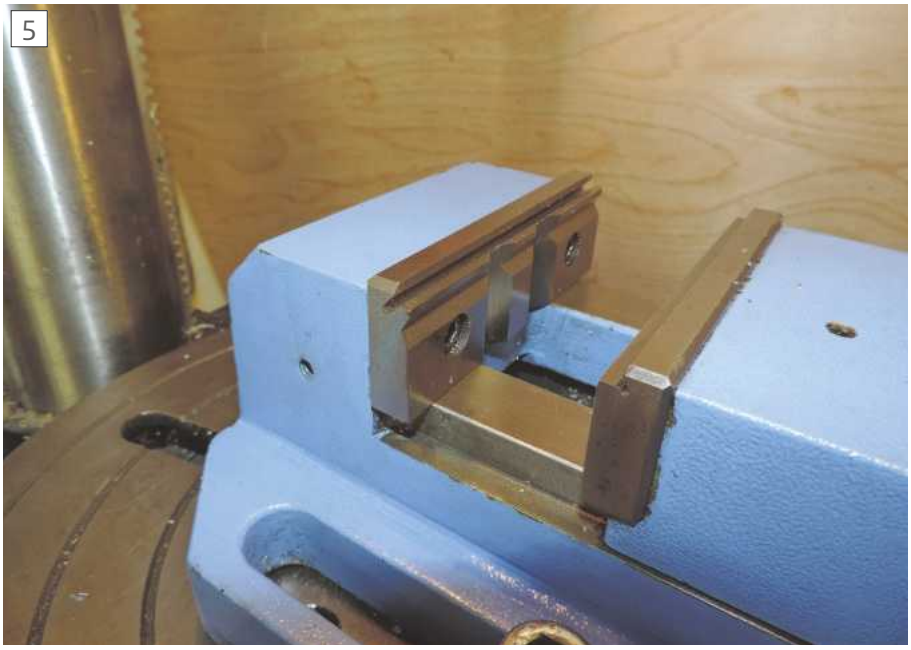
> ...the jaws moving smoothly through their full travel without noticeable shake or lift...

In use I found the vice very pleasant to use, the extra weight paradoxically making it easier to position accurately than a smaller vice.

Very often well-built drill vices are sold as 'suitable for milling'. Axminster do not make that claim for this vice, all I will say is that this vice appears more robust and better made than some vices I have seen for which this claim is made. They certainly have the accuracy need for co-ordinate drilling with a vertical mill.

Probably the least important feature of any piece of engineering equipment is the colour, but that said this vice brings a cheerful splash of sky blue into the workshop.

All in all, I am very satisfied with the quality of the vice, and I am sure it will prove very popular. The 100mm version reviewed costs £105.06, and the 60mm which will suit those with smaller bench drills is £46.69. All four versions are obtainable from axminster.co.uk or visit one of their eight stores across Wales and England. ■



The fixed jaw and mounting hole for an end stop (not supplied)

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Eclipse Round Hacksaw Blades

In issue 269, Australian reader Richard Cains wrote enquiring for a source of Eclipse round hacksaw blades. My understanding was that these have not been produced for some years, but it seems I was very wrong as there has been a tidal wave of letters and emails from readers offering help to Richard. I can't print every response for obvious reasons, but here are a few:

Abrafile Blades – 1

Dear Neil, r.e. Issue No269 "Eclipse Round Hacksaw Blades" as well call them "Abrafile blades". I have been using these since 1958, and over the years I have quite a stock of them in my workshop, s I use them for my model boats projects etc; the problem we have is if you mislay the end clips.

I have my model engineer's workshop, where I complete all my parts etc. and projects for my boats and engineering bits.

If I could have Richard's full name and address I will post him a handful of all grades etc. of these blades.

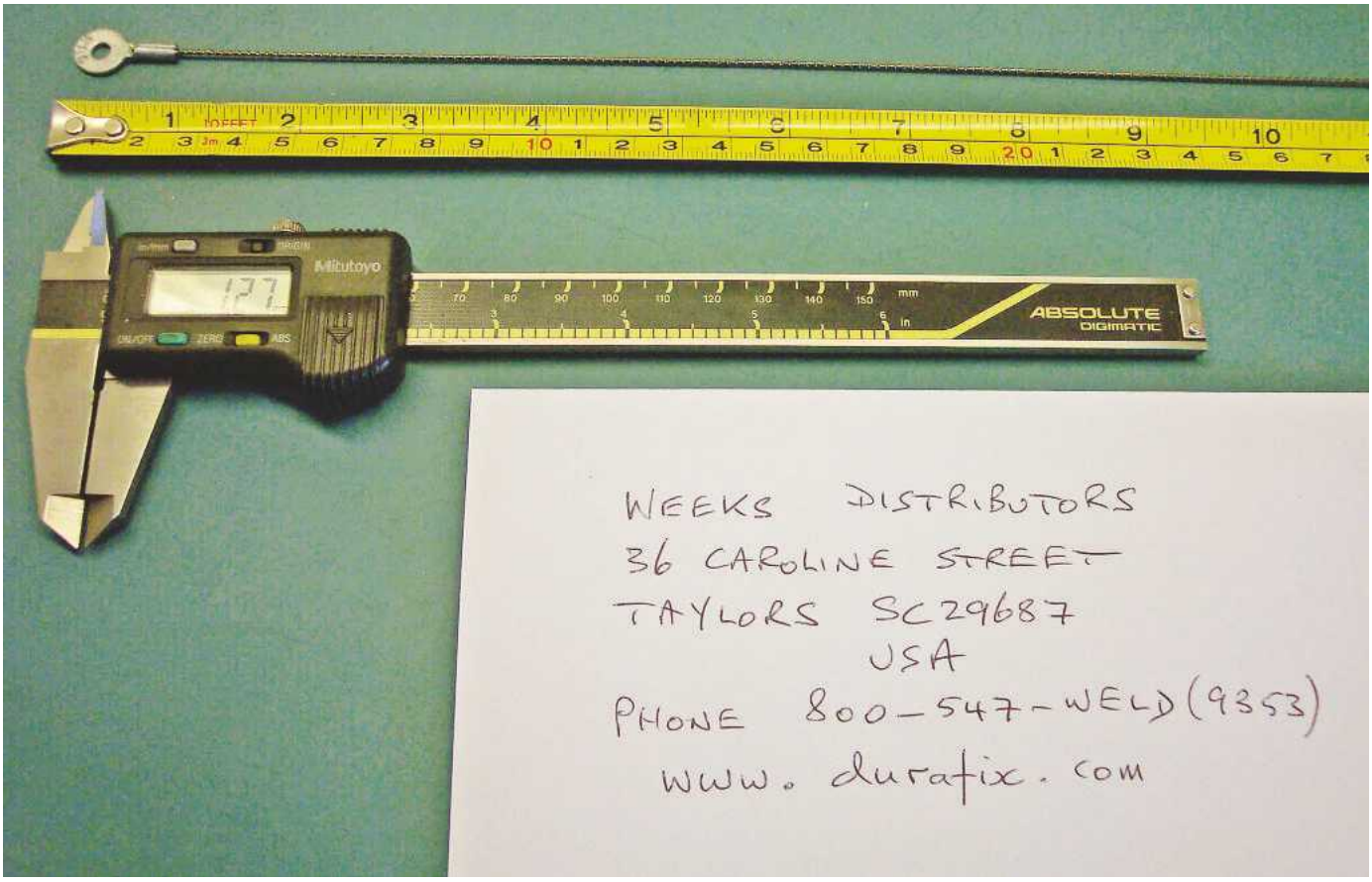
Steady Eddie, Dorset.

Abrafile Blades – 2

Dear Neil, Richard Cains in Australia, writes in Scribe a Line MEW 269 in hope of finding a source to replace his dwindling stock of these useful items. I think the attached picture tells him all he needs to know, they will send 5x 12 inch blades plus 3 coping saw blades by air mail for 30$ US.

I found them some years ago, the quality is good and they get a lot of use. For convenience, I keep a second hacksaw frame to hand with one of these permanently fitted for immediate use.

Brian Wood



Abrafile Blades and Rotary Tables

Dear Neil, I've just read the No.269 Scribe a Line and I have the following answers and comments to make.

Eclipse round hacksaw blades.

I inherited such a hacksaw from my father's workshop many years ago and in those days it was supplied by "Abrafile".

I required some new "blades" about three years ago and found some on eBay. They are by Abrafile and are called "Tension Files (sawing wires)".

The ones I obtained are TF 20 200mm/8in Fine, I cannot remember the price. See attached photo.

Rotary Table Indexing.

I have nearly completed a pair of John Wilding Elegant Scroll Frame Skeleton clocks. I used my Geo. Thomas dividing head lathe attachment which I made about sixteen years ago to cut the wheel teeth using the Hemingway kit for the Geo. Thomas Versatile Dividing Head. I used his book "Dividing and Graduating" to make the equipment and the charts supplied in the book. All this is also included in his book "Workshop Techniques" and the charts obviate the necessity of making your own calculations for the different divisions. I have used this equipment extensively since I made it and it is invaluable.

However, here's the point of the story. The Third Wheel in the clocks have 84 teeth and from the chart a plate containing a 43 hole circle is required and the fingers set to encompass 30 spaces. I thought there was an error on my part as the teeth looked rather thin and after a lot of checking and head scratching discovered from the chart that if I had wanted to cut 86 teeth I should also use a 43 hole circle and 30 spaces. ERROR. It should be a 42 hole circle for 84 teeth, not 43.!!

I contacted Kurt Burwell who supplies Hemingway kits and mentioned this to him. He said that when he took over the business he personally did all the maths and found this anomaly. Anyone buying a kit from him will have the correct charts supplied. I bought my kit in the late nineties together with the aforementioned books containing the charts.

I have informed Tee Publishing the book publishers and Camden Books for which they were very thankful and have amendment labels attached to their stock.

Andy Johnston, Corsley, Wiltshire.

Alan Wood and Geoffrey Thomas got in touch with a link to a 'blog posting' about an alternative to abrafile blades. In turn this linked to a product from Axminster UK, a 'Japanese free-way coping saw'.

www.axminster.co.uk/japanese-free-way-coping-saw-502229

This saw takes spiral coping saw blades (also available from Axminster) and diamond coated blades for cutting ceramics. Mr J. E. Kirby also wrote with details of this saw and mentioned that Chronos used to stock Abrafiles, however it seems they no longer list them.

Thanks also to Michael Gilligan who couldn't track down a supplier but did find the Abrafile patent.

Project Videos

Hello Neil, I am a retired electronics engineer who is branching out into mechanics. Now have my own lathe. I like your articles for beginners greatly.

In model engineers workshop I see lots of projects which I struggle to understand how they work. The Author assumes a prior knowledge in the description which is understandable.

An example is the CNC Tool changer, I have seen video of large industrial machines with tools it picks up and uses.

I cannot see anything in the photos that resemble this action.

Would it be possible to get the authors to post a small YouTube video of the machines working or in use to bridge this gap for me and others?

Roger Kirby, by email

Hello Roger, the toolchanger current being described in MEW is loaded manually, but rotates between four stops to bring different tools into play. It's not practical to insist that authors provide videos, but it is very easy to embed YouTube videos into posts on the forum at www.model-engineer.co.uk and I would encourage any authors who are able to post videos of their devices. – Neil

A Simple Thread Cleaner

Shelly Curtis makes a set of simple tools that are wll worth having handy.

What is more frustrating than, after having tapped a hole, finding that odd scraps of swarf are obstructing the free passage of the screw?

Running the tap through again may help, a blast from the airline may work. Expletives always fail! One yearns for something that works first time, every time – even in blind holes.

Well, here it is! Run it through after the tap. Job done!

Not my idea, but given to me many years ago by a model engineer, since deceased, of lifelong experience.

I pass it on in deference to his memory.

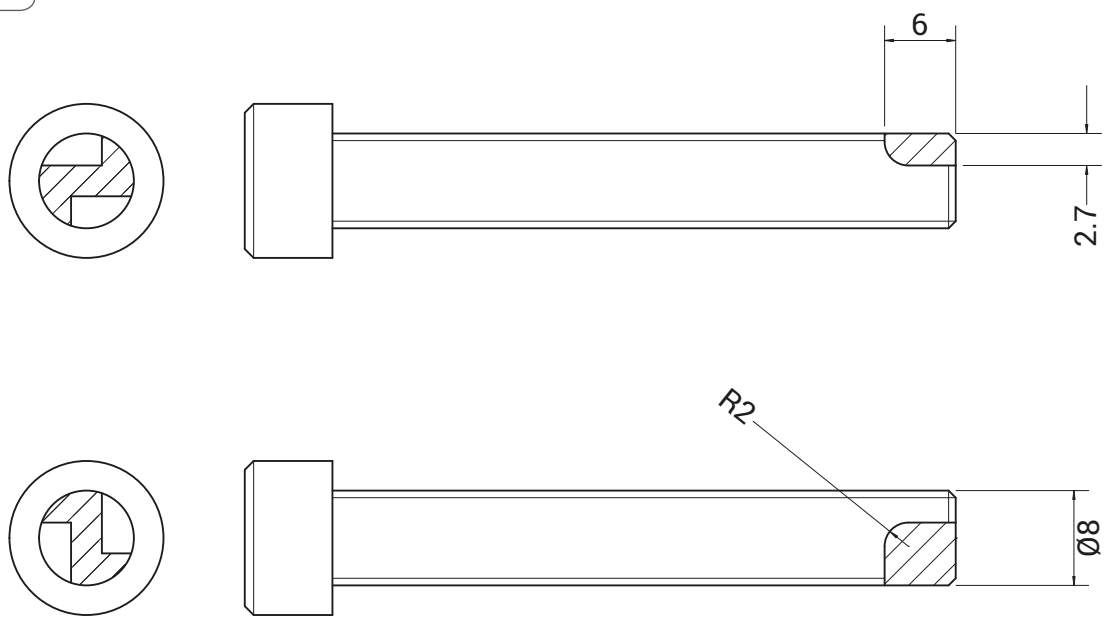
Figure 1, in this case for an M8 thread, shows the details.

Some of my collection, made as and when required, are shown in **photo 1**. ■

1

A set of cleaners for various metric threads

Fig.1



Thread Cleaner

All dimension metric unless otherwise stated

On the Wire NEWS from the World of Hobby Engineering

Sparmax Zeta Airbrush Compressor from the Airbrush Company

The Sparmax Zeta is a top-spec compressor with some really nice features that make it very easy to use.

