No.159

MILLING • DRILLING • TURNING • GRINDING

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

JANUARY 2010

£3.95

FREE PLANS

FOR A SWIVELLING BENCH VICE AND A TAILSTOCK TURRET FROM EDGAR WESTBURY

MAKE AN ELECTRICALLY OPERATED SPINDLE DRIVE CLUTCH

MAKE A FULLY ADJUSTABLE GRINDING HEAD

FIT A HARRISON M300 WITH A DRO

MAKE A SIMPLE SURFACE PLATE

MAKING A HAND TURNING REST

MAKE A HIGH SPEED SPINDLE

VISIT OUR WEBSITE www.model-engineer.co.uk

EMCO unimat 4
The Machining Centre

Basic Equipment

Lathe bed, head stock, tailstock, saddle and cross slide with single toolholder, 3-jaw chuck, fixed centre, drive motor, operating tools and operating instructions, spare part list.

EMCO Unimat 4:
Basic machine incl. bed for connecting vertical column

Price **£339.00 incl. Vat** Order No.**1770BC**

Technical data

Basic machine

Height of centres	46 mm
Distance between centres	200 mm
Spindle nose	M 14x1 mm
Swing over bed	92 mm
Turning Ø above cross slide	62 mm
Cross slide adjustment travel	52 mm
Leadscrew Ø	10 mm
Range of speeds	8 speeds 130–4000 rpm
Drive motor	Permanent magnet motor 65/95 W
Weight	6 kg

Vertical attachment

Max. working height	310 mm
Working radius	82 mm
Sleeve stroke	60 mm
Spindle nose	M 14x1 mm
Ø of vertical attachment	35 mm
Drive motor, speed	see basic machine

Like this or like that?
Always the best solution

The Unimat 4 together with the new vertical attachment (also for Compact 5) is a universal-machine tool.

»Turning – drilling – milling – thread cutting«
The vertical attachment in connection with the new co-ordinate table can be used as a separate drilling and milling machine.

Easy – accurate – precise

The new compact milling- and drilling machine consists of following accessories: Vertical attachment, Motor package, Co-ordinate table.

Unimat 4: The machining centre for various requirements. Vertical support with machine vice and collet chuck holder for milling cutters.

MODEL ENGINEERS' WORKSHOP

Published by **MyHobbyStore Ltd.**
PO Box 718, Orpington, Kent BR6 1AP
Email: customer.services@myhobbystore.com
Tel: 0844 412 2262
www.myhobbystore.com
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 08456 777 807
Email: modelengworkshop@subscription.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001) 877 363 1310
Email: expsmag@expressmag.com
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 (0)1858 438798

BACK ISSUES & BINDERS
Tel: 0844 848 8822
Email: customer.services@myhobbystore.com

EDITORIAL
Editor: David Clark
Tel: +44 (0)1847 821136
Email: david.clark@myhobbystore.com

PRODUCTION
Designer: Yvette Masson
Illustrator: Grahame Chambers
Retouching Manager: Brian Vickers
Ad Production: Robin Gray

ADVERTISING
Sales: Katie Kelleher
Email: Katie.Kelleher@myhobbystore.com
Tel: 0844 848 5239
Online Sales: Ben Rayment
Email: ben.rayment@myhobbystore.com
Tel: 0844 848 5240

MARKETING & SUBSCRIPTIONS
Subscriptions Marketing Manager:
Heather Morrison
Online Marketing Manager: Kate Barrett

MANAGEMENT
Special Projects Publisher: Nikki Parker
Head of Design & Production: Nikki Coffey
Deputy Head of Design & Production:
Julie Hewett
Group Sales Manager: Michael Gray
Head of Events & Retail: Daniel Webb
Subscriptions Director: Rebecca Blighton
Chief Executive: Owen Davies
Chairman: Peter Harkness

myHobbystore media

Model Engineers' Workshop, ISSN 0959-6909, is published monthly 13 times per year (October twice) by MyHobbyStore Ltd. c/o USACAN Media Dist. Srv. Corp. at 26 Power Dam Way Suite S1-S3, Plattsburgh, NY 12901. Periodicals Postage paid at Plattsburgh, NY. POSTMASTER: Send address changes to Model Engineers' Workshop c/o Express Mag, P.O. Box 2769, Plattsburgh, NY 12901-0239.

Contents

ON THE COVER

A fully adjustable grinding head. See article on page 10. Photo by David Haythornthwaite

SUBSCRIPTION GIFT! HEADBAND MAGNIFIER
Please see page 8 for our latest subscription offer. This is a headband magnifier with four different lenses and it is ideal for small work in the workshop or maybe even for reading Model Engineers' Workshop!

Arc Euro Trade

Unbeatable Value Engineering Products by Mail Order

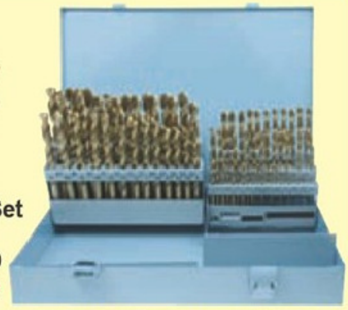
5C Collet Fixture Type B

For Horizontal or Vertical use with threaded or un-threaded 5C collets. Screwed Ring Type Closure.
050-070-00100 **£29.95**

5C Collet Fixture Type C

For Horizontal or Vertical use with threaded 5C collets only. Lever Closure.
050-070-00200 **£29.95**

115pc TiN Coated Imperial Drill Set
1/16" to 1/2" in 1/64" increments
Letter sizes: A-Z, Number sizes: 1 to 60
060-010-00400 **£38.00**



91pcs TiN Coated Metric Drill Set
High Grade, Fully Ground
1.0 - 10.0mm in 0.1mm increments
060-011-00300 **£62.00**

5C Collet Block Set

Square and Hexagonal collet blocks. Closure: Quick Release Lever or Screwed Ring where space is limited.
050-070-00300 **£28.00**

5C Collet Chuck

Key Operated for threaded 5C Collets. Recessed Mount. Front Fixing. Diameter: 126mm
050-070-00400 **£109.00**

32pc HSS Metric Tap & Die Set
3 Taps each M3, M4, M5, M6, M8, M10 & M12 + Tap Wrench & Die Holder + Thread Gauge & Screwdriver
060-080-00004 **£36.95**

ER Collets now in Imperial Sizes

NEW

ER16 Imperial Collets

050-110-16210	1/8"	£5.60
050-110-16220	3/16"	£5.60
050-110-16230	1/4"	£5.60
050-110-16240	3/8"	£5.60

ER20 Imperial Collets

050-110-20210	1/8"	£5.60
050-110-20220	3/16"	£5.60
050-110-20230	1/4"	£5.60
050-110-20240	3/8"	£5.60
050-110-20250	1/2"	£5.60

ER25 Imperial Collets

050-110-25210	1/8"	£5.20
050-110-25220	3/16"	£5.20
050-110-25230	1/4"	£5.20
050-110-25240	3/8"	£5.20
050-110-25250	1/2"	£5.20

ER32 Imperial Collets

050-110-32310	1/8"	£5.50
050-110-32320	3/16"	£5.50
050-110-32330	1/4"	£5.50
050-110-32340	3/8"	£5.50
050-110-32350	1/2"	£5.50

Tapping Fixture

Holds taps perfectly square to the base so threads are cut straight every time. The smooth turning, steel spindle and large chrome plated handwheel provide the 'feel' needed for hand tapping to minimize breakage, and the cast iron base assures stability for extra control.
Drill chuck holds taps with shanks up to 1/4 inch diameter.

- Clearance under chuck: adjustable up to 155mm.
- Throat: 125mm.
- Base includes 8mm T-slots (T-Nuts available separately) for mounting a vice or clamps.

Can also be used for hand-powered drilling and reaming.
060-250-00750 **£36.95**

ER20 MT2 Milling Collet Chucks
050-110-20500 MT2 Set with 8 collets **£76.00**
050-110-20520 MT2 Collet Chuck Only **£34.00**

50mm / 2" Boring Head

Rugged design for chatter free boring. Recessed back with 1.5" x 18tpi thread fits our standard boring head arbors (below) so you can choose the right one to fit your machine.
Supplied with 9pc Carbide Tipped Boring Tool Set.

Code	Model	Body Dia.	Tool Shank	Max Offset	Boring Dia	Min. Grad.	Price
060-290-00400	Metric	50mm	12mm	16mm	10mm to 125mm	0.01mm	£48.00
060-290-00500	Imperial	2"	1/2"	5/8"	3/8" to 5"	0.001"	£48.00

ER25 Milling Collet Chuck Sets
050-110-25500 MT2 Set with 6 Collets **£63.50**
050-110-25510 MT3 Set with 6 Collets **£63.50**
050-110-25520 R8 Set with 6 Collets **£63.50**

ER32 Milling Collet Chuck Sets
(With 6 Collets and C Spanner)
050-110-32500 MT3 Set **£67.50**
050-110-32510 R8 Set **£67.50**

ER32 Milling Collet Chucks
(With C Spanner only)
050-110-32490 MT2 Collet Chuck **£38.00**
050-110-32505 MT3 Collet Chuck **£38.00**
050-110-32515 R8 Collet Chuck **£38.00**

Boring Head Arbors with 1.5" x 18tpi thread

060-290-00600	MT2	M10	£9.75
060-290-00700	MT2	3/8" Whit	£9.75
060-290-00800	MT3	M12	£10.75
060-290-00900	MT3	3/8" Whit	£10.75
060-290-01000	R8	7/16" UNF	£10.75

ER16 Lathe Collet Chuck
050-110-16600 62mm Dia. **£14.95**

ER25 Lathe Collet Chucks
050-110-25600 60mm Dia **£31.95**
050-110-25610 95mm Dia **£32.95**

Precision Compound Sine Vice
Used to set accurate compound angles using gauge blocks (not included)
Tilts in both X & Y axes by 45°
Width 75mm Hardened and precision ground for parallelism and squareness to a high finish.
130-040-01400 **£89.95**

Visit us on-line at: www.arceurotrade.co.uk to see the full range

Phone us on 0116 269 5693 for Catalogue No.6
10 Archdale Street, Syston, Leicester, LE7 1NA

All prices include VAT. P&P is extra and based on order value:
£0-£10 = £1.75, £10-£25 = £2.95, £25-£60 = £3.95, Over £60 = Free E. & O. E.

Arc Euro Trade

Chronos Engineering Supplies

Glanze
Indexable Tool Holders

Great Performance & Reliability
Being in touch with the future

BORING

CODE	SHANK	PRICE
XC34	6MM	£18.50
XC35	8MM	£18.50
XC36	10MM	£19.50
XC37	12MM	£21.00
XC38	16MM	£23.00
XC48	10 INSERTS	£23.95

PROFILING

CODE	SHANK	PRICE
XC39	6MM	£15.00
XC40	8MM	£16.00
XC41	10MM	£17.00
XC42	12MM	£20.00
XC49	10 INSERTS	£24.95

RH TURNING

CODE	SHANK	PRICE
XC43	6MM	£15.00
XC44	8MM	£16.00
XC45	10MM	£16.50
XC46	12MM	£17.50
XC47	16MM	£23.00
XC48	10 INSERTS	£23.95

LH TURNING

CODE	SHANK	PRICE
XC83	6MM	£15.00
XC84	8MM	£16.00
XC85	10MM	£16.50
XC86	12MM	£17.50
XC87	16MM	£23.00
XC48	10 INSERTS	£23.95

PARTING

CODE	SHANK	PRICE
GX67	10 X 10MM	£26.95
GX68	12 X 12MM	£27.95
GX69	16 X 16MM	£29.95
GX70	20 X 20MM	£33.95
GX71	INSERT FOR 10, 12 & 16MM	£ 4.50
GX72	INSERT FOR 20MM	£ 4.50

CLAMP TYPE PARTING

CODE	SHANK	PRICE
CGG081	8MM	£25.95
CGG101	10MM	£31.00
CGG121	12MM	£33.00
CGG122	16MM	£35.00
CGG120	20MM	£36.00
CGGSP	INSERT FOR 8-16MM	£ 4.50
CGGSP20	INSERT FOR 20MM	£ 4.50

GLANZE SCLCR INDEXABLE LATHE TOOL SETS C/W 7 CARBIDE CCMT INSERTS

CODE	SHANK	PRICE
XC50	6MM	£ 84.00
XC51	8MM	£ 84.00
XC52	10MM	£ 90.00
XC53	12MM	£ 98.00
XC54	16MM	£135.00

METRIC THREADING INTERNAL

CODE	SHANK	PRICE
722100	10MM	£25.00
722210	12MM	£25.00
SIR016	16MM	£29.95
1116160	INSERT 10 & 12MM	£ 7.25
1116A60	INSERT 16MM	£ 7.25

METRIC THREADING EXTERNAL

CODE	SHANK	PRICE
775100	10MM	£25.00
775118	12MM	£25.00
SER16K16	16MM	£29.95
11ER1A60	INSERT 10 & 12MM	£ 7.25
A6ERAA60	INSERT 16MM	£ 7.25

GLANZE DCMT INDEXABLE LATHE TOOLS

INC THREADING TOOL, BORING TOOL & 2 TURNING TOOLS

CODE	SHANK	PRICE
XC55	8MM	£52.50
XC56	10MM	£54.00
XC57	12MM	£62.00
XC58	16MM	£74.00
XC59	INSERT	£ 4.00

NEW! FROM GLANZE! SWUCR 02 MINIATURE BORING BAR

THIS NEW GLANZE BORING BAR IS GREAT FOR THE SMALLEST OF JOBS! THE MINIMUM BORING SIZE IS A STUNNING 5.8MM ONLY!
THE WAY THE SPECIAL SMALL INSERTS IS MOUNTED ALLOWS STRAIGHT BORING UP TO A SHOULDER AS WELL AS ALLOWING INTERNAL FACING CUTS
SHANK IS 8MM WITH FLATS TOP AND BOTTOM
LENGTH IS 100MM. REDUCED PART IS 18MM LONG

CODE	ITEM	PRICE
SWUCR	MINI BORING TOOLS & ONE INSERT	£32.95
WCMT	SPARE INSERT	£ 5.20

NEW BRAZED CARBIDE THREADING & BORING LATHE TOOLSETS

INCLUDES 55 & 60 DEGREE INTERNAL & EXTERNAL THREADING, A BORING TOOL & A LH FACING TOOL

CODE	SHANK	PRICE
131300	1/4	£17.95
131310	5/16	£18.95
131320	3/8	£21.95
131330	1/2	£24.95

SET OF 6 BRAZED TURNING TOOLS TCT

COMPRISES OF ROUND FACING, RH FACING, LH FACING, PARTING & ROUGHING TOOLS

CODE	SHANK	PRICE
131350	6MM	£17.50
131360	8MM	£17.50
131370	10MM	£18.50
131380	12MM	£22.50

SET OF 8 GLANZE HSS LATHE TOOLS

CODE	SHANK	PRICE
XC64	6MM	£22.50
XC65	8MM	£28.95
XC66	10MM	£36.00
XC67	12MM	£55.00
XC6712	16MM	£93.00

SET OF 38 TCT BRAZED TIP LATHE TOOLS

Fantastic Value

CODE	SHANK	PRICE
XC60	1/4	£22.00
XC61	5/16	£24.00
XC62	3/8	£27.95
XC63	1/2	£34.00

CLOCK CONSTRUCTION & REPAIR
Books by:
John Wilding MBE FBHI, E. J. Tyler, John G. Wright, Eric Woof, John Tyler and others.
SPRINGS
BEARINGS
FRAMES
DIALS etc.
FREE Catalogue
Telephone: +44 (0) 1420 487747
www.ritetimepublishing.com

PROXXON
TBM220 Bench Drill
Vice not included
£172.50
Inc.vat
Order No. 702060
Valid until 31.12.09
Engineered in Germany, these smaller size power tools and accessories are unique in design and perfect for hobbyists working in miniature.
www.brimarc.com/proxxon
To view the full range of these quality products, request a FREE copy of the Proxxon catalogue – call 0300 100 1008 or email email@brimarc.com

THE SOUTH'S LARGEST
Model Engineering & Modelling Exhibition
LONDON MODEL ENGINEERING EXHIBITION
Over 1000 models on display from over 40 clubs and societies.
See the leading specialist suppliers.
NOW IN ITS 14TH YEAR
Great Hall
Alexandra Palace
Friday 22nd to Sunday 24th January 2010
Extra special discounts available for group travel of 20 or more
New Event Layout to give you more space to enjoy your day and see what you want to see easily
ENTRY Prices HELD... plus FREE show guide
Save £££'s by booking in advance by 8th January
Sponsored by
ENGINEERING in Miniature
Opening Times
10.00am – 5.30pm Friday & Saturday
10.00am – 4.00pm Sunday
Last admission one hour before closing
Ticket Office opens daily at 9.00am
Free Car Parking Exclusively for our event.

TICKET PRICES	DISCOUNT For tickets ordered before 8th January	FULL PRICE For tickets ordered before 14th January or purchased on the day
Adult	£8.50	£9.50
Senior Citizen	£7.50	£8.50
Student	£7.50	£8.50
Child (5-14 inc)	£4.50	£5.50
Family Ticket 1	£13.00	£15.00
Family Ticket 2	£21.50	£24.50

For more information visit our website www.londonmodelengineering.co.uk
Meridienne Exhibitions Ltd, The Fosse, Fosse Way, Leamington Spa, Warks, CV31 1XN
Tel: 01926 614101, Fax: 01926 614293
Email: info@meridienneexhibitions.co.uk Web: www.meridienneexhibitions.co.uk

David Clark

ON THE EDITOR'S BENCH

Well, 2009 is just about over. It has been a long year and I am due for a holiday and fortunately have some time off at Christmas. I hope to spend a bit of time in the workshop. By the time you read this the Best of Model Engineer Volume 2, should be finished. December as usual is busy and the head office is also moving so please make sure you use the current PO Box address from the contents page. Letters to the old address will still find us but there will be a delay in them being forwarded.

Overseas readers

Model Engineers' Workshop is going from strength to strength and as part of our new expansion program, this issue of Model Engineers' Workshop, No159 will be available in many Barnes and Noble book stores in USA and Canada. Also, the copies sent to Australia have been more than doubled for this issue. This means we are welcoming many overseas readers for the first time. Our sister magazine Model Engineer is also being made available through Barnes and Noble so a few words on the content of both magazines may be useful for these new readers. Model Engineers' Workshop specialises in making machines and tools, how to do workshop processes and machining methods. Model Engineer tends towards live steam engines, both stationary and locomotives and also caters for the Intenal Combustion engine enthusiast. It also includes all sorts of general how to articles, some of which can be a bit specialised but nonetheless useful.

US and Canadian subscriptions

We have again had to change subscription services to the USA and Canada this year. Express Mags took over from EWA at the start of November. This meant that issue 157 was not sent out on time but should be with subscribers by now. If you missed issue 156, please ask EWA first and if no joy then contact me at the editorial email address. Hopefully this is the last change we need to do.

2009 - The year of the website

This year saw the launch of the Model Engineer website. Although it is called the Model Engineer website it is equally applicable to Model Engineers' Workshop. So far, we have not had any major problems with unwanted posts or dangerous advice. Many back numbers have been made available to subscribers and The Model Engineer Centennial Specials, The World of Model Engineering and Model Mechanics magazines have been put on the web for your enjoyment. About 50% of the magazines and articles are free to readers and subscribers alike. Much more material will be loaded up in the New Year.

MEX 2010

In order to carry on and take the exhibition forward I intend to start the organization of the 2010 exhibition as soon as possible. This means deciding on a date even earlier this year so we can start accepting entries straight away. At the time of writing, it looks like being the same weekend as this year, the 10, 11 and 12 of December. The 2009 Exhibition looks like being a huge success compared with the last two years at Ascot. It will be all over with by the time you read this. I will be publishing exhibition reports in Model Engineer and also on the website. A short report will probably appear in MEW as well.

Articles for 2010

I have received many articles over the last year but could still do with some more. Guidelines for contributors are available on request and I will be updating these slightly soon.

Free Adverts

All adverts must be on a Free Adverts form. Please use the new form with the PO Box number address. A photocopy of the form is also okay. The head office is moving from Berwick House just before Christmas and while letters will be diverted, it will increase the time taken for delivery.

I am starting to receive many adverts with mobile phone numbers. I have printed a few in this issue but would rather not do so. Therefore, in future, any adverts received with mobile phone numbers will be binned and you will not be notified. Although most people are honest, mobile phone numbers can leave readers open to fraud.

Please do not email or fax adverts to the office. If you can use a computer you can put Free Adverts on our website, www.model-engineer.co.uk Alternatively use the printed form.

The Greatest Model Show in the North

The Yorkshire 2010 Model Exhibition, hosted by the IPMS Wakefield, will be held at the Huddersfield Sports Centre, Huddersfield HD1 1TW on Sunday 21 February from 10am to 5pm. There is an open competition and aircraft, vehicles, figures, Sci-fi and ships will all be on display.

Telephone Alan Paul on 07811 358355 or Andy Scholefield on 07775 641315.

E. **huddersfieldshow@ukonline.co.uk**

Competition page

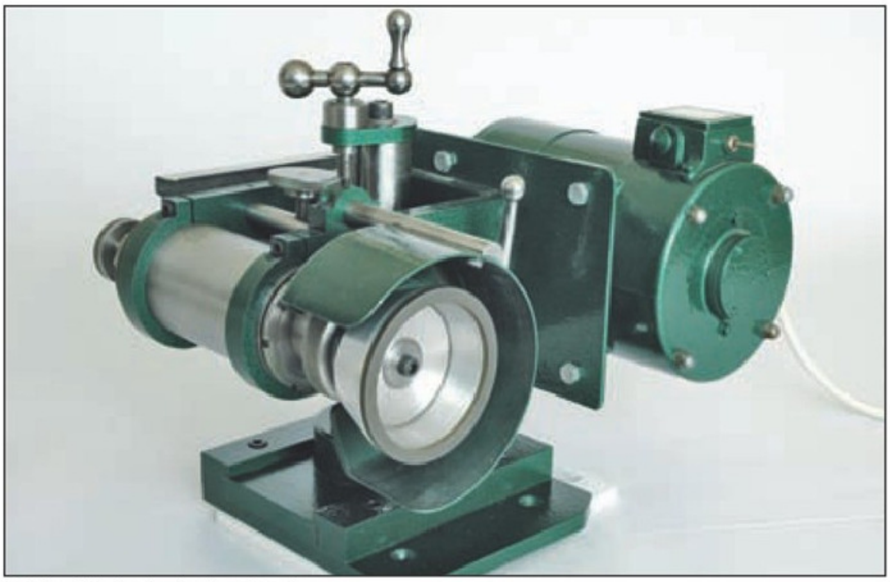
We have another competition starting in this issue. It is for one of six copies of a Haynes Manual for the Messerschmitt Bf-109 aircraft. Haynes is doing a more varied range of manuals and there is even one for Thomas the Tank Engine (see review this issue) that has been released recently.

Model Engineers' Workshop online archive

As we go to press, I have heard that the online Model Engineers' Workshop Archive is going live very soon. This will give access to all magazines from no 1 issued in 1990 up to and including all of the 2007 issues. Without checking actual numbers, this will be about 130 issues. A digital subscription fee will be payable and this has been set at £29 per year. This works out at about 22 pence per issue. When you consider that MEW issue No1 can sell for upwards of £30 on EBay I am sure you will consider £29 a bargain. You do not need to be a paper copy subscriber to subscribe to the online digital editions.

■ OVERVIEW

This stand alone grinding head (**photo 1**) can be used with various different designs of cutter grinders. It is ideal for use with the Worden Cutter grinder, the Stent or the Kennet. It can also be bolted to a lathe cross slide for use as a toolpost grinder although you may have to adjust the spindle centre height. It is suitable for internal and external grinding. As the spindle has a Myford standard nose thread and takes Morse taper collets, it can also be used for milling and drilling in the lathe. This would need a separate motor with speed control fitted. Construction is fabricated and no castings are required.



1. The finished grinding head.

HOW TO MAKE A FULLY ADJUSTABLE GRINDING HEAD

David Haythornthwaite builds a useful tool grinding head

Carbide lapping machine

A few years ago I purchased a Tiplap tool lapping machine made by Boremasters for a reasonable price at a machinery auction (**photo 2**). The machine had many of the features of a Quorn tool and cutter grinder but the motor was set at a fixed height and had a fixed grinding wheel, limiting the versatility of the machine. I set about making a bolt on column with an adjustable grinding head capable of using interchangeable grinding wheels and I also added some other Quorn features to make it equal in every respect to the Quorn. The finished unit is illustrated in **photo 3**.

The design

The general Layout is shown in **fig 1**. The base plate supports a column (**fig 2**) via a steel mounting bush (**fig 3**). The baseplate is clamped to the cutter grinder itself via two mounting rails (**fig 4**). When the mounting setscrews are loosened, this allows the baseplate to be slid from side to side varying the position of the column. You will see from photo 3 that in the case of the Tiplap machine, I found it best to mount the rails on an intermediate plate in order to set the unit back a little and allow more working space for the workhead to move. If you create long rails, it will allow you to rotate the head through 90deg. to use the circumference of the grindstone and then slide the whole unit to the left to leave the grindstone still presented to the work.

Moving head

On the column is fixed a central pivot block (**fig 5**) and this is clamped to the column by means a split cotter (**fig 6**) which grips the column when a ball handle is tightened. The central pivot column can be raised or lowered by a threaded leadscrew (**fig 7**) fixed to the top of the column using the pillar top swivel plate and bush (**fig 8**) and passing through a suitably threaded hole in the pivot block. Two conical holes on either side of the pivot block are formed directly in line with the central column as it passes through the pivot block.

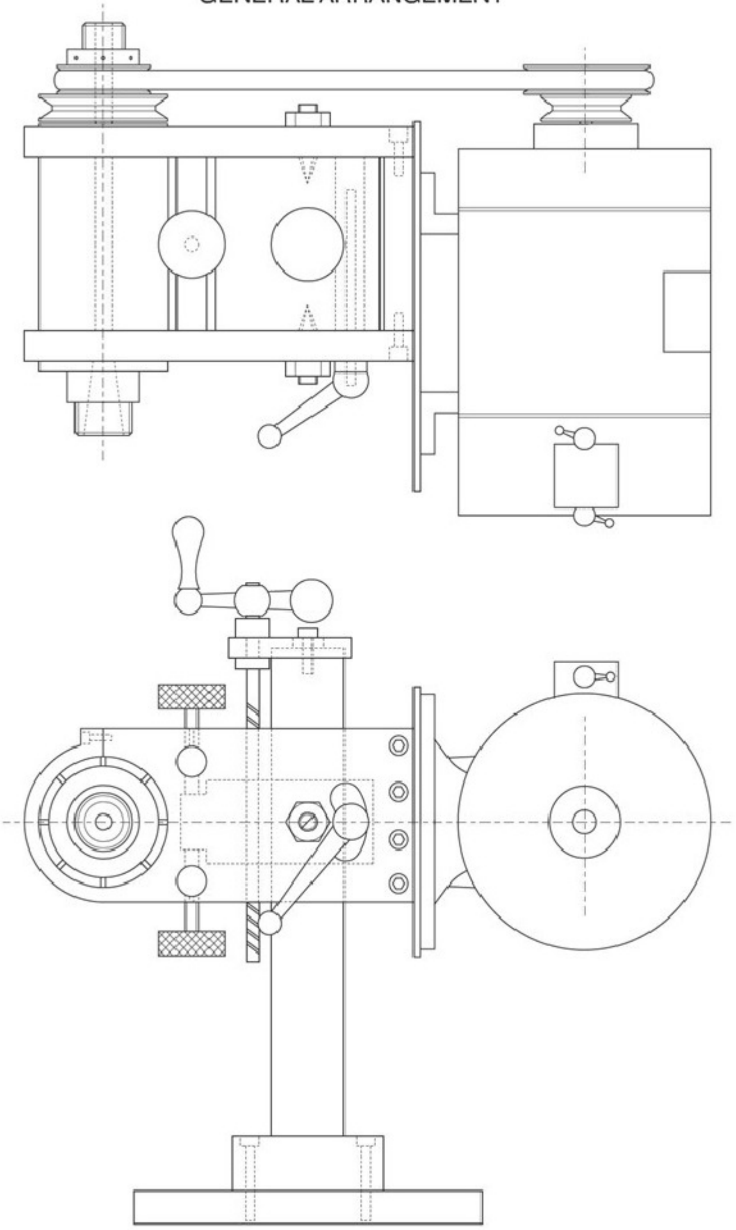
An outer casing carrying the motor at one end and the grinding spindle at the other end is formed by the left and right frames (**figs 9** and **10**) and the back frame (**fig 11**). This outer casing pivots on the central pivot block by means of two hardened headless steel bolts (**fig 12**) which screw through the pivot points in the left and

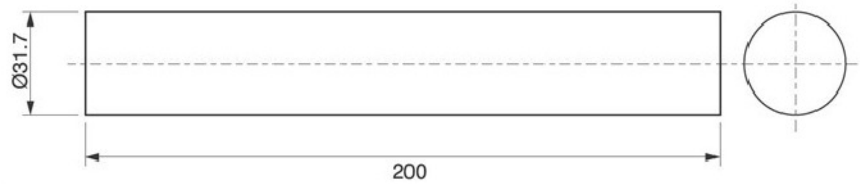
2. The original Tiplap cutter grinder.

3. Finished grinder with adjustable head.

Fig. 1

GENERAL ARRANGEMENT

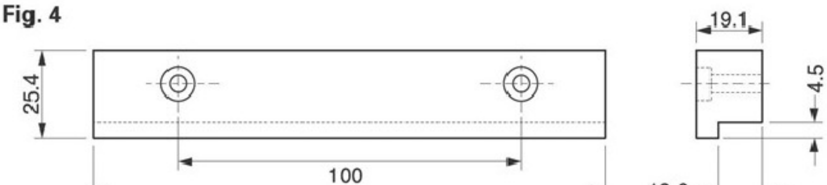




COLUMN
MAT'L: GROUND SILVER STEEL OR STAINLESS STEEL

Fig. 2

Fig. 4



MOUNTING RAIL
(2 REQ'D)

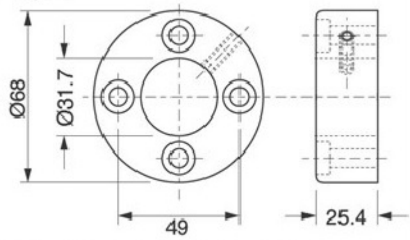
right frames. Pivot points are provided on these bolts to run in the conical holes in the central pivot block. This arrangement allows the height of the spindle to be finely adjusted without unclamping the central block from the column. Thus it is possible to finely adjust the grinding height without losing the register around the column. The fine adjustment is controlled by two adjusting screws (**fig 13**) which screw through horizontal adjustment bars (**fig 14**) between the two left and right frames and bear upon a recessed area at the front of the central pivot block. The whole arrangement is very similar to that achieved by the Quorn castings.

Grinding spindle

Any grinding spindle of a suitable size may be used. I made a spindle from the drawings in the 'Spindles' book - No. 27 in the Workshop Practice Series. (See box at end of article for ordering details.) The spindle that I made was the Basic spindle from chapter 3 and I selected this for several reasons.

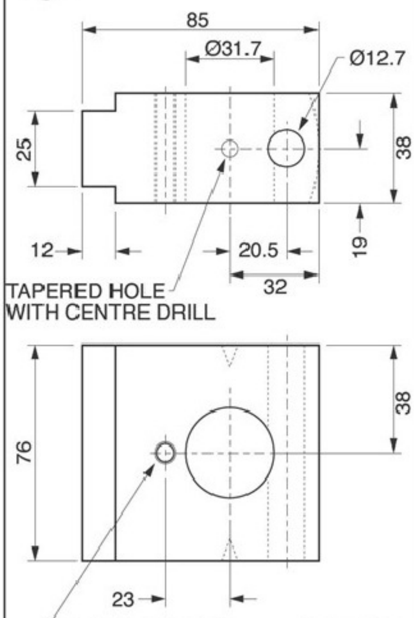
Although quite large at 2.25in. dia. the spindle has a hollow shaft allowing the use of a drawbar and it has a No. 2 Morse Taper in the nose. It also has a threaded nose identical to the Myford ML7, Super 7 and ML10 lathes and therefore will take all my Myford accessories. This spindle also

Fig. 3

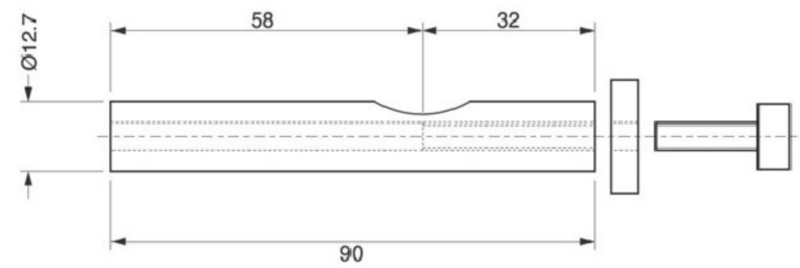


COLUMN MOUNTING BUSH

Fig. 5



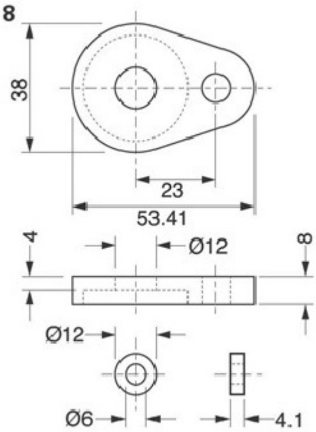
CENTRAL PIVOT BLOCK
MAT'L: STEEL OR C.I.



CLAMPING COTTER
MAT'L: BRASS

Fig. 6

Fig. 8



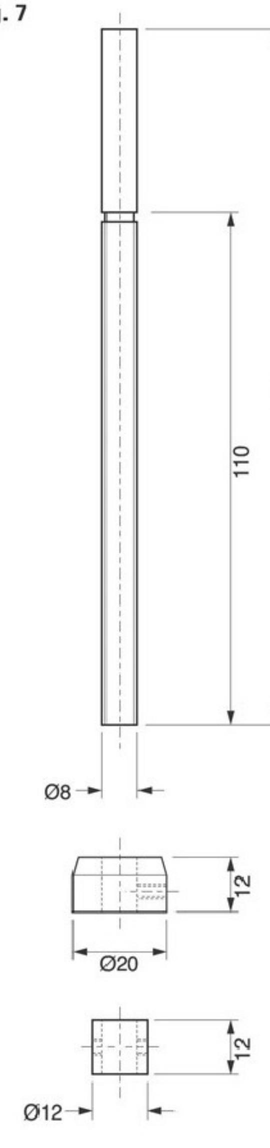
PILLAR TOP SWIVEL PLATE AND BUSH

finds use as a milling and drilling spindle on my Myford lathe where a clamping arrangement has been made, complete with a separate motor to attach it to the cross slide or vertical slide. Making tools for the workshop, which have multiple uses in this way, has a lot to commend it.

You may use an existing spindle or design a different spindle but the 2.25in. holes in the side frames will need to be adjusted to suit. When I made the spindle I used a double angular bearing instead of two separate bearings at the front. I also recommend that you make a round pulley nut on the rear of the shaft with tommy bar holes for tightening. The standard 3/4in. BSF nut that the instructions suggest for the pulley nut looks totally inappropriate when spinning around at 5,000 RPM.

I cannot duplicate the drawings for the spindle, which will be copyright, but to give readers some idea of the construction, I show **photos 4** and **5** to illustrate both the finished spindle and the work involved in making the parts. It proved no problem to make this in free cutting mild steel. I suggest that if you intend to use the spindle for multiple uses, the rear pulley should be made no larger than the body of the spindle to facilitate extracting the spindle from the various clamping arrangements.

Fig. 7



HEIGHT ADJUSTMENT SCREW

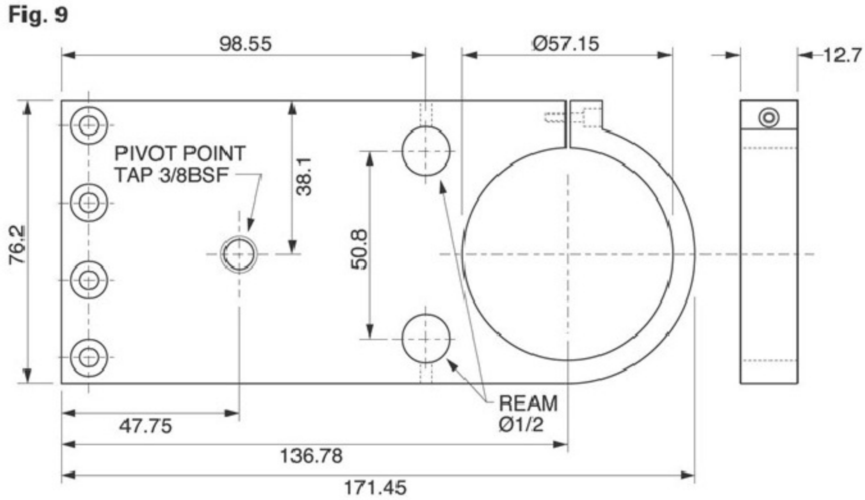
Dimensions

Although dimensions are given in mm it will be obvious that the machine was actually made from imperial materials. The outer casing was made from 3in. X ½in. flat plate. The spindle was 2¼in. dia and the main column was made from 1¼in. dia. stainless steel bar. Also most of my stock of reamers is imperial, so the machine is a mixture of both systems. Metric cap head set screws were used throughout.

Making a start on construction

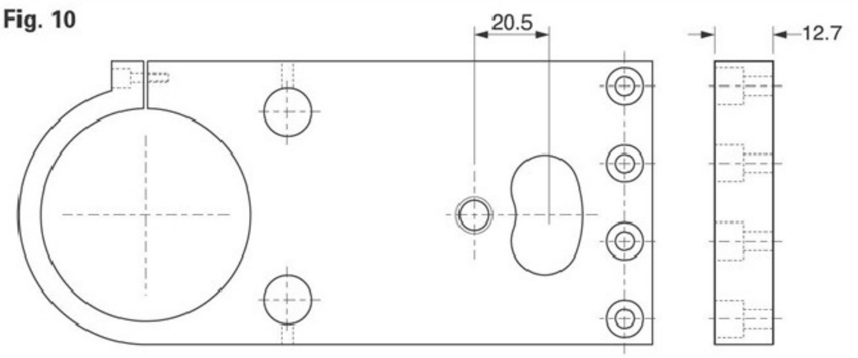
It is some time since I made this machine so my photography skills during construction

Fig. 9

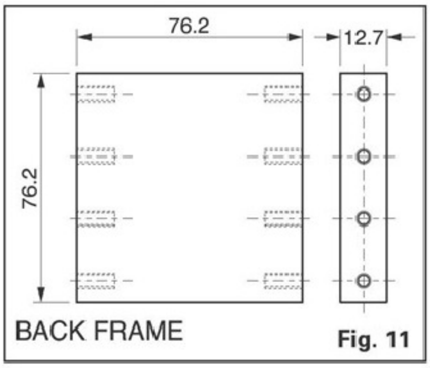


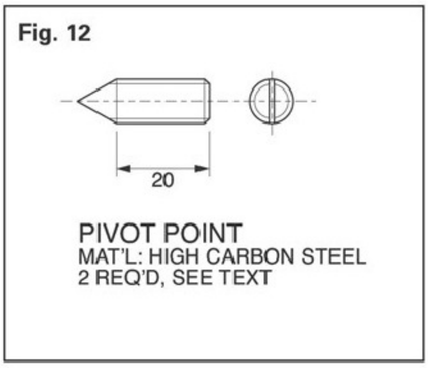
LEFT FRAME

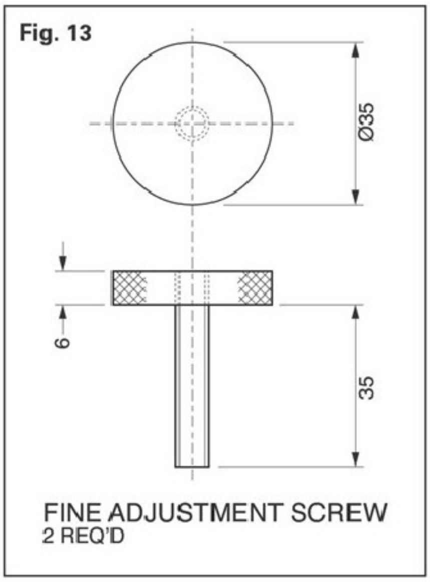
Fig. 10

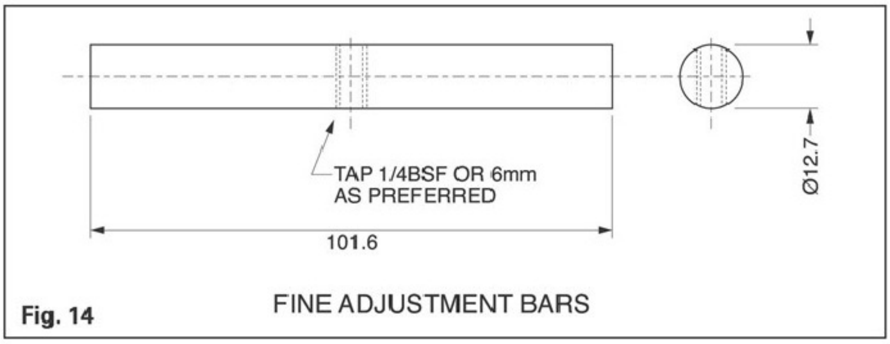


RIGHT FRAME









were limited. I did however take many photographs at the time and I am a great believer that one or two photographs are often better than a thousand words.

Base plate and column

Cut a piece of 76.2mm x 12.7mm flat steel bar to just over 150mm long and trim square and parallel on the milling machine if necessary. It is important that the long sides are parallel if you intend to run them in slides as I did to give a horizontal adjustment. Mark the centre of the plate.

Cut the column to length from stock material. I had been given some ground stainless steel bar, so I used that, but if purchasing, I would probably have used ground silver steel for this part. Put the cut length into the lathe 3-jaw chuck and support the end with a fixed steady. Face and slightly chamfer the end then centre drill, following up with a 5.2mm drill. Then tap M6 ready for the setscrew holding the top swivel (fig 7). Reverse in the lathe and chamfer the bottom end.

The column mounting bush is a straight turning job with four countersunk holes to take four recessed 8mm cap head set screws at 49mm pcd. Drill these 6.9mm at this stage and spot through the positions onto the baseplate. Drill the four holes in the baseplate 6.9 mm and tap M8. Open the fixing holes in the bush to 8.00mm and countersink to a depth of 7mm. The size of countersink required for 8mm set screws is actually 13mm. If you have a 13mm drill, then your workshop is better equipped than mine. I drilled ½in. and reduced the heads of the set screws slightly on the lathe. It is important that the bush is bored to a nice close fit on the column to ensure a rigid structure. The drawing shows a grub screw to hold the column captive, but I actually Araldited the bush onto the end of the shaft once the drilling of the mounting holes was finished.

The two fixing rails were actually made from 1in. x ¾in. flat bar and were grooved out on the milling machine to fit the base plate. Make the rebate slightly tight on the thickness of the baseplate so that when the set screws are tightened, the baseplate is held captive. I used 6mm cap head set screws to hold these down. Now you have a rigid column on which to mount the grinding head, you can move onto the head itself.

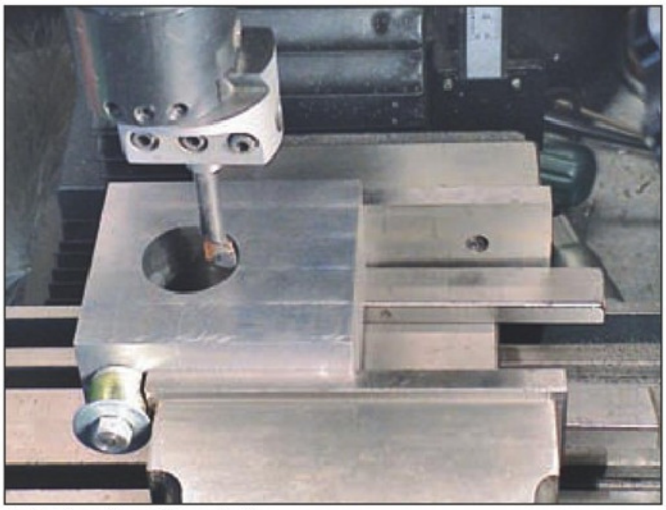
Clamping cotter

Before making the central pivot block you will need to prepare the clamping cotter. The sequence of machining is that the cotter is made and bolted rigidly into the hole in the pivot block. The column hole is then bored in the pivot block, and this boring process also cuts the curve in the clamping cotter at the same time, thus ensuring that the cotter clamp fits the column exactly. After boring the column hole, the cotter is split into two parts along the centre line of the curved section, to make two matching cotter clamps.

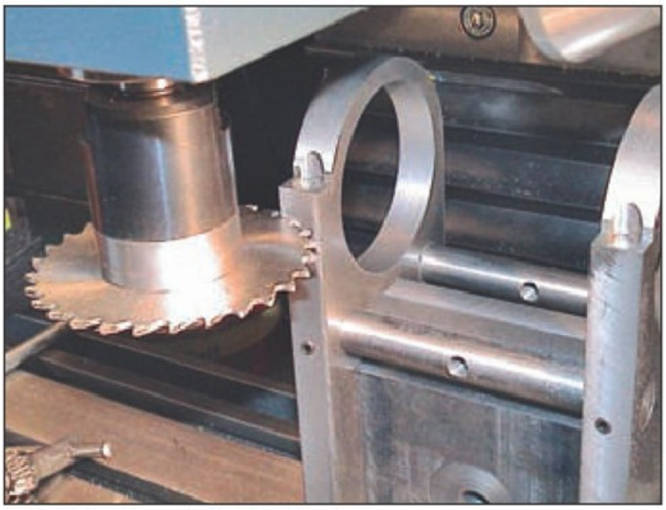
Cut a length of 12.7mm (½in.) brass bar to just over 90mm long and face in the lathe at each end to finish 90mm long. This length is so that the cotter will pass through the pivot block (76mm) plus the thickness of one side frame (12.7mm) with clearance to spare. If you change the thickness of either of the side frames then adjust accordingly. With the brass piece accurately centred in the lathe chuck or collet, drill 5.2mm (tapping size for M6) down the centre to a depth of 32mm. Reverse in the lathe and drill 5mm from the other end until it breaks into the original hole. Follow up by drilling or reaming 6mm from this end to a depth of 58mm to give clearance for a 6mm bolt. Fit a large, strong, washer to the threaded end by means of a 6mm set screw which effectively puts a temporary "head" onto the brass cotter. Put on one side until it can be inserted into the pivot block.


4. The parts of the spindle.

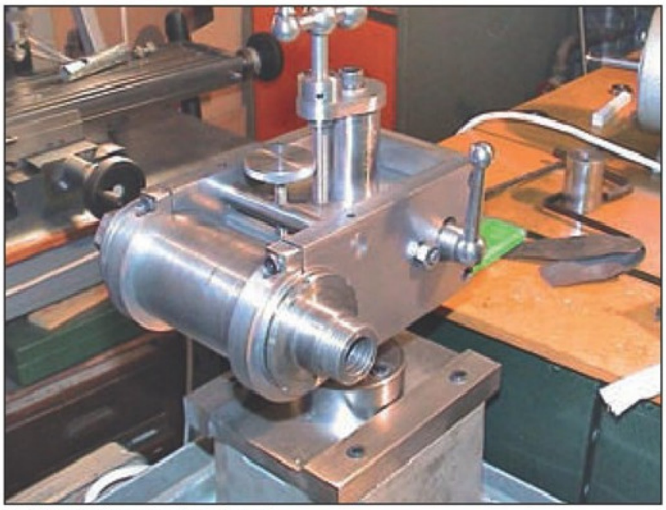

5. The finished spindle ready for attachment.



6. Boring the column hole.



7. Splitting the spindle clamping hole.



8. The basic grinding head.

9. Milling the step.

Central pivot block

I made the pivot block from steel and also the cotter from steel although ideally I would make the pivot block from cast iron and the clamping cotter from brass.

Start off with a block of cast iron or steel 76.2mm x 85mm x 38mm thick. The thickness is not critical; I cut mine from a piece of 3in. x 1½in. flat steel bar. Ensure that the block is absolutely square in all directions and mark out the positions of the pivot centres, the column hole and the hole for the cotter clamp. It is absolutely essential to the accuracy of the machine that this pivot block is dead square. It is also essential that the pivot centres and the central column hole lie exactly in line with each other and that this line is at right angles to the side of the block. It is worth taking time over this marking out. Check the position of the cotter clamping hole and ensure that it is 32mm exactly from the pivot line. If the hole were closer than 32mm then the column hole would impinge upon the clamping bolt, and if further away, there is a danger that the clamping cotter would not clamp the column correctly.

Drill the two pivot centres using a No. 4 centre drill and then mount the block on its side on parallels in order to put the 12.7mm hole through for the clamping cotter. This is a VERY deep hole (76mm) and in order to drill a smaller pilot hole, you would need a long series drill or alternatively only pilot to halfway and for the bottom half, go straight through with the smallest drill that is long enough. Withdraw the drill regularly and lubricate well whilst drilling. Take the hole up to (say) 12 mm diameter or $^{31}/_{64}$in. by drilling and then follow up with a ½in. machine reamer or D bit at very slow speed. Keep the reamer moving until you have withdrawn it.

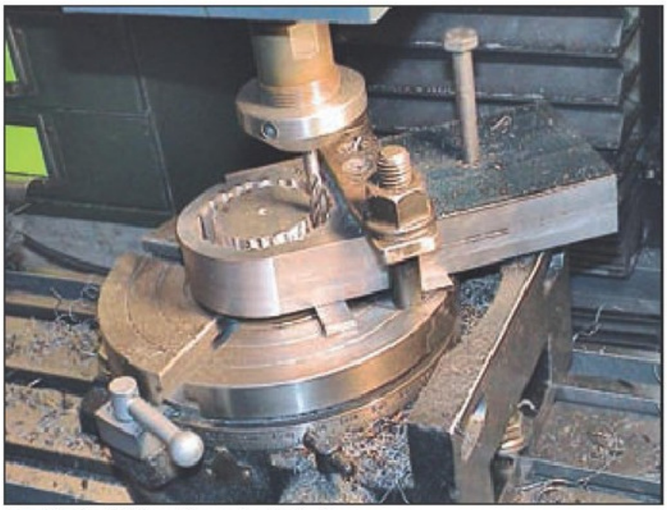
Place the clamping cotter through the hole, and from the side with the 6mm clearance hole in it, insert a 6mm bolt and washer with a short bush round the outside of the cotter in such a way that the cotter is firmly held in the hole (**photo 6**).

Place the block in the machine vice - or clamp to the milling machine table tapping securely down on parallels as in photo 6. Start by drilling the column hole through the block using first a centre drill and then successively larger drills until you have reached either your largest drill or the capacity of your milling machine. Bore out until the hole is a nice CLOSE fit on the column. As you approach the finished size, do take several passes at the same setting to ensure that all the spring in the tool has been eliminated. As the work progresses, you will be able to see, and indeed hear the change in note as the boring operation cuts into the brass cotter. You can just see this in the photo although my cotter was steel. If the boring operation breaks into the central hole in the cotter and touches the bolt, then you have got your measurements wrong or one of the holes is not at right angles.

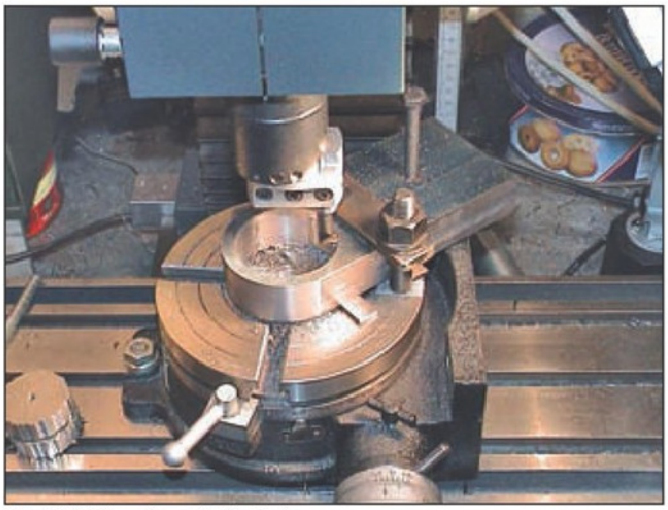
Once you have finished this hole, you may, at this point, also drill and tap the hole through the block which will act as a nut on the main head raising leadscrew. Move the table 23mm to the left and drill through the block at the tapping size for the thread of the head raising screw. I used $^{5}/_{16}$in. BSF for this and drilled 6.9mm, but fully metric engineers will probably prefer to use an 8mm x 1.25 thread. The thread is unimportant, but a fairly fine thread gives a nice slow adjustment of the head on the column.

Finally, mill the rebate on the block, turn over and mill the rebate on the other side. The dimensions of these are not particularly critical, so long as the fine adjustment screws can eventually bear on the central portion. **Photograph 7** shows the two fine adjustment bars with the rebated part of the block visible between them.

In use, there is not much clearance between the back of this block and the back of the back frame pivoting round it. This can mean that the back of the block can foul the back of the pivoting frame when substantially raising or lowering the grinding head using the fine adjustment screws. I have shown a curve on the drawing and I suggest that you may like to curve the back of the block in a vertical curve to increase this movement. I simply milled an angled chamfer on the top and bottom edges.



10. Chain drilling the spindle hole.



11. Finishing the spindle hole.

Constructing the pivoting casing

This consists of a steel cage made up of the left and right side frames and the back frame, which holds both the motor and grinding spindle and pivots about two hardened steel points in the centre.

First cut two lengths of 76.2mm x 12.7mm flat steel bar to finish fully 171.45mm long. These will make the left and right side frames. Also cut a length to finish 76.2mm to make the back frame. The side frames are almost identical in layout, except they are handed by the countersinks on the setscrews holding the sides to the back. Additionally, the kidney shaped hole is only required in the right hand frame as the clamping cotter protrudes through this to allow tightening of the cotter using a ball handle. Mark out the required holes on one piece only and clamp the two side pieces together. Drill and ream the two ½in. holes which will hold the fine adjustment beams and insert two silver steel dowels 20mm long into the holes. This ensures that from now on the two sides will stay in alignment whilst being machined together. Drill the pivot holes 8.4mm tapping size for ⅜in. BSF. Pilot drill the centre of the large hole for the grinding spindle right through and drill the setscrew holes to fasten the sides to the back piece, but only drill at M6 tapping size with a 5.2mm drill. These holes will be opened up to 6mm after spotting through onto the back frame and will be countersunk on opposing sides when the two sides are separated. What we are aiming at eventually is illustrated in **photo 8** showing the head unpainted before fitting the guards and motor. I always feel that a photo is often clearer than drawings.

If you wish, at this stage you can tap ⅜in. BSF through both pivot holes whilst clamped together and insert a ⅜in.BSF bolt to ensure that everything stays in register. The next task is to shape the sides and I started by creating the step where the clamp screws will clamp the spindle in place (**photo 9**). I sawed the corners off the two sides and then milled down to the outside of the clamping circle whilst the parts were held together in the vice. One of the short silver steel dowels can be seen holding everything in register. Once this is completed, the side frames should be mounted flat onto a rotary table to cut the curved ends of the pieces. In order to do this, fit a spigot into the centre of the rotary table of such a diameter that it will locate the pilot hole in the centre of the large hole. Finally bolt the stack onto the rotary table (**photo 10**). You can clearly see the ⅜in. bolt holding the stack together.

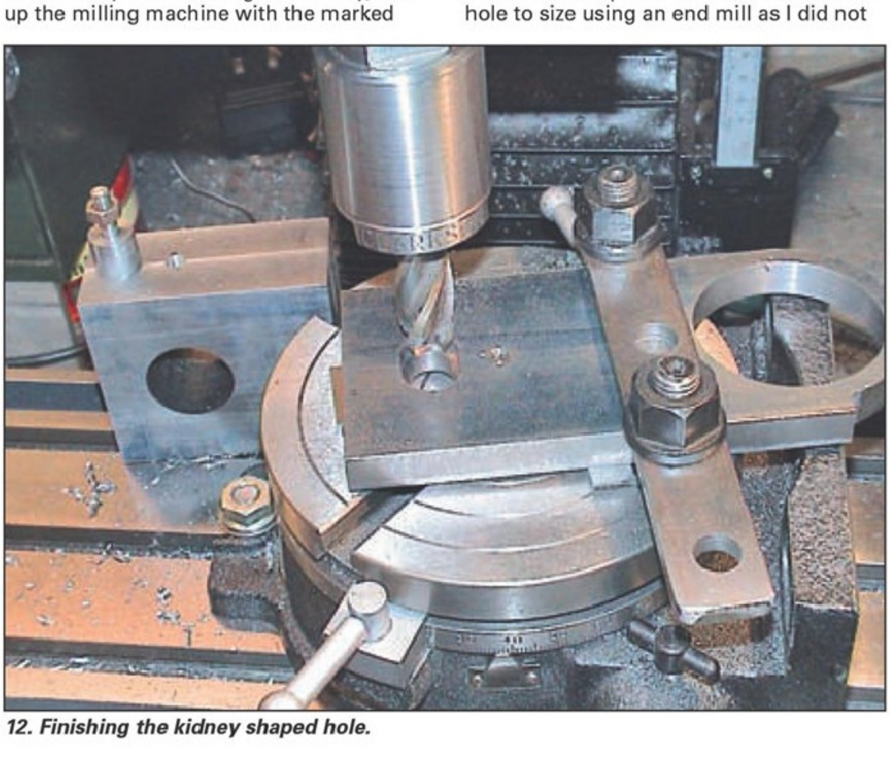
Using a large end mill, mill the curve on the outer end of the stack, being particularly careful to rotate the rotary table against the cutter rotation to eliminate climb milling. You will have to be careful or set stops when approaching the step which has already been formed.

Once the outer contour is completed the next task is to bore the large hole for the grinding spindle itself. This can be done by drilling and then gradually increasing the size with a boring head, but in order to save time I chose to chain drill the circle and then join the holes using a slot drill (photo 10). This proved to be quite a vicious operation when breaking through the drilled holes and I wished that I had chosen to slot drill all the way through, instead of chain drilling.

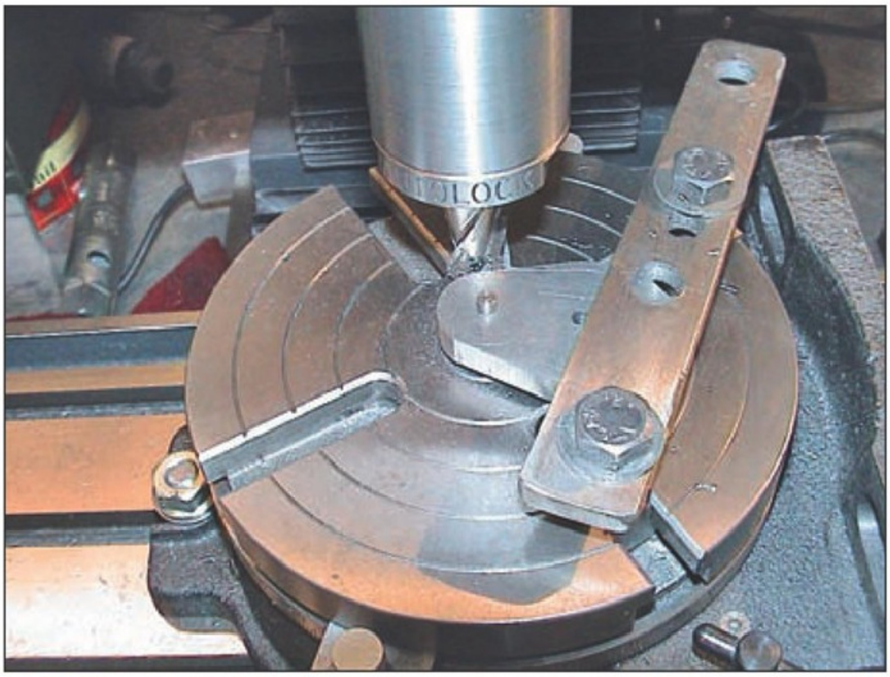
Once the majority of the circle has been removed by chain drilling in this way, line up the milling machine with the marked out circle using the boring head as an alignment tool and then finish off the hole using a boring head (**photo 11**). Of course if your lathe is big enough you can bore this out on the faceplate, but I did not fancy swinging all that weight around.

While you still have the rotary table on the milling table, and the milling head is lined up with the centre of the rotary table, separate the two sides and identify the right frame. Mount that part on the rotary table, lining up the centre of the table with the ⅜in. BSF pivot point hole, as shown in **photo 12**. Rotate the rotary table so that the long side of the part is parallel to the X direction of the milling table and move the table in the X direction by 20.5mm. This point will be the centre of the kidney shaped hole clearing the cotter clamp. Mill the kidney shaped hole with a slot drill by rotating the rotary table. The amount of angular rotation is not critical providing it gives enough angular movement for the final fine adjustment of the grinding height to work. The slot drill used should give easy clearance on the clamping cotter and I used a ⅝in. cutter.

You will see (photo 12) that I finished the hole to size using an end mill as I did not



12. Finishing the kidney shaped hole.



13. Shaping the pillar top swivel.

have a suitable slot drill. In the picture the rotary table is positioned at the end of the kidney shaped hole i.e. not with the part in line with the X travel. Also in the background you can see the semi finished clamping block complete with fitted clamping cotter and showing one of the pivot points.

Ensure that the central clamping block is finished in order to use it during assembly of the whole unit.

Assembly of the Pivot Casing

Assembling the unit is a bit fiddly, but it is important to get everything right and square if the final unit is to be accurate in use. I would suggest that you follow my procedure as follows:-

First I made the two pivots that screw through the sides and upon which the whole casing will pivot, motor, spindle and all. These could be made from silver steel, threaded ⅜in.BSF turned to a 60deg. point and then hardened and tempered. I cheated and cut sections from ⅜in.BSF high tensile steel set screws, first removing the heads. I then formed the pivot points by turning the set screws in the lathe, holding them in a collet and using a tungsten carbide tool to turn the point. Finally I cut a screwdriver slot in the end and provided locking nuts by thinning down commercial nuts.

Secondly I made the two fine adjustment bars and fitted 3mm grub screws into the side frames to hold the adjustment bars securely (photo 8). I have shown these to be made of silver steel. They do not need to be hardened, but silver steel is a good way of getting accurately ground bar that is a good fit in a reamed hole.

I then clamped both side frames to the central block with the pivot points loosely fitted into the sides. I clamped the sandwich of side/central block/side together with the whole lot resting on a surface plate and screwed in the pivot points tightly. It is one of those occasions where you do not know how tightly to clamp things. If the clamps are too tight, then the pivot points will not align the three items correctly. Once I was sure that everything was in alignment, I fitted the two adjustment bars and secured with the grub screws.

Finally, I inserted the back frame. This needs to be a tight fit so that inserting the back just, ever so slightly, spreads the two sides apart. Once I was happy with that, I clamped the sandwich tightly and used the 5.2mm holes in the sides as a template to drill the tapping holes into the back frame. Once this was done the assembly was taken apart, the holes in the back tapped 6mm and the holes in the sides opened out to 6mm diameter and countersunk for 6mm cap head set screws. Before re-assembling the pivot casing, I drilled and tapped the two fine adjustment bars for the fine adjustment screws. It is advantageous for this thread to be a fine one and I used ¼in. BSF for mine as I had the necessary taps. However, I would state that it is better to use a left hand thread here, if you can get hold of a LH tap - and also a LH die if you don't fancy screwcutting left hand threads (away from the chuck). My threads are all RH and I have learned to live with that, but the fine adjustment is not really intuitive in use and if I did it again, I would try to use a LH thread. With a RH thread, screwing the top adjusting screw DOWN, RAISES the grinding head which to my mind just feels strange. The purpose of the lower adjusting screw is to lock the whole pivoting head action rigid once the correct position has been found with the top screw.

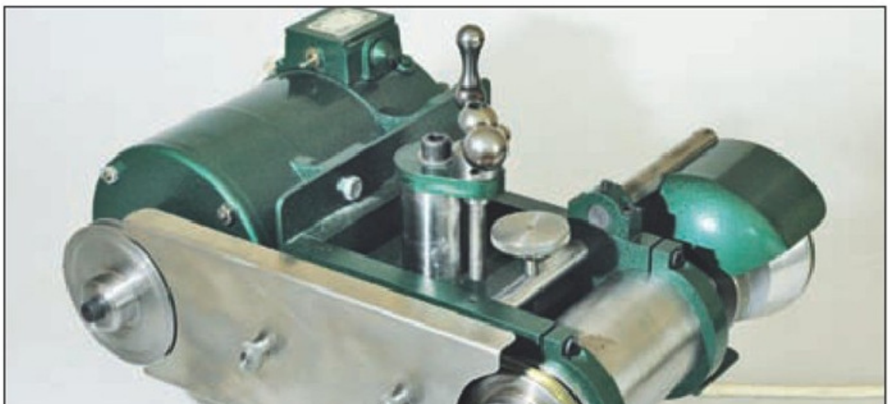
Clamping the spindle

With the assembly set up as in photo 7 clamp the back plate down to the milling table, with the assembly set in line with the table. Mark where the clamping screws for the spindle should go and using a 4.4mm drill, drill a hole 25 mm deep, - tapping size for a 5mm set screw. When you have done the first one, keep the table in the same position and open up the top of the hole with an 8 mm slot drill for the cap head. Take this down into the flat area for say 3 mm in order to partially countersink the set screw. You will see from the photo why we must use a slot drill or end mill for this as it cuts into the outer curve of the clamping hoop. Treat the second screw in the same way.

Measuring from the table, work out the centre line of the spindle hole and split the clamping strap along the centre line on both sides with a slitting saw. Use a reasonably thick saw to give space for the arrangement to clamp the spindle and ensure that the table is moving from right to left if set up as in the photo to ensure that you do not "climb mill" i.e. the table should move in the opposing direction to the saw movement. When both sides have been slit, open up both holes with a 5mm drill down to the level of the split and tap the lower part of the hole M5.

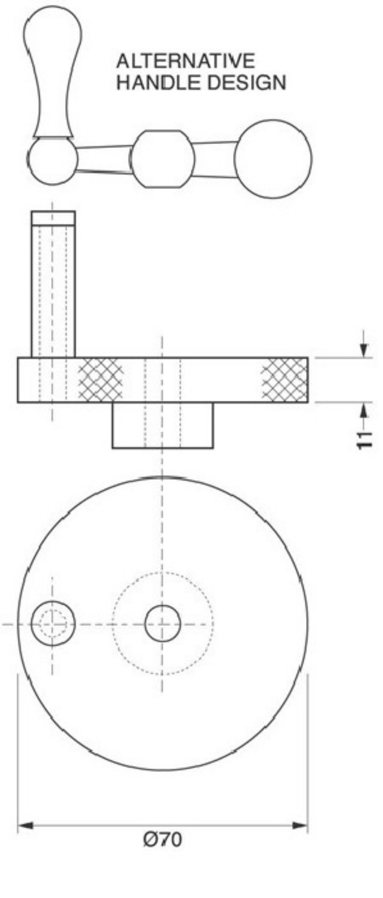
Head raising screw and pillar top swivel

How you make the outer shape of the pillar top swivel is up to you. It can be shaped by sawing and filing, or done on a rotary table (**photo 13**). Start with a piece of mild steel 55mm x 40mm x 8mm thick and mark out the centres of the holes. Drill these to a nominal size such that the piece can be mounted, by each hole in turn, on a



14. Motor drive and guards.

Fig. 15



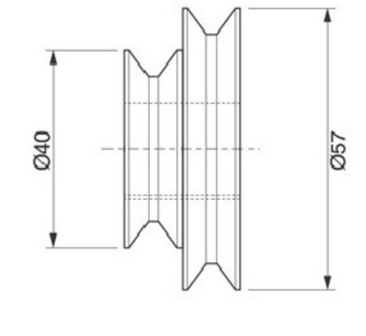
HANDLE, TO SUIT

mandrel held in the centre of the rotary table. Clamp the piece and then mill the curves, taking care to ensure that the rotary table rotation is always feeding the cut on - i.e. not climb milling. Once this has been done, move to the lathe and clamp to the lathe faceplate, centring the hole on the large end. Simply pushing the tailstock into the hole is probably good enough. Open up the hole to nearly 12mm and then finish with a 12mm reamer. Then using a boring tool bore a recess to a nice fit on the end of your column and to a depth of 4mm.

The 12mm diameter bush with a 6mm hole should be just a fraction thicker than the swivel plate so that when a setscrew with a large washer clamps the two parts to the column, the bush is captive and the swivel plate can still swivel around but with no play whatsoever.