The 1/8 horsepower compressor achieves a maximum airflow of 14-18 litres per minute, so while it isn't suited to spraying full size cars, it's ideal for any reader who uses airbrushes or small spray guns to paint their models. Weighing in at 4.6kg, it's a robust piece of kit. The outer casing is largely decorative, although it provides a useful handle and protects the compressor and its factory set pressure adjustment (60psi) while allowing excellent airflow for cooling. It is also nice and quiet in operation.

The compressor itself is nice, but what really sets it apart is the combined moisture trap, regulator and smart-stop switch. This assembly combines several functions. The use of a proper regulator, rather than an air bleed valve, stops the annoying hiss of escaping air. The regulator incorporates a pressure gauge and I was easily able to adjust the pressure between the maximum of 60 psi down to allow of less than 10psi, I found 20 psi worked well with my Sparmax airbrush. The regulator's adjustor knob has a great feature – you press it down and it clicks into place stopping accidental changes to the air pressure, pull it up and you can change the setting.

Beneath the regulator is a built-in moisture trap, with a sight glass and bleed valve. I haven't yet run the compressor enough to need to drain the sight glass, but I noted that it is fitted with a union to allow a length of pipe to be used to lead the water to a suitable container.

This assembly has a clamp which can be fitted to the compressor or to the workbench, on top of this you can fit the 'Smart Stop' hanger switch, this incorporates a nice padded stand that takes a standard size airbrush. A lead from the Smart Switch goes to the compressor. Placing an airbrush in the hanger stops the compressor, lift it and the compressor starts instantly. I found it very convenient to use, and it certainly suits my style which seems to involve lots of fiddling with the subject and preparing colours, and relatively little actual spraying!

The Sparmax Zeta with Smart Stop Hanger costs £199 including VAT and it is available from the Airbrush Company at **www.airbrushes.com**.

Airbrushes.com

The Airbrush Company Ltd

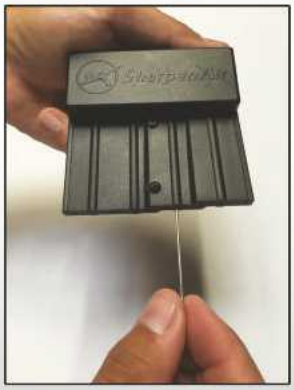
Airbrush Supplies - Paints & Accessories - Training - Servicing - Spares

SharpenAir

iwata

SPARMAX Air Compressor ZETA

SHA-NR



SharpenAir™ is the first and only hand-held device that is designed specifically for repairing bent and damaged airbrush fluid needles.

IW-HP-CH

Iwata Airbrushes

- the world's leading manufacturer of high quality professional spray equipment.

C-AC-ZETA

Position the Smart-Stop hanger and regulator on your worktop!

The Smart-Stop Hanger pauses the compressor when airbrush is placed into hanger and restarts when airbrush is taken off again.

Iwata Airbrush Cleaning Kit

Iwata Universal Workstation

Iwata Airbrush Maintenance Tool Kit

www.Airbrushes.com 01903 767800 sales@airbrushes.com

An Indexing Head for the Unimat SL1000

Terry Gorin has devised a neat accessory that may inspire devices for other types of machine.

The Unimat indexing head which inspired this accessory

Body of the indexing head

Should the description of this accessory for my Unimat lathe be dividing or indexing head? The terms are often used interchangeably', Harold Hall in his book 'Dividing' terms both simple and advanced indexing devices as dividing heads. My marine modelling needs for indexing on the Unimat will be limited to simple radial and circumferential dividing and the title 'Indexing Head' seems appropriate for the relatively simple attachment described here.

The indexing and dividing attachment, marketed by Unimat, shown in **photo 1** and described as 'simple and serviceable', is now only available second-hand but merited attention. A spindle with integral v-notched index plate rotates within the die-cast body of the attachment and is held in place by a snap ring. The spindle is lockable for machining and the front of the spindle is drilled and tapped for direct attachment of Unimat clutches with their mounting plates removed. A 48 notched spindle and plate was fitted as standard, giving a useful range of divisions, but alternative notched plates and spindles were available.

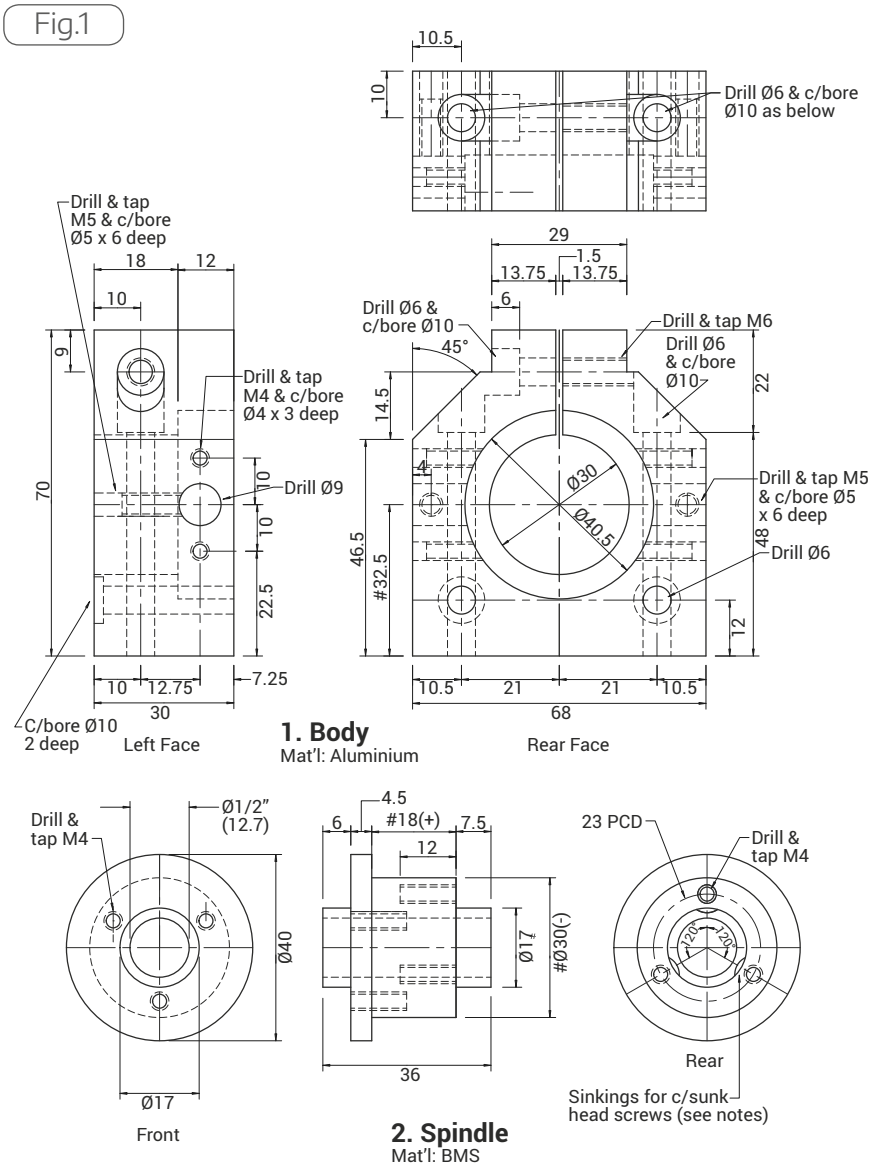
After consideration I felt a homemade version of this index head would adequately suit my needs, but not possessing a suitable cutter for milling the v-grooves, and to simplify construction, why not replace v-grooving with holes drilled around the periphery of a detachable index plate? Admittedly a tapered detent engaging v-grooves (or gear teeth) is a little more forgiving than a circular indent smoothly engaging a drilled hole with minimal perceptible play. The only way of ensuring smooth engagement of the detent was, of course, to drill the holes in the blank index plate at exactly the same horizontal and vertical axis of the detent, and I decided that this drilling would be carried out on the Unimat with its headstock at raised level. The following prototype design notes and drawings are for a simple, 'basic' head, using drilled plates for indexing, but with attachments added, in 'extended' form, to enable the head to drill its own index plates.

Head and components including an undrilled index plate

Construction of Basic Head

The components of the 'basic' head are detailed in **figs 1** and **2**, shown assembled in **fig. 4** and in **photos 4** and **5**. In this form the head can be mounted vertically as shown, with head and lathe spindles at the

Fig.1



Index Head Body And Spindle

4

Front and detent side of the tool

5

Rear view of the indexing head

same height, or horizontally with the head spindle perpendicular to the lathe spindle.

Whilst not complicated to fabricate the body is quite 'busy' with plain and tapped holes, in addition to being bored. To help in interpreting the drawing front and right faces of the completed block are shown in **photo 2** and rear and left included with **photo 3**. The orientation of these views is also indicated in **fig.4**, with the front facing the spindle and left the operator, and the details of most main components have been drawn to the same orientation. The prototype was fabricated in the following sequence.

Body (fig. 1)

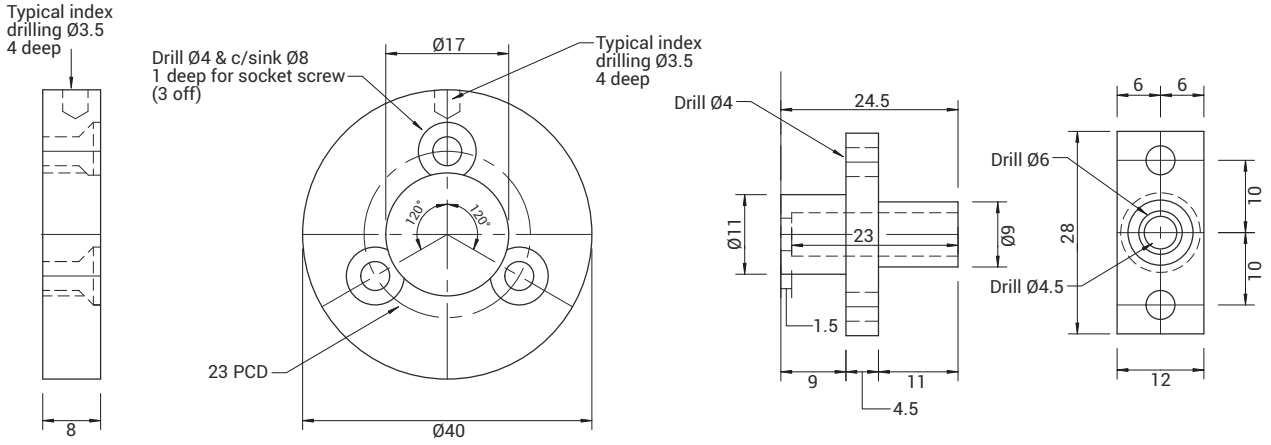
A block of aluminium was first square turned to overall size. The 6mm diameter plain vertical holes were drilled full depth, from above, and counter-bored 22mm deep. The plain horizontal 6mm diameter holes, crossing the vertical, were drilled and counter-bored from the front, the two sets of holes enabling the block to be clamped to the Unimat cross-slide vertically and horizontally. The vertical drillings are close to the centre boring and accurate setting out will be repaid. A prototype witness mark to be seen in photo 3 is proof of this!

Next to be considered was the stepped boring for the spindle and the 9mm diameter front and rear holes for locating the detent. Accurate location of these is essential if the head is to perform as intended. Centre of both holes and boring need to be at the same vertical height above the cross-slide and the centre of both holes to be the same horizontal 7.25mm distance from the rear of the block. To achieve this, setting out and initial drilling was carried out on the Unimat.

With the block clamped vertically to the Unimat cross slide, using cap bolts and t-nuts, with the front face perpendicular to and facing the lathe spindle and the left facing the operator, cross-slide travel was sufficient to locate the centre point of the boring from the right face which was centred, establishing the #32.5mm dimension shown in fig.1, and drilled 6.5mm diameter This being the largest the drill chuck will hold. The block was next rotated 90 degrees anti-clockwise and clamped with front face facing the operator and right face perpendicular to the spindle. The centre point of the 9mm diameter hole was then located from the rear and centred and drilled 6.5mm diameter for the full width of the body to establish the position of the opposite 9mm diameter hole. It is not possible with the limited travel of the Unimat's single slotted cross-slide to rotate the block 180 degrees to separately locate this second hole, but centralising both holes by through drilling proved satisfactory for the prototype.