The purpose of the head raising leadscrew is to raise the whole head up or down the column. It is a straight turning job in mild steel. However you should bear in mind that the clamping block into which this will screw is in effect an enormously thick nut and therefore the thread on the screw must be accurate. I screwcut the thread on the lathe to almost full depth and then finished it off by running a die down it. This guides the die and eliminates any chance of a drunken thread. Any misfits may be helped if necessary by opening up the hole in the block to clearance diameter for part of the way thus effectively "thinning the nut". I made two bushes to fit on the screw either side of the swivel plate in order to take the thrust in either direction. The lower one is very short of room being close to the main column, and is pinned to the adjusting screw. The top one is held by a 5BA grub screw. I used a handle from an old scrap cross slide which was a push fit on the shaft, but I show an alternative design (**fig 15**) on the plan.

Fig. 16



SPINDLE PULLEY

Fine adjustment screws

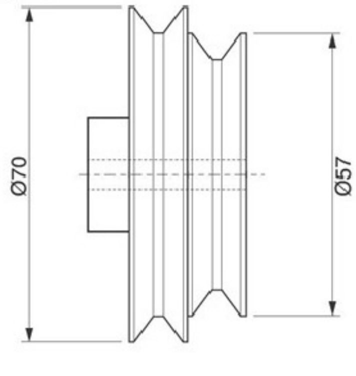
The purpose of these items is to swivel the motor and spindle about the pivot points, thus giving a fine height adjustment without losing register by unclamping the head from the column. I used ¼in. BSF but I suspect that most people will use 6mm for these. As previously mentioned there is an advantage to using a left hand thread for a more intuitive feel. I made these in two pieces. I turned the heads with a blind hole in the centre and knurled the edges to create a good gripping surface. I then turned the threaded part leaving the last 6mm plain, which was then fixed into the blind hole in the head using two part epoxy resin.

Motor drive, pulleys and guards

My Tiplap grinder came with an Induction split phase motor by Carter Electrical and the plate reads G8/212 ⅛ HP 2800 RPM. so I used that for the grinding head. I cannot find any up to date reference on this motor. I also have a Parvalux motor ref M3 ⅛ HP 2800 RPM with an external capacitor which gives a better starting torque. Both are of similar size and both are reversible which is important. A motor plate was cut from 3mm steel plate 120mm x 160mm and the motor was attached to this using set screws and nuts through the plate. The plate was then attached to the back frame using cap head set screws into holes tapped into the frame. These cap head set screws need to be carefully placed so that the set screw positions are not covered by the motor feet. The bolts holding the motor to the plate came above and below the back frame as the feet mounting points were 95mm apart (**photos 14** and 1).

The two step pulleys (**figs 16** and **17**) detailed on the plan give spindle speeds of 2800RPM and roughly 5700RPM respectively and the drive is through bond-a-band round belting which can be made to any length in the workshop. Unless driving grinding points, I almost always use the slower speed setting. If I need the higher speed, the motor

Fig. 17



MOTOR PULLEY

struggles a little on starting up but runs effectively after that. I think that the Parvalux motor with the higher starting torque is an advantage there.

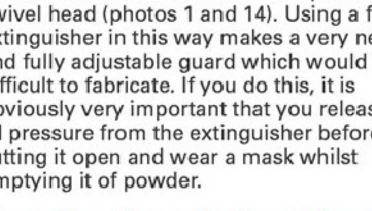
Guarding the drive will depend upon your arrangement, but I made a stainless steel channel which is supported on two posts screwed into the side of the swivel head. The guard is fixed with two knurled finger nuts for easy removal and fixing without tools (photo 14).

For a guard for the grinding wheels, I used an old redundant small dry powder fire extinguisher 112 mm diameter. I sawed the top off the fire extinguisher and cut away an access segment. I then mounted it on an arm supported by a small plummer block type of fixture made from steel and mounted on the top of the swivel head (photos 1 and 14). Using a fire extinguisher in this way makes a very neat and fully adjustable guard which would be difficult to fabricate. If you do this, it is obviously very important that you release all pressure from the extinguisher before cutting it open and wear a mask whilst emptying it of powder.

Mounting the grinding wheels

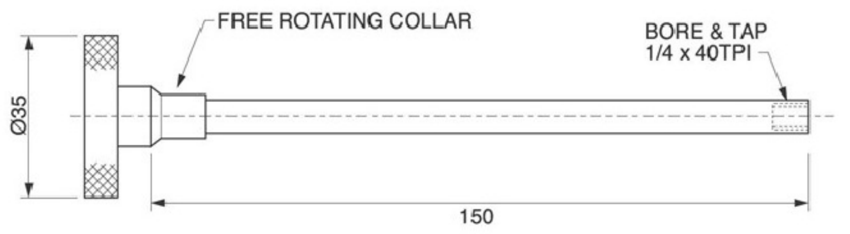
The advantage of using the basic spindle from the 'Spindles Book' as the grinding spindle is that it is very adaptable. It carries a nose that is identical to the Myford ML7 and it has an internal 2 MT fitting with a through bore. This means that you can mount your grinding wheels using 2 MT collets, Myford collets or a variety of other methods. I started off by using Professor Chaddock's method of mounting the Quorn wheels. This involves a 5⁄16in. arbor that widens out into a 40 Deg. taper to locate into the grinding spindle and is secured by a drawbar with a ¼in. X 40 TPI thread. I made an adapter to go into my 2MT socket and bored it to fit the Quorn arbor (**fig 18**).

Fig. 18



MORSE TAPER ADAPTER

Fig. 19



DRAWBAR

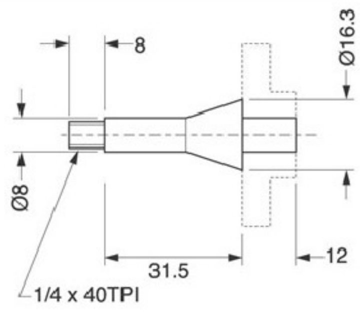
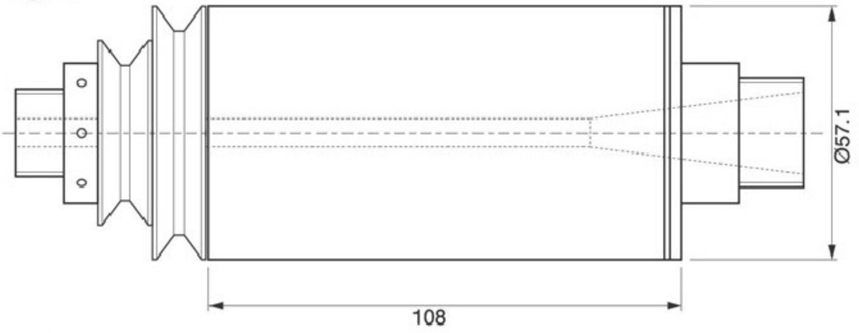


Fig. 20 ARBOR

Fig. 21



GRINDING SPINDLE

BASIC SPINDLE FROM 'SPINDLES WORKSHOP PRACTICE SERIES 27'

However as I needed quite a few grinding wheels, I did not fancy making a lot of arbors with a 40 Deg. taper and I eventually settled on mounting my grinding wheels on a 5/16in. plain arbor with a 40TPI drawbar end and using a Myford 5/16in. collet on the nose of the spindle to locate the arbor. This means that I only need to prepare 5/16in. plain arbors and when I wish to mount a new grinding wheel, I fix a flange onto the arbor with 2 part epoxy. When dry, I run the arbor in a collet in the lathe to finally true up the flange face and mount the wheel.

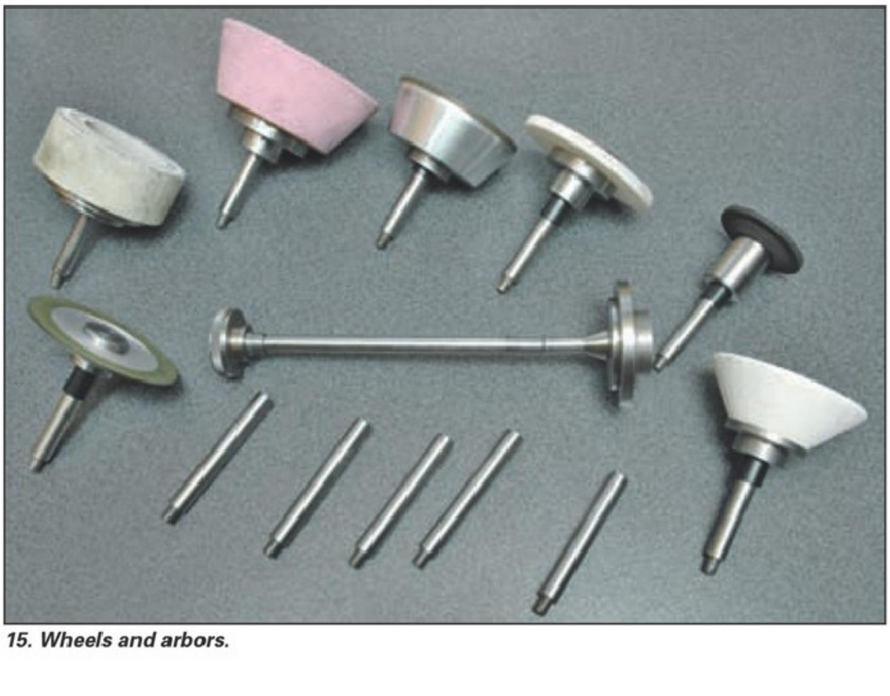
However, I realise that most readers will not have Myford collets (although plain 2MT collets would work) so I have drawn on the plan, my original method using a drawbar (**fig 19**) a Quorn type arbor (**fig 20**) and the 2 Morse Taper socket adaptor. I have drawn it using an 8mm arbor rather than my imperial system. Note the drawbar has a loose locating collar on the bar which locates in the chamfered end of the bore in the spindle. The measurements of the MT adapter show the larger end at 17.5mm and, with a 2 Morse taper, this should cause it to pull in flush with the end of the 2MT socket in the spindle. You should fit this first with an arbor and if necessary adjust the length of the loose collar on the drawbar to ensure that the arbor is held firm. The outline of the spindle is shown in **fig 21**.

Where size permits, I prefer to clamp the grinding wheels using three setscrews on the flange in order to eliminate any possibility of anything unscrewing when running the spindle counter clockwise. However, I have many grinding wheels held by only a single set-screw and I have never had a wheel come loose.

Photograph 15 shows the drawbar with a Quorn type arbor and flange. Note that the arbor is partly unscrewed to show the join, as otherwise the drawbar and arbor appears to be one piece. The photo also shows a selection of wheels mounted on plain arbors and some pre-made silver steel arbors ready for future use.

In use the head can be removed from the column and fitted inverted to more easily present the edge of a disk wheel to the work, as can be done with the Quorn. Actually I have never used it in this way.

I hope that this article will give some inspiration to those readers who would like to make a tool and cutter grinder of their own design and are hesitant to spend the substantial amounts of money required for some of the casting kits. The making of this unit gave me much pleasure and it is simply a dream to use. ■



15. Wheels and arbors.

HARRISON M300 WITH DRO

Keith Wilson fits a digital readout

■ OVERVIEW

Having purchased a Harrison M300 (**photo 1**) and converted it to inverter power there was one more step to take and I have now fitted it with my standard Newall based DRO system with a Newall C80 Display (**photo 2**). My previously DRO fitted machines had all used Newall C80 displays and I decided to go down the same route again.

1. The Harrison M300.

Power circuit

When rewiring for the single to 3-phase Inverter, I installed a Miniature Circuit Breaker and line socket within the left hand pedestal, (which houses the power control circuits etc.) to enable this later DRO update. From a mechanical point of view, it has not been necessary to drill and tap many threaded holes (five only) since there are several conveniently placed locations, with tapped holes on the standard machine, which could be used without additional work being required. On the rear face of the bed there are numerous threaded holes, intended no doubt for the hydraulically controlled copy device, but this will never be fitted in my case.

My previously DRO fitted machines, Myford S7 Lathe, 3 axes, Boxford VM30 Mill, 3 axes, Bridgeport Series 1 Mill, 3 axes, had all used Newall C80 displays and in the case of the Myford and Boxford had used my own design of miniature mounting hardware. By a fortunate coincidence, the M300 can also usefully employ the same miniature mounts to carry the transverse Z-axis scale (**photo 3**). I have used a Newall C80 display taken from the Bridgeport and used it here on the M300 (photo 2). This may not be the most economic approach in having three available displays but it gives me security of use, with no lost time changing them around when working between machines. An overriding benefit of using the Newall products is that the component parts of the "Microsyn" system are very compact and do not intrude upon the physical operation of the machine to any great extent. The Scales themselves are a carbon fibre tube fabrication and come with a Calibration Chart showing the true accuracy of that particular scale. All component parts are immune to all the usual fluids involved with machine tools.

Cable chain

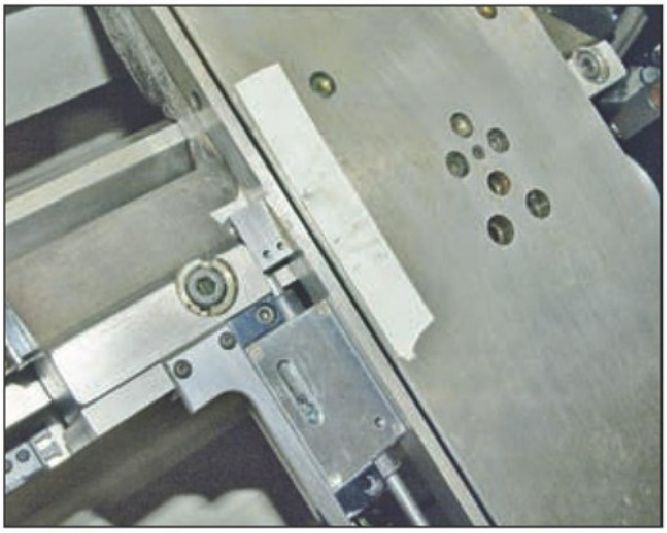
There is, in this Harrison M300 application, one common mounting plate carrying the X and Z axis Read Heads with the cables being carried away using plastic cable chain to avoid the armoured cables just hanging about below the bed. There is not

2. The readout console.

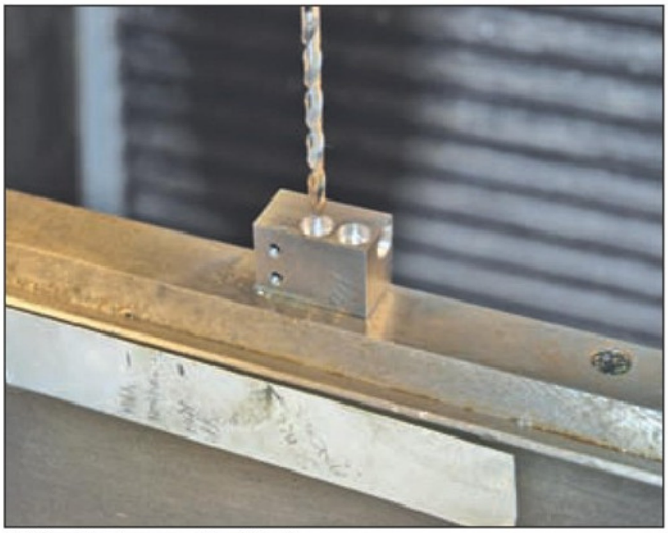
3. The miniature mountings.

4. The cable chain.

5. The read head mountings.



6. The X axis scale.



7. The X axis mounting block.

any physical reason to carry the cables in this way, but it does mean that the installation is neat, uncluttered and looks more professional, the three previously equipped machines also have cable chains installed (**photo 4**).

Photograph 5 shows the component parts made for the Read Head mountings, including the strengthening bracket machined from the solid using BMS square bar, (fully annealed of course before machining), thus firmly aligning the X-axis Read Head which would otherwise be secured only by one M4 cap head screw. This photograph was taken prior to chemically blackening all component parts as can be seen on the final installation photographs. On the plate, vertically mounted on the rear face of the lathe carriage, again using existing tapped holes, the holes for the Z-axis are slotted to provide final alignment with the scale, the scale itself can be aligned freely in the required two planes by adjustment of the miniature mounts. The Z axis scale is secured at one end using a drilled stainless steel ball held within the union nut and at the other; the scale passes through a polyethylene "olive" bush, which just lightly holds the scale in place. Across the top of the scale position linking both end mounts is a strip of 25mm x 3mm stainless steel, secured to each mount with two M3 button head socket screws. This stainless steel strip provides a substantial and rigid physical protection to the scale mounted below.

Because it is short, the X axis scale is mounted only at one end directly on the side of the cross slide, using a multi-drilled block. All holes in the block are 3mm for M3 clearance with some counterboring for cap head screws. The only adjustment provided here is get right the first time or shim to fit! This is not as difficult as it may seem. Having made the end mount block, a guide pin is made from 0.250in. BMS rod with a 3mm stepped down diameter at the end. This is slid through the pre-aligned read head to hold the block in place and the block is fixed temporarily with a quick setting Araldite adhesive to the side of the cross slide. Some side packing is necessary whilst the adhesive sets (**photo 6**).

Remove the guide pin and read head, remove the cross slide from the carriage and set in an upright position in the milling vice. Find the centre of one of the 3mm diameter mounting holes and drill through into the side of the cross slide. Note the mill X and Y coordinates, check the remaining hole and drill, or first remove the block and offset for the 2nd hole using the same hole centres as used when making the block initially. Tap the two holes M3 using a "squaring block" or similar aid to keep the tap perpendicular (**photo 7**).

As was the case with the Z axis, the X axis is also provided machined from 25mm X 3mm stainless steel strip for the physical protection of the scale. This is attached to the single end mount, again with two M3 button head socket screws. However, because the Scale is single end mounted, it is necessary to add a further support for the rearward end of this strip and this is accomplished by a small plate which is attached to existing holes at the back of the cross slide.

The clamp plates used for the cutting oil ("Suds") pipe has a small area cut away on its forward face to accommodate the strengthening bracket where it intrudes under the pipe clamp plate, the clamp plates merely needing longer attachment bolts to be provided.

The requirement for a fixed end for the cable chain again makes use of newly tapped M6 holes to anchor the attachment plate to the rear of the bed by means of a plate spanning the two M6 threaded holes fitted with a bracket. The armoured cables are lead away below the chip guard and routed around to the column mounted on the rear of the headstock gearbox, holding the Newall C80 display.

8. The console mounting.

The Newall C80 Display has been attached by a standard bracket consisting of two balls linked by a double "figure 8" clamp plate, affixed to the top of a square tube column, this in turn is attached via three M5 tapped holes in the rear of the headstock gearbox. Viewed from the rear, the gearbox-casting wall is thick enough on the right hand side to allow the use of three M5 cap head screws without breakthrough into the gearbox, provided care is taken to align the threaded holes with the threaded hole on the right hand rear corner which holds (one of six such threaded holes) the gearbox top cover plate, as well as limiting the hole depth (**photo 8**). Having carefully marked out the positions for the threaded holes, using the pre-drilled square column as a guide, the use of the "squaring block" made from square BMS bar, pre-drilled with various holes to suit tapping holes sizes and tap diameters is a great aid to keeping it all square! The M5 clearance holes are in the forward face only with cap head clearing holes on the rear face, a short internal pillar was used at each location to spread the load more widely.

9. The X axis scale awaiting its guard.

Photograph 9 shows the final assembly ***without*** the scale cover in place and was followed by alignment in accordance with the Newall Installation Guide. Calibration checks showed that the readout values corresponded to the dial settings noted on the cross slide handwheel sets "diameter" readings. Cross slide backlash was found to be 0.012mm (0.00047in.) and free moving.

As a final point, fortuitously the headstock facing side of the tailstock base is already tapped M 8, midway between the shears. Put an M8 x 20 Cap Head screw into this hole, fill the socket with a short length of plastic rod to act as a buffer and it will then touch the Carriage below the DRO Scale, this will ensure that the tailstock never touches the Scale and hence removes this potential source of damage.

It may well be that at a later date I will fit a scale and read head to the topslide (See MEW Issue 150 for a view of such a device fitted to a Myford Super 7). In this case the topslide is somewhat larger and hence more amenable to such a fitting. ■

■ MEW RESOURCE BOX

References: -

Digital Read Out Scales and Heads - Newall Measurement Systems Limited, Technology Gateway, Cornwall Road, South Wigston, Leicester. LE18 4XH.

Cable Chains (Size 0130.15.28) Metool Products Limited, Unit 1 Mercian Park, Mercian Close, Ilkeston, Derbyshire. DE7 8HG

AN ELECTRICALLY OPERATED SPINDLE DRIVE CLUTCH

Ken Wilson modifies the drive to his lathe

■ OVERVIEW

Whilst many lathes used by Model Engineers, such as the Myford Super 7, have a manually operated clutch to disconnect the drive at will there are many other machines that do not have such a facility as standard or may only have been retrofitted with one by their owners. Ken has set to and designed a clutch to fit on his new Harrison M300 lathe (**photo 1**). The idea could be applied to many other small lathes and even milling machines.

1. The finished clutch.

2. Myford Super 7 clutch plates.

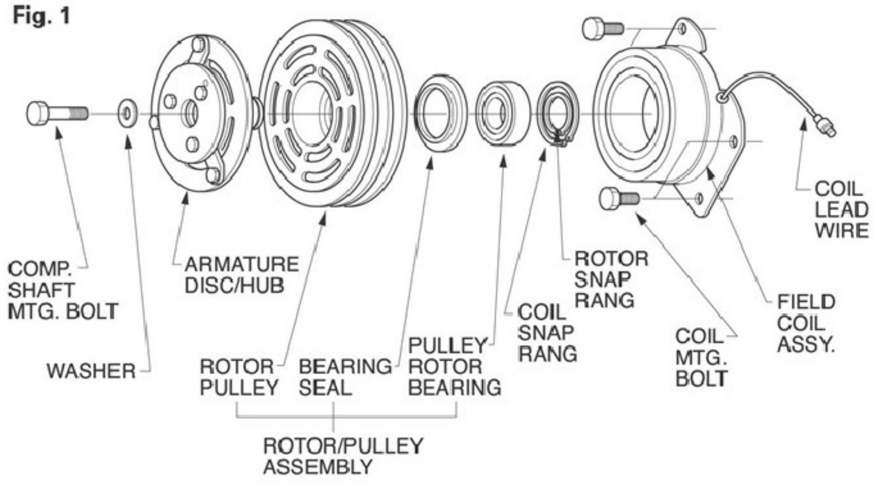
The Myford clutch

This consists of a countershaft, being part of the swing shaft assembly and has a twin vee pulley carried on its own pair of ball bearings, (which when in the declutched, no drive position, is freely driven) and a coned clutch plate (**photo 2**).

The coned clutch plate is held against the coned face part of the twin vee pulley, which selects the primary speed ranges available. The countershaft is driven by a spring loaded driver plate, of the dog clutch type, operated by a push rod, which in turn is operated by the lever camshaft assembly at the right hand side of the swing shaft assembly.

I have become for many years now used to having this facility on my power cross feed Myford Super 7, this being extremely useful during screwcutting or when working to a shoulder. Having now in addition, purchased a larger industrial lathe, a Harrison M300, that did not include this facility, thoughts turned to how to achieve this useful aid. Some modern lathes of similar size, a Dalian CDS 6232, include a wet (oil) multi-plate mechanical clutch, similar to a motorbike clutch, which is located within the headstock gearbox. Initial thoughts revolved around using similar components for such a device, whether purchased new or devised from a second hand purchase. However, such an approach would have meant much rearrangement of the spindle drive motor, its mounting and additional support for other bearings, as well as the operating levers etc. The concept of a lever operated single plate was dismissed on the basis of complexity in the space and location available and the power to be transmitted.

Fig. 1



Electrical clutch

Approaching this problem from a different direction, an electrically operated clutch, similar to the clutch system used for driving the compressor used for air conditioning on a car from the engine belts system, would or could be both simple to install and operate.

There are a wide range of drive clutches available in the market, many far too large (and expensive) for our use. However, after searching for a more suitable supplier or parts source, the following system has been adopted with the minimum of change to the standard machine. Everything has been done and made so that the machine could be converted back to the original standard without any problems, i.e. nothing has been changed on the machine, only additions and/or substitutions have been made (and hence they may be easily removed).

A number of considerations must be taken into account. The unit must be sized to deal with the motor torque, it must be compact, it must involve the minimum of change to the original machine and hopefully be easy to set up and use. To avoid the use of additional bearings and to minimise additional loading on the motor bearings, the overhang of the belt driveline centres should, if at all possible, not be changed adversely or indeed, at all. This design approach is not dependant upon being used on the same lathe as mine; it is adaptable to other makes and types of machines if you have the space and the desire to make it work in this manner.

Similarly it should be possible to make the whole of the clutch assembly from scratch without recourse to commercial parts. It is all a matter of choice, time and cost.

This project has been applied to my Harrison M300; the original standard belt setup is as shown in **photo 3**. The M300 spindle motor is a 3hp 2.2kw size 90 frame machine. Motor shaft dimensions for this motor are 24mm diameter x 50mm long with a standard 8mm keyway and the shaft end is bored and threaded M8. The belt pulley is aluminium alloy and measures 35mm wide and 110mm

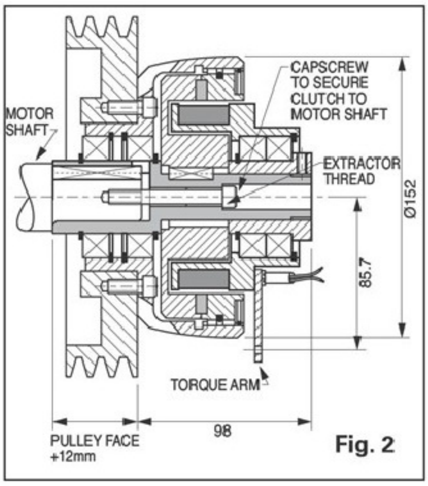


Fig. 2

diameter with twin grooves for the standard A30 belts.

Motor mounted clutch assemblies are available to fit on the end face of the motor, to fit on the shaft (which can increase the bearing load due to overhang) or as in this case are totally shaft mounted with the clutch outboard of the pulley, thus keeping the bearing load approximately the same. There is a requirement to physically stop the clutch coil from rotating but being ball bearing mounted this is a relatively small torque load and therefore does not require too substantial an anchorage. The clearance between the stop peg and the anchor slot can be filled with an elastic material to damp any possible vibrations in use.

Figure 1 shows the General Arrangement for an air compressor clutch and **fig 2** shows a motor mounted pulley clutch. Such a clutch, with the motor shaft extension keyed using the original pulley key, can be attached by means of a cap headed screw to the threaded hole at the outer end of the shaft. The clearance hole in the shaft extension is threaded one size larger to provide an extractor thread should the extension need to be removed from the motor shaft at any time.

Foot brake modification

Before commencing with the additions to the Harrison M300 it is necessary to make a minor change to the Footbrake operating rod location. As standard, viewed from the Tailstock end, the rod crosses the face of the spindle pulley (photo 3). After drawing the required details at full scale, a temporary adaptation was made to the rod assembly to check the new location, prior to cutting away the redundant length. In order to remove the rod, it is necessary to remove the lower bearing from the footbrake lever extension and then to slacken the two M10 nuts, located beneath the swarf tray, which secure the lever extension to the footbrake arm. In this way sufficient clearance may be obtained in order to move the lower joint pin from the bearing hole in the footbrake lever extension arm. Failure to slacken the retaining nuts will prohibit the required clearance for easy removal. The offsetting blocks are made from 0.750in. square mild steel drilled and reamed 10mm at the required rod separation centres and tapped M6 on the ends (one per block) for temporary grub screws. Set the blocks square on a surface plate, lock the grub screws and drill each joint 3.0mm and press a spring pin or roll pin into each block. The whole will now remain square and true and the redundant length can then be cut away. Replace the operating rod in its normal location and remake the connections.

A word from the wise, whilst you are doing this and before you start fixing the operating rod replacement in position, make a 20 X 10 X 8mm thick washer and insert this between the connecting stud and the upper of the two M10 nuts on the lower end of the operating rod. In this way the final tightening of the lower two M10 nuts may be accomplished by using an open-ended spanner in the very restricted space at the bottom of the left hand pedestal. Without the spacer you cannot do this since the nut is almost completely hidden behind the footbrake lever extension arm.

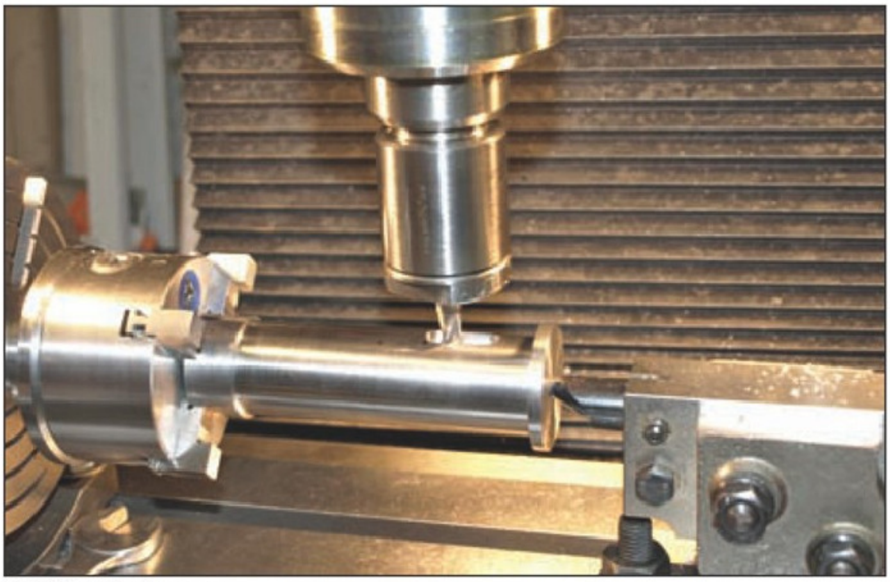
Motor mounting

On the Harrison M300, the spindle motor is carried on a motor mounting plate using soft washers under the four mounting feet and is aligned vertically by two adjusting screws, the whole being attached with three bolts through three slots to the rear of the bed casting below the headstock gearbox. In order to align the drive belts with this new arrangement, the motor as a whole could be moved backwards away from the end of the shaft, i.e. to the left, by 15 mm viewed from the front of the bed. This may be required because the clutch assembly now occupies the whole of the 50mm of motor shaft and hence the centreline of the drive belts would be moved to the left if it were not for the above described change. However, by choosing the right dimensions for the motor shaft adapter and by the use of spacers, the pulley can occupy the same position as before and changes to the motor mount may be avoided. By this means the pulley location is chosen independently of the space taken up by the clutch and the whole assembly may be put into position as required. Because the pulley is now carried on internal ball races so that when declutched (as in the Myford example above) the motor continues to be active but the drive is not passed on via the belts. This will require the making of a new pulley to the same overall dimension to maintain the ratios with a larger bore and undercuts for the ball bearings and retaining internal circlips or a similar arrangement using a stepped abutment and spacers.

Motor extension

The motor shaft extension first needs to be made complete with internal and external keyways. I used EN8DM (212A42), which gives a fine finish and good strength. Initial machining of the shaft was carried out for convenience on my Myford S7 and then it was transferred to the Harrison and finished using my Crawford KC manual multisize collet chuck, which has inbuilt excellent repeatable concentricity. It has a further advantage that as is the case with this stepped shaft, the larger diameter may be accommodated behind the collet, within the spindle bore, when necessary. The shaft needs to be bored concentrically with the outer surface and the bore dimension needs to be such that a snug, but push on fit is obtained. I used a gauge of equal size to the spindle shaft size. Be sure to make the bored hole just deep enough to accommodate the motor shaft, but no deeper; more about this later. A keyway to match the parallel key used on the motor shaft will need

3. The original drive arrangement.



4. Milling the keyway.

5. The component parts.

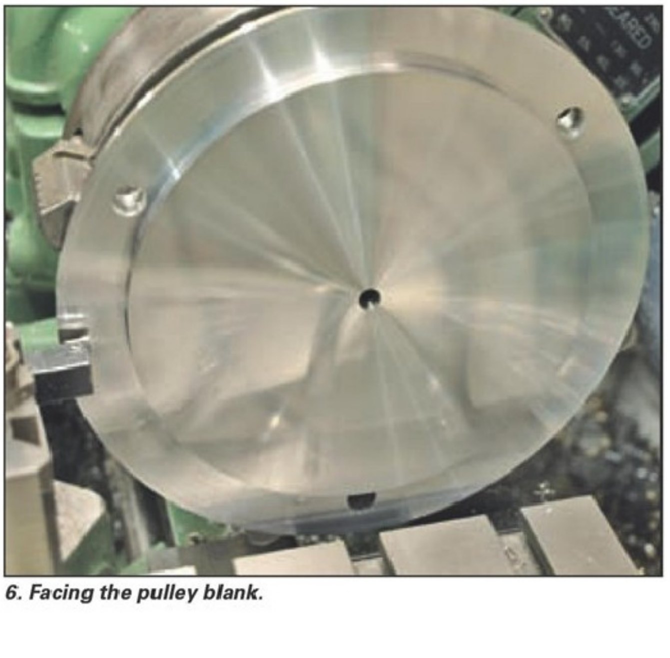
to be broached for part of this depth. In order to provide for maximum freedom of adjustment, I have chosen to make the extension shaft the same diameter for the whole length. A ring gauge of the correct internal diameter is made to check the extension for the pulley bearing internal diameter fit and also for the internal diameter of the clutch bush. This constant diameter may not be necessary on every occasion, but this depends upon the individual circumstances of each application. A key slot is also milled into the outer surface to couple the clutch bush to the extension shaft (**photo 4**) but because of the increased diameter of the shaft, a larger size key has been chosen to match the International Standards for such keys. In addition an annulus 1.6mm wide and 1mm deep may be machined to accommodate the 1.5mm wide external circlip that sets the free pulley bearing position on one side, all other positioning being done by the various spacers set out below. In my own case I used a slightly larger material size than the overall bearing bore (35mm), turning it down to the 35mm diameter but leaving a stepped length to the same position as an external circlip would otherwise have been installed.

The components

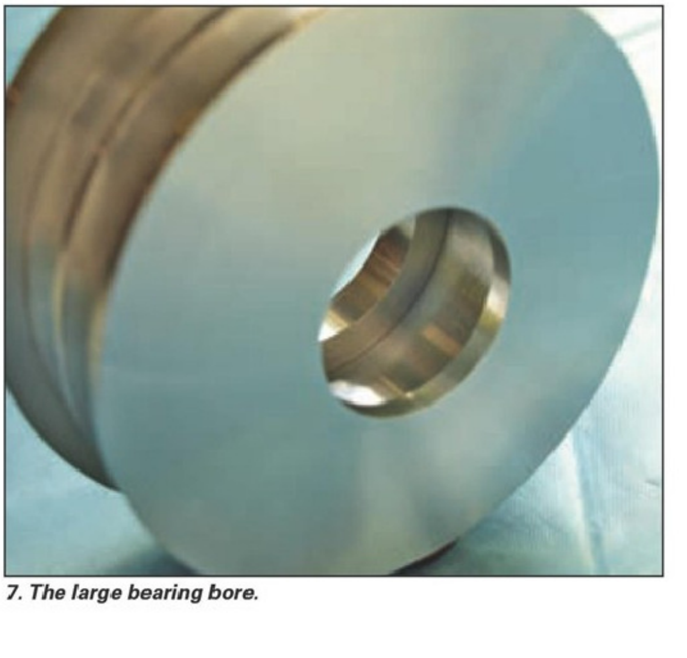
Photograph 5 shows the various parts that are needed for the project. Spacers may be required to move the extension shaft outwards away from the motor, to set the air gap for the clutch faces and a further spacer will be used as a tolerance ring to take up any difference in shaft extension clear of the clutch hub. The whole arrangement is clamped in position by the sleeve. Having set the sizes for the various spacers including the armature standoff spacers to give the initial required air gap size, I can in future merely increase the standoff spacer thickness using shim washers or new spacers to take up any subsequent wear arising from use. Knowing the initial spacer size, 3.4mm in my case, and the initial air gap, 0.15 - 0.2mm, when the need arises to replace these spacers, it is merely a matter of adding the difference between the initial and worn air gap to the initial known spacer thickness to give the new spacers required, These can therefore be prepared in advance of any later refurbishment strip down.

The pulley is a special case; I kept the machine's standard twin Vee pulley untouched for machine reinstatement if required and made another one with a larger stepped bore to take the twin single row ball bearings. By using a stepped bore and the recessed side ring as shown, their outer races are held in the correct position to hold the bearings. You may care to make a suitable bore gauge rather than using the bearings themselves to check the pulley bore, thus keeping the bearings away from the swarf making process that is not kind to bearings. **Photograph 6** shows the initial machining of the pulley blank. The aluminium round bar is mounted in a 4-jaw independent chuck and clocked as true as possible. The outer face is trued and then a facing cut is taken along the bar until all blemishes are removed. The bar is then reversed on the chuck with the now machined transverse face held tight against the chuck jaws. It is now re-clocked to run true, which should be better than 0.0005in. (0.01mm). This can be achieved with patience. Now face the new outer face and take a facing cut along the bar so that it is now all true and square.

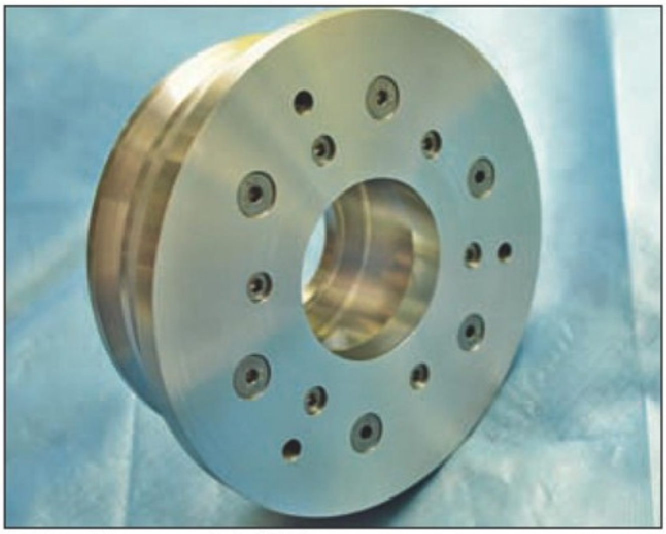
The bar is now bored to clear the full diameter of the spindle extension with a small clearance allowance and then counterbored to give the required bearing outside diameter. The depth in my case is 2 x bearing width + cover plate (3mm). One last boring job to do is to relieve (but not to full diameter) the end face of the full spindle diameter hole axially by 0.008in. (0.2mm) to give some axial clearance to the bearing inner ring and possibly the seal. Finally counterbore the pulley outer face 3mm deep from the recess for the end cover/ bearing clamping plate. Because the pulley grooves are close to the end of the pulley and the armature attaching screws would break through into the outer groove, a 6mm thick steel circular plate could be attached over the end cover. The fixing screws are placed between the cover attaching screws so that they are drilled and tapped into the thicker part of the pulley below the grooves. The outer face is now drilled and tapped for the M6 clutch armature mounting springs and also the holes for the screws securing the end cover. The end cover securing screw clearance holes must be countersunk so as to avoid any contact with the armature springs. As an alternative, a stepped all-in-one cover plate and clutch armature attachment plate can be machined from aluminium



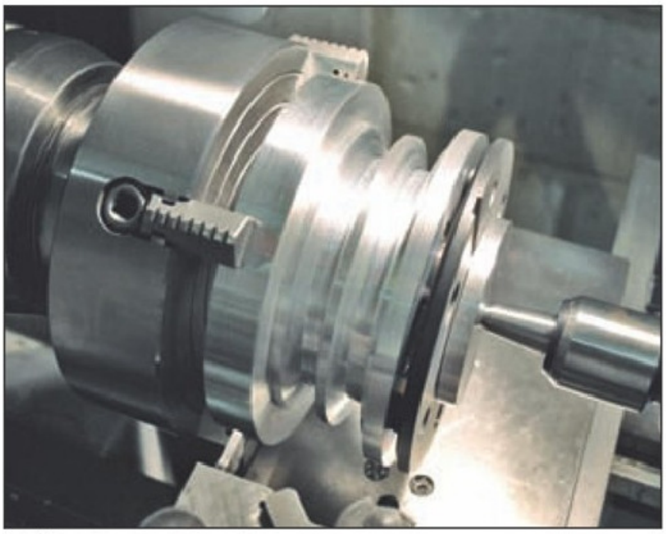
6. Facing the pulley blank.



7. The large bearing bore.



8. The pulley cover plate fitted.



9. Finish turning the pulley.

(the green part in photo 6) which is the route I chose to follow. All drilling is done on a rotary table using the same chuck (unchanged). In my case this was all done by coordinate drilling using the milling machine DRO, having first established the true centre in both X and Y axes. **Photograph 7** shows the large bearing fit bore, **Photograph 8** shows the cover plate fitted over the recess.

Normally I use indexable tool inserts that are intended for steel, but with careful speed selection and lubrication, a reasonable surface finish can be achieved on aluminium alloy. In this instance I have decided to use CCGT inserts which are specifically intended for aluminium (and its alloys) used dry with extra fine results.

Clutch guard

If you have a standard splashguard attached, you will need to make an appropriate sized hole in the left hand sidewall and also to provide a cover, i.e. box in, the clutch assembly, which may be attached to, and also sealed to, the same left hand sidewall and rear panel. As an aid to placing the hole in the correct place, make a cardboard template exactly the same as the left hand end of the splashguard. Pick off the centre line of the spindle with the aid of measurements and physical confirmation. This will give you the centre of the required hole. Do not forget to allow the necessary vertical movement of the motor when fitting or adjusting the drive belt tensions. The required hole will not therefore be round, merely a round ended slot.

This cover may be best made as a plain box form taking up the whole of the angle so as to leave a relatively smooth outline. This cover may be made detachable so as to facilitate access to the clutch assembly without removal of the splashguard as a whole.

Turning the Pulley Vees

The next stage is to cut the Vee for the belts, which in my case are A belts. At the pulley diameter I used, the included angle is 34deg. and the top width is 0.500in. (12.7mm) and the depth is 11.1mm. **Photograph 9** shows the completed pulley prior to parting from the surplus material. Once parted, the pulley may be reversed, clocked true and faced to clean up the parting face and to achieve the design thickness. In order to provide for maximum durability and for cosmetic reasons I have chosen to anodise the whole pulley. The choice of colour is black for hard anodising on aluminium; if you merely anodise the pulley, the colour choice is rather wider. Aluminium alloys will not hard anodise but will accept standard anodising, which may be in a variety of colours.

Power supply

A nominal 24Vdc 2amp power source is needed to power the clutch coil; in my case I could have provided a full wave rectifier and smoothing capacitor attached to the 24Vac transformer used for the machine light. The output of this arrangement is higher than 24V but by inserting a dropper resistor in series, the required voltage is applied to the clutch coil, however on reflection I decided to provide a dedicated power supply and used one of the small switch mode power supplies readily available from a number of sources. A N/O push to make switch operates the clutch, with an illuminated button fed via a second N/O switch plate. This is enclosed in a splashproof moulded box. The box is in turn attached to an angle plate, which has been attached to the top right of the headstock gearbox cover using two existing M5 tapped holes. The 22mm Illuminated Push on/Push off buttons are an industry standard type. The switch contacts are protected by a resistor and capacitor to reduce arcing due to the collapsing magnetic field of the actuating coil on switch off. The multi-way cable passes through the plastic sealed gland on the left hand side of the box and is routed via a similar gland into the rear of the left hand pedestal.

Setting the clutch up

Now to set it all up - the spacer between the pulley bearings and the clutch bush needs to be such that the clearance on the clutch armature is set to 0.15 - 0.2mm. Fine adjustment may be obtained by placing shims with this main spacer and/or shims between the armature spring arms and the pulley plate at each of the three attaching screws. This is probably the quickest and easiest final adjustment since access is simplified by merely sliding the clutch bush away from contact. The spacer is dimensioned to give the initial requirement for 3.4mm at these three points to start with. Once the correct running clearance has been obtained the clutch bush, which I had machined to length in stages, may be locked in position by means of cap head screws in the end or the long attachment bolt, whichever method you have chosen to use. For simplicity of setting up and later servicing, the use of an end cap will enable the partial removal of the clutch components without disturbing the belt alignment and tension. ■

■ MEW RESOURCE BOX

Commercially available electrically operated clutches - Clark Electric Limited, Whyteleaf, Surrey.
www.clarkelectric.co.uk
Tel. 0208 668 1763

Electric clutch components - Warner Electric Europe
www.warnerelectric-eu.com
Clutch Type - SFM Size 70 VAR10

Power supply for clutch - Rapid Electronics
www.rapidonline.com
Part No. 85-2953 24Vdc 2.5A Desktop SM PSU

22mm switches - Lamonde Automation Limited, Project House, Redhill, Surrey. RH1 5SA.
www.lamondeautomation.co.uk
Tel. 01737 824600
Product Codes - Switch GCX1193-120L Yellow 120Vac LED, Extra N/O Contact Blocks ECX1040-2

Splashproof box - 65x65x81 - Spelsberg els UK Ltd., Unit 17, Stafford Park 12, Telford, Shropshire TF3 3BJ
www.spelsberg.co.uk
Tel 01952 200716
Product Code 105-901

MAKING A HIGH SPEED SPINDLE

Dick Stephen describes his high speed milling spindle

■ OVERVIEW

Dick Stephen makes clocks and had a need for a high speed engraving spindle (**photo 1**). The spindle is designed to fit his Sieg X3 milling machine but it has other uses. It would make an ideal milling/drilling spindle when mounted on the lathe cross slide and could also be used for internal grinding. The original ran at 7,000 RPM but the specified bearings will run up safely to 21,000RPM.

1. The finished spindle.

The original spindle

In an earlier article in which I described the modifications I made to the head of my X3 mill, I illustrated a high speed spindle that I had fitted to the new head. This spindle was a Jones and Shipman small grinding spindle. As a spindle it is absolutely superb. However, it was just a bit short for the new head. To fit the spindle to the head I had to fit an extension of approximately 50mm long to the pulley shaft. The spindle is driven directly from the motor by an inextensible 10mm wide, flat high speed belt. The belt needed to be quite tight in order to stop it from coming off the two crowned pulleys. The belt tension pulling on the rather too long extension puts an unacceptable sideways load on the top bearing. After using the spindle for some engraving, I had the feeling that the life of the bearings would be very limited if I carried on using it. There was a second drawback with the spindle, namely the ⅛in. fixed diameter collet. It is now rather difficult to find ⅛in. shank cutters as everything is now metric (which I prefer).

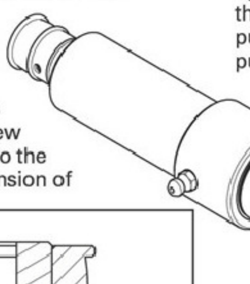
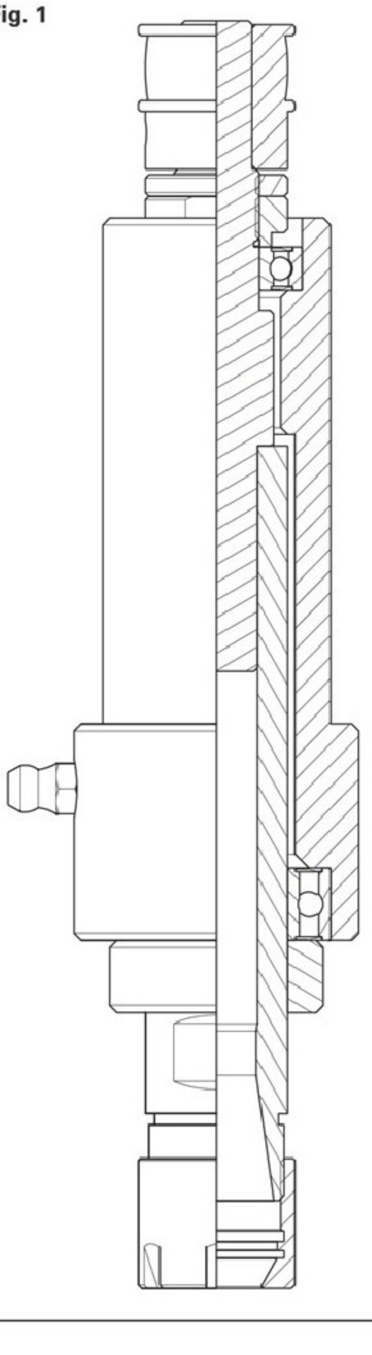


Fig. 1



The new spindle

These two problems made me begin to start looking for a replacement spindle. While looking through the J&S industrial catalogue I noticed that an ER16 collet holder with a 20mm ground extension was available for £44. After a bit of thought I realized that this collet holder could easily be adapted to make a replacement high speed engraving spindle (**fig 1**). I used metric components and dimensions in the construction of my spindle. Some readers may wish to construct the spindle using Imperial units. It is left up to these readers to make the appropriate modifications to the design to accommodate the Imperial components and dimensions apart from the 20mm i.d. ball race.

Materials required

1) ER16 straight shank extension collet chuck. Available from J&L Industrial supplies www.jlindustrial.co.uk Order code HHV-50606C
2) 12mm i.d. 24mm o.d. ball race Arc Euro Trade code 69012RS
3) 20mm i.d. 32mm o.d. ball race Arc Euro Trade code 68042RS
4) 200mm, 16mm diameter EN1A steel bar.
5) 150mm, 40mm diameter EN1A steel bar.
6) 50mm, 25mm diameter free machining aluminium bar

Construction of the spindle

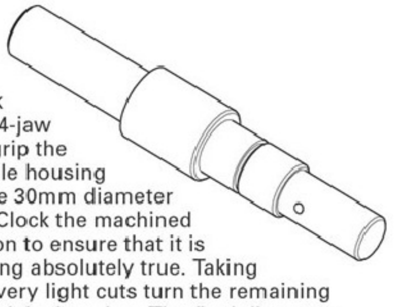
The shank extension of the ER16 collet chuck is not long enough for the spindle and requires an extension. The extension is fitted into the bore of the collet chuck and secured with Loctite 326 structural adhesive. Some readers may wonder if the Loctite is strong enough to withstand the forces imposed when the spindle is being used. I have used 326 extensively; I used it to attach the extension shafts onto the ball screws I used in the conversion of the X3 mill. The mill has been used heavily ever since I completed the conversion and the extension shafts show no signs of coming away from the screws. The secret is getting the clearance between the two parts being joined correct and ensuring that the two surfaces are grease free and absolutely clean. The surfaces of some metals such as titanium, aluminium and to a limited extent brass will oxidize. This oxide layer is often invisible but its presence will prevent the Loctite from curing and significantly reduce the strength of the joint. The two surfaces should not be too smooth. It is worth going over the surface with say 300 grade wet and dry to remove any oxide and give a surface for the adhesive to "key" onto.

The shaft extension

Remove the nut from the collet chuck and hold the chuck in a 20mm collet, if you have one, or in a 3-jaw chuck. Wrap some coarse wet and dry paper around a length of dowel rod and carefully clean the bore of the collet chuck. The dimensions of the extension are shown in **fig 2**. The extension is made out of a length of 16mm diameter EN1A steel rod. No dimension for the diameter of the end that inserts into the collet chuck has been given. The extension needs to fit with a clearance of about .01mm on the diameter. If the clearance is made any less than this most of the Loctite will be removed from the two surfaces when the two parts are fitted together resulting in a weaker joint. Cover both the bore of the chuck and the extension with a thin layer of Loctite. Don't apply the Loctite onto the surface directly from the bottle. If the two surfaces are really clean the Loctite should cure within about 10 seconds. Put the spindle to one side until the spindle housing has been made.

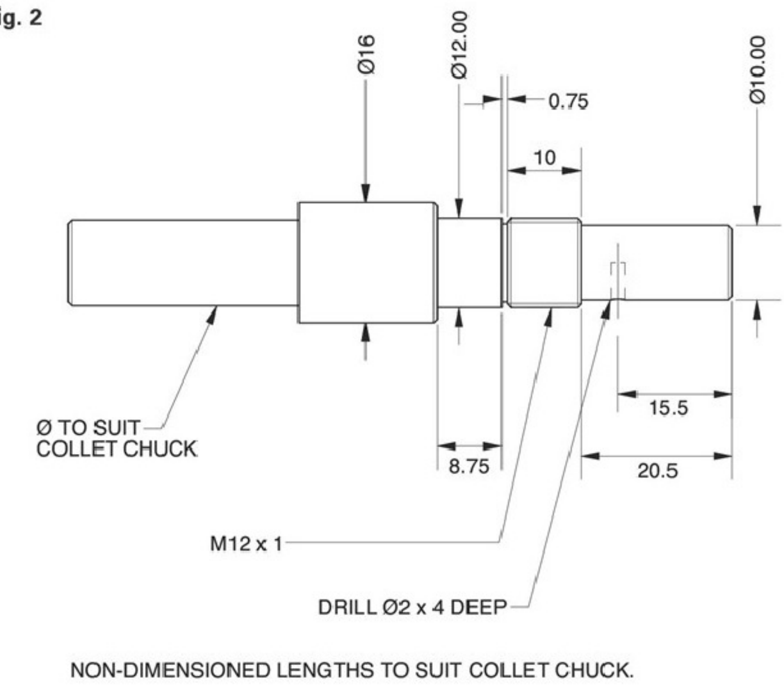
The spindle housing

This is made from a 100mm long EN1a bar 40mm (1½in.) in diameter. The dimensions of the housing are given in **fig 3**. Grip the length of bar in a 3-jaw chuck and turn down the bar to 32mm diameter for a length of 70mm. Support the bar with a fixed steady to ensure that the outside of housing remains true. Drill and bore a hole 18mm in diameter the full length of the bar. Bore the recess for the upper ball race 25mm diameter for a depth of 10mm. This leaves a space for a spindle locking nut and an oil reservoir for the upper ball race. Change the 3-jaw

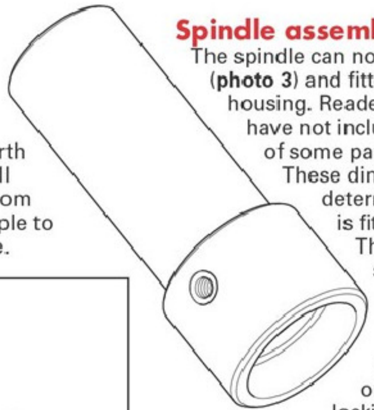


chuck for a 4-jaw and grip the spindle housing by the 30mm diameter end. Clock the machined section to ensure that it is running absolutely true. Taking only very light cuts turn the remaining part of the housing. The final diameter is not important just ensure that both sections are true. Support the end of the housing with a fixed steady. Now bore the central hole to 22mm diameter to a depth of 60mm. The32mm diameter recess for the bottom ball race is bored to a depth of 7mm. If you have been using really sharp and appropriately ground tools with EN1A the housing should need almost no further finishing. The surface on my housing shown in **photo 2** is the final machined finish using a slow feed rate and brushing with suds. Recently I bought a length of 11% cobalt HSS to replace the M2 tool steel I had been using for lathe tools. The 11% cobalt HSS is very significantly harder and tougher than M2 HSS. As a consequence the edge is retained far longer and the resulting finish is far better. The downside is the cost of the 11% cobalt, a 100mm X 8mm square length is about £15. Even at this price I feel the advantages are really worth the extra expense. Finally drill and tap a 6mm hole 20mm from the bottom end for an oil nipple to lubricate the bottom ball race.

Fig. 2



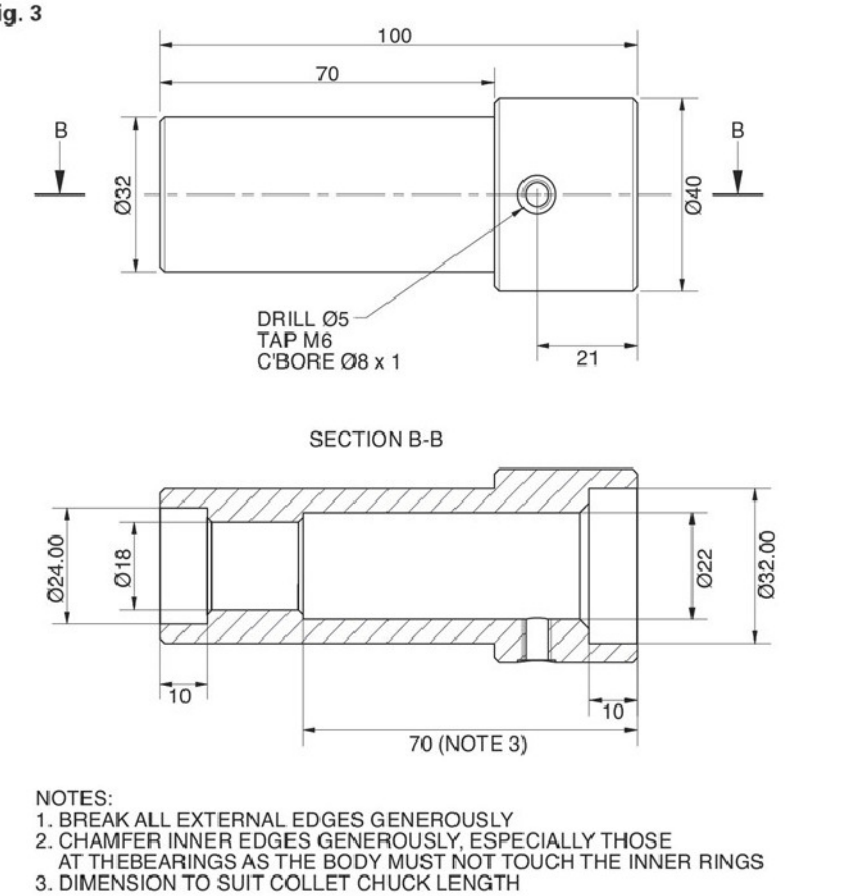
2. The spindle housing.



Spindle assembly

The spindle can now be completed (**photo 3**) and fitted in the spindle housing. Readers will note that I have not included the dimensions of some parts of the spindle. These dimensions are best determined as the spindle is fitted into the housing. The two threaded spindle locking rings and the spindle collar need to be made before any further work is done on the spindle. The locking rings are made from 20mm diameter EN1A mild steel. I used a 12mm by 1mm metric tap to thread the rings as this is a convenient thread to cut on my metric lathe. If you are using Imperial dimensions you may wish to use a different thread for these rings, one that is convenient to cut on your lathe.

Fig. 3

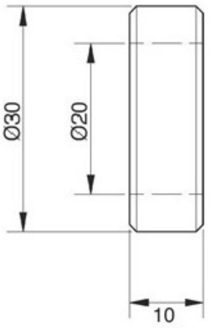


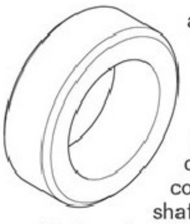
3. The spindle extension.

The spindle collar

The collar (**fig 4**) is made next. This is made from the remainder of the 40mm EN1A bar. Begin by facing the end of the bar. Drill and bore a hole about 19mm in diameter to a depth of 20mm. Turn down the outside of the bar to 30mm for a length of 20mm and chamfer the end of the bar. Part off a 10mm length from the end to form the collar. Grip the collar in the 3-jaw chuck and face the parted off end square and chamfer the corner. The hole in the collar is now bored to 20mm. The collar should have a clearance of no more than 0.01mm, just sufficient to allow for the adhesive that will attach the collar to the collet chuck extension. Figure 1 illustrates the position of the collar just

Fig. 4



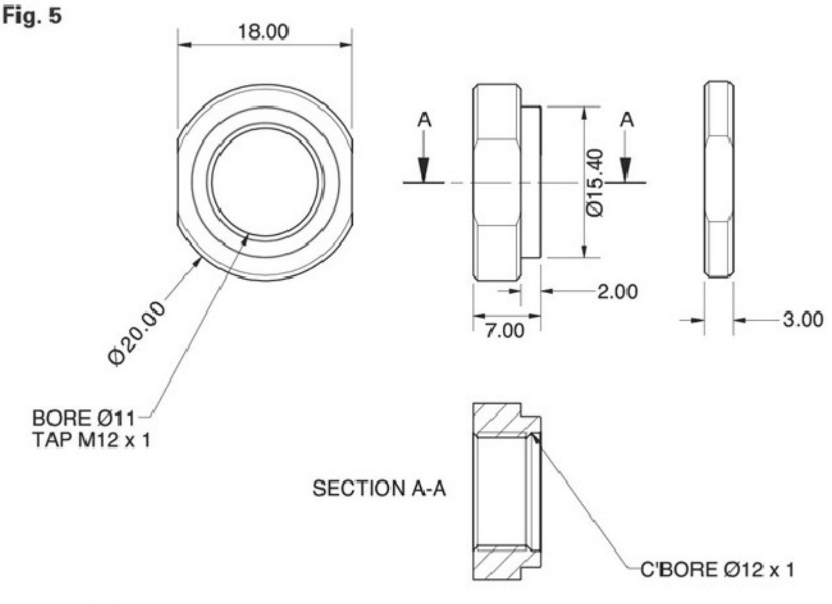


above the two flats in the collet chuck extension. Carefully clean the collar and the collet chuck extension. Apply Loctite 326 only around the collet chuck extension. Slide the collar onto the extension shaft over the area covered with the adhesive. Rotate the collar when in position to spread the adhesive onto the bore of the collar. Hold in place until the adhesive has cured. This will take about 15 seconds so you need to be quick positioning the collar. Once the adhesive has set wipe off any excess.

Grip the end of the collet chuck in a 20mm collet if you have one or in a 4-jaw chuck. Check that the collet chuck is running absolutely true using a dial indicator. This is very important if the spindle is to run at high speeds. Start by drilling a center in the end of the extension. The extension shaft will in all probability not be true. Skim the extension until it is true with the collet chuck shaft. With the tailstock live center in position check that the collet shaft is still running true. Now check that the face of the collar that is in contact with the ball race is also running true. If not carefully true the face of the collar. Remove the tailstock center and slide the 20mm i.d. ball race onto the collet shaft. Fit the housing over the spindle and fit the ball race into the recess in the housing. Now measure the length of the extension protruding from the bottom of the recess for the upper ball race (length = L). Note this measurement L. Remove the housing and the ball race and replace the live tailstock center. Turn down the end of the extension to 12mm for a length of (L + 1)mm. Cut a groove 1mm wide with center at (L - 6mm) X 1mm deep. Turn down the end of the extension to 10 (L - 16mm). Finally thread the extension with a 1mm pitch thread for the locking rings as illustrated. This essentially completes the spindle except for attaching the pulley. Assemble the complete spindle using the locking rings (**fig 5**) to take up any end float in the ball races. Check that the spindle runs nice and freely.

4. The pulley and locking rings.

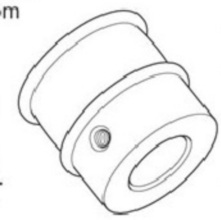
Fig. 5



NOTES:
1. C/BORE Ø12 x 1 IS TO ALLOW NUT TO EXTEND PAST THREAD. BEARING SURFACE DOES NOT HAVE TO BE THREADED
2. Ø15.4 x 2 SHOULDER IS TO ALLOW OIL PENETRATION UNDER THE NUT TO THE SHIELD ENTRY (NEAR THE INNER RING)
3. CHAMFER EDGES GENEROUSLY

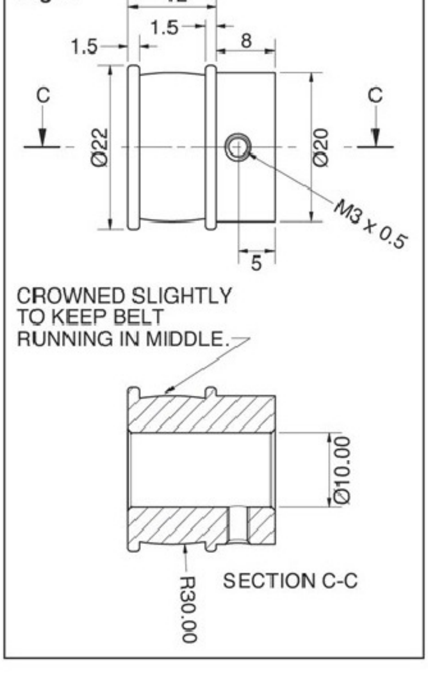
The pulley

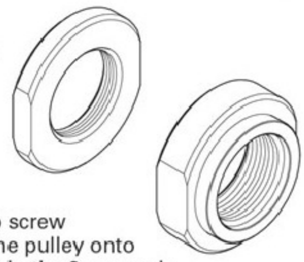
The final job is to make and fit the pulley (**fig 6**). The pulley on my spindle is 20mm in diameter and the motor pulley 50mm in diameter giving me a 2.5 times increase in speed (approximately 7,000 r.p,m.) which is plenty for CNC engraving on most materials. The finished pulley and locking rings are shown in **photo 4**.