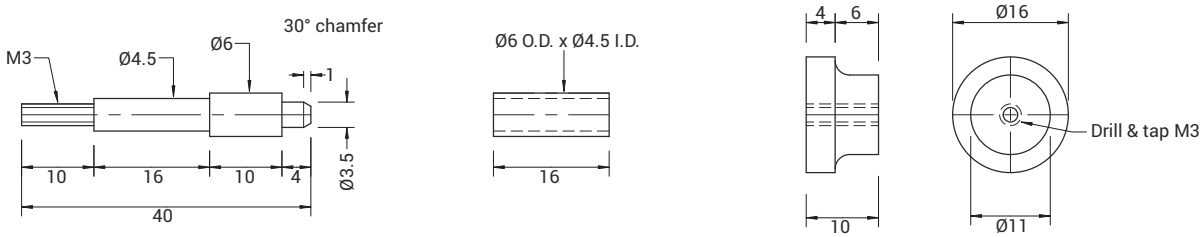
The block was then transferred to the Myford, centralised in the 4 jaw chuck around the central pre-drilled hole, and then drilled, bored and counter-bored to the

Fig.2



3. Index Plates
Mat'l: BMS, 3 off

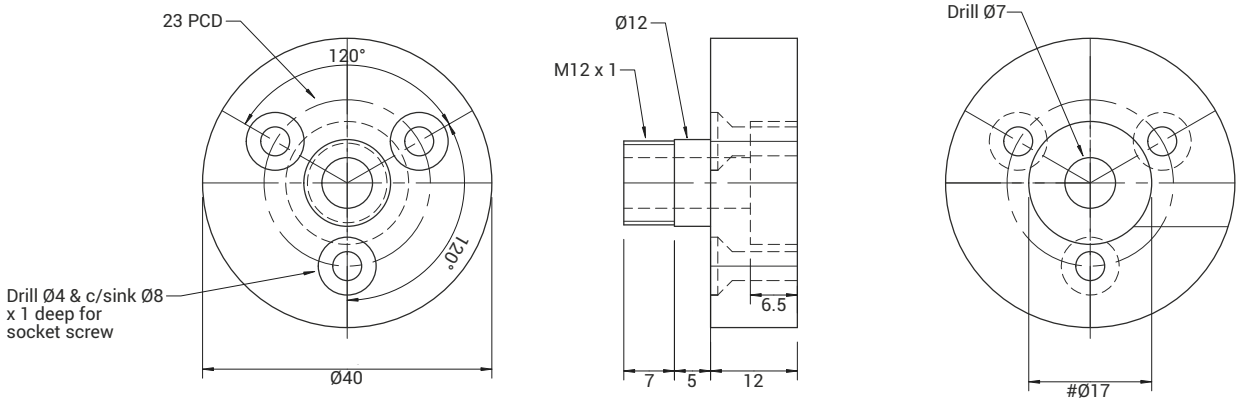
4. Detent Body
Mat'l: BMS



5. Detent Spindle
Mat'l: BMS

6. Detent Spring
Mat'l: Compression spring

7. Detent Knob
Mat'l: Brass



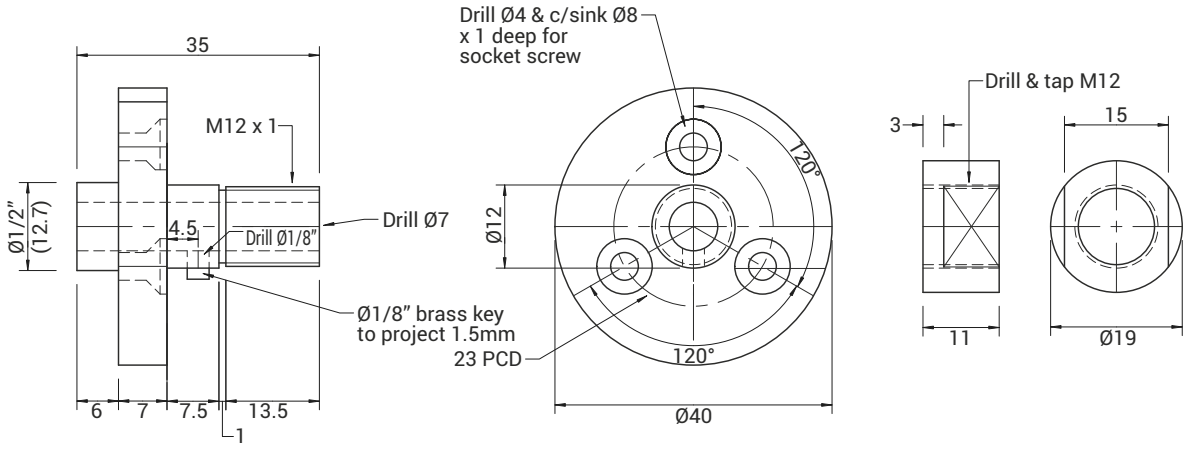
8. Chuck Backplate
Mat'l: BMS

Index Plates, Index Plate Detent And Chuck Backplate

dimensions shown. Moving to the drill press the 9mm diameter opposing holes were then opened out, the front to rear holes connecting with both drilled and tapped M5 and the 5mm diameter horizontal pilot hole for the M6 clamping bolt, positioned at the top of the finished body, was through drilled.

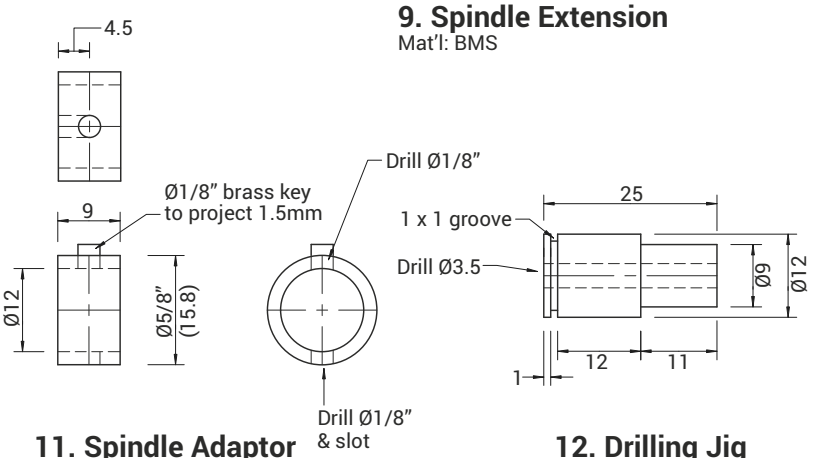
At this stage the tapered, stepped shoulders of the block were formed by sawing, milling, using the Myford vertical slide, and finished by filing. The angle and dimensions shown are not critical but sufficient to enable the cap heads of the vertical and horizontal clamping bolts to clear each other. The top of the block was then slit sawed as shown. The top pilot hole to the left face was opened to 6mm diameter and counter-bored as shown and pilot hole to the right face tapped M6. The positions of the M4 tappings, above and below both 9mm diameter holes, were determined later, by the detent body, when this had been fabricated.

Fig.3



9. Spindle Extension
Mat'l: BMS

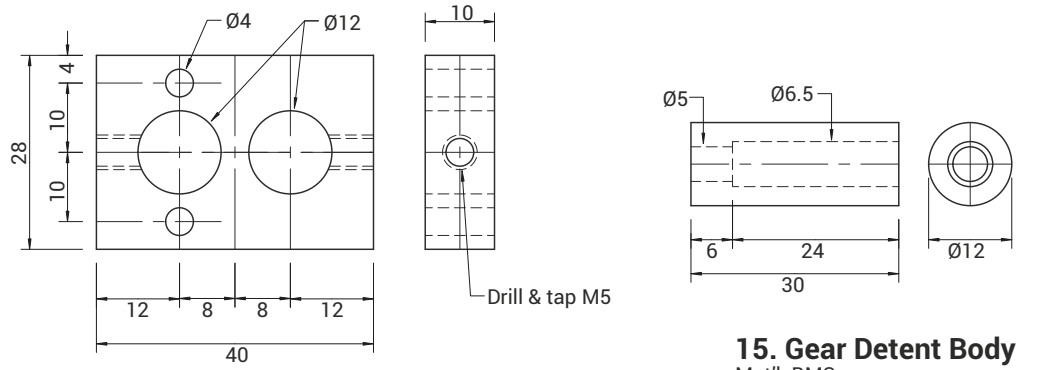
10. Locking Nut
Mat'l: BMS



11. Spindle Adaptor
Mat'l: BMS

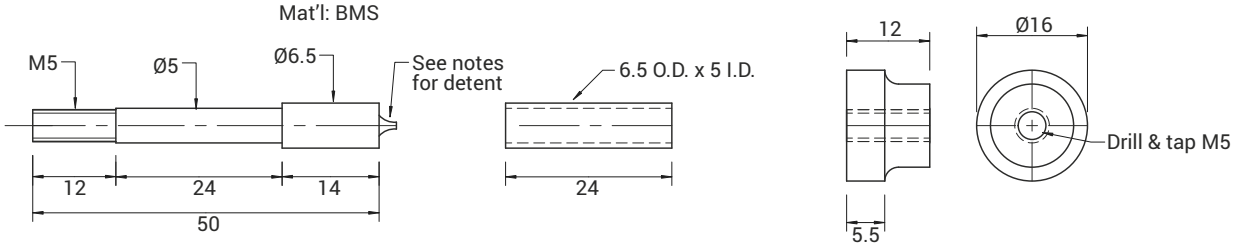
12. Drilling Jig
Mat'l: BMS

13. Gear Spacer
Mat'l: BMS



14. Gear Detent Holder
Mat'l: BMS

15. Gear Detent Body
Mat'l: BMS



16. Gear Detent Spindle
Mat'l: BMS

17. Gear Detent Spring
Mat'l: Compression spring

18. Gear Detent Knob
Mat'l: Brass

Index Head Attachments

Various accessories

Spindle (fig. 1)

Fabrication of this component is relatively straight forward turning, drilling and tapping. The only critical dimensions were the 30(-)mm diameter centre of the spindle which is fractionally smaller than the corresponding boring in the body, sufficient only for the spindle to rotate freely but lockable within the body without undue tightening of the clamping bolt, and the 18(+)mm length of this central diameter is fractionally longer than the length of the boring in the body, ensuring that the spindle will still rotate freely, with barely perceptible axial play, when an index plate is bolted to the spindle. The M4 drilled and countersunk tappings were located by a primitive single gear indexer earlier made for the Myford. An index plate was used as a jig to machine the partial sinkings indicated at the end of the rear spigot.

Index Plates (fig. 2)

An index plate, turned and drilled as fig. 2 but not yet countersunk, was located on the spigot, bolted to the spindle with a temporary cap screw and both index plate and spigot at each vacant hole countersunk together. With the cap screw moved to one of the latter the remaining hole could then be countersunk.

Only three index plates were originally made. If opting for individual plates for specific divisions, as previously mentioned, it is sensible to produce several plates at the same time. The detent is conventional in design apart from the end of the detent spindle which is circular and chamfered to assist in engaging the drilled holes in the index plates. The 4mm diameter holes of the detent body were used to spot drill the positions of the M4 tappings above and below the 9mm diameter drilled holes in the index head body and enabled that component to be completed.

With mounting plates removed Unimat clutches can be bolted direct to the front of the index head spindle with no risk of chucks 'unscrewing' and the index head having a 12.7mm through diameter. If 'unscrewing' is not thought to be a problem with some machining operations, the chuck backplate, shown in fig.2, can be bolted to the spindle for screwing chucks direct. The M12 thread and shoulder are Unimat standard and the 17mm diameter bored recess to the rear is a close running fit to the spindle spigot. The 'through' diameter of the head, however, is restricted by the 7mm diameter central drilling. The separate, completed components of the 'basic' indexing head are shown in photo 3.

Construction of Attachments (fig. 3)

All of the index head attachments are detailed in fig.3 and shown separately when completed in **photo 6**. Again, none of these components were difficult to fabricate but the following points are worth noting.

The spigot at the front of the spindle extension is a close running fit to the 12.7mm diameter bore of the index head spindle. The 12mm diameter shoulder to the rear is a close running fit to the bore of my Unimat change gears. The 7mm diameter central through drilling was not essential and only included with no obvious reason not to! Similar to the chuck backplate, it will restrict the through diameter of the index head in the unlikely event of indexing direct by gear in 'extended' mode.

● To be continued

In our Next Issue

Coming up in issue 271
On Sale 10th August 2018

Content may be subject to change

The September issue, number 271, of Model Engineers' Workshop brings you some more fascinating articles:

Morgans Kilde gives a step by step description of making his neat wire straightener.

Christopher Robinson describes a screwcutting dial for lathes that lack this accessory.

Barry Chamberlain fits a variable frequency drive to his lathe.

MODEL ENGINEERS' WORKSHOP

SUBSCRIPTION ORDER FORM

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY)

Yes, I would like to subscribe to *Model Engineers' Workshop*

☐ Print + Digital: £13.50 every 3 months

☐ Print Subscription: £11.25 every 3 months

YOUR DETAILS MUST BE COMPLETED

Mr/Mrs/Miss/Ms.....Initial .....Surname .....

Address .....

.....

Postcode ..... Country .....

Tel ..... Mobile.....

Email ..... D.O.B .....

I WOULD LIKE TO SEND A GIFT TO:

Mr/Mrs/Miss/Ms.....Initial .....Surname .....

Address .....

.....

Postcode ..... Country .....

INSTRUCTIONS TO YOUR BANK/BUILDING SOCIETY

Originator's reference 422562

DIRECT Debit

Name of bank.....

Address of bank .....

.....

.....Postcode .....

Account holder .....

Signature..... Date .....

Sort code ☐☐☐☐☐☐ Account number ☐☐☐☐☐☐☐☐

Instructions to your bank or building society: Please pay MyTimeMedia Ltd. Direct Debits from the account detailed in this instruction subject to the safeguards assured by the Direct Debit Guarantee. I understand that this instruction may remain with MyTimeMedia Ltd and if so, details will be passed electronically to my bank/building society.

Reference Number (official use only) ☐☐☐☐☐☐☐☐☐☐

Please note that banks and building societies may not accept Direct Debit instructions from some types of account.

CARD PAYMENTS & OVERSEAS

Yes, I would like to subscribe to *Model Engineers' Workshop, for 1 year* (13 issues) with a one-off payment

UK ONLY:

☐ Print + Digital: £56.99

☐ Print: £47.99

EUROPE & ROW:

☐ EU Print + Digital: £64.95

☐ EU Print: £55.95

☐ ROW Print + Digital: £64.95

☐ ROW Print: £55.95

PAYMENT DETAILS

☐ Postal Order/Cheque ☐ Visa/MasterCard ☐ Maestro

Please make cheques payable to MyTimeMedia Ltd and write code MEW0818P on the back

Cardholder's name.....

Card no: (Maestro)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐

Valid from..... Expiry date..... Maestro issue no.....

Signature..... Date.....

TERMS & CONDITIONS: Offer ends 9th August 2018. MyTimeMedia collects your data so that we can fulfil your subscription. We may also, from time to time, send you details of MyTimeMedia offers, events and competitions but you always have a choice and can opt out by emailing us at unsubscribe@modelengineersworkshop.co.uk Please select here if you are happy to receive such offers by email ❑ by post ❑ by phone ❑. We do not share or sell your data with/to third parties. Details you share with us will be managed as outlined in our Private Policy here http://www.mytimemedia.co.uk/privacy-policy. Please visit www.mytimemedia.co.uk/terms for full terms and conditions

POST THIS FORM TO: MODEL ENGINEERS' WORKSHOP SUBSCRIPTIONS, MYTIMEMEDIA LTD, 3 QUEENSBRIDGE, THE LAKES, NORTHAMPTON NN4 7BF

Please visit **www.mytimemedia.co.uk/terms** for full terms & conditions

CODE MEW0818P

PRINT + DIGITAL SUBSCRIPTION

- 13 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- ***Download*** each new issue to your device
- A ***75% discount*** on your Digital Subscription
- Access your subscription on ***multiple devices***
- Access to the ***Online Archive*** dating back to Summer 1990

PRINT SUBSCRIPTION

- ***13*** Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- Save up ***to 23% off the shop price***

SUBSCRIBE TODAY

Repairing a Lathe Motor

Paul Murray breathes life back into a recalcitrant lathe.

The motor on my Warco BH600 lathe decided not to start but to sit there twitching slightly and making a humming noise. The safety switches were all in the 'go' position, the power light was on and the start relay audibly activated on command from the power selection lever. This indicated that the motor centrifugal switch was the most likely cause of the problem.