The pulley is made from free machining aluminium bar. I have not given the diameter of the pulley as readers may wish to make the pulley to suit their own particular requirements. The construction of the

Fig. 6





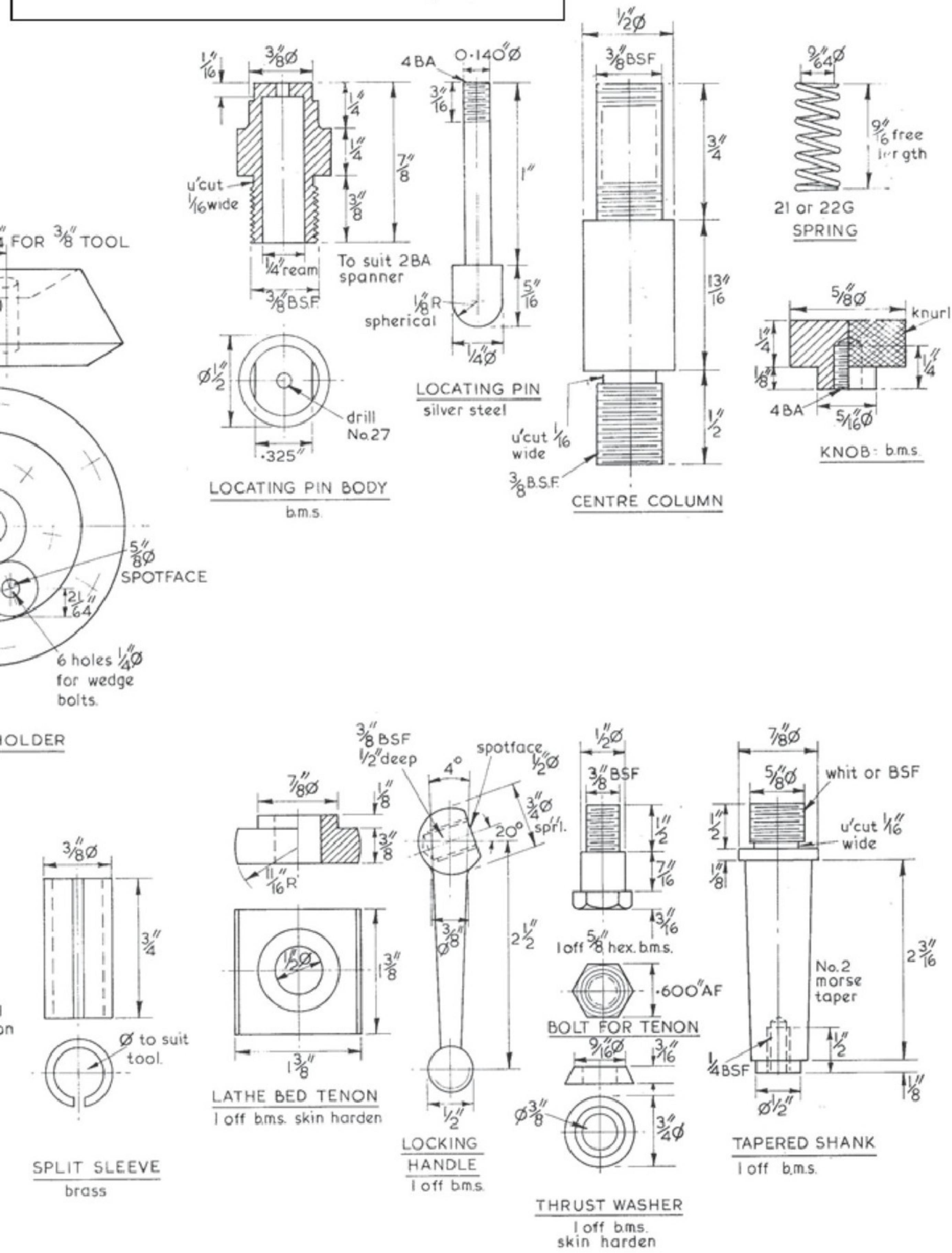
pulley should not present any difficulties. Drill and tap a hole as indicated for the 3mm grub screw that secures the pulley onto the spindle. Grip the 3mm grub screw in a collet or chuck and using a chamfering tool, turn a sharp point on the end of the screw. Fit the pulley in position on the spindle and tighten the grub screw firmly. Remove the grub screw and the pulley. Drill a 2mm hole 4mm deep at the point marked by the grub screw on the spindle. Turn down the end of the screw to 2mm for 4mm leaving the point on the screw. The point will help to locate the pulley when securing it. I find this method superior to grinding a flat on the side of the spindle. ■

■ MEW RESOURCE BOX

ER spindle supplier
J&L Industrial
7 Pacific Avenue
Wednesbury
West Midlands
WS10 7WP
T. 0800 663355
www.mscjlindustrial.co.uk

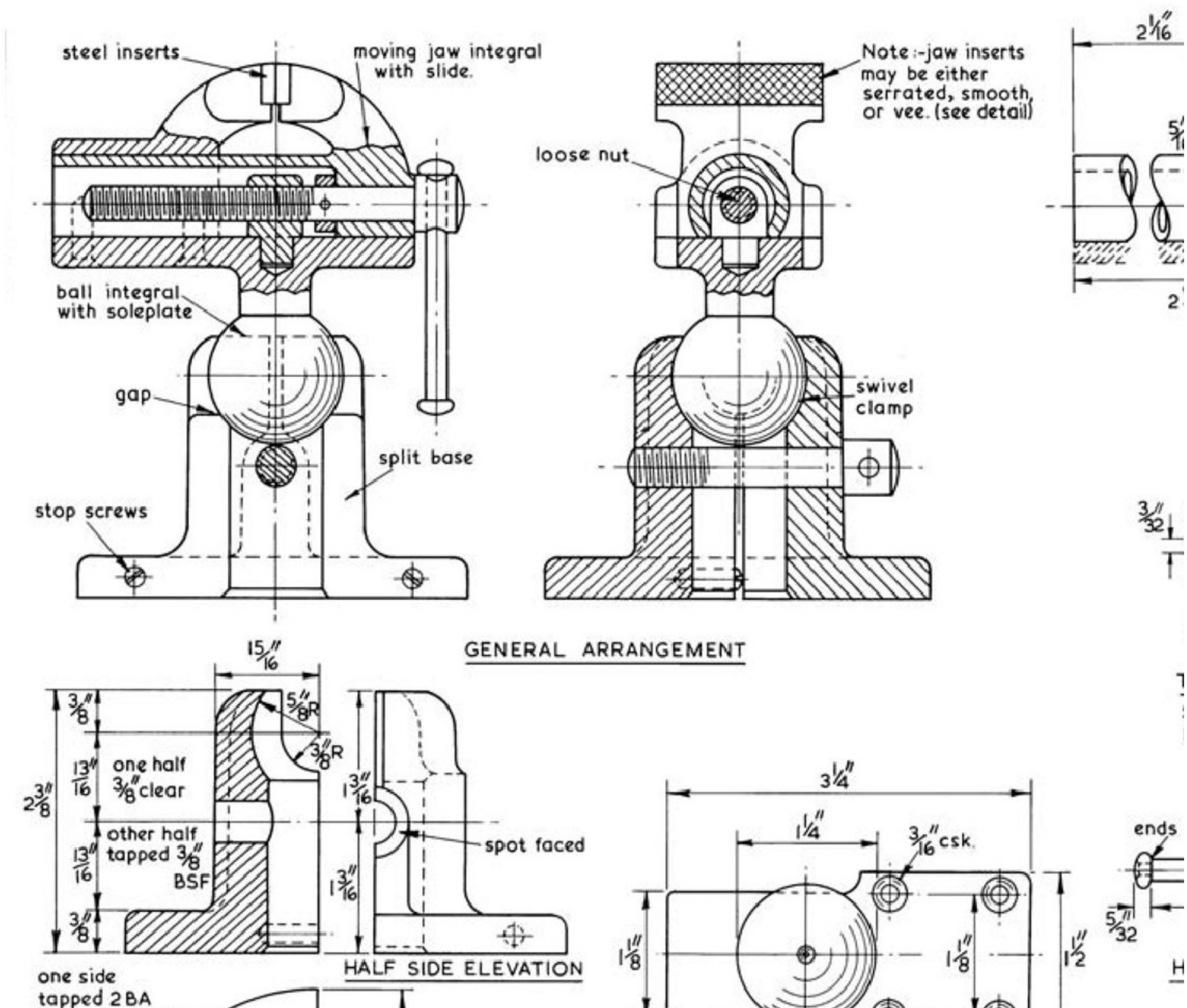
Bearing supplier
Arc Euro Trade
10 Archdale Street
Syston
Leicester
LE7 1NA
T. 0116 2695693
www.arceurotrade.co.uk

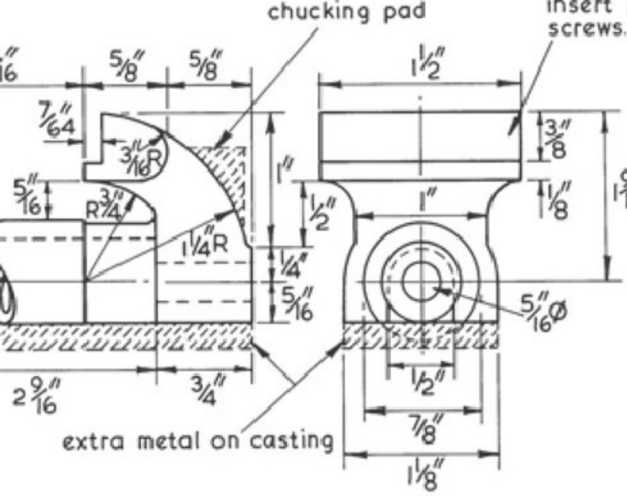
WARCO
WARCO
Our next exhibition
London Model Engineering Exhibition
Alexandra Palace,
22nd to 24th January 2010
See you there!
SPECIAL OFFERS
THAT REALLY MEASURE UP!
MINI LATHE
available in metric or imperial
• Centre height: 90mm
• Distance between centres: 300mm
• Tailstock taper: 2MT
• 100mm long tailstock base for added rigidity. Over centre clamp – quick action locking
• Digital rev counter
• Speed memory buttons
• Hardened & ground bedways
• Each lathe supplied with individual accuracy test report
£395.00
MINI MILL
• Powerful 550w motor
• 3MT with draw bar
• Fine spindle feed
• Unique spring loaded plunger to locate column in vertical position
• Table: 460 x 112 mm
• Distance spindle to table 290mm
available in metric or imperial
£410.00
WMT 500
The Ultimate Combination Machine
• Centre height: 150mm
• Distance between centres: 500mm
• Power cross feed
• Imperial/metric threadcutting
• Thread dial indicator
• Fine feed handle and calibrated dial for accurate milling
• Machine can be used immediately using standard accessories supplied
£1,250.00
WMT240 VARIABLE SPEED LATHE
• Metric or imperial leadscrews and dials
• Centre height: 105mm
• Distance between centres: 400mm
• Tailstock quill: 2MT
• Range of spindle speeds: 50 – 2,200 rpm
• Supplied with 3 / 4 jaw chucks, fixed and travelling steadies, faceplate
• Precision spindle on taper roller bearings
• Metric/Imperial threadcutting
• Individual accuracy test report
Including free of charge drill chuck, arbor, live centre and 5 piece lathe tool set.
£780.00
WM16 VARIABLE SPEED MILLING MACHINE
• Table size: 700 x 180mm
• Maximum drilling capacity: 16mm
• Cross travel 175 mm
• Range of spindle speeds: 50 – 2,250 rpm
• Motor 600w
• Locks to head, column and slideways
• Digital rev. counter
• Captive, self ejecting draw bar
• Digital depth gauge
£925.00
New DIGITAL SCALE
Digital scale. Inch, metric and fractions. Magnetic counter.
575mm alloy scale, easily cut to suit specific requirements.
£65.00
New POLISHER GRINDER
£50.00
including VAT and UK mainland delivery.
DI-3 BACK PLATE
• 160mm. Will suit Myford, Harrison and Colchester lathes.
£45.00
ER-25 COLLET CHUCK
• To suit ML7. Internal thread for minimum overhang.
£45.00
ML7 BACK PLATE
• 100mm £12.50 - £3.50 P&P 125mm £13.00 - £3.50 P&P
All prices include VAT and U.K. manland delivery • Please ring for our latest info packed brochure!
WWW.WARCO.CO.UK
WARCO, FISHER LANE, CHIDDINGFOLD, SURREY GU8 4TD
Tel: 01428 682929 warco@warco.co.uk


FOR 3/8" TOOL
LOCATING PIN BODY
b.m.s.
1/4" ream
3/8 BSF
u'cut 1/16 wide
To suit 2BA spanner
drill No.27
·325"
LOCATING PIN
silver steel
4BA
0·140"Ø
1/8"R spherical
CENTRE COLUMN
3/8 BSF
u'cut 1/16 wide
3/8 B.S.F.
SPRING
21 or 22G
9/16 free length
KNOB: b.m.s.
knurl
4BA
5/8"Ø
SPOTFACE
6 holes 1/4"Ø for wedge bolts.
OLDER
SPLIT SLEEVE
brass
Ø to suit tool.
LATHE BED TENON
1 off b.m.s. skin harden
LOCKING HANDLE
1 off b.m.s.
3/8 BSF 1/2" deep
spotface 1/2"Ø
3/4"Ø spr'l.
BOLT FOR TENON
1 off 5/8" hex. b.m.s.
·600"AF
THRUST WASHER
1 off b.m.s.
skin harden
TAPERED SHANK
1 off b.m.s.
whit or BSF
u'cut 1/16" wide
No.2 morse taper
1/4 BSF

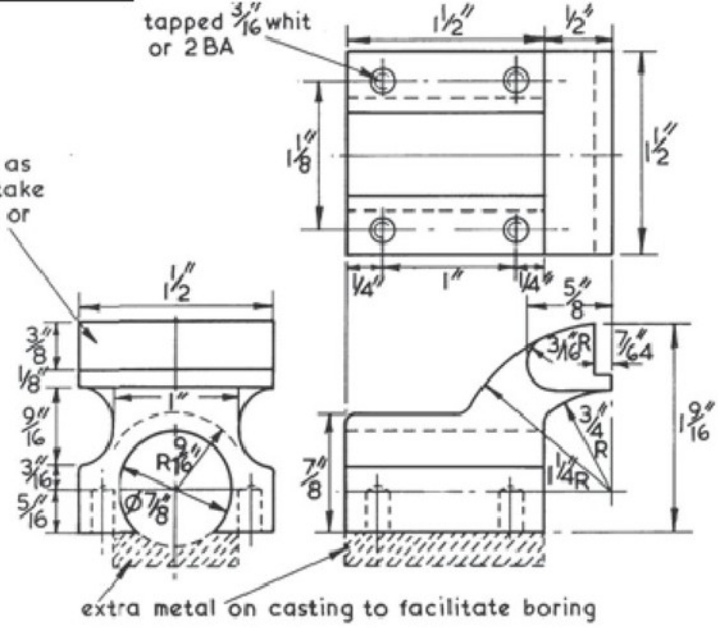
PLAN: THE M.E. ½″ UNIVERSAL SWELLING BENCH VICE

by Edgar T. Westbury

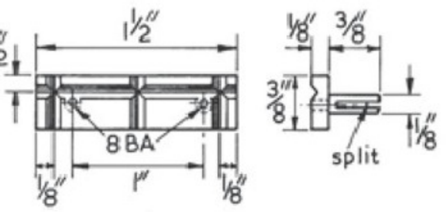




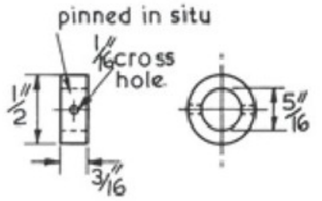
SLIDING JAW & RAM: 1 off c.i.



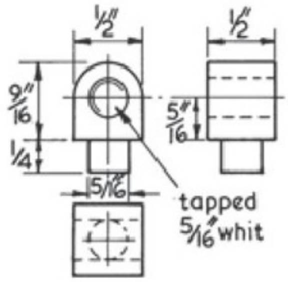
STATIONARY JAW: 1 off c.i.



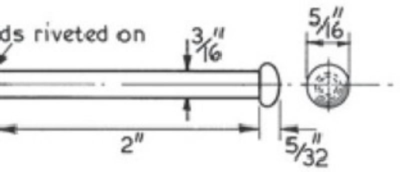
TYPICAL JAW INSERT: 2 off tempered tool steel
Showing quick-change plug fitting.



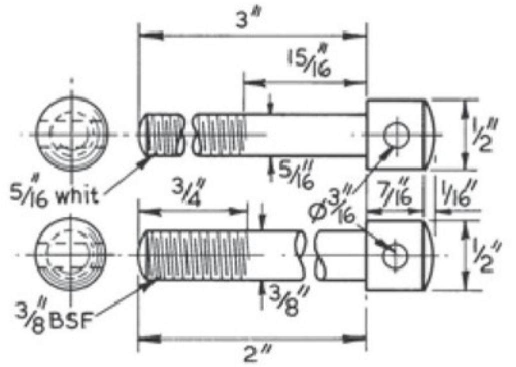
COLLAR FOP JAW SCREW
1 off b.m.s.



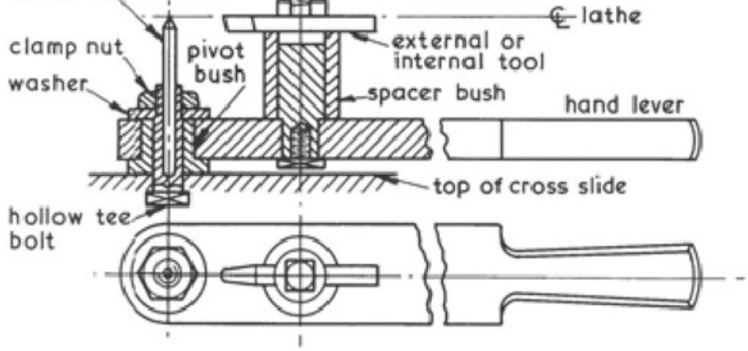
LOOSE NUT: 1 off bronze



HAND LEVER: 2 off
silver steel



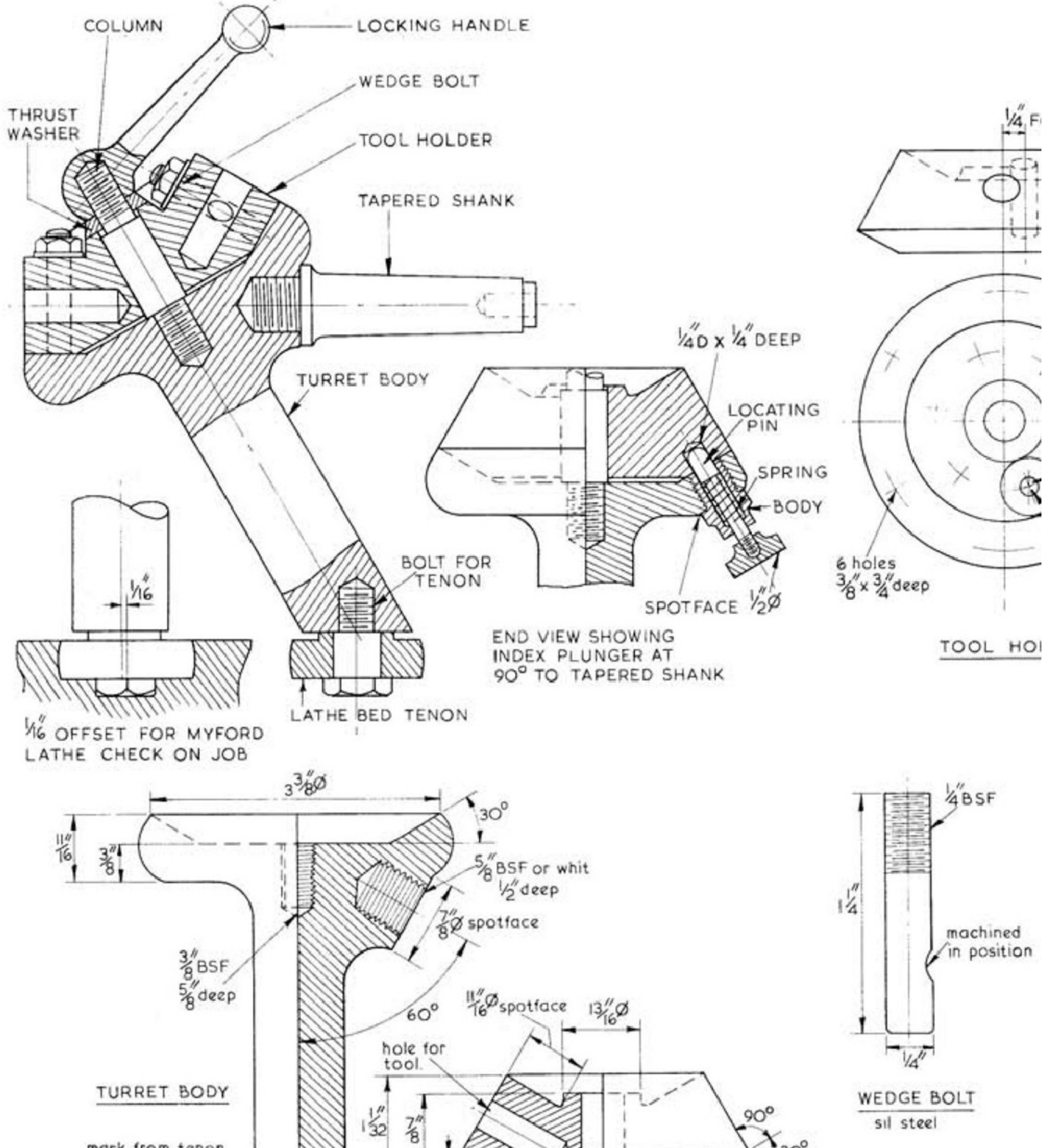
SCREWS FOR JAW & SWIVEL CLAMP
1 off each b.m.s.



SPHERICAL TURNING TOOL FOR EXTERNAL & INTERNAL RADII OF SWIVEL CLAMP COMPONENTS

PLAN: **TAILSTOCK TURRET**

by Edgar T. Westbury



1. A selection of pens.

■ OVERVIEW

Hand turning is thought of as a woodworking activity but there is no reason why you can't try a bit of hand turning on a metalworking lathe. Mike shows you how to hand turn and for a bonus, you can make yourself a handsome pen or even make a few (**photo 1**) and hand them out for Christmas.

LEARNING HOW TO HAND TURN

Mike Freeman makes some Christmas presents

Christmas Time

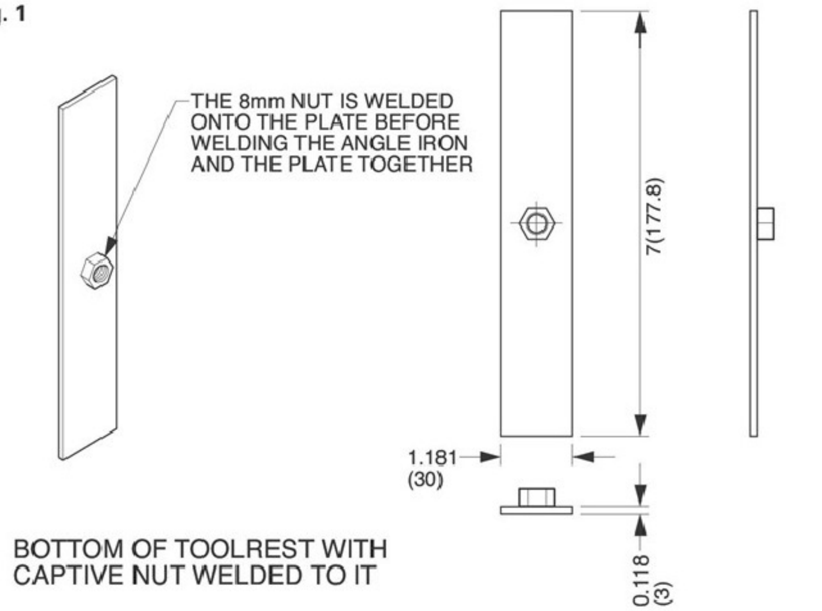
Christmas comes but once a year and I was looking for a project that would both be challenging for me and produce items good enough to give as Christmas presents. Last year I made a pair of 'wobblers' for my son and son-in-law bringing expectations for future handmade presents. So this year I wanted to make something that I could give, but to more members of the family.

Turning video

I knew that Axminster tools have a good gift section; although aimed more at the wood turner than the model engineer (they do sell 3 Stirling engine kits though), so when looking through their website I came across their pens section and decided that these may fit the bill. However, before committing myself to several kits (since I am looking at 15 plus!) I thought it would be wise to try a couple first to check out the quality I could achieve since I have never turned anything 'freehand' before. The decision to go the pen route however was made easier because Axminster Tools have an excellent video of one of their staff turning, then assembling one of their pen kits. It certainly spurred me on to have a go at hand turning.

I decided to make it a little easier for myself by buying their blank turning mandrel, barrel trimmer and specific bushing set for the pen I chose (**photo 2**) rather than make my own even though these purchases added to the trial cost. However, I comforted myself with the fact that the mandrel could be used for some future project.

Fig. 1



Quality components

When the parts arrived I was very impressed with the quality. The pen kit (**photo 3**) was very well made; indeed the main components are gold plated. The acrylic pen blanks were quite colourful and the tooling of a good quality. However, I did have one problem to address before starting. I didn't have a suitable tool rest for my Myford ML7, and so producing the tool rest became the first priority. I decided that a simple construction comprising of some scrap angle iron I had would be the answer since I didn't want to devote too much time making a fixture if I wasn't successful in making the pens.

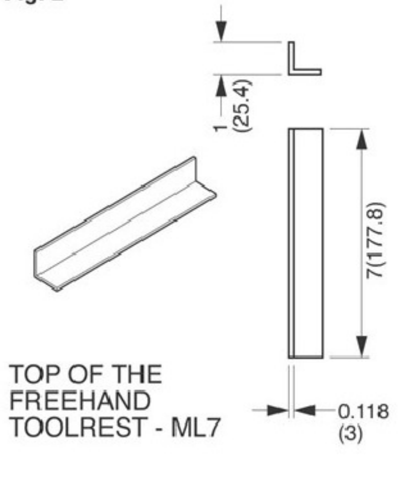
Tool rest

To make the tool rest the first task was to weld a captive nut to a piece of 30mm X 3mm steel (**fig 1**). This forms the underside of the rest, which was welded to the inverted angle iron (**fig 2**) forming its base. I then squared off a piece of steel in the milling machine to form the main block (**fig 3**) before drilling and tapping an 8mm hole centrally. The bracket that is secured to the Myford cross slide itself

2. Kit of parts including mandrel.

3. A basic pen kit.

Fig. 2



4. The homemade tool rest.

Fig. 3

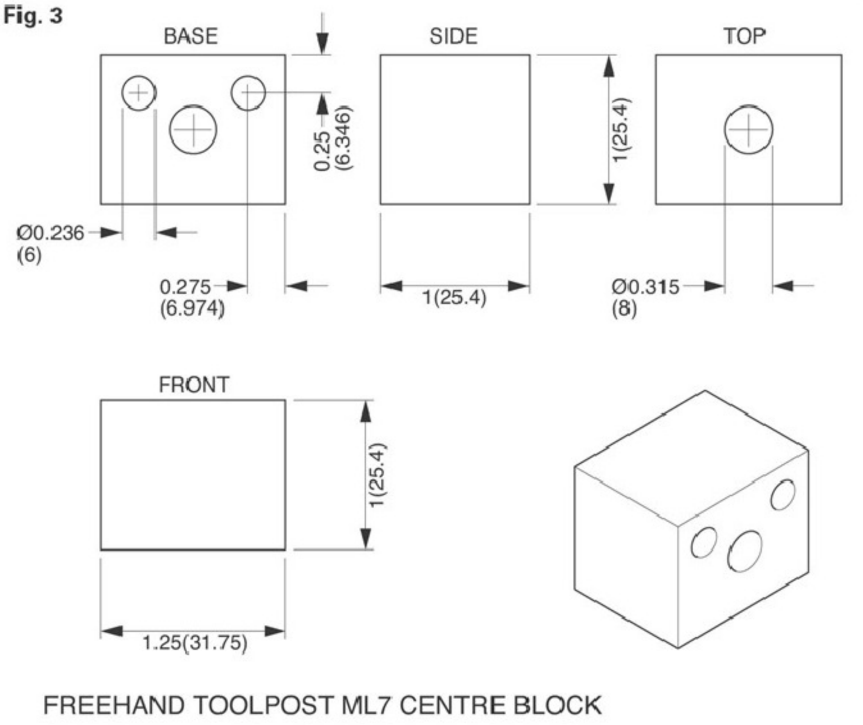
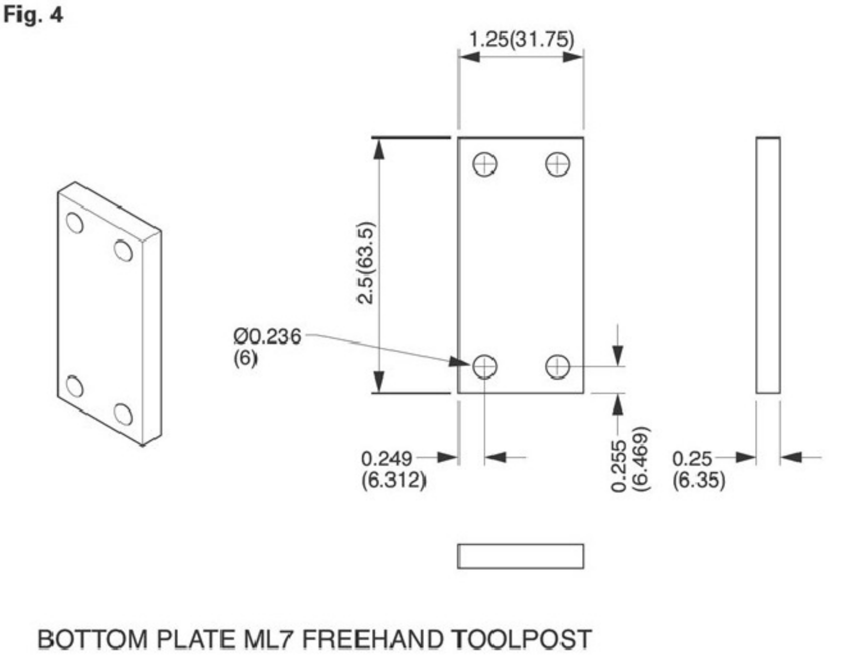


Fig. 4



was made from a piece of 1.25in. wide X 0.25in. thick scrap steel (**fig 4**).

The height of the tool rest was set after watching the Axminster video. Their tool rest height is set to the midpoint of the piece being turned. Once the bracket was made the whole assembly was attached (**photo 4**) and a trial pen produced using it. Whilst the original tool post height did produce a nice finished article, I thought for comfort that the rest be lowered for future use. Once this modification was made the whole assembly was painted with Myford green paint left over from the refurbishment of my Myford ML7 earlier in the year.

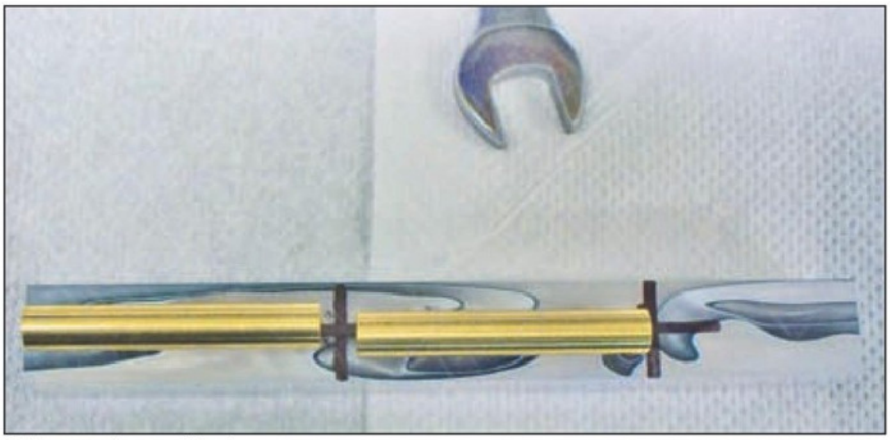
The turning tools (**photo 5**) recommended in the video was a ¼in. bowl or spindle gouge, ½in. skew and a ⅛in. parting tool which I managed to source locally. Armed with the tools required I set about making my first pen. I bought a couple of spare blanks to allow for mistakes, after all I have never turned anything freehand before. In the end they were not needed as I got on better than I had hoped.

Methodology for turning the pens

Before starting I had a few thoughts about safety (they now call this risk assessment!) and decided I would wear my sleeves turned up and approached the material to turn cautiously but with a firm hold on the tooling. I also invested in the special cloth that Axminster sell especially for lathework such as pen making so to make sure I wouldn't get anything (including an arm!) dragged into the machinery. In practice though I feel it is no more dangerous than operating any other form of equipment found in the workshop and if treated with respect, it's just as safe.

5.The set of turning tools.

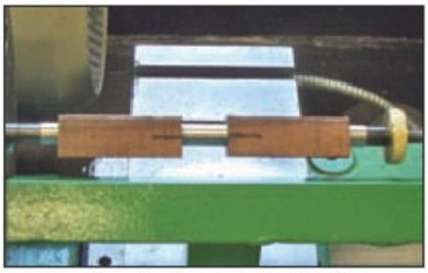
6. Wood and Acrylic blanks.



7. Brass tubes on blank.

8. Gluing the tubes on.

9. Blanks ready for mandrel.



10. Wooden blanks ready for turning.

Next I made a list of the sequence to follow in making a pen from a kit of parts. The first kit I used was the 'Artisan' click pen kit consisting of 11 separate parts.

The first task was to produce the blanks ready for turning. Now these can be either wood or acrylic (**photo 6**) so for my first pen I used a white acrylic blank. In the kit there are two brass tubes and these are laid on the blank, making a mark approximately ⅛in. longer (**photo 7**) than the tubes. One tip to ensure the pattern remains the same is to mark another line in the centre of the blank so after parting them you can still line up the pattern/grain.

I used a Proxxon bandsaw to cut my first blanks but any method can be used as long as it's square to the end. Next a hole was drilled in the centre of the two blanks, corresponding to the diameter of the brass tubes. Once drilled the brass tube was set in place using thick superglue (**photo 8**).

When the glue had set, each end needed trimming so the acrylic/wood is flush with the brass tube (**photo 9**) and I used the tool purchased for this purpose, held loose in a chuck held in the hand. This is an important step since if the material is proud of the brass tube you may get a malfunction of the clicking mechanism (it happened to me on my 3rd pen) when it's assembled.

The first cut

Both blanks were then put onto the mandrel, with their orientation lined up using the centre mark made earlier (**photo 10**) making sure the bushes were fully home. The rear of the mandrel was supported with a live centre in the tailstock. I will admit to some apprehension before switching the lathe on and picking up the gouge tool for the first time. I had a few nervous cuts but in the end, like many things, the reality did not match the apprehension felt beforehand. Indeed it was both enjoyable and therapeutic, if messy. Once the square edges had been removed with the gouge chisel the tool was changed to the ½in. skew chisel to complete the turning. The final stage on the lathe was to bring the two parts to a polished finish. I used a foam covered sanding block (**photo 11**) before graduating to wet 'n' dry paper in 180, 360, 800, 1500 and 2000 grades. The last two sanding operations were lubricated by using a spray polish, although Axminster sell a burnishing product ideal for the final polish, best done with the special safety cloth for use on lathes (**photo 12**).

11. Sanding block for 1st stage of finishing.

Assembling the pen

Removing the two finished parts from the mandrel, it was over to the bench to assemble the pen. This is where the quality of the kit really showed itself, the parts were a tight push fit, but there is no fear of the parts coming loose. To help with the assembly I laid out the pen parts in their order (**photo 13**). To make sure no damage occurred when pressing the parts together I made a pair of wooden jaws for the bench vice, although you can buy a special press for this job if you wish (or make your own).

The first stage was to press the pen tip into the barrel (**photo 14**) being careful to ensure the fitting and blank are in line. With a gentle approach, linked with constant alignment checks, this was soon completed with little drama. Next, the centre threaded joint was screwed together, then pressed into position. Once the part was fully home, the joint was unscrewed and the free part pressed into the top blank using the wooden jaws as before (**photo 15**).

With the Artisan pen kit the clicking device was pressed home, making sure the pocket clip is in position first. The first time I did this I was concerned about damaging the parts when pressing them home, but in the end there was nothing

12. The safety cloth.

13. Pen kit laid out ready for assembly.

14. Pressing in the front part.

to worry about. All that was left to do then was fit the standard ink tube, complete with its spring, and screw the two halves together. With fingers and toes crossed and worried whether the clicking mechanism still worked, it was with a sigh of relief that I found everything was fine. Indeed I was really pleased since it was a lovely pen to hold, very tactile and a joy to write with (**photo 16**). That is, after I found the ball was protected with a hard substance needing removal before it could work.

In the end there were no dramas and everything worked as it should. I was very slow for the first pen as you may expect. The second though was much faster and both pens were good enough to be given as handcrafted gifts. The second pen was approached with increased confidence and made with a different colour acrylic blank, (this one I shall keep for myself, since I like its chunky shape). Buoyed with this success I ordered enough pen kits for Christmas. Because of the numbers I needed to make I thought it would be worthwhile to make a few fixtures to help with the mass production!

The first device was a fixture to hold the blank when cutting it to size, and designed to fit my homemade saw table. This allows me to cut the required lengths of blank without the need to measure each time, as long as I am making the same kits (**photo 17**). The second part was a new insert for the barrel trimming device, since the fountain pen kits have a larger barrel size and the trimmer needs to be kept central in use (**photo 18**).

15. Pressing in the centre joint.

Freehand turning tips

There were lessons learned during my embryonic freehand turning experience and you may find them of interest if you decide to have a go. At the beginning of each pen, sharpen both the gouge and skew chisels. During turning keep downward pressure on the tool against the tool rest. This pressure makes quite a difference when controlling the cut. The gouge tool is best held with the handle low and the tool face high when making the first cuts on the square blank. The gouge will remove material quite quickly so I only use it for the roughing stage, whereas the skew is a useful tool used with its front edge or even its whole blade width, to get a nice parallel cut. By moving the handle of the chisel low to high you can vary its cutting action and it's something you have to experience to understand really. A twist of the wrist when using the gouge tool can be useful especially at the end of cuts.

Finally, at the end of a session I clean the chisels and lightly oil with Camellia oil before storing them away. Whilst my tools may be cheap they are HSS, and therefore you can get a nice edge to them.

General observations on the pens made so far

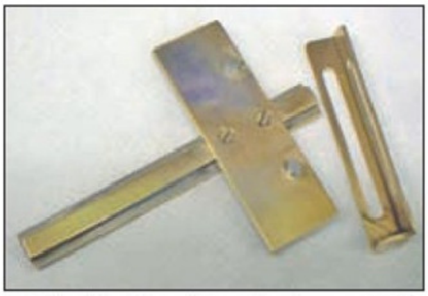
Remember to line up the blanks pattern when pressing in the centre screw joint. When turning to a profile remember the pocket clip and its clearance to the diameter of the pen. If it's too thick the clip won't sit right. The middle gold plated ring of the 'Artisan' pen can be inset (i.e. the body on either side can be thicker than the centre ring) but remember to take the edge off the gap, to save it being sharp. Also I wouldn't use white acrylic for a thin pen profile since the brass barrel can be seen through it if you're not careful. Finally, different acrylic blanks can cut differently. Some 'mixed' bars have a normal feel during turning but then soft parts can be found during the cut.

My experience of freehand turning and pen making has been a bit of an eye opener for me. Normally I do not like wood at all. However when turning it I find the freedom of using the tools freehand, very satisfying. So much so that my thoughts are turning (sorry) to making a wood turning lathe in the future. I would love to turn a large wooden bowl and I count my pen sessions as a real treat. Something I would never have thought of when setting out just to make a few gifts. ■

■ MEW RESOURCE BOX

Axminster Power Tool Centre Ltd
Unit 10 Weycroft Avenue
Axminster
Devon
EX13 5PH
T. 0800 371822
www.axminster.co.uk

16. The first completed pen (white).

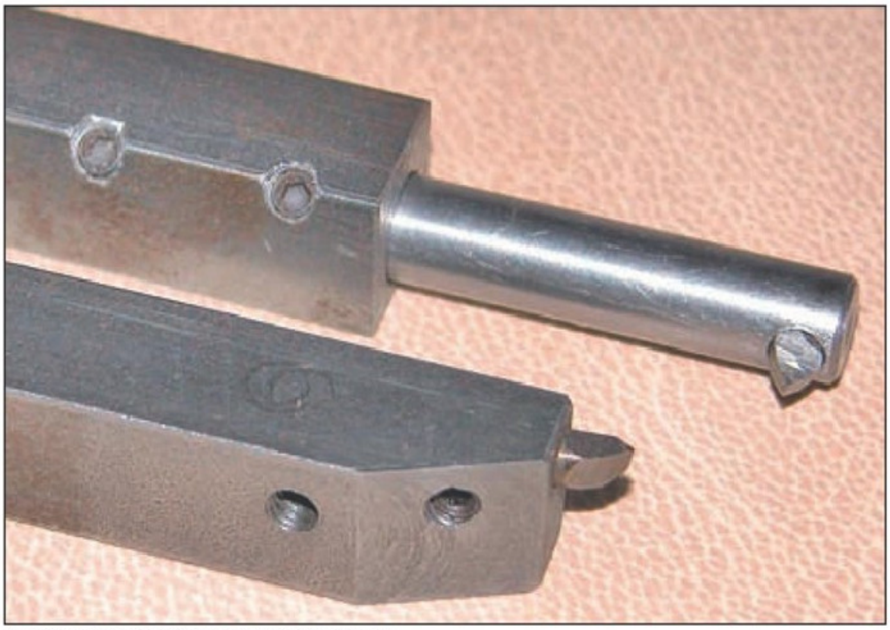


17. Blank holding fixture for the saw table.

18. Trimming an insert.

REALLY SIMPLE THREADING TOOLS

Gary Wooding looks at thread cutting tools



1. Internal and external threading tools.

Needing to cut some large diameter threads in hurry, and never having done any screw cutting on the lathe before, I found myself scanning through various books for suitably easy-to-make cutting tools. I rather liked the design for an internal tool as described by Martin Cleeve (**ref 1**) and the similar external tool by Geo. Thomas (**ref 2**) both designs being essentially holders for small tool bits made from lengths of HSS drill rod. The round tool bits appealed by virtue of the ease of setting them to the correct helix angle. Whereas the Martin Cleeve design was simple enough even for me to make, the same couldn't be said for the Geo. Thomas design, which was far more elaborate than I could cope with so I decided to use the basic concepts in my own design.

I was then left with the problem of grinding the short tool bits to the correct angles. All the published designs looked far too complicated for my limited abilities, so I decided to brew my own. The result surprised me - it was very easy to implement, and every bit as accurate as I'd hoped. This article describes the tool holders and grinding components I made, and, for those that want to read it, the maths behind the design.

■ OVERVIEW

Many people have described thread tool grinding jigs over the years. Gary looked at the existing designs, found they were a bit too complicated so he made his own simplified version. His design, detailed in this article, is based on a simple slotted plate and some home made angle templates.

The tool holders

As can be seen from **photo 1**, these are very simple affairs indeed. Since I had some 5/32in.HSS drill rod, that's what I used, but any size, within reason, 1/8in. to 1/4in. say, will do. I based my holders on 1/2in. square bar, but again, use whatever you have.

The only points worthy of note are:

1) On the external holder, the tool is angled at 7deg. to the horizontal, as per Geo. Thomas, and offset to the left of the centre line to make it easier to cut threads up to a shoulder.

2) On the internal holder, the round section bit holder is offset from the centre of the square bar and the retaining grub screws enter from an edge to allow for adequate thread engagement.

Figure 1 shows both tool holders with dashed hidden lines to illustrate their internal features. A useful feature of the internal threading tool is that it is easy to reverse the bit to allow cutting threads in blind holes with the lathe turning backwards and the saddle moving left to right.

Contrary to what might be expected, the pressure required to clamp the tool bit by the thrust rod in the internal holder

Fig. 1

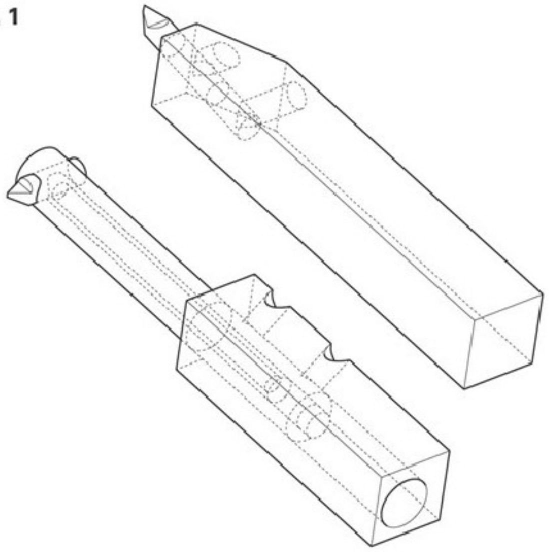
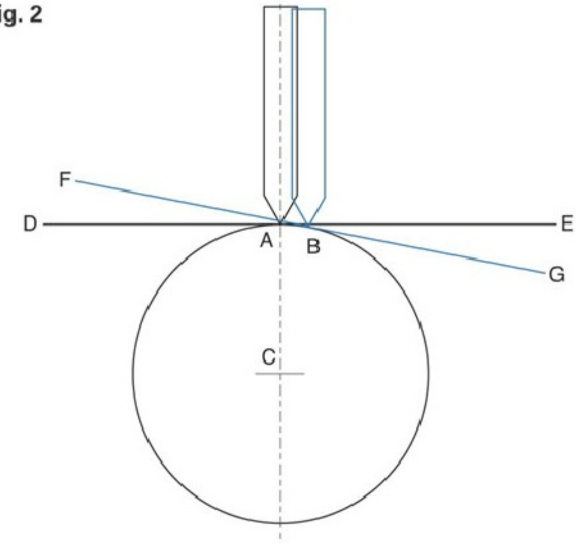


Fig. 2



is not great; only a half turn of the grub screw is needed. The 7deg. hole for the external tool is easily drilled with the aid of a vertical slide on the lathe.

Cross drilling the bit holder

There has been a lot written on the subject of cross drilling round bars. If you have a purpose made jig, or DRO on your mill, then you should not experience any problems with cross drilling the bit holder. If not, then consider the following very simple, but surprisingly accurate, method. All you need is a pointed rod, a steel rule (6in. is OK, but 12in. is better), and a drill press, vertical mill or vertical slide on the lathe. The pointed rod can be made from an odd bit of ¼in. dia. mild steel with a point turned on one end. Any angle around 60deg. included will do.

Place the workpiece (bar to be cross drilled) in an appropriate vice and put the pointed rod in the drill chuck. Position the workpiece by eye as best you can and place the steel rule against it so that it can be gently pinched by the pointed rod. **Figure 2** shows the general idea. Point C is the centre of the bar to be cross-drilled and the line FG shows the rule pinched between the tip B of the pointed rod and the workpiece. Because B is not directly above the centre C of the work piece, the rule FG is not horizontal. Slightly slacken off squeezing the rule and move the workpiece until the rule is horizontal, like DE, when A will be exactly on the centre line of the bar. Replace the pointed rod by a centre drill and start drilling.

The accuracy is surprising because the error, AB, is magnified to EG by the ratio of AE/AC. For example, for a ¼in. bar and 12in.rule, AC = ⅛in. and AE = 6in. so the magnification is 48. It's easy to see an EG distance of 1/20in. in which case the error AB would be about 1/1000in. In practice, rather than estimating the distance EG, it's easier to compare the rule against something known to be horizontal, when even greater accuracy can be achieved. .

The grinding jig

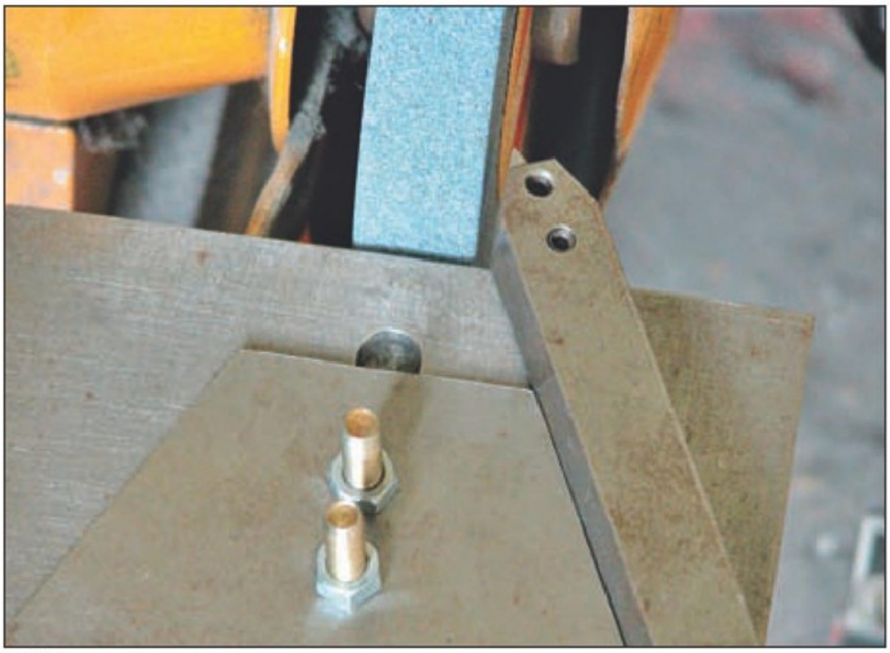
The jig grinds the tip angle and the side relief angles at the same time. It is comprised of three basic parts: the tool holder, the guide base, and the angle templates.

Figure 3 shows a typical grinding setup.

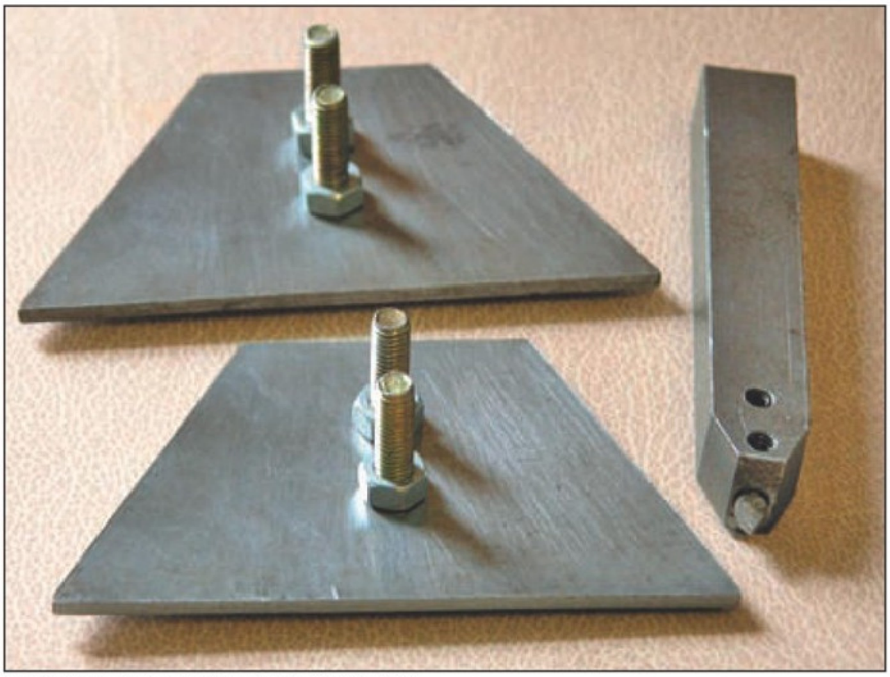
Don't confuse the tool grinding holder with the external threading tool; they are not the same. The tool grinding holder is used to hold the tip for grinding, and is used to grind both the internal and external threading tips.

You will need one template for each thread form you want to cut. I made two: one for 55deg. Whitworth threads and one for 60deg. Metric threads. **photo 2** shows the complete set-up, **photo 3** shows the two templates and the tool grinding holder, and **photo 4** shows the guide base. The slot in the guide base is just wide enough to accept the heads of the set screws on the underside of the templates, and the actual screws can be used as handles to slide the template back and forth on the plate. The guide base can be left in position on the grinder where it acts as an extended grinding rest when the rest of the jig is not in use.

The tool grinding holder is made from ½in. square MS bar, but the secret ingredient is the shape of the underside, the purpose of which is to allow the holder

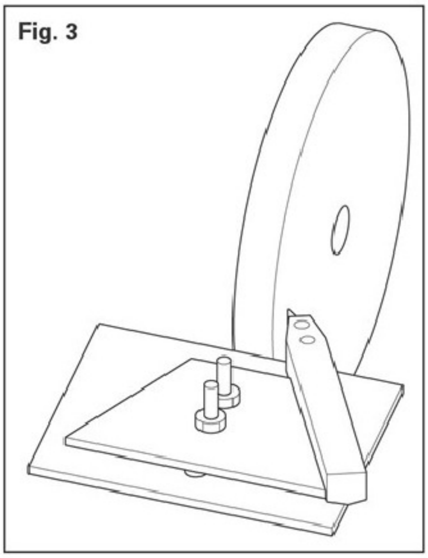


2. The complete setup.



3. The templates and tool grinding holder.

Fig. 3



4. The simple guide base.

to be tilted left or right so as to grind the side relief when the side faces are ground. Both the tool holder and templates are symmetric to enable both sides of the tip to be ground at the same setting. I used 8deg. angles on mine to give 7deg. side relief, but you can choose what you want from the tables shown below. As long as the surface of the guide base is in line with the axis of the grinding wheel the fore/aft inclination is irrelevant.

The templates and guide base are made from 2.5mm (0.1in.) mild steel plate, but the thickness is by no means critical. The guide base should be a little thicker than the heads of the set screws in the templates, and the templates should be thick enough so that the tool holder doesn't ride up when it is tilted.

Operation

To grind a tool bit, clamp the drill rod in the tool grinding holder with the grub screws (for short, internal bits, only one grub screw is used). Select the required template, and engage the template screw pegs into the support plate slot. Hold the tool grinding holder against a cheek of the template, rock it 'outwards' onto its outer bevel (**fig 4**) and check that you can bring the tool tip up to the side of the grinding wheel whilst sliding the template and holder, as a unit, back and forth in the slot. Switch the grinder on and form the side cheek of the tool tip, then place the holder on the other cheek of the template, rock it to its outer bevel and grind the other cheek in the same way. When you have created the point on the tool bit, remove the template, place the holder on its side on the guide base, inline with the slot, and grind the top face of the bit (**fig 5**). If the bit is to be used for internal threading,

Fig. 4

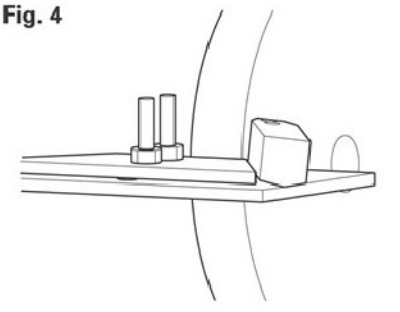
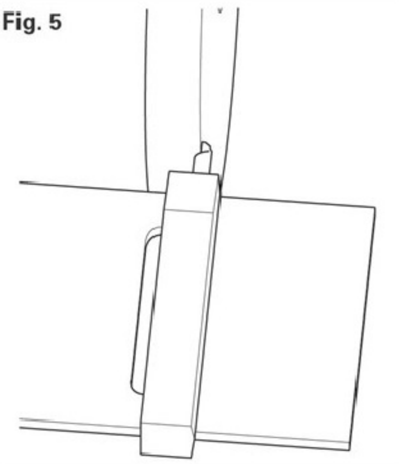


Fig. 5



you might need to grind some of the underside away to allow for clearance in small diameter holes. You can then remove the bit from the holder and place it into the appropriate lathe tool holder.

That's all there is to it.

Design Considerations

The whole point of a single point thread cutting tool is that the point is the correct shape. For metric and American threads it must be 60deg. but the trouble is that a 60deg. tip will only cut a 60deg. thread if it is held horizontally. If, as recommended by Geo. Thomas, you tilt it upwards to give some back rake, it will no longer cut a 60deg. thread angle; it will be slightly more than 60deg. For example, a 60deg. tool at 7deg. will actually cut 60.4deg. It's not a big difference, but it is almost half a degree.

Table 1 shows how the required tip angle ϕ (phi) varies with the back rake angle θ (theta). For example, in order to cut a 60deg. metric thread with a tool having a back rake angle of 7deg. you would need to grind the tip to an angle of 59.6deg.

Another point is that, when grinding the tip by tilting it 'outwards' to give the required side relief, the actual tip angle that is created is greater than expected. This is easy to visualize; imagine a square bar; rotate it through 90deg. about its axis and then grind the end by holding it at 45deg. to the side of the wheel. Rotate it back by the same 90deg. and look at the top surface; it's at 90deg. - the 45deg. chamfer is underneath. Furthermore, the actual side relief obtained is not the same as the 'tilt' angle. In the previous example, although the tilt angle is 90deg. the side relief turns out at zero.

Table 2 illustrates how the various angles interrelate with each other. It shows how the tilt angle ρ (rho) and the incident angle α (alpha) combine to produce cutting tips of the required profile with a side relief of λ (lambda). The tilt angle is the same as the facet angles machined on the underside of the tool holder, and the incident angle is the angle at which the template guides the tool holder onto the side of the grinding wheel.

For example, to grind a 60deg. tip with a side relief angle of approx 7deg. the tilt angle should be 8deg. and the incident angle would be 29.76deg. This would result in an actual side relief angle of 6.92deg. Using the same tilt angle, the corresponding incident angle for Whitworth threads would be 27.27deg. with a side relief angle of 7.09deg.

Table 2 assumes the tool is held horizontally in the holder, i.e. no back rake. If you want to cut threads with the tool tilted slightly upwards, ie. with back rake as per Geo. Thomas, it can be difficult to choose the correct combination of alpha and rho from tables 1 and 2. For example, for a back rake angle of 7deg. as per Geo. Thomas, a 60deg. thread would require a 59.6deg. tool, but Table 2 only shows angles for a 60deg. tool.

Table 3 solves this by calculating the same data as in Table 2 but with a 7deg. back rake angle. Using this table to grind the same 60deg. tool tip gives an incident angle of, for example, 29.54deg.

The templates I used were designed to grind tips with 7deg. back rake and 8deg. tilt angle. As can be seen from Table 3, this resulted in half angles of 29.54deg. and 27.07deg. for metric and Whitworth threads respectively. Both templates give side relief angles of approx. 7deg. Patterns for these are given elsewhere.

Table 1: Effect of Back Rake

Back Rake Angle	60deg. Metric	55deg. W'worth	47.5deg. BA	29deg. Acme
θ	ϕ	ϕ	ϕ	ϕ
1	60.0	55.0	47.5	29.0
2	60.0	55.0	47.5	29.0
3	59.9	54.9	47.4	29.0
4	59.9	54.9	47.4	28.9
5	59.8	54.8	47.3	28.9
6	59.7	54.7	47.3	28.8
7	59.6	54.6	47.2	28.8
8	59.5	54.5	47.1	28.7
9	59.4	54.4	47.0	28.7
10	59.2	54.3	46.9	28.6

Table 2

Tilt angle	Calculations based on back rake of 0deg.							
	60deg. - Metric		55deg. - W'worth		47.5deg. - BA		29deg. - Acme	
ρ	α	λ	α	λ	α	λ	α	λ
4	29.94	3.46	27.44	3.55	23.70	3.66	14.47	3.87
5	29.91	4.33	27.41	4.43	23.67	4.58	14.45	4.84
6	29.86	5.19	27.37	5.32	23.63	5.49	14.42	5.81
7	29.81	6.06	27.32	6.21	23.59	6.40	14.40	6.78
8	29.76	6.92	27.27	7.09	23.54	7.32	14.36	7.74
9	29.69	7.79	27.21	7.98	23.49	8.23	14.33	8.71
10	29.62	8.65	27.14	8.86	23.43	9.15	14.29	9.68
11	29.54	9.51	27.07	9.74	23.36	10.06	14.24	10.65
12	29.45	10.37	26.98	10.63	23.29	10.97	14.20	11.61
13	29.36	11.23	26.90	11.51	23.21	11.88	14.14	12.58
14	29.26	12.09	26.80	12.39	23.12	12.79	14.09	13.55
15	29.15	12.95	26.69	13.27	23.03	13.70	14.03	14.51
16	29.03	13.81	26.58	14.15	22.93	14.61	13.96	15.48

Table 3								
	Calculations based on back rake of 7deg.							
Tilt angle	60deg. - Metric		55deg. - W'worth		47.5deg. - BA		29deg. - Acme	
ρ	α	λ	α	λ	α	λ	α	λ
4	29.72	3.47	27.24	3.55	23.52	3.67	14.36	3.87
5	29.68	4.34	27.21	4.44	23.49	4.58	14.34	4.84
6	29.64	5.21	27.17	5.33	23.46	5.50	14.32	5.81
7	29.59	6.07	27.12	6.22	23.42	6.41	14.29	6.78
8	29.54	6.94	27.07	7.10	23.37	7.33	14.26	7.75
9	29.47	7.80	27.01	7.99	23.31	8.24	14.22	8.72
10	29.40	8.67	26.94	8.88	23.25	9.16	14.18	9.68
11	29.32	9.53	26.86	9.76	23.19	10.07	14.14	10.65
12	29.23	10.40	26.78	10.65	23.11	10.99	14.09	11.62
13	29.14	11.26	26.69	11.53	23.03	11.90	14.04	12.59
14	29.04	12.12	26.60	12.41	22.95	12.81	13.98	13.55
15	28.93	12.98	26.49	13.30	22.85	13.72	13.92	14.52
16	28.81	13.84	26.38	14.18	22.75	14.63	13.86	15.49

Templates

I made mine from 2.5mm MS plate. The actual thickness is not important, as long as the tool grinding holder cannot ride up it when tilted outwards. I have included patterns for four templates, calculated for a back rake angle of 7deg.; they can be photocopied, stuck onto the sheet and used as guides. I cut mine with a hacksaw and trued them up by draw filing, but obviously they could be milled if preferred. The holes for the screws were drilled and tapped but clearance holes would serve just as well because I used locknuts as can be seen in the photos. You may think that the angular differences are too small to make any difference, but consider the following.

Draw three 60deg. templates, all the same overall width and height of 85 and 47mm respectively; one for zero tilt and back rake, one for 8deg. tilt and no back rake, and one for 8deg. tilt and 7deg. back rake. Measure the lengths of the small top lengths: they are 30.73mm, 31.25mm, and 31.73mm respectively. *Hardly insignificant.*

5. Machining the angles on the tool grinding holder.

The Tool grinding holder

This was made from a short length (approx. 3in.) of ½in.square MS bar; the actual size is really not important, use whatever you have. First face the two ends and then drill an axial hole for the drill rod you have (mine was 5/32in.). Do this by centring the bar in the 4-jaw chuck, start with a centre drill and then drill 5/32in.for about an inch or so, enough to take the longest bit you intend to use; it's not that important. Centring in the 4-jaw is made a lot simpler if you use two chuck keys in opposite holes. If you don't have another chuck key, make one. It's not difficult and you won't believe how much it speeds up the job.

Remove from the lathe, drill the two 3.5mm holes and tap M4 for the grub screws. You are then ready to machine the tilt faces.

Photograph 5 shows the setup I used with a vertical slide in the lathe. Notice the packing rod to ensure that the holder is truly vertical, rotate the vertical slide by 8deg. and machine a facet to half the width of the holder. Note the position of the saddle and, without moving the vertical slide, remove the bar and turn it over to machine the other facet - the packing rod ensures symmetry. Machine the other facet and when the saddle is in the previously noted position, the two facets are bound to be symmetrical. You can then trim the cheeks as shown and the tool grinding holder is complete.

The guide base

This was made from the same material as the templates. There is not much to say about this component; the slot can be machined with a slot drill, or chain drilled, sawn and filed as I did. Make sure that the screw heads are a nice smooth fit it the slot, with no excessive side play. I found it necessary to skim each screw on the lathe to ensure smooth concentricity, and then cut the slot to fit. As can be seen, the guide base is retained on the grinder rest by two counter-sunk socket head screws, and the grinder rest was drilled and tapped to suit. Once attached, the guide base makes a useful extension to the tiny rest supplied with my grinder; the only requirement is that the slot is inline with the centre plane of the grinding wheel.

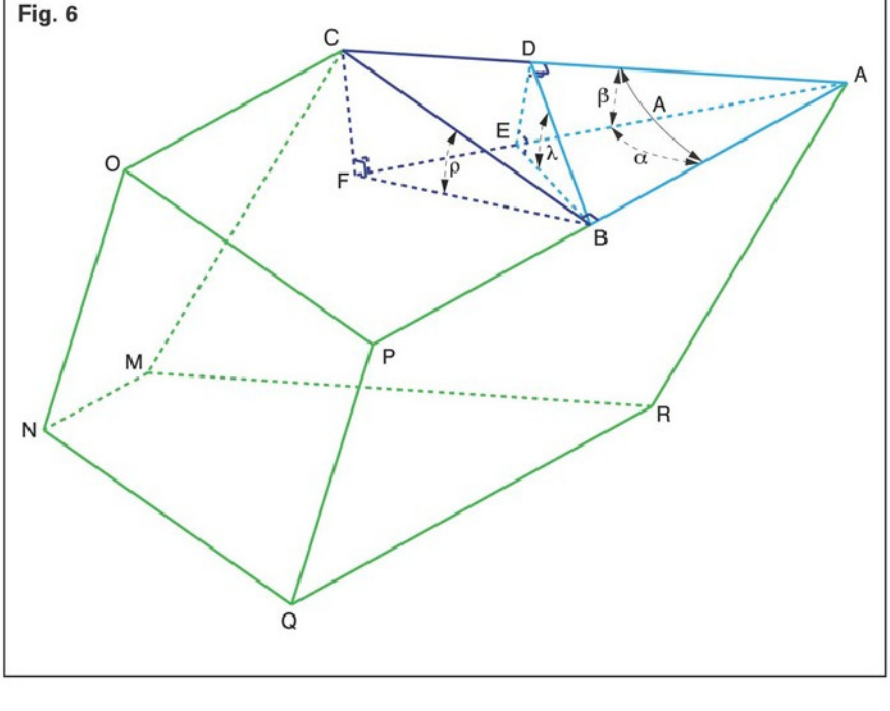
The maths behind it

The Tip Angle

Figure 6 is a schematic of a threading tool being ground on its left edge to make one half of the tip angle **BAC**. This is one half of the angle that is actually ground onto the tool tip.

A square section rod is shown instead of a round one in order to make the various angles clearer. It shows a 3-D view of the square rod **NOPQ** that has been rotated about its axis through an angle ρ rho with one end cut off at an angle α (alpha). The lozenge **ACMR** is the surface that results from cutting the square bar at the angle shown, and is, in fact, the surface in contact with the cheek of the grinding wheel.

Fig. 6



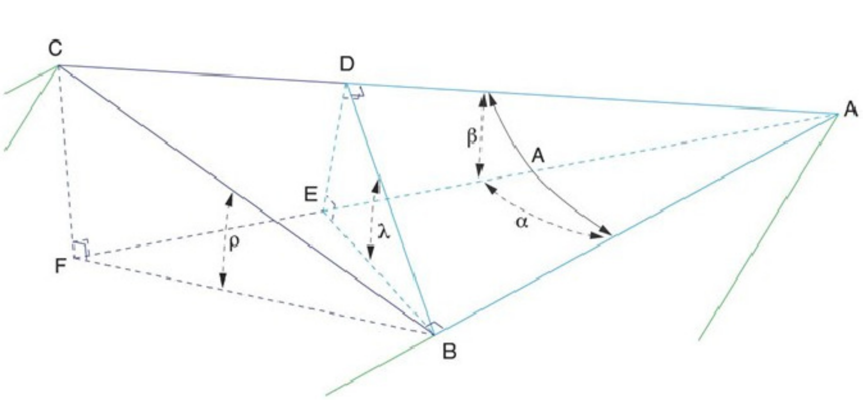


Fig. 7

The triangle **ABF** is the horizontal plane through the tip **A**, with the rotate angle ρ shown as angle **CBF**, and the incident angle α shown as angle **BAF**. **Figure 7** is a close-up of the important section that shows the angles rather more clearly.

Calculation of Tip angle

Because the rod is rotated about its axis, the actual tip half-angle **A** (the cutting angle) is always greater than angle α When the rod is rotated, the plan view of the thickness (line **BC**) is seen as a narrower thickness, shown as line **BF**, so...

$$Cos\rho = \frac{BF}{BC}$$

In the tetrahedron ABCF,

$$TanA = \frac{BC}{AB}, Tan\alpha = \frac{BF}{AB} \text{ so } \frac{TanA}{Tan\alpha} = \frac{BC/AB}{BF/AB} = \frac{BC}{BF} = \frac{1}{Cos\rho}$$

$$\therefore TanA = \frac{Tan\alpha}{Cos\rho} \text{ or } Tan\alpha = TanA \times Cos\rho$$

Calculation of Side Relief angle

The maths behind this calculation is no more difficult than for the tip angle, but it's a little harder to visualize. The objective is to calculate the angle λ (lambda) as shown in the section through triangle BED.

The line BD is on the top surface of the rod and is at right angles to line AC on the ground surface. DE is on the ground surface, and is also perpendicular to AC. BE is horizontal, perpendicular to the ground surface, and meets the edge of the rod at B. Line BC is on the surface, point C is where the edge CO meets the ground surface, and angle ABC is 90deg.

In the tetrahedron ABCF

$$Tan\beta = \frac{CF}{AF}, TanA = \frac{BC}{AB}, \text{ so...}$$

$$\frac{Tan\beta}{TanA} = \frac{CF/AF}{BC/AB} = \frac{CF}{AF} \times \frac{AB}{BC} = \frac{CF}{BC} \times \frac{AB}{AF} = Sin\rho \times Cos\alpha$$

In tetrahedron ABDE

$$Tan\beta = \frac{DE}{AD}, TanA = \frac{BD}{AD}, \text{ so...}$$

$$\frac{Tan\beta}{TanA} = \frac{DE/AD}{BD/AD} = \frac{DE}{AD} \times \frac{AD}{BD} = \frac{DE}{BD} = Sin\,\lambda$$

Combining these two equations...

$$Sin\,\lambda = Sin\rho \times Cos\alpha \text{ or } Sin\rho = \frac{Sin\lambda}{Cos\alpha}$$

Effect of Back Rake

In **fig 8** the plane through ADF is horizontal, BDFG is vertical, and ABG is inclined at angle θ (theta) to the horizontal. The triangle ABG represents a tool-tip where the angle BAG, the tip angle, is 2A. The plane ACE is vertical to both ADF and BDFG and divides the tip into two equal parts. Angle BAC, the tip half angle, is shown as A (capital alpha). Angle DAF represents the tip angle in the horizontal plane, which is, of course, the angle that is actually cut. The half angle of the cut angle is DAE, shown as angle ϕ (phi). Lines DE and BC are parallel and equal in length.

In the triangles ABC and ADE,

$$TanA = \frac{BC}{AC} \text{ and } Tan\phi = \frac{DE}{AE}$$

So $AC = \frac{BC}{TanA}$ and $AE = \frac{DE}{Tan\phi}$

In triangle ACE,

$$Cos\theta = \frac{AE}{AC} = \frac{DE/Tan\phi}{BC/TanA} = \frac{DE}{BC} \times \frac{TanA}{Tan\phi}$$

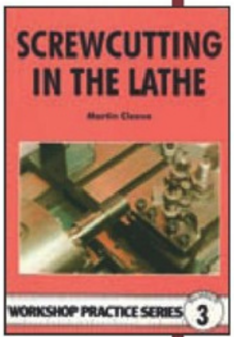
But DE=BC, so

$$Cos\theta = \frac{TanA}{Tan\phi} \text{ or } TanA = Tan\phi \times Cos\theta$$

■ MEW RESOURCE BOX

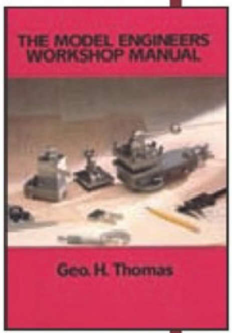
Ref 1
Workshop Practice Book 'Screwcutting In The Lathe'
by Martin Cleeve
Page 122

Available from
www.myhobbystore.com



Ref 2
'The Model Engineers Workshop Manual'
by Geo. H Thomas

Available from
Chronos Ltd
Unit 14
Dukeminster Estate
Church Street
Dunstable
LU5 4HU
T. 01582 471900
www.chronos.ltd.uk



Thus, to cut a 60deg. thread with a back rake of 7deg. ϕ =60/2=30, and θ =7

So Tan A =Tan30 x Cos7 = 0.5774 x 0.9925 = 0.573

Therefore A = Atan0.573 = 29.81deg.