Safety

It should go without saying that if you have any doubts about working on mains-powered equipment you should seek the assistance of someone competent to do so. The machine must be isolated from the mains supply before commencing any work on the electrical system or any mechanical disassembly. It is essential that both line and neutral are isolated: if it is plugged in with a 13A plug then withdraw the plug, if it is wired in via an isolator the turn off the isolator. If the machine is in a shared workspace then provide mechanical protection by, for example, putting the 13A plug into a plastic bag with a label or locking the isolator in the off position, **photo 1**.

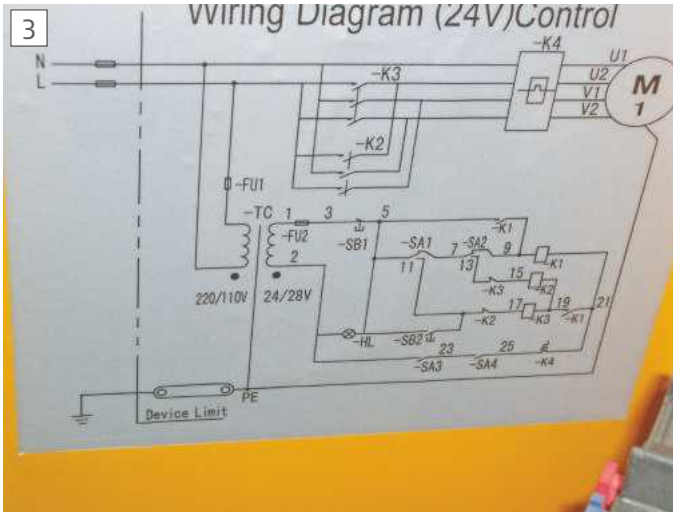
Capacitor Start Induction Motors

Single phase AC induction motors have a starter winding formed by a capacitor in series with an auxiliary winding to provide phase shift and a high starting torque. This auxiliary winding is switched out of circuit as the motor approaches its rated speed by the use of a centrifugal switch. The centrifugal switch consists of weights attached to and held close to the rotor by fairly strong spring. Levers attached to the weights rest against a non-conductive plate which can slide along the rotor shaft and, when at rest, hold contacts together against a small spring force. As the motor speeds up the weights overcome the main strong spring force, moving the non-conductive plate away from the contacts and allowing the small spring to open the contacts, thus breaking the circuit. If any part of this mechanism fails, such that the contacts do not make good contact when the rotor is stationary, then the motor will not start.

The direction of rotation of the motor is determined by the phase shift in the auxiliary windings compared to the main

Isolator locked in the Off positioned

Motor connections



Circuit diagram

Motor information plate

windings. What this means is that the direction of rotation can be reversed by changing the connections of line and neutral to either the main winding or the auxiliary winding. The direction of rotation has no effect on the centrifugal switch operation.

Wiring

It is essential to record the motor wiring connections prior to removal. The motor is, of course, positioned behind the headstock under the countershaft box and is further protected by a splash shield running the full length of the lathe. As is usual in a small home workshop the lathe is sited quite close to the workshop wall and is far too heavy to move to gain access to the rear. Removal of the splash back revealed the motor and motor connection box. After removing the connection box cover a small camera was used to record the connections to the motor, **photo 2**. These connections should also be compared with the circuit diagram, if available, **photo 3**. In this case the bottom half of the diagram shows the safety interlocks. The top half shows the mains connections to the motor M1. Relay K4 is the 'No Volt' relay and just passes the connections through when energised. The neutral, N, is permanently connected to U1. Operation of relay K3 connects the neutral, N, to V1, and the line, L, to U2 and V2. Operation of relay K2 connects the neutral, N, to V2 and the line, L, to U2 and V1. Operation of relays 3 and 2 are mutually exclusive.

The motor

Or, in tabular form:

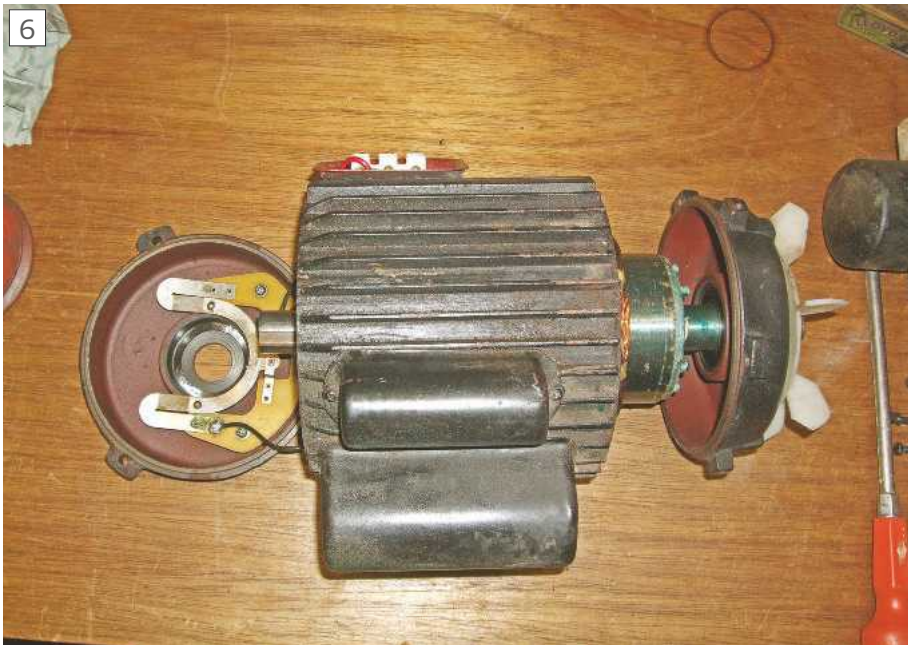
Relay	L	N
K3	U2 & V2	U1 & V1
K2	U2 & V1	U1 & V2

This satisfies the conditions for direction reversal. This information is necessary for testing after repair and will be referred to later.

The motor information plate contains similar information, but the terminology is slightly different, **photo 4**.

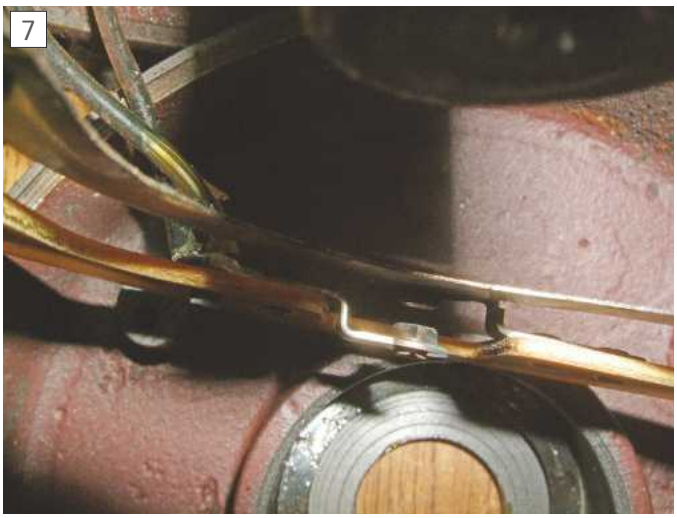
The Motor

The motor, as extracted from the machine, is shown in **photo 5**. All that can be said about the centrifugal switch at this stage is that it will be at one end. The fan cover was removed to show a totally enclosed motor. The pulley was removed, and the motor ends carefully removed, **photo 6**, In this case the switch contacts were attached to the inside of the motor cover at the pulley end and the rotor had to be partially extracted through the fan end to allow access to the screws retaining the contact plate in the end casing. The contacts are underneath the contact plate and can be accessed by removing the contact plate from the



The motor dismantled to show the centrifugal switch

> It is essential to record the motor wiring connections prior to removal...



Contacts showing soot on the contact board

Contacts showing the normally open state

The centrifugal switch can be tested by pressing on the non-conducting plate to override the strong spring.

casing. **Photograph 7** shows some of the soot where the contacts have been arcing. The contacts were dressed using a diamond needle file and are shown in their normally open state, i.e. when the motor is running at its design speed, **photo 8**. The contacts can be pressed together by hand and tested for continuity using a test meter.

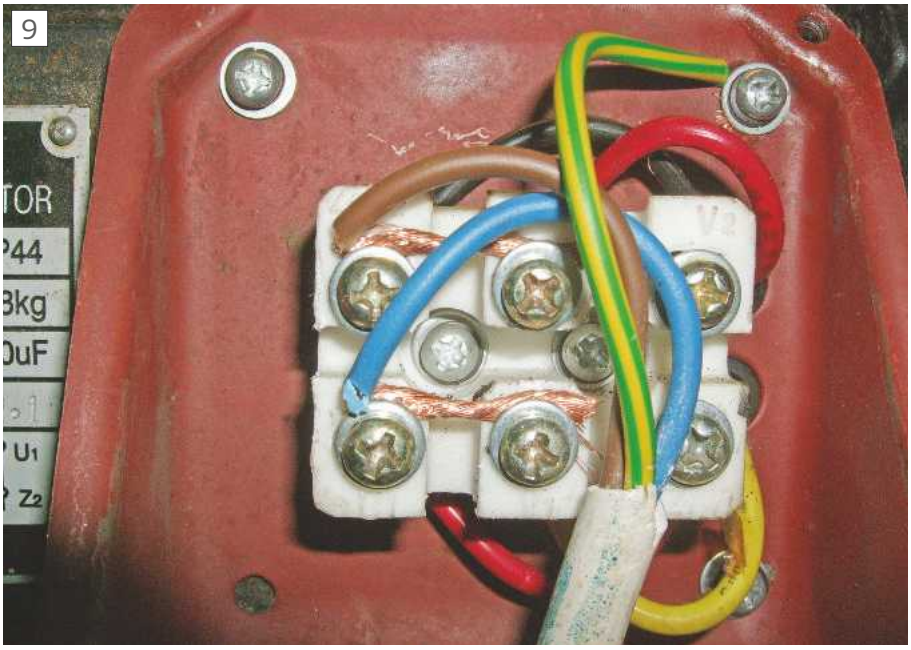
The centrifugal switch can be tested for freedom to operate by pressing on the non-conducting plate to override the strong spring.

It is then just a matter of carefully re-assembling the motor.

Testing

The motor should be tested for operation before re-mounting on the lathe. If the motor is reversible connect the wires to pairs of terminals either horizontally, **photo 9**, or vertically as shown on the motor information plate, photo 4, and replace the terminal cover plate to make sure all live contacts are inaccessible. Place the motor on the floor, **photo 10**, so it cannot 'walk' off the bench top, plug in and turn on the socket switch. The motor should run and the operation of the centrifugal switch should be indicated by a click.

The motor is now ready to re-install, taking care to replicate the original wiring so as to maintain the correct direction of rotation according to the selector switch. ■



Test wiring

On the floor ready for testing

PRO MACHINE TOOLS LIMITED

Tel: 01780 740956
Int: +44 1780 740956

emco · WABECO 1895 1895 · CERIANI · TECO · GOLmatic Maschinenbau · EMCO Hobbymaschinen · PROXXON · swiss tec Since 1865

Precision European made machine tools for the discerning engineer!

Wabeco CNC Mill CC-F1410

- Table – 500 x 200mm
- Z axis – 280mm
- Speed – 140-3000 rpm
- Power – 1.4 KW

2 year warranty

Wabeco Lathe D6000

- Centres – 600mm
- Centre Height – 135mm
- Speed – 30-2300 rpm
- Power – 1.4 KW

5 year warranty

TECO Mill VF400

- Table – 450 x 160mm
- Z axis – 320mm
- Speed – 365-1800 rpm
- Power – 250 W

Ceriani Lathe David 203

- Centres – 500mm
- Centre Height – 200mm
- Speed – 100-1800 rpm
- Power – 0.75 HP

Wabeco Mill F1210

- Table – 500 x 150mm
- Z axis – 280mm
- Speed – 140-3000 rpm
- Power – 1.4 KW

5 year warranty

Ceriani Mill David 403

- Table – 420 x 160mm
- Z axis – 300mm
- Speed – 100-3000 rpm
- Power – 1.5 KW

ACCESSORIES

Lathe Chucks, Drill Chucks, Tipped Tools, Boring Bars, QCTP, HSS Tools, End Mills, Slot Drills, Machine Vices, Clamping Sets, Slitting Saws, Arbors, Boring Heads, Radius Mills, DROs, Rotary Table, CNC fits, Collet Chucks, Collet Sets, Flanges, Face Mills, Shell Mills and Much More...

Wabeco CNC Lathe CC-D6000

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30-2300 rpm
- NCCAD
- Power – 1.4 KW

2 year warranty

TECO Lathe MD 200

- Centres – 300mm
- Centre Height – 52mm
- Speed – 250-2000 rpm
- Power – 250 W

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • int: +44 1780 740956
email: sales@emcomachinetools.co.uk

Two Useful Workshop Phone Applications

Chris Gill describes two phone apps he has created to help in the home workshop.

The apps are designed to run on the main phone operating systems (Android, Windows and Apple) or in a standard desktop browser. The apps are Geometry, which handles several calculations in plane geometry and MetalBender, which makes calculations for using a bending brake.

As explained below, these apps are not available through app stores but source code and debug versions of the Android and Windows Phone installers are available from **www.model-engineer.co.uk/apps**. This note also explains how to build the apps or derivatives that might be based on the code.

I am making the code available under the MIT license **choosealicense.com/licenses/mit/**. In brief, the code can be copied, modified or reused as long as the license and copyright are preserved. There is no implied warranty but if problems are found, please report them through the forum.

User Interface

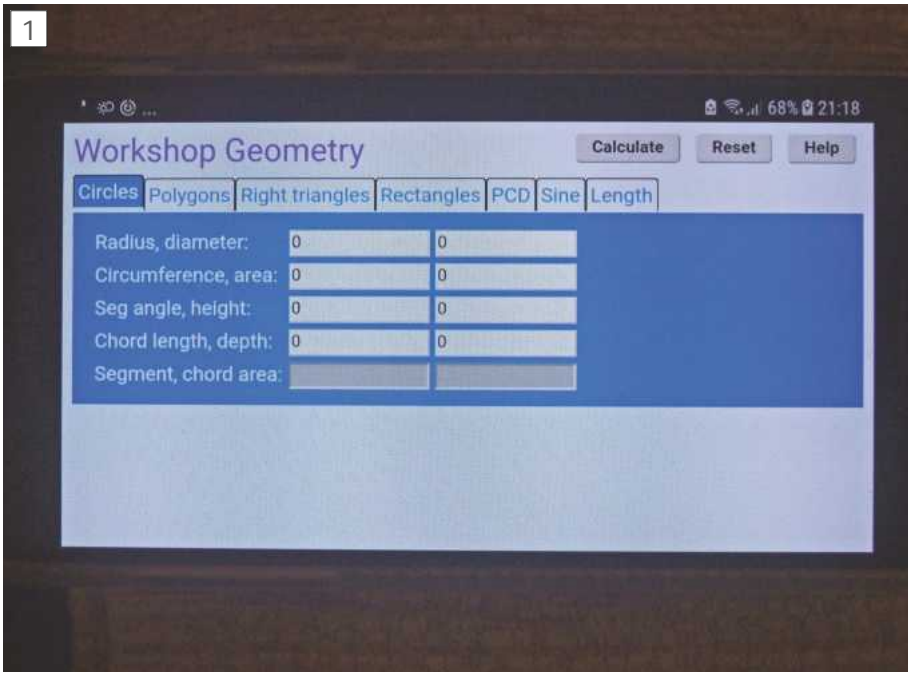
When opened, each app presents itself as a simple form with buttons to perform the main operations – Calculate, Reset and Help. The apps have been designed to run best in landscape mode and in most cases, do not require any scrolling (other than on the help pages). To achieve this, the buttons are at the top.

Fields with a grey background are not user editable and only fields with a non-zero value are treated as inputs. Fields containing zero are calculated if appropriate. For example, if the radius of a circle is entered but the diameter is left as zero, it will be calculated and vice versa.

Pressing Reset clears the visible fields on the current tab, but other tabs are unaffected.

Both apps are self-documenting – pressing the Help button displays a page describing the usage of the app. As far as possible, accessibility guidelines have been followed although this may not be evident on a phone or tablet.

> When opened, each app presents itself as a simple form with buttons to perform the main operations...



Geometry app screenshot

Geometry App

The Geometry app performs a collection of geometrical calculations often encountered in a workshop. The calculations and their required fields are described in the help text and are summarised below. Each type of calculation has its own tab:

- Circles – basic properties as well as chords and segments. For example, finding the depth of cut when machining a flat of a particular width on a round bar
- Regular Polygons with at least 3 sides. This relates side length, inscribed and superscribed circles, internal angles, overall height and area. Circular, square and hexagonal stock materials are often encountered and their relationships are important
- Right-angled Triangles relates side lengths, angles and area
- Rectangles relates side lengths, diagonals and area
- PCD calculates the angles, distance across centres and distance across holes for a Pitch Circle Diameter situation. It can also calculate the list of coordinates based on the centre or one corner
- Sine Bar is a simple version of the right-triangle tab and relates the bar length, the height above the datum and the elevation angle
- mm-inch conversion includes fractional inches

The circles tab is shown in **photo 1**.

By default, all results are calculated to 3 decimals. This can only be changed by altering the code – look for the line "var dps = 3;" in geometry.js (see notes on source code below).

MetalBender App

The Metal Bending app calculates the position of the clamp plate and hinge for using a bending brake that might be found in the home workshop. This is not suitable for industrial bending machines.

The calculation requires a "K factor" that depends on the metal being used. However, this factor isn't well defined and, in industry, can vary from one workshop to another. The app uses a table of commonly used defaults, but these can be updated by the

user. The help page explains the calculation in more detail.

The main screen is shown in **photo 2**.

By default, all results are calculated to 1 decimal place. This can be changed through the user interface (on the settings page).

The app stores the number of decimals and the table of K values in local storage and should not need any special permissions. Data is stored in JSON format.

Supported Platforms

As described below, I have built debug versions of Android and Windows apps but I have only tested the Android version. For anyone with a suitable developer accounts or build environment it should be possible to build full release versions and the iPhone version as well.

Since the code doesn't rely on any phone-specific features, it should also run without modification on all modern browsers. I have tested it on Firefox, Chrome and Internet Explorer although you may have to allow scripts to run.

The Source Code

The apps are written using HTML, CSS and JavaScript. They use JQuery but not JQueryMobile, which placed too many restrictions on the UI design. They do not rely on any platform-specific libraries.

Each app has a similar structure, consisting of the following files:

- License – describes the MIT license under which this code is made available
- Readme.md – a very brief description of the app
- Config.xml – required by PhoneGap Build, which is described below
- Icon.png – the image that appears in app lists and on the home screen
- Index.html – all of the app user interface is defined in this file
- \res folder – contains a 96 x 96 icon and any other images needed in the help text
- \js folder – JavaScript files:
  - Bending.js or Geometry.js – the code required to perform calculations, manage the screen, etc.
  - Jquery-3.2.1-min.js – a minified copy of the JQuery library. This has to be included explicitly rather than use an online reference because the phone can't be guaranteed to have network access
- css folder – contains appstyle.css, which defines the styles for various elements.

The source code can be maintained in any development environment and several of them allow apps to be built for specific phone operating systems. Examples include Visual Studio with Xamarin, Eclipse or Mono. However, it can also be edited in a simple text editor such as Notepad++, which provides a degree of syntax checking.

Building the Apps

A disadvantage of using a locally installed development environment is that the target platform SDKs must also be loaded, and these can be onerous, particularly if multiple targets are to be supported.

An alternative is to use an online build environment and the attached apps were built with PhoneGap Build (**build.phonegap.com**). This builds apps for Android, Windows Phone and Apple iPhone without needing to install anything on the host system. An Adobe logon is required but there is no fee for non-commercial users.

PhoneGap Build allows the user to build one project if uploading a zip file or several projects if they are linked to open-source GitHub repositories. The zip files associated with this article are in the correct format for uploading to PhoneGap Build. PhoneGap rebuilds the app whenever the source code is uploaded and, once built, the installable files can be downloaded.

If you have a developer account on an app store you can up-load the associated developer key. Without this key, you will only be able to build debug versions of Android and Windows Phone apps although this should not affect their operation and would allow remote debugging if developer mode is enabled on the phone (on Android, at least).

Installing the Android Apps

Apps that aren't available from an app store have to be installed in a different way. On Android, there are two options for "side loading" an app:

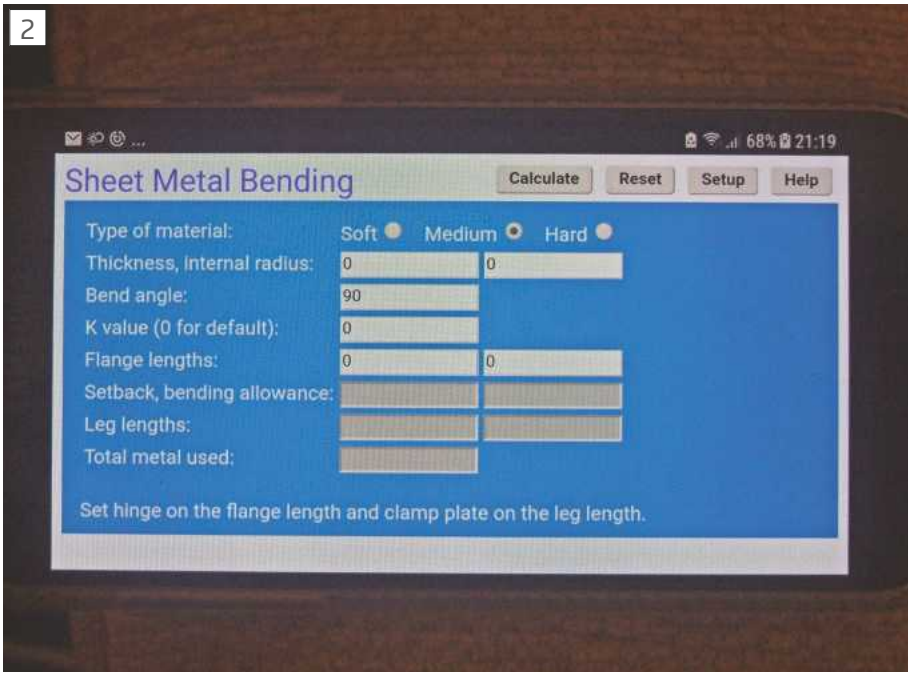
- Send an email to yourself with the apk file as an attachment. Open the email on the phone and load the attachment, then select the install option.
- Connect the phone to a PC and copy the apk file to the Download folder on either the internal storage or the SD card. On the phone, navigate to the folder (eg: Settings > Storage > Internal storage > Explore > Download) and tap on the file. Note that this may vary between Android versions and between manufacturers.

You will probably need to enable "Unknown sources" in the security settings. Both apps have home page icons.

For anyone with suitable developer accounts or build environment it should be possible to build full release versions and the iPhone version as well.

Editor's Footnote:

I have only been able to test the Android versions of the apps on my phone. They were very easy to install by emailing them to my gmail account. The only issue I found was that to see the tabs in the Geometry App the phone must be in 'landscape' mode. Thanks to Chris for these useful workshop apps. ■



Metal Bender app screenshot

My Unique Discovery of The Ajax Benchtop Horizontal Milling machine

Geoff Adams tracked down this delightful small horizontal mill

I was in search of a horizontal bench top milling machine, so therefore I set out on buy and sell websites such as eBay and Gumtree. I had the misfortune of missing out on an eBay auction for such a machine but my luck took a better turn when I had discovered the ajax benchtop horizontal mill via Gumtree, **photo 1**. It was just around the corner from my home, and as a bonus, came with an abundance of raw material and odd tools and cutters.

The machine came with an elaborate pulley system which upon further inspection was not original. I then proceeded to remove the pulleys and attach the motor back into its original position. The pulleys seem to be in good working order, though I may have to change one of the pulleys if the speed proves to be too fast. The mill has a homemade powerfeed, and as you can see in **photo 2**, the wiring was executed in a somewhat unique fashion. I will rewire this with a new on/off switch and all connections safely tucked away in a new plastic casing.

I intend to make a new mild steel arbour bearing for the yolk. Having checked the brass bearing in the yolk, it is not oval, but is slightly worn on the diameter.

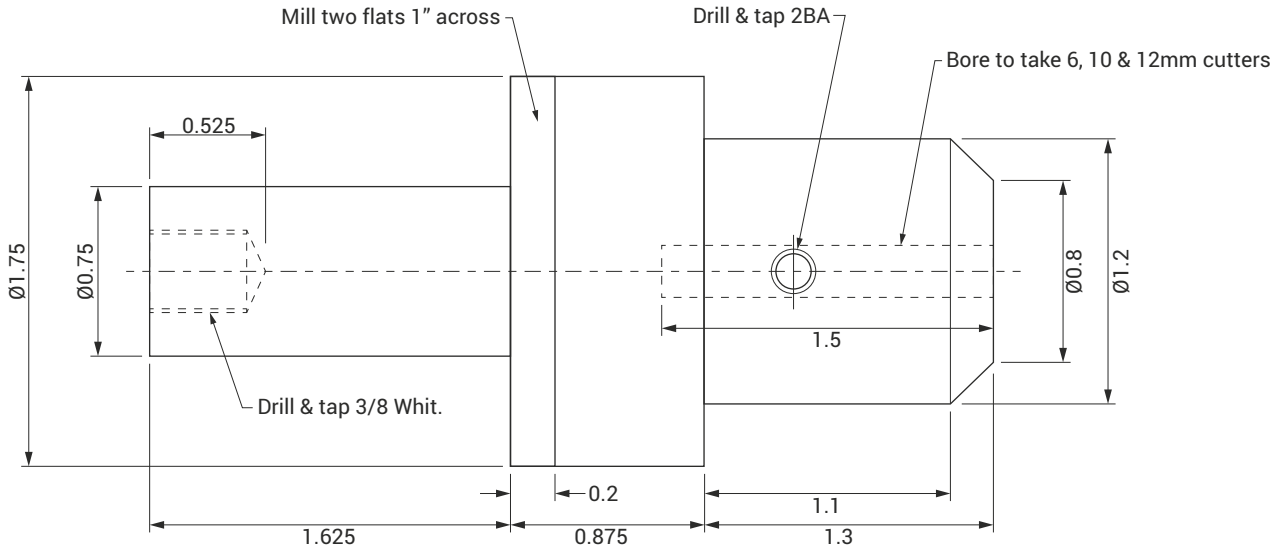
The machine came with the pictured milling attachment, see above. I don't know if this was an original optional attachment, however the rear pulley has 3 vee pulleys and 1 pulley to take a round belt, **photo 3**. Unfortunately, it came with only one collet (1/4"). Personally, I do not think it will be a problem for myself, as I already own a very capable vertical mill in my workshop so I doubt I will be using this very much, but a useful attachment anyway. I mainly bought this mill for slotting links etc as I have found myself slightly frustrated with setting up my vertical mill to complete such tasks.

The arbour does not have a standard taper for location, as you can see from the drawing, **fig. 1**, it locates on a 0.750" diameter shank and is driven by a dog, So a standard milling chuck i.e. Clarkson, R8 etc will not fit this mill. I am going to make my own to hold 6, 10 and 12 mm diameter cutters.

The Ajax horizontal and vertical milling machine is small but made of robust castings.

Headroom in horizontal mode is not huge. The wiring for the homemade power feed looks a bit suspect.

Testing belt length for the simple but effective vertical attachment. Custom collets are needed.



End Mill Chuck For 6, 10 And 12mm Cutters
3 off req'd

I am looking forward to using this mill once I have carried out all the desired modifications. In short, I am happy to have obtained such a machine, and would recommend it to any engineer, as it takes away the hassle having to set up the usual vertical mill to complete tasks that the horizontal mill can do with ease.

Coincidently, as I was in the process of writing this article, the inch and 3/4 mild steel bar for the bearing and chucks had arrived. More work to do tomorrow. ■

Production Runs on the Lathe

For those who find themselves facing a lot of repetitive machining tasks Alex du Pre describes his approach.

Model engineers are sometimes required to make a large number of identical or similar parts. This can be tedious and time-consuming, but with the right tooling and a little time spent on setting up, the lathe can quickly be adapted for the purpose. This article looks specifically at the accessories and techniques required for production runs on the lathe, although a similar approach can be used for the milling machine.

Discussion

In an industrial context, mass production can manufacture many thousands of identical components, justifying dedicated, automated machinery. In the home workshop, smaller numbers of parts, typically ten or a hundred items, such as screws or nuts or other fittings, **photos 1** & **2**, may be needed. Although it is often possible to purchase these items, they can be expensive or not to the exact specification required. Many model engineers may choose to make these parts themselves, even if they are commercially available, so that a model may be genuinely all their own work.