The remaining drawings are as follows: **fig 9** is the tool grinding holder; **fig 10** is the zero rake templates, **fig 11** is the 7deg. rake templates, **fig 12** is the guide base; **fig 13** is the external threading tool; and **fig 14** is the internal threading tool. ■

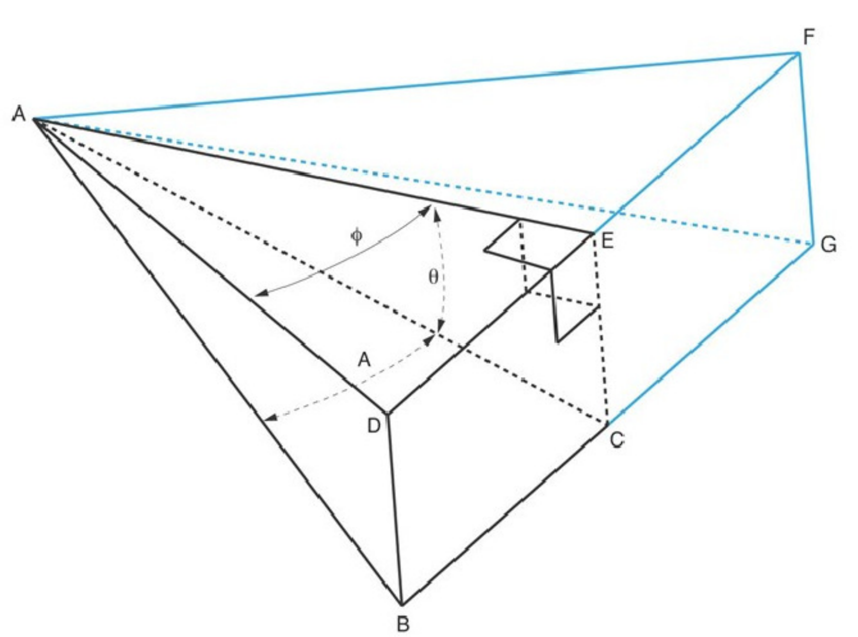
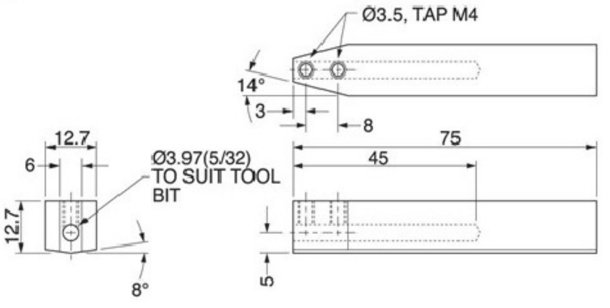


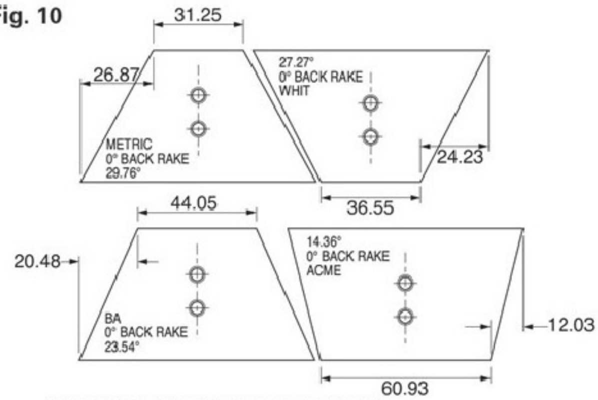
Fig. 8

Fig. 9



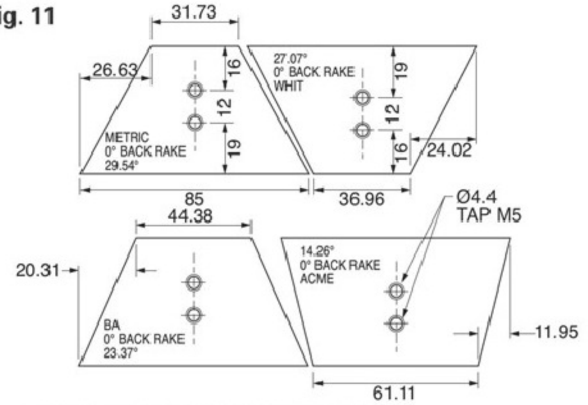
GRINDING TOOL HOLDER
MAT'L: 1/2in SQ. M/S

Fig. 10



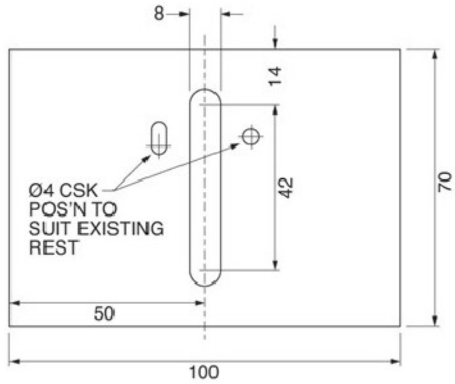
TEMPLATES FOR 0° BACK RAKE
MAT'L: 2.5mm M/S

Fig. 11



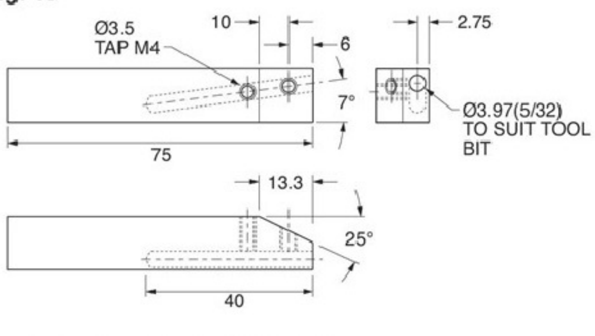
TEMPLATES FOR 7° BACK RAKE
MAT'L: 2.5mm M/S

Fig. 12



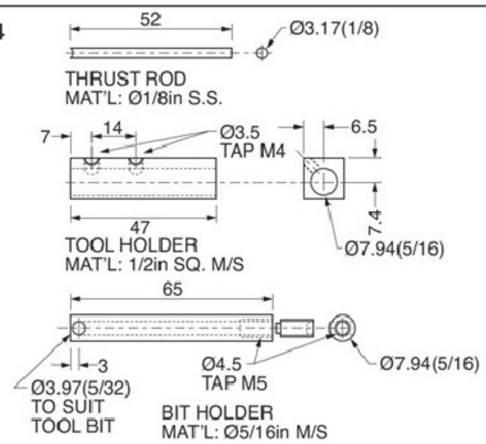
GUIDE BASE
MAT'L: 2.5mm M/S

Fig. 13



EXTERNAL THREADING TOOL
MAT'L: 1/2in SQ. M/S

Fig. 14



INTERNAL THREADING TOOL

ARTICLES REQUIRED

I am seeking new contributors for Model Engineer and Model Engineers' Workshop. I do have some articles in hand but if I don't ask on a regular basis I will quickly run out. We do pay well and overseas readers are quite welcome to send articles in as well. Long and short articles are equally welcome and as we pay by the printed page, even a short article will soon add up to a reasonable payment. For the new US and Canadian readers, I think we pay about double what the US magazines do and there is no reduction in fee if we have to redo the drawings.Please be aware that due to English law we can't publish articles on any type of firearm, either construction, modification or repairs. Articles on the use of CNC machines are welcome. A typical recent series of articles covered the construction of a CNC cutter grinder, probably a world first for a hobby magazine. So get writing today. Guidelines are available by email or post and by the time you read this, they should be on our website www.model-engineer.co.uk

FIRESIDE READING

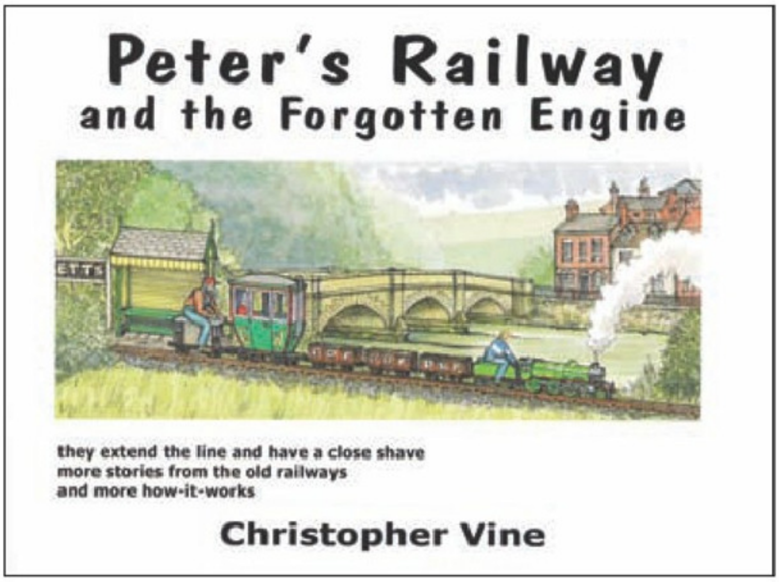
Peter's Railway and the Forgotten Engine
by Christopher Vine

ISBN 978-0-9553359-3-8

RRP is £11.99 + £1.50 P&P. You can order the book from Mr Chris Vine, PO Box 9246, Bridge of Weir, PA11 3WD. Books 1 and 2 are also still available at the same price. The book is also available at www.myhobbystore.com

Christopher Vine has sent me a preview of this, the third book in the Peter's Railway series. This book is about extending the line and also about a traction engine. The book is written in the same easy to read style of the other two books and includes more of the easy to understand technical pages. There are 96 pages with 30 watercolour pictures and 14 pages of diagrams all in full colour.

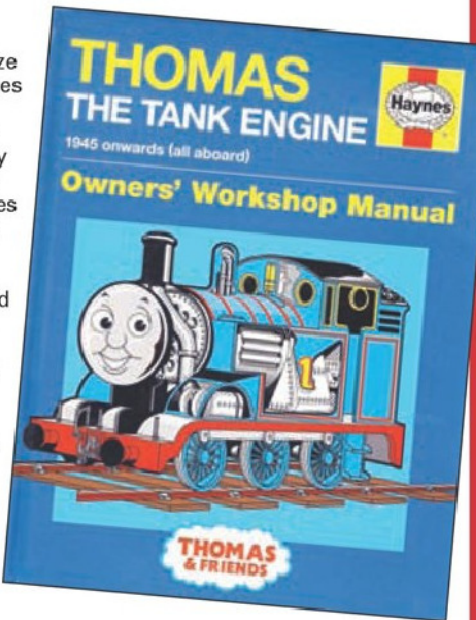
This book is highly recommended as are the first two books in the series.



Thomas The Tank Engine Haynes Manual
1945 onwards Owner's Workshop Manual

ISBN 978 1 84425 835 2
RRP£9.99

This book is almost A4 in size and has 40 pages of full colour diagrams. The book is not only about Thomas but also includes information on a wide range of his railway friends. It would be useful as a learning aid for youngsters who want to know more about Thomas.

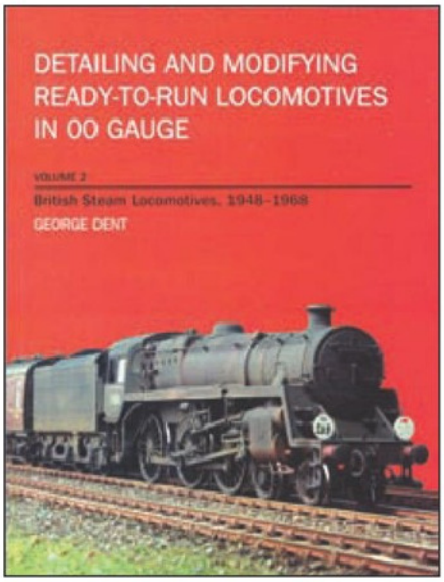


Published by **Haynes Publishing**
Sparkford, Yeovil, Somerset BA22 7JJ
Tel: 01963 442030

Detailing And Modifying Ready-To-Run Locomotives in OO Gauge
(volume 2) British Steam Locomotives 1948-1968

ISBN 978 1 84797 145 6
RRP£18.99

This book is 7½in. x 9in. and contains over 190 full colour pages. It is all about improving ready to run model locomotives. It is suitable for a modeller with some basic model making experience who is capable of adding extra detailing parts, new transfers and name/number plates etc. It is very comprehensive and would make an ideal gift for any small scale railway modeller.

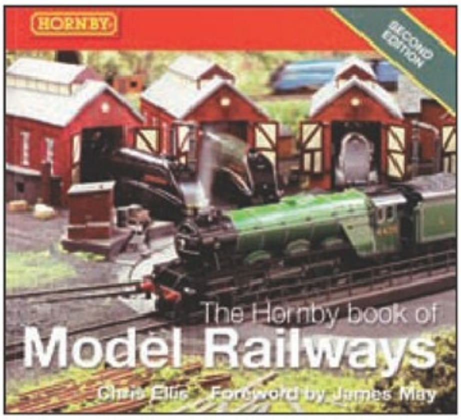


Published by
Crowood Press Ltd
Ramsbury, Marlborough, Wilts SN8 2HR
www.crowood.com

The Hornby Book Of Model Railways (2nd Edition)

ISBN 978 1 84486 095 1
RRP £14.99

This book is 8¼in. x 7½in. and contains 178 pages. The majority of the photos are in colour. The book gives a good overview of the model railway hobby and is written by Chris Ellis who has many years of model railway magazine and book editing under his belt.



Published by **Conway Publishing**
Anover Books, 10 Southcombe Street
London W14 0RA

Messerschmitt Bf109 Manual

ISBN 978 184425 6426
RRP £17.99

This is an A4 size book with 164 pages. It is packed with colour and black and white photos and includes a full colour cockpit photo with all controls listed by number. It would be a great book for a modeller and also useful if you have a Bf109 of your own to service.

Published by
Haynes Publishing
Sparkford Yeovil
Somerset BA22 7JJ
Tel: 01963 442030

CARING FOR YOUR CNC MACHINE

Dick Stephen looks at cleaning your ballscrews

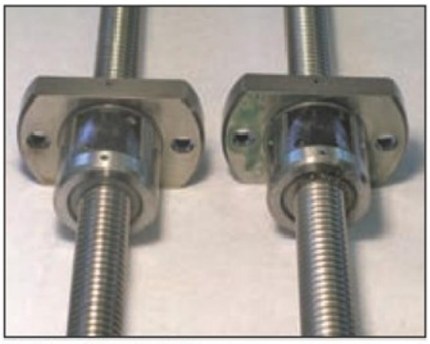
■ OVERVIEW

To obtain the best performance from your CNC machine, be it a mill or a lathe it is necessary to periodically service it. The majority of CNC machines are fitted with ball screws (**photo 1**). This is certainly the case for most CNC milling machines.

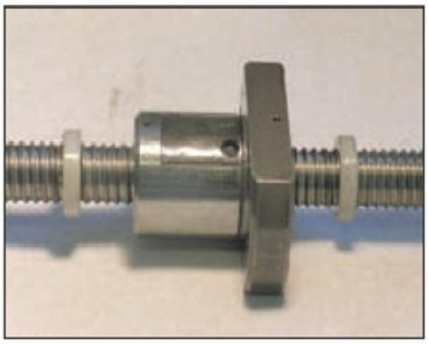
Until recently most mills were fitted with Acme screws and nuts, which need very little maintenance apart from regular lubrication. As the mills are used manually, any backlash in the screws is easily compensated for during operation. The same cannot be said for the ball screws and nuts that need to be fitted to CNC mills. The computer programmes that operate CNC machines require that the backlash in the screws is constant along the length of each screw as well as being constant with the passage of time. Any change in the magnitude of the backlash will significantly affect the accuracy of the work done on the machine. In order to minimise the backlash in a ball screw it is necessary for the ball nut to be completely clean. Most modern ball nuts are fitted with nylon wipers (**photo 2**) that remove any dust and fine particles of swarf that adhere to the oily surface of the screw. Unfortunately the action of the wipers does not keep all the fine particles out and over time the nuts become contaminated. This contamination leads to a significant increase in the backlash and loss of precision of the machine.

I use my CNC mill mostly for clock making, which means that most of the work I do on the mill involves machining engraving brass. The swarf produced ranges in size from chips to very fine dust. I am very particular about keeping the mill as clean as possible and regularly vacuum up the swarf while the machine is working. It is impossible to prevent swarf from accumulating underneath part of the Y-axis table as can be seen in **photo 3**. The fine particles of brass dust adhere to the oily surface of the screw and eventually find their way into the nut. Some time ago I described how to replace the ball bearings in a ball nut and at the same time to clean the nut. Replacing the ball bearings in a ball nut is a slow and tedious business. It is also very difficult to replace the ball bearings on some of the modern ball nuts; in fact the manufacturers suggest returning the nut to have the balls replaced.

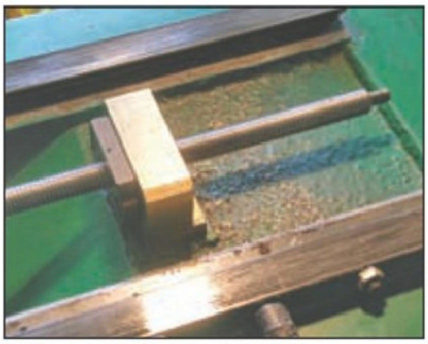
In order not to have to remove the nuts from the screws I tried the following method to clean the nuts on my mill. I removed the screw and the nut from both the X and Y-axes. Photograph 1 shows the X nut on the left and the Y nut on the right. Note the accumulated swarf on the wiper of the Y nut, which accounted for the significant increase in backlash on this axis. Move the nut down to near one end of the screw. The wipers at both ends of the nut were then removed from the nut housing and screwed a few centimetres away from the nut (photo 2). The nut and screw were then immersed vertically in a container filled with clean paraffin (**photo 4**). The nut was then screwed up and down the screw sufficiently far to ensure that all the balls made a complete circuit within the nut. The up and down movement quickly cleaned out all the grot from the nut. **Photograph 5** shows the amount of dirt I removed from the two nuts. It may not seem to be a great amount but take it from me, it was sufficient to reduce the accuracy of my mill by a lot more than I was prepared to accept. All that remained was to re-assemble the mill and re-calibrate the backlash which now was back at just under 0.05 mm for both axes, a very acceptable level indeed. ■



1. X and Y axis ball screws.



2. The nylon wipers moved clear.



3. Brass swarf under the table.

4. Cleaning the ball screw.

5. The dirt that has been removed.

A SURFACE TABLE FOR FREE

Mark Noel recycles some builders' waste

■ OVERVIEW

Anything that can save money is a bonus for the hobbyist. Mark Noel has transformed some builders' waste materials into an excellent little surface plate (**photo 1**). Even if you have to buy a tile and some cement, you will still find this is a cheap project.

1. The finished surface plate.

The local dump

Like me, you'll probably find any excuse to visit the local 'Civic Amenity Site' and return with more 'junk' than you delivered. In my case anything from old photocopiers and computer printers, to kitchen appliances and lawn mowers have provided the metal, gears, motors and other parts that feed my workshop.

Recently, however, I didn't even need to visit the tip to spot an engineering opportunity. The builders had just finished work on our house and discarded some surplus materials, which have since been recycled to create some useful workshop tools. In this article you will see how I made an engineer's surface table at a total cost of zero £s.

Builders' skip

From the builders' skip I salvaged two new and unbroken 12in. porcelain tiles and some lengths of PVC fascia board. Elsewhere on the site were heaps of sand and gravel, plus a sack of cement, sufficient to make several buckets of concrete.

The porcelain wall/floor tiles can be bought from any large building suppliers (ours came from B & Q) and are lapped and polished to a mirror finish on one side, with an embossed pattern on the other. Out of curiosity, I checked the flatness of the polished surface with a quality 12in. rule and feeler gauge and discovered to my surprise that the surface was flat to about 0.001in. It then dawned on me that this could form the basis of a surface table.

Porcelain is distinct from ordinary ceramics in being fired to a higher temperature, vitrifying the constituents to a non-porous glassy solid, which will not absorb oil. Also, since the coefficient of thermal expansion is very low, it seems that such tiles are perfect for the job of making a surface table.

On their own these tiles are too thin to support the combined weight of metal parts and marking out tools without significant warping. I decided to solve this problem by casting concrete onto the back face, adding stiffness but with a similar thermal expansion factor. The components of the project are shown in **photo 2**. Note that more sand, cement and gravel were used than are actually shown in the picture.

Construction

I started by cutting lengths of PVC fascia to make a close-fitting casting box 3in. deep, jointed with tape, with the shiny surface inside. In the builders' skip I found a pair of old chrome handles and holes were drilled in the casting box to fit these halfway up the sides.

Next, the two porcelain tiles were carefully cleaned and placed with their polished faces together to provide support and minimise warping during the casting process. The PVC frame and handle assembly was fitted around the upper of the two tiles and any gaps grouted with a thin smear of tile cement (**photo 3**).

I made up a standard concrete mix in a clean bucket by mixing gravel, sand and

2. The raw materials.

3. Ready for pouring concrete.

cement in the volume ratio 3:2:1. The sand and cement were first stirred together thoroughly and then the gravel was added. Finally, water was added slowly - stirring all the time until the consistency was that of a stiff porridge. The mix is best left to stand for several minutes before stirring again, adding more water as required.

The concrete was then spooned into the mould, working it into the corners and ramming it down to expel all bubbles. Once the mould was full, the top (later to be the base) was planed level with a piece of wood, and some old rubber feet pressed into the surface while the mix was still soft (**photo 4**). I covered the surface with cloth to slow the drying process and then left the casting in a cool place for several days to set solid.

The plastic mould box was then removed and the concrete left to dry for another week. Finally, after trimming off the mould flashes and applying 2 coats of masonry paint I had my very own precision surface table - and in a colour and style to match our bathroom. ■

4. The underside of the finished surface plate.

TOOL TIPS, QUESTIONS AND IDEAS

■ OVERVIEW

Tool tips, questions and ideas is a new section where readers can offer suggestions and ask other readers to solve their problems.
Send your tip or question to the usual editorial address.

TOOL TIP
For drilling large holes in thin material

A tip which I was given years ago, by the supervisor of our student workshop, has often proved useful when trying to drill large holes in thin sheet material. The classic problem is that, even with the part clamped securely and a pilot hole in place, the drill wanders and forms a polygonal hole. Tip: place a thick wad of rag over the pilot hole and then bring the wide drill down smartly through the rag and metal sheet, to leave a clean, round hole. Somehow the rag stops the drill wandering and the results are superb. Note: the rag should be folded up so it is just larger than the hole. You don't want a whole sheet or similar rotating with the drill.

QUESTION
Smelly metals

Something that has always puzzled me is why do metals smell? The coins in your pocket, cut steel, brass and cast iron all produce distinctive odours when rubbed with the fingers, though I'm not aware that any of these give off a gas. So what's the reason?

1. How do I remove burrs?

TIP AND QUESTION
Getting rid of burrs

I'm currently working on a project that involves drilling 2, 4 and 10mm holes in 6mm thick aluminium tubing and it is important that the inside of the tube is cleared of all resulting burrs (**photo1**). I have found that a deburring tool supplied by RS Components (**photo 2**) will reach in to clean up holes down to 4mm, but the 2mm size remains a problem short of sending a grass snake down the tube armed with a file, can any readers offer a solution?

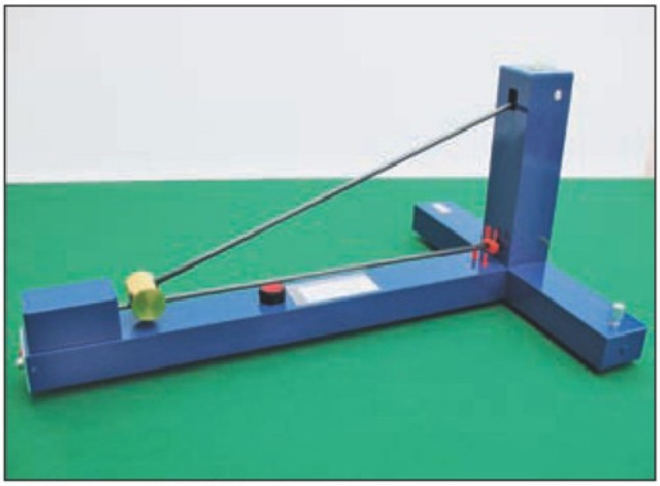
2. A Radiospares deburring tool

TRADE COUNTER

Please note that unless otherwise stated, trade counter items have not necessarily been tested. We give news of products and services which have been brought to our attention and we consider may be of interest to our readers.

■ OVERVIEW

Trade counter is a page (or two) where the trade can have details of their latest products mentioned. Inclusion of an item in these pages does not necessarily mean that the editor has seen or tested the item. Always confirm prices and postage with the supplier before placing an order.



1. Fully assembled HS-3 seismometer.

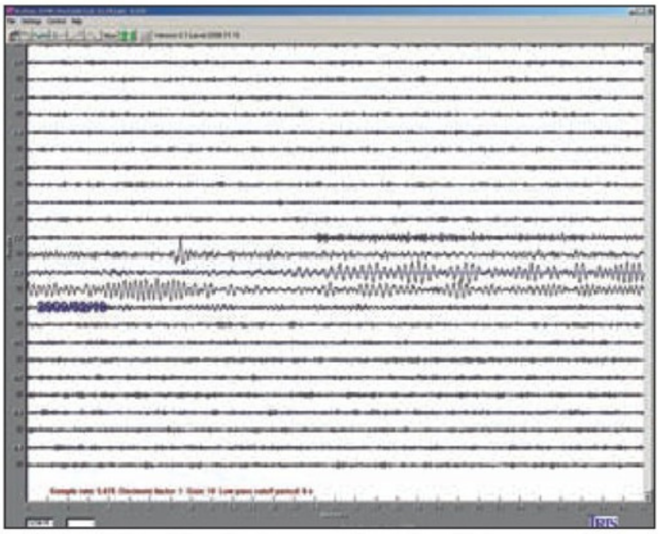
Trade Counter has been sent details of an unusual piece of equipment which neither cuts metal nor makes steam, and which is best hidden in a quiet corner of your garage where you will rarely see it again! The machine in question is a seismometer - a sensitive combination of mechanics and electronics that can detect the microscopic ground motion caused by earthquake events all around the world.

Rockwave's new HS-3 (**photo 1**) essentially comprises a horizontal pendulum made of carbon fibre, with a heavy brass weight at one end, swinging on a pair of low-friction tungsten carbide roller bearings. As the ground moves in response to seismic waves, the mass remains stationary, and the relative displacement is measured with a special sensor that can resolve these shifts down to 1 nanometre (a millionth of a millimetre). These readings are sent to a PC as a continuous stream of numbers, stored on the hard drive, and plotted on the screen as a wiggly line representing the ground motion (**photo 2**).

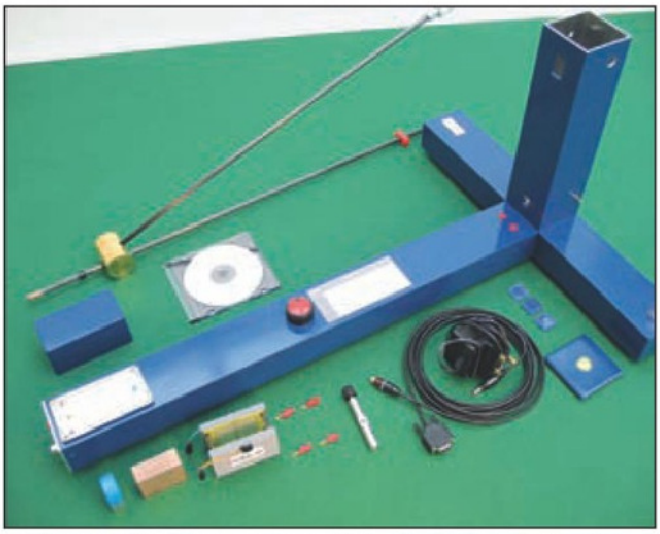
Every 3 to 4 days on average you can expect to record an earthquake from somewhere on the globe, provided your location is not close to a busy road or swaying trees whose noise might swamp the signal. Rockwave's website includes a video and tips about installing their seismometer, plus a blog of seismic signals detected at their monitoring station. On their website you can also listen to earthquake sounds.

The instrument is delivered with the major components assembled and it can be put together in about 10 minutes without any special tools (**photo 3**). It must be installed on a concrete ground floor away from heavy traffic and draughts and this process, which involves micro-levelling, takes about another 45 minutes. The kit includes logging and graphics software, a data cable and power supply. To complete the system you will need to provide a dedicated Windows PC running 98, XP or Vista.

The seismometer kit costs £310.
For more details go to www.rockwave.co.uk
or telephone **Rockwave** on (01624) 819364



2. Record of the Magnitude 6.9 earthquake which occurred near Tonga in the South Pacific on 18th February 2009, picked up by Rockwave's HS-3 on the Isle of Man.



3. The complete kit of parts supplied to build the seismometer.

Please mention Model Engineers' Workshop when talking to advertisers'.

Each competition will run for 4 weeks, entries will not be carried over to the next period. Keep on entering every four weeks to maximize your chance to win.

WIN A 500ML BOTTLE OF METCUT MCT LIQUID FROM MORRIS LUBRICANTS

MCT Metal Cutting Lubricant

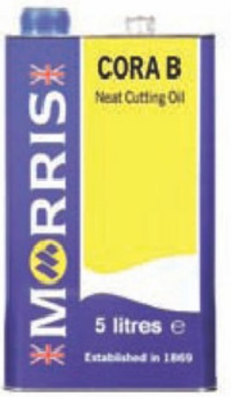
MCT is an advanced extreme pressure metal cutting lubricant for all hand-applied machining operations, particularly hole tapping and drilling. Extreme pressure properties make it highly effective on difficult materials and work hardening alloys such as stainless, high tensile steels and nimonics.

It is available in a modern, low-odour formulated liquid form and in the traditional compound and spray forms to suit users' desired method of application and is particularly suited to use on machines that do not have a flood applied coolant facility.

MCT is suited to drilling, tapping, cutting, threading, reaming, thread rolling and broaching, and is ideal for use in many model engineering machining applications.

The competition will run for 13 four week periods. Every four weeks, four lucky winners will receive a 500ml bottle of MCT free of charge. (Sorry, UK readers only.)

WIN A 5 LITRE TIN OF MORRIS LUBRICANTS CORA B METAL CUTTING LUBRICANT



Every four weeks for the next year, one winner will receive a 5 Litre container of Cora B from Morris Lubricants in our new competition. The competition will run for 13 four week periods. (Sorry, UK readers only.)

CORA B general purpose neat cutting oil

CORA B is medium viscosity neat oil containing extreme pressure and lubricity additives. It is suited to general machining operations on ferrous metals up to medium tensile steels and non-ferrous metals. The additive system ensures improved surface finish and tool life whilst remaining non-staining to copper and its alloys. Careful selection of base oils and additives ensure the product is pale in colour, low in odour and low viscosity in use.

Also new this week:

WIN a copy of the new Haynes Manual for the Messerschmitt Bf109 aircraft

There are six copies of this book to be won over the next 6 four week periods. (UK only.)

You can also enter the competitions on our website **www.model-engineer.co.uk**

Please enter me into the competition to win

- ❑ **A 500ml bottle of MCT fluid** ID272
- ❑ **A Messerschmitt Bf109 Haynes Manual** ID161
- ❑ **A 5L tin of Morris Lubricants Cora B** ID237

Postal entries must be on this entry form. Photocopies are acceptable.

Name ______________________________

Address ______________________________

____

____

______________ Postcode ______________

Phone ______________ D.O.B ______________

Email address ______________________________

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

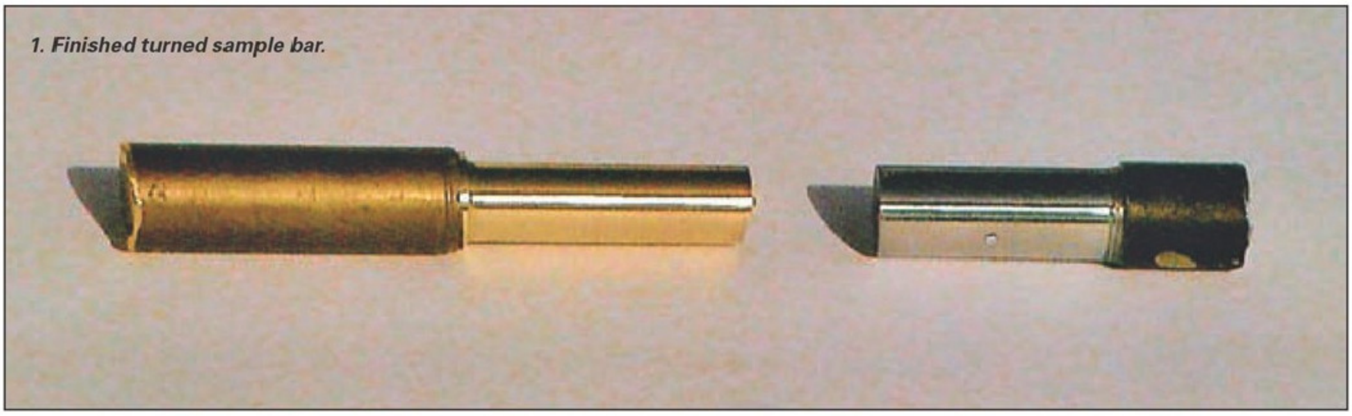
Please post to: MCT/Model Engineer competition,
PO Box 269, Rossendale BB4 0DG

Terms and Conditions:

PLEASE NOTE: We need a name and address to send the winner the prize. By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/telephone/ post from MyHobbyStore Ltd. and other relevant 3rd parties. If you DO NOT wish to be contacted by Model Engineer and MyHobbyStore Ltd please tick here: Email ❑ Phone ❑ Post ❑ If you do not wish to be contacted by carefully chosen 3rd parties please tick here: Email ❑ Phone ❑ Post ❑ For full Privacy Policy and Terms and Conditions please see **www.model-engineer.co.uk**

ID272/161/237

1. Finished turned sample bar.



A SIMPLE TOOL POLISHING FIXTURE

Ron Wright improves his surface finish

■ OVERVIEW

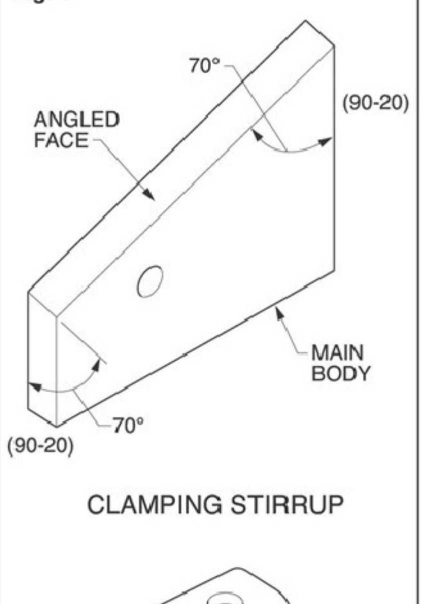
Accurate tool grinding is an important step in producing quality work. The little fixture described in this article will help in producing accurate tool shapes.

A fine finish

The fixture illustrated in **fig 1** is designed to allow a finely polished finish to be applied to the top face of a carbon steel lathe tool with the intention of producing a fine finish on turned work.