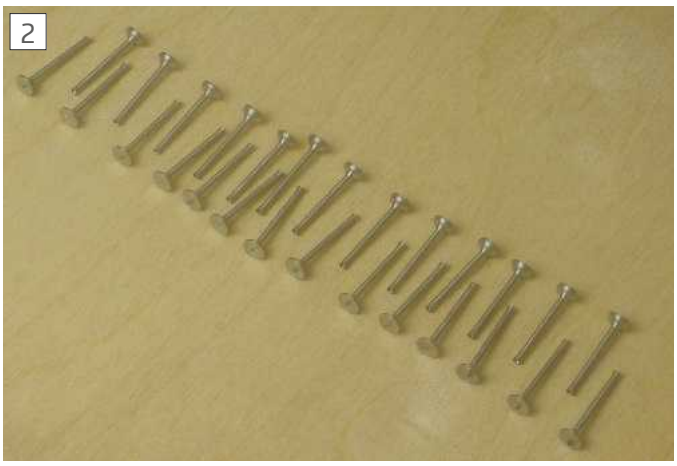
In the home workshop, this sort of work is more correctly called repetition work. The term 'production run' is perhaps not strictly correct, but where the boundary between repetition and production lies is debatable and probably not worth worrying about for our purposes.

This article considers manual lathes. A CNC lathe or a repetition lathe would of course allow some operations to be automated, but only a very sophisticated machine would be able to cope with all of the processes that I will discuss.

A production run of bucket tappets for miniature IC engines.

Basic Concepts

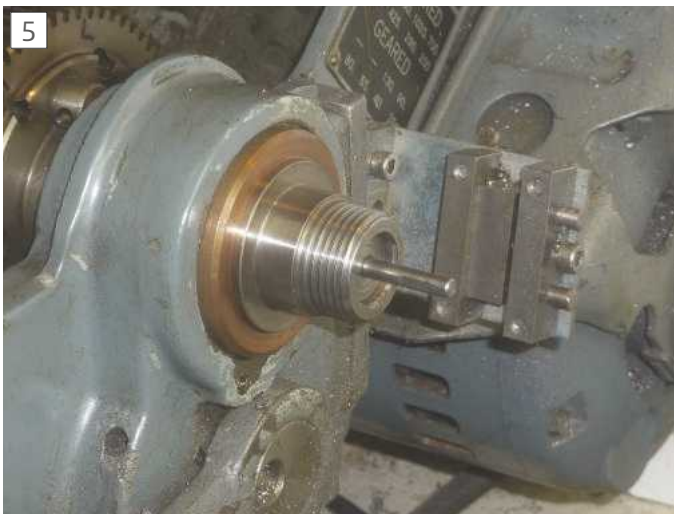
A one-off part requires a number of machining operations to be carried out in a particular sequence, checking the dimensions of the part as you go and probably using a number of machine set ups to complete the part. Normally, much more time is spent setting up the machine than in the machining itself. This repeated measuring, checking and tool changing is an extremely inefficient approach if several or many parts are required, although it may be unavoidable if specific lathe accessories are not available. For production work, a few basic concepts can be applied to make life easier.



Engine valves made using production techniques.

The parts of a mandrel backstop.

The mandrel backstop fitted to the outer end of the lathe spindle.



The inner end of the mandrel backstop with chuck removed.

Carriage multi stop fitted to the lathe.

Lathe cross-slide dial.

Set up once, use many times

Since setting the lathe up for a job is often time consuming, it makes sense to do it only once and to use the same set up for all similar operations until they are complete. Although the aim is to set the lathe up to produce the finished component in one set up, this is not always possible, in which case all components should be finished to a certain stage before setting up the machine tool again for the remaining operations. The main aim is to avoid changing the machine set up for each component.

Repeatability without the need to measure every time

The set up should avoid the need to spend time measuring and positioning the work and should place cutting tools and blank material in exactly the correct position for each component. Machine stops are used to position both workpiece and tools, whilst tools can also be positioned by reference to the lathe handle dials.

Rapid tool changes

Normally, several different cutting tools are required to machine the component and they must be able to be presented to the work in quick succession, minimising time wasted in tool changes. All tools required should be set up on the lathe, ready for use.

Tolerances

A good production set up should achieve the correct machined dimensions on the work, although variations can creep in due to tool cutting edges wearing and repeatability of tool positioning not being spot on each time. The dimensions of the work should be checked every so often to ensure that parts remain within tolerance. The key point here is that time spent checking the dimensions can be reduced if permissible dimensional tolerances are greater.

The tooling required to apply the above concepts are described in the next section.

Tooling and Accessories

In most cases, a selection of dedicated lathe accessories will be required for a successful production set up. This section describes the most useful accessories which should cover most requirements. Most of these can easily be made in the home workshop and make satisfying and worthwhile projects in the own right.

Mandrel backstop

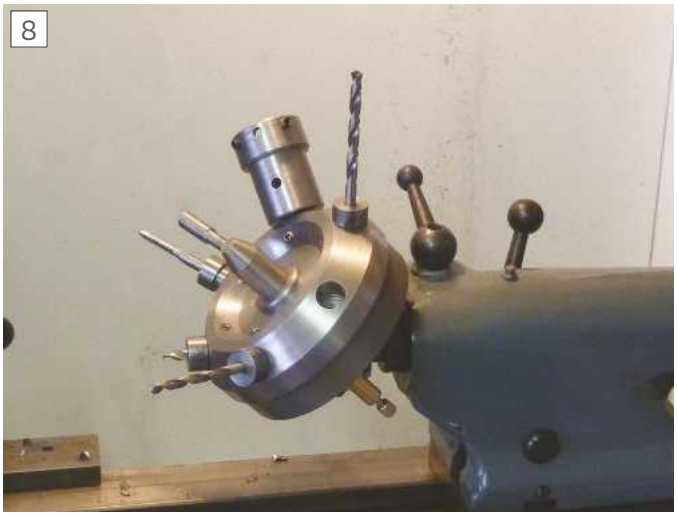
This device fits into the outer end of the lathe spindle bore and is used to ensure repeatable positioning of workpieces held in the lathe chuck or collet, **photos 3, 4** & **5**. It is normally used for shorter workpieces that have already been cut into blanks. A sliding rod running through the backstop's bore forms the stop against which each workpiece is positioned before tightening the chuck. The working end of the sliding rod can be fitted with interchangeable pads of varying diameter to suit the work in hand. For shorter workpieces, the sliding rod is supported by a tapered guide which fits into the spindle taper, but this is not needed for longer workpieces. The backstop and the sliding rod are locked in place with a collet mechanism.

As an aside, mine is home made and I adapted the design so that it doubles as a mandrel handle for manual rotation of the lathe spindle and can also mount a gear wheel for dividing operations using the lathe spindle – three for the price of one!

Carriage multi-stop

Various designs of carriage multi-stop are available, **photo 6**. Mine is home made and based on the design available in kit form from Hemingway Kits. This design fits to the front of the lathe bed to the right-

›



Tailstock turret fitted to the lathe.

A quick change tool post with a selection of tool holders.

A rear tool post with parting-off tool.

hand side of the carriage. It is fitted with a rotating turret which can be indexed into six positions, each position being fitted with an adjustable stop that bears against a fixed stop attached to the lathe bed. This device allows the carriage to be quickly moved to six repeatable positions without the need to measure the position each time.

The carriage multi-stop is particularly useful for facing cuts or when machining up to a shoulder. In fact, it is also useful for one-off jobs of this nature and mine remains permanently fitted to the lathe.

Cross-slide stop

Somewhat less common and not essential, some lathes are fitted with a single cross-slide stop which performs a similar job to the carriage stop where precise diameters are not important. My lathe does not have a cross-slide stop.

Lathe handle dials

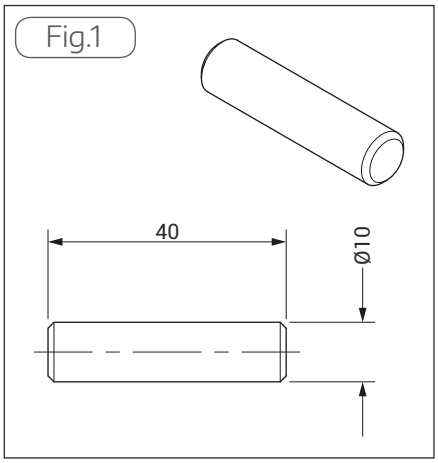
Not an accessory as such, rather an integral part of any lathe worth its salt, **photo 7**. The lathe handles are normally fitted with adjustable dials allowing the cutting tool to be positioned accurately. The dials are of course commonly used in lathe work more generally, but the cross-slide dial in particular is likely to be invaluable for production work, allowing the cross-slide to be positioned accurately and repeatably without recourse to measuring the workpiece when machining diameters.

Tailstock turret

This is the tailstock's equivalent to quick change tool post and it allows a succession of cutting tools, typically centre drills, drills and taps, to be presented to the work in quick succession. It effectively converts the lathe into a capstan lathe and is all but essential where repeated tailstock tool changing is necessary. Mine is home made, **photo 8**. A construction article for this device was recently featured in *Model Engineer's Workshop*.

Quick change tool post

The quick-change tool post, or QCTP, allows lathe cutting tools to be rapidly placed and replaced on the tool post in preset positions, **photo 9**. Each tool is held in a dedicated holder which is slid onto the rails of the tool post and locked in position. Different designs are available, some home-made. The QCTP is a great boon for lathe work in general but is really essential for production work where time lost to tool changes must be minimised. It is vastly superior to the single toolpost, which not only requires each tool to be shimmed to height but has no positional repeatability. It is also a better option than the generally-unsatisfactory four-way tool post, which in my opinion is little better than the single toolpost in that four tools are not nearly enough to cover the normal range of lathe operations and will require continuous changing and setting up.



The component to be produced in example 1.

Rear toolpost

The rear toolpost is often used for parting off and in a production run has the advantage of allowing an additional tool to be positioned ready for use, **photo 10**. When used with a tailstock turret, it may be found that clearance becomes a problem. Mine is home made from the Hemingway Kit.

Lever feed tailstock

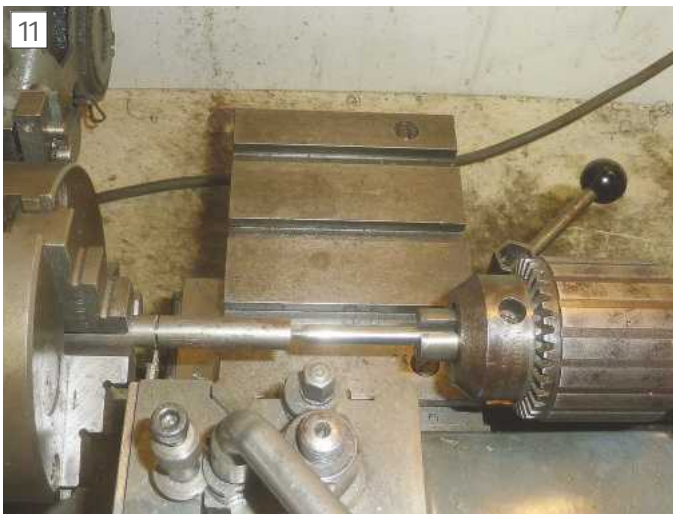
This allows tailstock tooling to be presented more quickly to the work, and with greater sensitivity, than is possible with the screw feed. It is very useful when the drill bit has to be frequently withdrawn from the work to clear swarf. Unfortunately, my lathe is not so equipped, but it is certainly on the list of future projects.

Tailstock depth stop

A tailstock depth stop is used to drill holes to a set depth. It is not essential, as when used with a tailstock turret it will only be usable with one of the tools. An alternative is to fit collars to the drills or cutters held in the turret as this will act as an individual depth stop for each tool.

Other accessories

There are other accessories or lathe equipment that will help to speed up a production run, although in most cases these are down to the lathe specification and are not easily achievable upgrades. A spindle clutch will avoid continually stopping and starting the motor and may help to bring the spindle to a stop more quickly. The ability to vary the spindle



Parting off the blanks slightly over length using a stop set in the tailstock.

Facing and chamfering one end of the blank, which has been positioned against the mandrel backstop.

speed quickly, either by electronic means or through a quick-acting gear box, can be a great help when the component's manufacture requires a range of spindle speeds, such as when screw cutting is required. A screw cutting gear box will allow you to change the feed rate rapidly for roughing cuts and finishing cuts. Finally, a quick release collet chuck such as the Myford lever operated collet chuck allows parts to be gripped and removed without having to stop the lathe spindle. Equivalent systems for other lathes may be available, but this is getting into the realms of specialist industrial machinery. Sadly I don't own one of these, but it is a feasible workshop project.

Examples

I will now run through three examples of repetition work that demonstrate the use of some of the principles and accessories described earlier. I will start with a very simple example of making a number of blanks to the same length, then describe the common tasks of making machine screws and finish with a more complex component.

Example 1 – Machining Blanks to Length

Let's assume we need to make a hundred or so simple blanks as in **fig. 1**, perhaps for some subsequent machining operation on another machine.

The part is a 40mm length of 10mm steel rod, with a slight chamfer at each end. For illustrative purposes, the length is critical and a good finish is required on each end. We will approach this task in two stages, the first being to part off all the blanks slightly oversize, then to machine the ends to the required finish and cut the chamfers. The steps are as follows:

Stage 1 – part off blanks

1. We will save a machining operation by selecting bar stock of the correct diameter. This may not always be possible if a non-standard diameter is required or the surface finish specified is better than that of the bar stock.

The finished part.

2. Fit a three-jaw chuck to the lathe such that the bar stock can pass through the lathe spindle bore. A collet could be used as an alternative if the surface finish needs to be protected.
3. Set up a stop in the tailstock. This a short length of steel rod held in the tailstock chuck that will allow the bar stock to protrude a set distance from the collet.
4. Fit the parting off tool to the tool post or rear tool post as preferred.
5. Adjust the position of the stop and the parting tool so that a blank can be parted off about 0.5mm over length. Now lock the carriage and tailstock quill and don't touch them again until the job is complete.
6. Part off all the blanks, checking the length occasionally to check they remain in tolerance.

This stage prepares the blanks for the finishing operations and illustrates the use of a stop held in the tailstock, **photo 11**.

Stage 2 – finish to length and chamfer

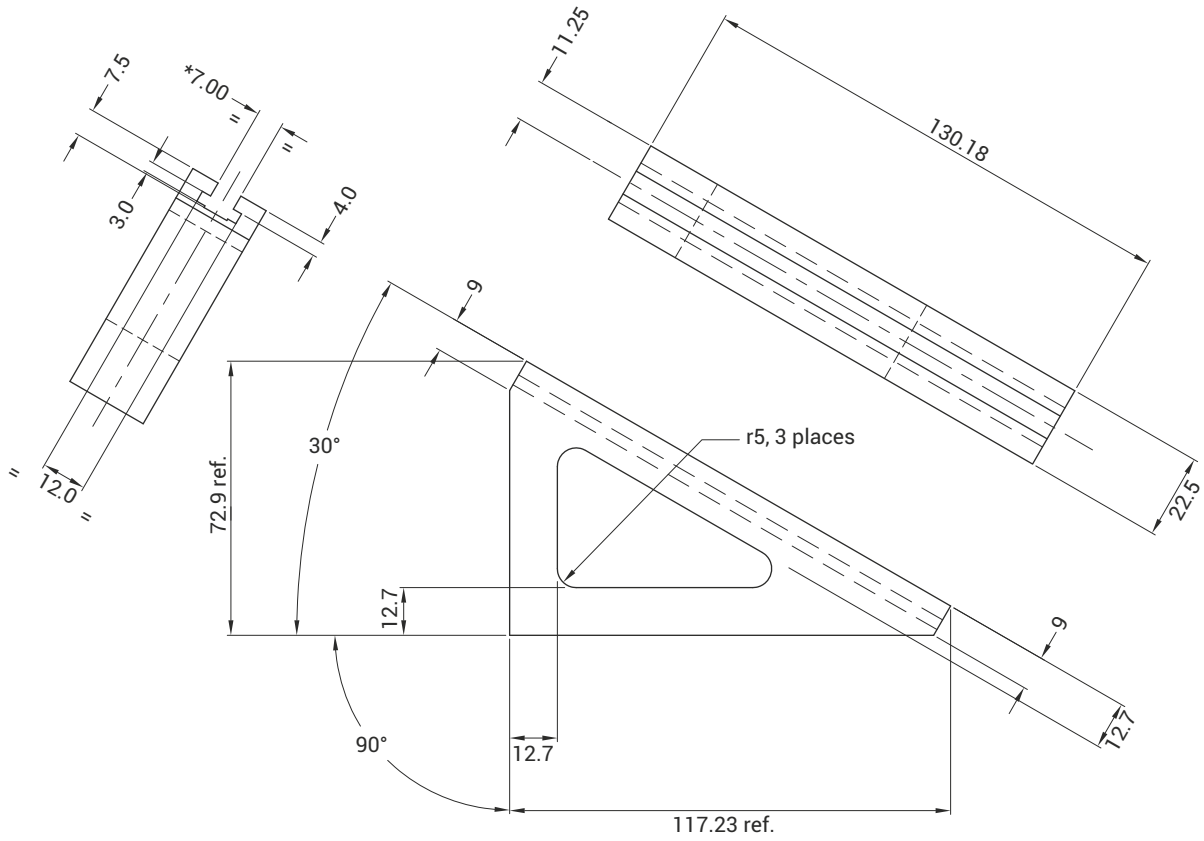
1. Set up the mandrel backstop so that the blank protrudes about 10mm from the collet chuck.
2. Place a facing tool and a 450 chamfering tool in separate QCTP tool holders. They need to be positioned so that the facing cut and the chamfering cut can be taken without adjusting the carriage position.
3. Take a light facing cut, just enough to clean up the end of the bar and lock the carriage in this position. Check that the blank is still slightly over length.
4. Fit the chamfering tool to the tool post and cut the chamfer, noting the cross-slide dial reading when the required depth of cut is achieved.
5. Machine one end of all the blanks to this stage, positioning them against the back stop and using the same dial reading for all chamfers, **photo 12**.
6. Now take one of the blanks and fit it into the collet, up against the back stop. Take a light facing cut and check the length of the blank. Calculate the depth of cut required to finish it to length and apply this cut using the carriage feed dial or top slide, then lock the carriage. Take the finishing cut and cut the chamfer as before. Check the length again and if it is within tolerance, all blanks can now be completed, **photo 13**.

● To be continued

Sine Bar Angle Setting Gauge

John Ashton describes a small tool that's a nice exercise in accurate working.

Fig.1



Saddle Block Carrier
Mat'l: EN8

*Close sliding fit in Saddle Block (drawing 2)

In issue 251 of MEW in *On the Editor's Bench* the Editor challenged readers to put their favourite or most successful small build down on paper.

My contribution has to be my "sine bar angle setting gauge", from here on in called the "setting gauge", a simple tool, that requires precise machining for it to function accurately. It is one of many tools I produced during the foundation year of my apprenticeship back in the early 1960s, and as you can see, in **photo 1**, it's got a bit shop worn during its 55-year history.

The setting gauge is used as a substitute for slip gauges when using a sine bar in a marking out set-up and more specifically in a machining operation set-up, to prevent possible damage or contamination of your slip gauges.

Due to the design of the saddle block my setting gauge does have some limitations, when used with my 5-inch sine bar. The angular range is limited from 11 to 71.5 degrees; however, I find this covers the majority of machining operations, anything outside this range I have to resort to using my slip gauges.

Machining the Sine Bar Angle Setting Gauge

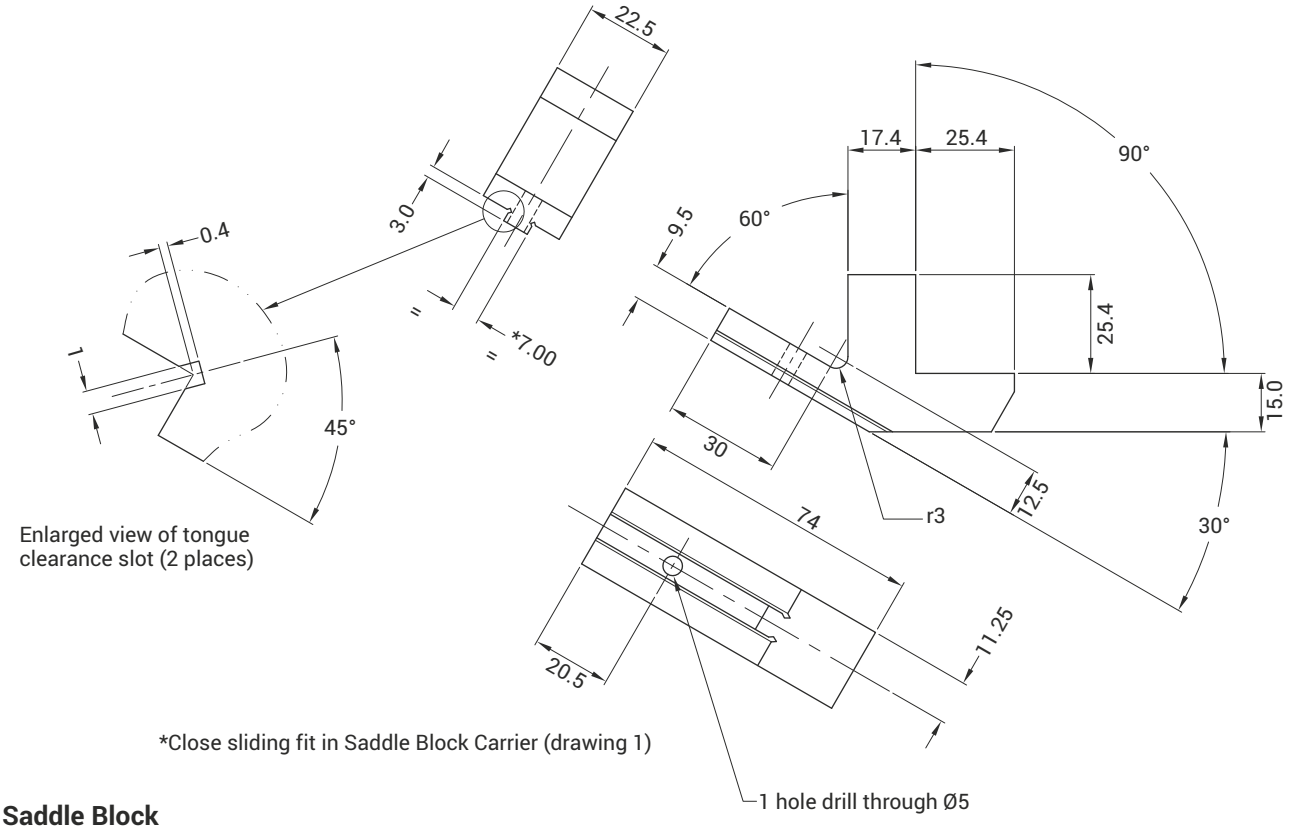
My setting gauge is made from KE672 tool steel, hardened then ground finished to size, but then I had the full facilities of a large toolroom at my disposal during my apprenticeship and beyond. Most model workshops don't have such luxuries as heat treatment and grinding facilities, so, for any reader wishing to make their own setting gauge, I would suggest using EN8, which is a medium carbon steel, for making the saddle block carrier and saddle block.

The most important features of the setting gauge are that the two table contact faces of the saddle block carrier are at 90 degrees to each other, the t-slot is a close slide fit to ensure the saddle block has no wobble and finally the saddle block setting faces are square and parallel with the table contact faces.

Saddle Block Carrier (fig. 1)

This was machined on a milling machine except for the t-slot for which I used a shaper, as this was a requirement of my

Fig.2

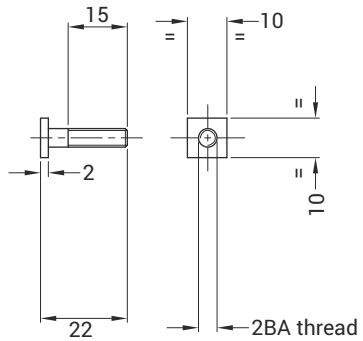


Saddle Block
Mat'l: EN8

apprenticeship training, prior to heat treatment and final grinding to size. The thought of machining a small t-slot with a shaper was a daunting task for a 17-year-old apprentice still in my foundation year. **Photograph 2** shows the finished t-slot. Shapers were generally used for heavy stock removal, such as rough machining of die bolsters, they were also used for machining internal and external keyways, irregular die shapes, gear teeth, dovetails, cams, splines, etc., a very versatile machine tool in its day that has largely been superseded by other machine tools especially of the CNC variety. If you wish to learn more about shapers a brief description and history can be found on Wikipedia and various engineering reference books (or read Bill Morris' articles in recent issues). However, I am not suggesting that any reader wishing to produce their own Setting Gauge has to use a shaper to machine the t-slot so I have dimensioned the t-slot to be machined with a 12mm diameter, 3mm thick t-slot/

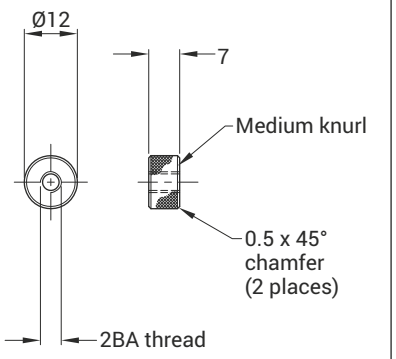
The setting gauge

Fig.3

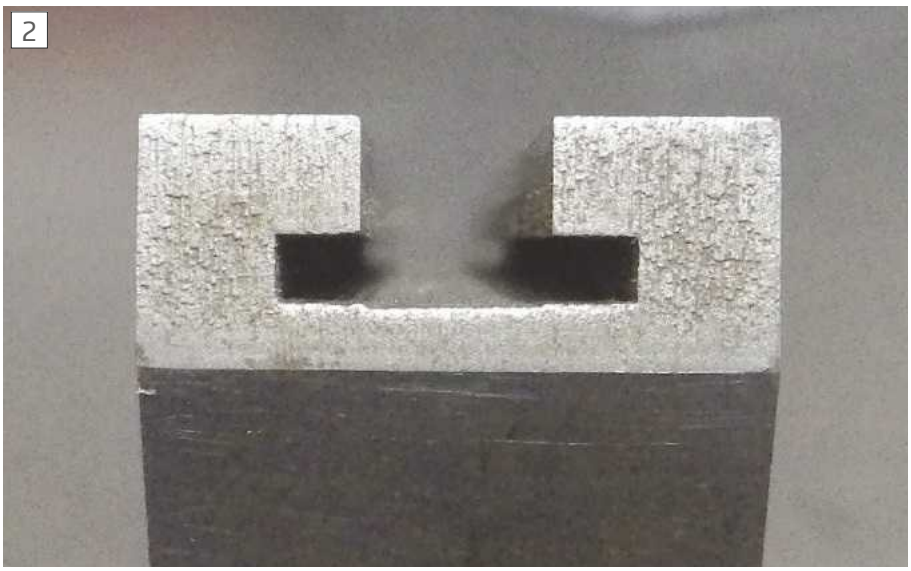


T-Bolt
Mat'l: BMS

Fig.4

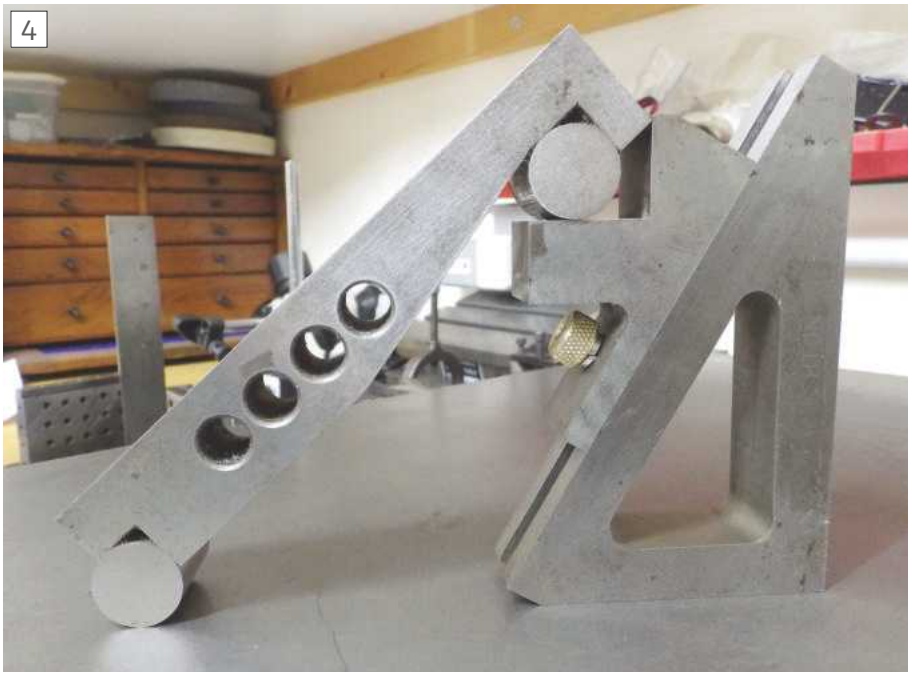


T-Bolt Nut
Mat'l: Brass



The t-slot, cut using a shaper

How the gauge is used



Use this setup for larger angles

Woodruff cutter or you may want to machine the t-slot to suit your own cutter size.

Saddle Block (fig. 2)

This was also machined on a milling machine prior to heat treatment and final grinding to size. The t-slot tongue corner clearance grooves were machined with a 1/32" slitting saw. I have modified the drawing from the original design to improve the angular range at the bottom end from 11 degrees down to 7 degrees.

T-bolt (fig. 3)

This was machined from 1/2" square black mild steel bar to produce machined 7/16" square bar then centred in a 4 jaw chuck on the lathe to machine and thread the shank, the thread is 2BA, finally part off to length to complete the part. Of course, I had to maximise the machining as part of my apprenticeship training, the machining can be reduced by using 7/16" or 10mm square bright mild steel bar.

T-bolt Nut (fig. 4)

This was machined from 1/2" diameter brass bar. The first operation was to machine the medium diamond knurl, face and chamfer then drill and tap 2BA, finally part off and chamfer to length.

Photographs 3 & **4** show the two orientations of the Setting Gauge. **Photograph 5** shows a typical setup on the mill and **photo 6** shows the component parts of the setting gauge as follows;

- Saddle block carrier.
- Saddle block.
- T-bolt.
- T-bolt nut.
- 2BA spring washer.

My Setting Gauge was machined to Imperial sizes because that was the main system used back in the 1960s. However, I have produced the drawings in metric as close to the original Imperial sizes as practicable.

Calculating the required angle

The required angle is calculated by the application of the **Sine Rule.**

Sine (Angle) = Perpendicular / Hypotenuse

Where the Perpendicular is the stack height of the slip gauges and the hypotenuse is the sine bar.

Example: Find the height required for an angle of 25°, using a 5" (127mm) sine bar.

Sine 25° = P/5

Therefore P = 5" x Sine 25° = 5" x 0.423 = 2.1131" (53.673mm)

To find the sine of an angle you can use trigonometric tables, which can be found in most engineering reference books, such as the Machinery's Handbook or probably the easiest way is to use a scientific/engineering calculator, which will usually have the trigonometric function keys along the top row. Enter the required angle then press the sine key and 'hey presto' the answer is the sine of the required angle. You can also use a sine bar calculator on line.

My slip gauges are imperial so the stack for 2.1131", in the example, would be made up of the following slips; 1.0000" + 0.9000" + 0.1130" + 0.1001".

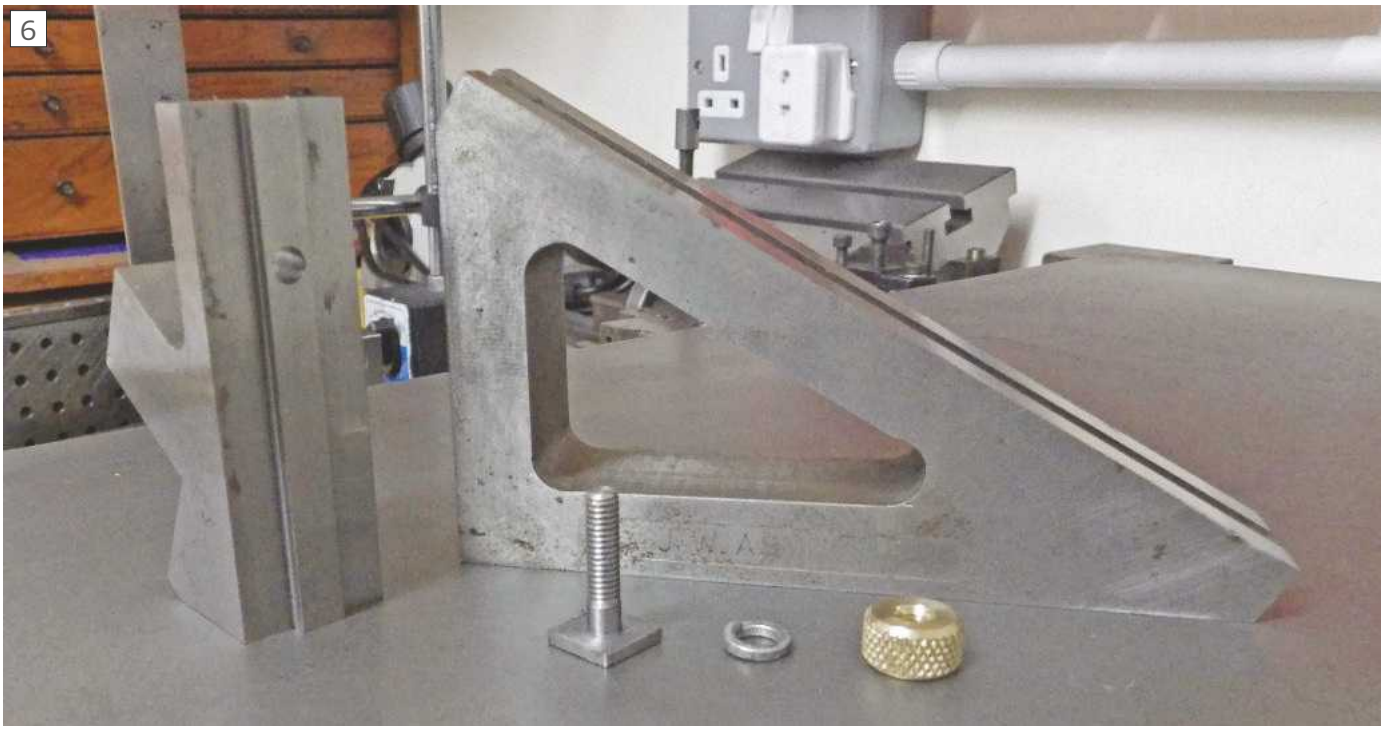
So, you do not need to remember any complicated formula just multiply the sine bar size by the sine of the required angle to give you the required height.

To set the setting gauge you can use a height gauge and set the saddle block directly to it, but this does not guarantee that you will be spot on. I fit a dial gauge to my height gauge then zero the dial gauge on a stack of slip gauges of the required height transfer the height gauge + dial gauge to the setting gauge then adjust the saddle block until the dial gauge reads zero and tighten the t-bolt Nut.

The most common sizes of sine bar are 5" & 10" imperial and 100mm & 200mm metric although there are other sizes available. If you have a larger sine bar than 5" (127mm) you may need to increase the size of the Setting Gauge to obtain a reasonable angular range.

I hope you find the *Sine Bar Angle Setting Gauge* as useful as I have. ■

Using an additional parallel to transfer an angle to a block in the milling vice



Components of the setting gauge

FREE PRIVATE ADVERTS

MODEL ENGINEER MODEL ENGINEERS' WORKSHOP

Did You Know?
You can now place your classified ads by email. Just send the text of your ad, maximum 35 words, to **neil.wyatt@mytimemedia.com**, together with your full name and address, a landline telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses to protect your security.

Machines and Tools Offered

■ Warco WM16 mill/drill 27" x 7" table. Electronic speed control to 2,000 rpm in two stages, 2MT bore, imperial dials fitted with SOBA swivelling 3" milling vice, drill chuck, imperial and metric drawbars. Excellent condition. £450. Power feed supplied by Warco to fit WM16 mill/drill. Bench tested but never used, £175. **T. 01491 412719. Henley on Thames.**

■ Taig lathe, tooling, collets and book. Precision. £250 ONO. **T. 01443 686111. Rhondda, South Wales.**

■ Myford Super 7B lathe for sale, 6 chucks, imp & metric collets, dividing head & 3 plates. £2,250. Dore Westbury milling machine, long column, electric power feed table, Clarkson chuck. **T. 01776 700611. Stranraer.**

■ Dore Westbury MK. 1 Two vices, milling and drill chucks. On stand. Ready to use. £450 ONO. **T. 01246 556330. Chesterfield**.

■ For free – Myford M-type cantilever flatbed lathe in pieces, not complete. Suitable for restoration or spares. Treadle version with stand. Good home needed. To be collected. T. 01322 224955. Dartford.

■ Transwave rotary converter 3hp £350 plus P&P at cost or collect. Also 6 sets of castings wheels for Simplex 5 in loco plus six sets laser cut frames, £250 ONO job lot, P&P at cost. **T. 01271 523786. Barnstaple**.

■ RJH Trimtool Lathe Tool Grinder. Single phase with worklight, £200. Large bench shear, Samson brand, £50. Wilson machine vice, swivel jaw, £50. El;ectric motors ¼ and 1/3 hp, £30 each. **T. 01617 614556. Bury, Lancs.**

■ 5 x 5.6ft trailer with hand winch & cover £ 350. **T. 01992412137. Hoddesdon, Herts.**

■ M&W 12" combination protractor, boxed, VGC. £30. M&W 0-6" depth micrometer, boxed, vgc, £25. Set used 0-8BA dies, VGC, £15. M&W 0-1" micrometer, VGC, £12, boxed. Box telescopic gauges, £15 assorted. **T. 0121 429 2322. Smethwick. W. Mids.**

Models

■ Duchess tender, exhibition standard. Professionally made Duchess boiler. Duchess engine needs building, all the parts are there. Offers. **T. 01773 872121. Chesterfield.**

■ LBSC 3 ½" gauge Molly close to prototype version of LMS Jinty. Working bottom half, copper boiler with paperwork. Drawing, casting to finish. £1,000 or very near. **T. 01162 783549. Leicester.**

Parts and Materials

■ Rob Roy jigs including 3 ½" quartering jig, £30 + postage. T. 01785 816101. Stafford.
7 1/4" King George V wheel castings, 6 D&C, 6 tender. Sensible offers. **T. 07570 945 257. Lingfield.**

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

Phone:		Date:		Town:	

NO MOBILE PHONES, LAND LINES ONLY

Please use nearest well known town

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

The information below will not appear in the advert.

Name .....

Address .....

.....

.....

..... Postcode.....

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

Email address. .....

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

Please post to:
ME/MEW FREE ADS, c/o Neil Wyatt, MyTimeMedia Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF
Or email to: neil.wyatt@mytimemedia.com

Photocopies of this form are acceptable.
Adverts will be placed as soon as space is available.

Terms and Conditions:
PLEASE NOTE: this page is for private advertisers only. Do not submit this form if you are a trade advertiser. If you wish to place a trade advert please contact Duncan Armstrong on 01689 899212 or email duncan.armstrong@mytimemedia.com

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

MODEL ENGINEERS' WORKSHOP CLASSIFIED

HOME AND WORKSHOP MACHINERY

Genuine Used Machines & Tooling

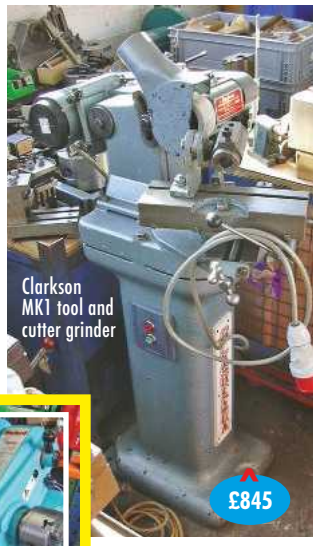
144 Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HS

Tel: 0208 300 9070 - Evenings: 01959 532199 - Fax: 0208 309 6311

www.homeandworkshop.co.uk • sales@homeandworkshop.co.uk

Opening Times: Monday-Friday 9am-5.30pm • Saturday Morning 9am-1pm

10 minutes from M25 - Junction 3 and South Circular - A205



MYFORD GENUINE PARTS

Running out fast!

Purchased from Nottingham

Check the **web site** for full list!

Please PHONE 0208 300 9070 to check availability or to obtain our list

DISTANCE NO PROBLEM! • DEFINITELY WORTH A VISIT • ALL PRICES EXCLUSIVE OF VAT

Just a small selection of our current stock photographed!

We are currently seeking late `Myford Super 7B` & `Super 7 large bore` model lathes!

SHIPPING WORLDWIDE

CHESTER MACHINE TOOLS

HOBBY STORE

HOBBYSTORE SUMMER OPEN WEEK

25th -29th JUNE 2018
9am - 5pm

A WEEK OF GREAT DISCOUNTS

FREE TEA COFFEE BISCUITS

LATHES MILLS DRILLS FABRICATION SAWS WORKSHOP TOOLING ACCESSORIES

Sawing Machines

T: 01244 531631

STAND INCLUDED

BAN-SAW-H80

H80 SWIVEL ARM BAND SAW
NOW £150
WAS £175
Max. Cutting Capacity @ 90 Degrees
Max. Cutting Capacity @ 45 Degrees

STAND INCLUDED

BAN-SAW-H110

H110 SWIVEL ARM BAND SAW
£295
Max. Cutting Capacity @ 90 Degrees
Max. Cutting Capacity @ 45 Degrees

STAND INCLUDED

BAN-SAW-HV128

H128 HORIZONTAL / VERTICAL BAND SAW
£385
Capacity (Round): 128mm
Capacity (Rectangle): 115 x 150mm

STAND INCLUDED

BAN-SAW-HV128S

H128-S BAND SAW
£599
Capacity (Round): 128mm
Capacity (Rectangle): 128 x 150mm

STAND INCLUDED

712

712 BANDSAW
£1,488
Capacity (Round): 178mm
Capacity (Rectangle): 178 x 305mm

STAND INCLUDED

812

812 BANDSAW
£1,800
Available as Single or Three phase
Capacity Round Bar: 8"/200mm
Capacity Rectangle Bar: 175 x 300mm

WWW.CHESTERHOBBYSTORE.COM
SALES@CHESTERHOBBYSTORE.COM
FIND US

ALL Prices Inclusive of VAT

Delivery Charge on Quotation

CHESTER MACHINE TOOLS . HOBBYSTORE
Hawarden . Clywd Close . Hawarden .
Chester . CH5 3PZ
UNITED KINGDOM