Photograph 1 shows two turned material samples, one of brass and one of mild steel. They were machined on a Cowells ME90 lathe at its top speed of 2100RPM using hand feed and a very fine depth of cut.

Fig. 1



The finishes shown were produced with single cuts followed by a 20 sec application of very fine wet & dry paper.

The polished face of the tool is intended only for this fine finishing and not for stock removal.

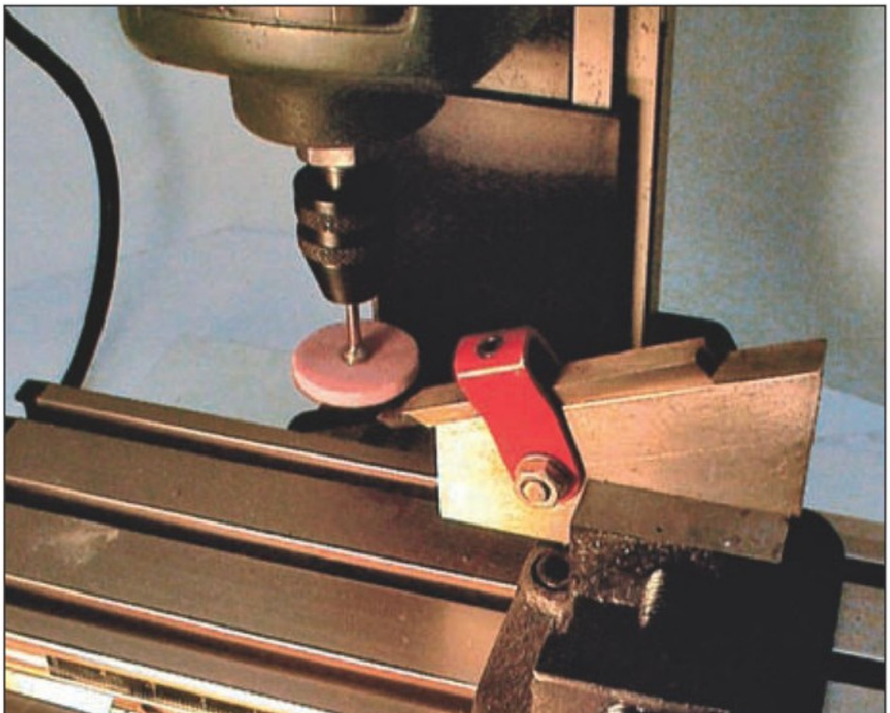
Using the fixture

Photograph 2 shows the fixture in use clamped in a vice on the table of a Proxxon micro miller which can be run at 20,000rev/min in order to produce the polished finish on the tool top face, shown in **photo 3**, by using a standard fine Dremel grinding wheel.

Constructional details are shown in fig 1 and **photo 4**, the main body being cut from mild steel plate with the angled face being milled to produce the compound angle necessary to hold the tool top face parallel to the Proxxon mill table.

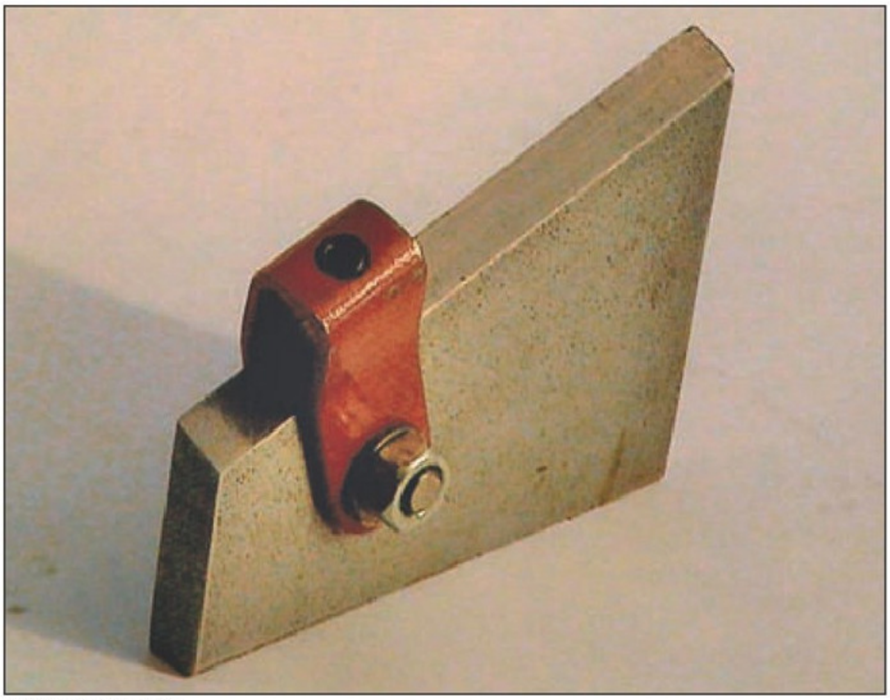
The angles used are shown in fig 1 but any other suitable angles could be selected.

The clamping stirrup was hot bent from a short length of 1in. x 16g mild steel and



2. The polishing jig in use.


3. A finish polished tool.


4. The finished jig.

angled to set the clamp screw square to the tool being ground. The clamp screw hole was drilled 4mm clear after bending and a 4mm nut trimmed and soldered inside the bend.

An Allen grub screw is used for clamping and the yoke is pivoted to the body by a 5mm bolt and nut, but of course any suitable dimensions will do.

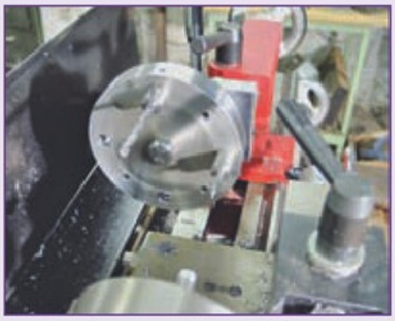
The angles used in my case were each 20deg. but any other figures can be used although these figures seem generally representative of those quoted in text books.

This whole gadget can be made in an hour or two quite easily and so far I have found it to be quite good at doing what it was intended to do, that is producing acceptable surface finishes on turned work and saving time in polishing etc.

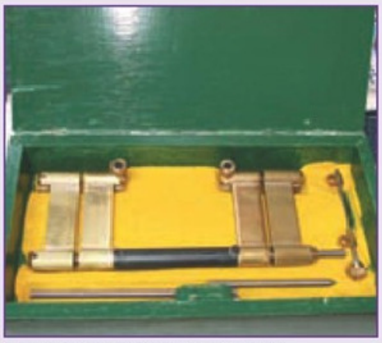
Note: photo 3 does not really show the top, polished, face of the tool very accurately and makes it appear rounded. In fact when observed under a microscope or through a magnifying lens it can be seen to be quite flat. ■

IN OUR NEXT ISSUE

Coming up in issue 160, on sale 22 January 2010


DAVE FENNER MAKES A TAILSTOCK TURRET FOR THE MINI-LATHE.

DAVE FENNER LOOKS AT DRAWINGS, MARKING OUT AND MEASURING.


DAVID ROGERSON SHOWS YOU HOW TO MAKE A CLOCK WHEEL DEPTHING TOOL.

(Contents may be subject to change)

DON'T MISS THIS GREAT ISSUE – see page 8 and subscribe today

SCRIBE A LINE

Anodising Titanium 1

I must say I have been totally enjoying the pages of ME and MEW since you have taken over. Well done on both and keep up the good work. I also like the direction and increasing content of the website! It's also interesting to note just how prolific a writer Mr Fenner has become since retiring from the editors desk. Glad to see he now has an outlet for his obvious talent!

Other the than kudos I am actually "Scribing a line" in reference to an article in issue 156. Tony Jeffree's article on Anodising Titanium. The diagram in Fig. 1 on page 48 shows fuses installed in the AC input side of the bridge rectifiers however the actual unit shown in photo 2 seems to clearly show the actual fuse holders in the DC side of the circuit. I wonder if Tony might comment on this as it could confuse some builders. I suspect the DC side is where they should in fact be for greatest safety.

Gerald Hynes, Winnipeg, Manitoba, Canada.

Anodising Titanium 2

I was pleased to see Tony Jeffree's article on anodising Titanium. I worked at the Central School of Art and Design in the early 1970's where we developed the first examples of this decorative anodising. We too found that Coke worked as an electrolyte but found that our preferred electrolyte was a 3 to 5% solution by weight of ammonium phosphate. This is quite innocuous and is often used as a plant food, sometimes strapped to the stems of cut flowers. I worked with the painting technique and was quite respectful of the 110 volts DC coursing through the metal ferrule of a paintbrush wetted with electrolyte. The sizzling concentrated the mind. My power supply looked almost exactly like Tony's but in addition it had a push-to-make momentary push button switch on the top panel. You had to push this with your left hand, while you worked on the titanium with the brush in the right hand. The idea was that it functioned as a simple deadman's switch if you made any mistakes. Regarding the colours, I understood that very much as in oil films or soap bubbles, it is the thinness of the film that refracts the light creating the colours, with 5 volt colours being in the .04 micron range, and the greys purples and rose golds at 110 volts being in the 0.12 micron range.

I enclose a photo of two experimental miniature constructions of Titanium/Sterling Silver/Acrylic. These are again from the 1970's. They are stylistically well past their sell-by date, but I enclose them as an indication of how controllable the colours can be, possibly being particularly suited to clock face design.

Chris Gabel, by email.

Manual skills versus CNC

I have read many times, sometimes in this magazine, about the parlous state of manual skills that apprentices and journeyman machinists now possess. There is a point at which I agree with those making the observations and another at which I disagree.

For the thirty-six of the last thirty-eight years I have concentrated on acquiring and learning to use hand tools. I built my current linisher twenty years ago cutting the frame from a piece of 10mm barbecue plate using an Oxy, a vertical drill, a piercing saw, a hacksaw, a bench and angle grinders and files. I had to send the rollers out to be bored because I could not achieve the accuracy I needed without a lathe. It is an excellent machine and is still going strong. It took me three weeks to make.

Similarly twenty five years ago I made a pair of bedside tables which took me two weeks to make. They too are still going but they just took so long to make. They have their imperfections.

I have built up a very large body of knowledge and skill in using hand tools but I am not all that good at it. I fiddle and fart around sharpening chisels and plane blades, spend hours rooting around trying to get a piece of timber to the correct and even thickness or one edge square to another.

I have recently acquired a 250mm table saw and a 350mm bandsaw along with a 305mm thicknesser, a milling machine and a decent metal lathe.

About six years ago I was reading Router magazine in which a bloke made the statement in a letter to the Editor that if you couldn't use a power tool to do the job then the job was not worth doing.

I was deeply offended. Very deeply offended. I ranted and raved to myself out in the workshop for months. It still gets my dander up but not to the same extent.

I wondered why it was that I was so offended by the statement and I came to realise that if I accepted the assertion then I had wasted a great deal of time. Time that could have been used far more productively. It was the notion that the knowledge I have accumulated was not really valuable that got to me.

In August this year I bought my son a new set of speakers for his computer. The sub woofer was such a monster that I had to make a new table under which it would sit. The table was tapered. The timber for the legs went through the thicknesser and they are all the same thickness. They were all docked to the same length. The chamfer on the edges was done on the router table and is the same depth and length on each leg. The angles for the tapered front rail are exactly right. The only time I used a hand tool was to match the piece of wood I used as an edge band on the top. It took me four hours to make.

So what does all of this mean? It means that those of us who have learned skills place great value in that which we have learned. For those of us who have spent a life time as a fitter and turner or a toolmaker there is a question of identity. We are the skills that we have learned. We value those skills because they give us value. If the skills are no longer valued then we are by extension no longer valued.

This is what the dry stone wall layer, the Suffolk hay wain maker, the blacksmith and the wheel wright felt when wire fences and cars came along.

I look around at young machinists today and I see a dearth of manual skills. Put

Keeping warm

If your workshop has a concrete floor, a good way of keeping your feet warm without using electricity is to cover those areas that you stand on with rubber doormats. These can be bought from B and Q for about £5 each. Get the one with a pattern of round holes in it. This has the advantage that large amounts of swarf can be "absorbed" by these holes without giving the nasty feeling under your shoes that you would get on a concrete floor.

John Florentin by email.

YOUR CHANCE TO TALK TO US!
Drop us a line and share your advice, questions and opinions with other readers.

them in front of a lathe or milling machine without a DRO or CNC control and they are lost. But that does not mean that they are inferior to the old crowd any more than having manual machine skills makes us superior.

Today's machinists have acquired just as much a body of knowledge as we did. Those skills are exactly as valuable today as our skills were when they were needed. The skills that are dying are doing so simply because they are not relevant, just like the skills of tradesmen I mentioned earlier. We developed skills suitable to the task at hand. The means of achieving the end have changed so the skills have changed. No matter how good we are as machinists, we cannot match the repeatability, accuracy or the productivity of the current generation of machinery. We cannot run twenty four seven. That is why we invented those machines. Our skills are nice; they give us an identity, a sense of worth and a place in history. But they are just not relevant any more. We should take great pride in our skills for they got us to this point, but we should not decry others with skills different to our own.

Lawrie Alush-Jaggs, Kew, Victoria, Australia.

Milling articles

First, let me congratulate you on your wonderful magazine; as a self taught, aspiring engineer I always look forward to seeing what information will be in the next issue. There have been any number of articles that I've taken quite a lot of insight from; the article on using a milling machine properly being one of the most useful.

Forgive me if I'm mistaken, but I thought I saw in a recent issue (we're a little behind in Australia; issue 155 arrived just this week) a request for more Scribe A Line comments, and possibly requests of what we'd like to see articles on in the future.

Could I possibly suggest, as a continuation of the milling and dividing article, an explanation of cutting bevel gears? I've searched all over the internet and still haven't found an actual tutorial as such. I vaguely remember from my university days, watching a video which showed setting the mill cutter above the height one would use for cutting a straight gear (i.e. above centreline), cutting all the teeth at this height, then setting it below the centreline, resetting the bevel gear blank in the indexing tool so that the cutter enters at the same point at the smaller end of the gear, and then re-indexing and cutting each tooth to give a tapered relief so that the gap between teeth is larger at the bigger end of the bevel gear.

Second, I suspect that in a past issue this was covered, but would it be worthwhile to do an article on hand scraping? This seems to have become a lost art in recent years. I've known a few ex army and navy people who have told me they used to be able to scrape and could make their own scrapers, but none have been able to actually demonstrate either. Further to this, I saw a partial article on the internet at one stage regarding scraping which detailed taking three rough pieces of cast iron, and creating three accurate surface plates by gauging each from the other two, round-robin style. (I.e. the only way each plate could accurately and fully touch the other two would be if each plate were completely flat.) Is there anyone that could do an article on this? The ability to create even a small surface plate of sufficient accuracy to be used in the home workshop would probably be of great benefit to many readers who can't afford (or can't trust the postal services not to break it.) to buy a commercial plate.

Although it might be of only academic interest to most readers, an article on scraping and accuracy could be followed with an introduction to metrology, the importance of and how to make/calculate your own go no-go gauges, which is an article I could possibly help with.

One final note, I've deeply enjoyed the articles on using the faceplate; for many years I did without one of these, however after finally obtaining my own lathe it was one of the first purchases (granted it's had minimal use since then). One of the tools that I've found most useful with it has been to drill and tap a piece of 1in. square bar so that it can be bolted to the faceplate and attach a HSS tool to the end, in effect turning the lathe into a vertical fly cutter. I've used this (as well as the t-slot cross-slide table) to generate my own angle plates, and was interested to see Harold Hall's method of cleaning up the cast angle plate in issue 155. I'm guessing that his method would be more accurate, since using the fly cutter would require the Tee-slot table to be accurately ground (mine is 40 years old and likely has warped a bit in that time) however for simple items, and facing off large sections, I've found it to be a useful tool which might be worth mentioning in a future article.

Nathan Stern, Australia.

REMAP Scotland

I was at a REMAP (Scotland) Panel meeting the other week, when Jim Fyffe told me that he had sent you an e-mail and that you had kindly agreed to mention us again in both Model Engineer and Model Engineers' Workshop. I'm very grateful David, since we are moving to ever more complex solutions which require the machining (and electronics) talents of people such as your readers.

For example, we had a young lady, a successful graduate just starting off in life, who suddenly went totally blind. As if this was not bad enough, she subsequently developed a condition which left her with little strength in her hands and was unable to raise her arms much above shoulder level.

She lives in an old high ceilinged flat and dries clothes using a "clothes pulley", the old 4 bar type drier hoisted up to the ceiling by a rope. She used the drier frequently, but we were called when she started dropping it on her head as the rope slipped out of her hands!

We designed a powered version, using a salvaged 24v wheelchair motor to drive a machined winch drum. The motor was stopped by limit switches at either end of the pulley travel. She merely pushes an UP or DOWN button and is delighted with the design.

Finally David, you were kind enough to make us your designated charity. Apropos that, can I say that we have a new, much brighter, website at www.remap-scotland.org which has an on-line donations facility.

Again, thank you for your support.

David Reid
National Organiser
REMAP (Scotland)
01466 730736

Saving back issues

In "An Introduction to Milling (4)", in MEW 151, Donald Brymer informs us that "these solid carbide cutters will rapidly lose their edges if used with a low cutting speed and a slow feed rate." Would it be possible to elaborate on how this occurs? Reading other articles in MEW over the years, I'd understood that high cutting speed and feed per tooth increased cutting edge temperature and wear. More detail on the counter-intuitive wear scenario would be very helpful. (Changing the speed on my hefty turret mill is awkward, so it's worth knowing whether a speed change really is warranted.)

There is much of interest in MEW 151, and the new milling machine coverage is much needed I think. My brother, for example, has a mill but no lathe, and I rarely use mine.

Thank you for many years of enjoyable and informative reading. If we have to evacuate during the coming fire season, as in the last, the boxes of MEW (back to #20) are ready to go.

Erik Christiansen, by email.

WRITE TO US!

We would love to hear your comments & questions and also feeback about MEW

Write to the Editor, David Clark, Model Engineers' Workshop, MyHobbyStore Ltd., PO Box 718, Orpington, Kent BR6 1AP. Alternatively email: david.clark@myhobbystore.com

MODEL ENGINEER

www.model-engineer.co.uk

WEBSITE NEWS

The website is going from strength to strength. By the time you read this we may well have over 4,000 members. As promised, I have had a lot of back articles from Model Engineer and Model Engineers' Workshop put on line. Also uploaded are several issues of The World Of Model Engineering, all the Model Mechanics from the late 1980s and several of the Model Engineer Centennial Editions. About 50% of the material is free to everyone with the remaining 50% free to subscribers.

The forums are very active with many questions being asked and many readers are chipping in to answer them. Anyone who joins our community can post messages so if you have not already joined, join today. The answer to that difficult question is just waiting to be posted.

In line with the current magazines, we are running online competitions. Most of these competitions do not require you to be a subscriber. More quality prizes are on their way to you. The current competitions run for 4 weeks and then start again and continue until the prizes run out. Enter every four weeks for the maximum chance of winning.

www.myhobbystore.com

Our corporate website has plenty of items to suit the hobbyist. Small tools, plans and books are all available. Please visit today to see what you are missing.

Workshop manuals online

A reader sent me some old Drummond Lathe Manuals he no longer required. I have decided to get PDFs of these put onto the website. It occurs to me that there is a need for machine manuals and similar literature (sales literature?) on the website that can be accessed free of charge.

If anyone has an old machine manual they don't want or would be willing to scan in or let us scan in the manual, can you contact me at the editorial address? We would have to upload them as there is no facility for the web user to do this. Please do not offer current manuals such as for the Myford Super 7 series which are still in copyright.

FREE Private Adverts

MODEL ENGINEER

MODEL ENGINEERS' WORKSHOP

Subscribers, see these adverts five days early!

SUBSCRIBE TODAY AND SAVE £££'S

Machines and tools offered

■ Myford ML7 lathe with clutch, lever feed tailstock, two chucks, long cross slide, milling vice, drip tray, spare countershaft, lots of tools, excellent condition, £500 OVNO. **Tel: 01992 633153 Hertfordshire.**

■ Myford 3½M type lathe completely restored, Dewhurst switch and tumbler gears, screwcutting, single phase, all original parts, splash guard, light added, cutting tools, £550. **Tel: 01895 251401 Uxbridge.**

■ Amolco milling attachment to fit Myford ML7 and Super 7. Myford spindle nose takes 2 Morse taper collets, £225. **Tel: 01923 670162 Watford.**

■ Boxford lathe, 4½in., power cross slide, vertical slide, meddings ½in. bench drill, Elliot 5in. rotary table, Nippy drill vice, £550 the lot, will split. **Tel: 01462 434698 Hitchin.**

■ Peatol lathe tooling, some as new, 1200 compound slide, £38, 1182 tailstock die holder, £16, 1151 live center, £10, 1190 steady rest, £18, 1251 riser block and kit, £17. **Tel: 01252 662653 Aldershot.**

■ Myford ML7 lathe, set of 6 stops, change wheels and accessories, GWO, buyer collects or pays carriage, £1,000. **Tel: 01908 586747 (evenings) Milton Keynes.**

■ Myford Swivelling Vertical slide as new, £175. **Tel: 0208 8442224 Middlesex.**

■ Bronx hand operated bending machine suitable for fine limit sheet metal work with blades and Vee beds, can arrange delivery, offers? **Tel: 01932 872702 Woking.**

■ Atlas lathe parts, including collets and Clare milling chuck. **Tel: 01935 824936 Yeovil.**

■ Collet set, 15mm long series (Lorch or Boley?) x 8, $\frac{1}{16}$in. to 1/2in. plus three dead centres in varnished rack, drawbar 217mm oa 156mm to shoulder, weight 4.5Kg, £15. **Tel: 01842 819969 Thetford.**

■ Warco variable speed vertical milling/drilling machine, 3 Morse taper, instruction manual, tools, £180. **Tel: 01453 823783 Gloucester.**

■ Conquest lathe spares, new lead screw and half nut, new 4in. 3 jaw chuck with internal and external jaws and backplate, £35 +P&P at cost. **Tel: 0161 6522404 Oldham.**

Machines and tools wanted

■ Can anyone help with a manual and/or information on a Woodhouse and Mitchel vertical turret milling machine? **Tel: 01284 704848 Buty St Edmunds.**

■ Unimat SL lathe and accessories, complete or not. **Tel: 01635 44482 Newbury.**

■ Adept hand shaper no 1A or 2A in any condition. **Tel: 01394 450892 Suffolk.**

■ Small (up to 500 Watt) double ended bench grinder, single phase, running at circa 1500RPM (not the more usual 3000RPM). **Tel: 0115 9376333 Nottingham.**

Models wanted

■ Drawings for Chelston Jowett Poppet Valve Engine and build articles from Model Engineer circa 1987, reasonable expenses paid. **Tel: 01275 375398 North Somerset.**

SEE MORE ITEMS **FOR SALE** AND **WANTED** ON OUR WEBSITE **www.model-engineer.co.uk/classifieds/**

YOUR FREE ADVERTISEMENT: (Max 30 words plus phone & town - please write clearly)

Phone: Town:

NO MOBILE PHONE NUMBERS, LAND LINES ONLY

Please use nearest well known town

MEW159

Please insert advert into: (Tick one box only)

❑ Model Engineer ❑ 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:

David Clark, **ME/MEW FREE ADS**, MyHobbyStoreLtd, PO Box 718, Orpington, Kent BR6 1AP

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@myhobbystore.com**

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

NO NEED TO WAIT – PUT YOUR OWN **FREE** CLASSIFIED ADVERTISEMENT ON OUR WEBSITE
www.model-engineer.co.uk/classifieds/

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

MODEL ENGINEERS' WORKSHOP CLASSIFIED

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

MODEL ENGINEERS' WORKSHOP CLASSIFIED

Macc Model Engineers Supplies LTD
(01625) 433938

www.maccmodels.co.uk
Check out the NEW look website.

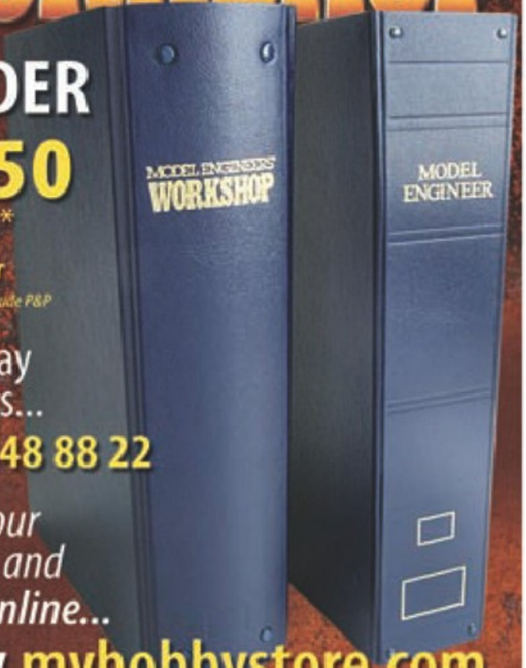
We stock copper, brass, steel and all tube. Also stock a wide renage of flat, round, hex and square , in steel, stainless steel silver steel, bronze, brass, copper and many more

New Steam Engine Kits, ready made engines and ready to run engines

Full range of Steam fittings and some new marine boilers.
Wide range of BA bolts and nuts

MODEL ENGINEERS' WORKSHOP

BINDER £7.50 each*
inc. 15% VAT
*Price does NOT include P&P



Call today for yours...
0844 848 88 22
or visit our website and Order online...
www.myhobbystore.com

EVENSON ENGINEERING

Quality Machines and Tooling

New Machines & Tooling

- Union Graduate Wood Lathe, 42" bed, 1 phase, as new £1050
- Union Graduate Wood Lathe, 32" bed, excellent condition £850
- Union Graduate Wood Lathe, short bed, excellent condition £750
- Viceroy Wood Turning Lathe, 16" bed, nice condition £375
- Junior Whithead Vert Bandsaw (wood) 16" x 16" table £175
- Bridgeport Mill, Belt Head, 42" table, power feed D.R.O. nice condition £2200
- Bridgeport Mill, Belt Head, no power feed, 36" table, nice condition £1500
- Bridgeport Mill, 48" table, x + y power feed, belt head, very nice £2250
- Boxford VM30 Mill, 24" x 6" table, vari speed with inverter with vice & collet chuck, outstanding condition £1750
- Colchester Master 2500 gap bed lathe with Q.C.T. 3 pt steady £3000
- chucks and taper turning
- Tom Senior "Major" with quill feed head, outstanding condition £1850
- Myford Super 7 with coolant, industrial stand & tooling £1000
- Jones & Shipman wheel balancing fixture, complete, lovely condition £550
- 24" x 24" Surface Table (English) with lid £125
- Burnard D14 Collet Chuck, lever operated £225
- Q & Smith 6" Power Hacksaw with coolant, excellent condition £325
- Fobco Star Pillar Drill, 3 phase £125
- R.J.H. double ended grinder 10", with pedestal & guards, as new £200
- Viceroy 10" ped grinder polisher, lovely modern machine £300
- Viceroy D.E. 10" polisher £235
- Viceroy 10" heavy duty ped grinder £200
- Startright Saw Benches. Tilt Arbor 23" x 22" table, 8" plate, ex school. (2 Off) Each £400
- Centec 2A Quill head mill. Single phase, average condition £890
- Record DMB 65 vert wood band saw, as new £150
- Well Saw 4" cap, power hacksaw, lovely small British made machine £300
- Tom Senior M1 vert/horiz mills, good condition. (3 Off) £800 - £1200
- Harrison L5 Lathe with tooling, single phase £950

WE ALSO PURCHASE QUALITY MACHINES & TOOLING

DELIVERY SERVICE AVAILABLE PLEASE TELEPHONE BEFORE TRAVELLING – WEEKEND & EVENING VIEWING AND DELIVERY SERVICE

More machines always in stock. **Tel: 01274 402208** **Mobile 07887 535868** 4 Duchy Crescent, Bradford, BD9 5NJ

To advertise on these pages contact Katie Kelleher on 0844 848 5239 or Katie.Kelleher@myhobbystore.com

HOME AND WORKSHOP MACHINERY
Genuine Used Machines & Tooling
144 Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HS
Telephone: 0208 300 9070 - Evenings: 01959 532199 - Facsimile: 0208 309 6311
www.homeandworkshop.co.uk • stevehwm@btopenworld.com
Opening Times: Monday-Friday 9am-5.30pm - Saturday Morning 9am-1pm
10 minutes from M25 - Junction 3 and South Circular - A205
Startrite 14RF metal cutting vertical bandsaw £1225
very nice condition £1125 Alexander 3A (3 dimension engraver)
Harrison M250 5" x 30 lathe £2950
Taking orders for the 'Ali-Pali' Show
Proud Sponsors of Vintage Vehicles!!
£950 Colchester Chipmaster lathe
NEW £125 Milling/Drilling ground X-Y table
RJH 4" vertical belt linisher (240 volts) £675
Colchester Bantam (800) £1575 Rare from NEW 240 volts lathe
• Adcock & Shipley 2E vertical heads, slotting heads £625 / £495 / £625
• J & S grinding wheel balancer + balance £245
• J & S balance + bottom base only £80
• Elliot Sturdimill (coming in) £2250
• Colchester Mascot (single) back toolpost £245
• Elliot 10" shaper £375
• Startrite 352 bandsaw £975
• Marlco keyway broaches just in!
• Harrison L5/L5A/140/L6 T/steadies
• Eclipse De-magnetiser £80
• Hofmann dividing head + gears £625
• Clarkson Autolock chucks Selection
• Colchester Triumph 2000 fixed steady £245
• Harrison M300 Ainjest attachment £345
• Axminster bandsaws, morticer, sanders, Scheppach planer, Startrite sawbench all just in!
£1150 Colchester Bantam lathe
Boxford AUD Mk11 5" centre height + gearbox £1250
Harrison L5 lathe + pcf & gap £950
£24 5 kilo anvil
Harrison 11" lathe + gearbox, pcf & gap £1400
Tom Senior M1 milling machine very nice!! £1575
Harrison 11" lathe + pcf & gap £1200
£2950 Elliot '00' vertical milling machine. Very nice example.
£950 Tom Senior Major milling machine
Kasto (Germany) toolroom power hacksaw 150 x 170mm £745
Duplex D29 toolpost grinder £345 + larger model £395
£145 Flamefast DS220 brazing hearth
Boxford Mk11 BUD lathe £875
SIP NEW (old stock) drilling machines, better quality! £125
Elliot 10" shaper £345
£1525 Boxford ME10 + power cross feed (240 volts)
£425 RJH Swordfish fretsaw + extractor
£2950 Colchester Triumph 2000 + gap & taper turning
Harrison/ Colchester etc. D14 tooling
Prazimat lathe
Meddings pedestal drill / 2MT £375
£164.50 Crompton/Tyco NEW motor for ML7/Super 7
JUST IN! Larger chucks and vices
< Excel 1440E lathe + chucks, steadies (1997) £1250
£2450
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 have wood lathes, saw benches, bandsaws, morticers and Record vices etc - large selection!


We have thousands of lathe tools, milling cutters, drill bits, centre drills, consumables and odd items all here in our workshop ready for you!!
Bridgeport milling machine 48" x 9" table (powered)
£2950
Myford ML8 lathe + accessories and turning tools
£425
Criterion 8" rotary tables
£225 each
Colchester Student lathe
£1250
£275
Norton No.3S flypress very nice press!!
£425
RJH buffer/ grinder
£245
Myford Multi stop
As NEW!
Axminster morticer
£495
£345
Scripta engraving machine
£525
Edwards 12" pedestal guillotine
Denford Viceroy 280VS lathe
£1475
£345
Q&S 6" hacksaw
£90
Moore and Wright 100mm - 200mm
£325
Meddings M10 high speed bench drilling machine
£625
Norton 6DB deep throat + handle and balls
£70
Eclipse de-magnetiser
£40 & £50 each
Keyway broaches 7/16" 18mm
As NEW!
£140
Crompton Parkinson Foot Mounted 2HP 240V / single phase 1400 revs as new.
36" x 24" surface table
£245
£45
Moore and Wright 6" - 12"
£1400
Boxford BUD + power cross feed 5" x 22"
£4.50 each
Eclipse 300mm / 12" x 1" x .050" machine hacksaw blades
Myford Super 7 lathe + power cross feed & stand
£2250
Photo taken 4th November 2009!
Abwood 6" universal vice
£345
£245
Colchester Triumph 2000 fixed steady
£2400
Myford Sigma lathe 3 1/2" x 19" (late model)
Arbor press
£120
Verdict sine bar (choice)
£40
£245
Denford Viceroy buffer's
£725
Marlco two speed broaching press
As NEW!
£245
J & S wheel balancer + level
Q&S 6" Sawmaster
£625
£495
Axminster linisher/ disc sander
Brallion (France) 18" x 6" fine magnetic chuck
£225
£425
DeWalt 125 power saw + Dado and Moulding head
Harrison 140 + gearbox just arrived!
£1650
From £20
Eclipse angle plates
£750
Myford ML7 + 3 jaw chuck!
Tom Senior M1 vertical
Only £950
As NEW!
£345
Harrison Imperial M300 Ainjest attachment + bar
>>>>> We are still OPEN SATURDAY MORNINGS dedicated to the model engineer <<<<<

SEE US AT THE MODEL ENGINEERING SHOW, ALEXANDER PALACE, LONDON, 22 - 24 JANUARY 2010

CHESTER MACHINE TOOLS

www.chestermachinetools.com

SEE OUR WEBSITE www.chestermachinetools.com FOR OUR EXCLUSIVE ONLINE OFFERS

DB7VS LATHE

£525.00 +vat

FEATURES
• Digital Speed Readout • Variable Speed Spindle
• Metric and Imperial Thread Cutting • Hardened and Ground Bedways • Cast Iron Construction

Centre Distance	300mm
Swing	180mm
Speeds	Variable 50-2500rpm
Motor	700w
Weight	55kgs

H110 BANDSAW

Capacity Round	110mm
Capacity Rectangle	100x150mm
Speed Range	20,30,50m/min
Motor	550w
Size	965x410x500mm

£155.00 +vat

626 MILL

£1320.00 +vat

FEATURES
• Head Swivels 90 degrees
• Head Tilts 45 degrees
• One Shot Lubrication
• 1.5hp Motor
• Machine Worklight
• Machine Stand

Max Drilling Capacity	32mm
Max End Mill Capacity	25mm
Face Mill Capacity	75mm
Table Size	156 x 745mm
Long Travel	380mm
Cross Travel	135mm
Knee Travel	330mm
Spindle Taper	MT3 or R8
Motor	1.5hp
Size	1085x990x1710mm
New Weight	410kgs

CHAMPION 16VS

£510.00 +vat

FEATURES
• Variable Speed Spindle
• Dovetail Column
• Tilting Head
• Wide Spindle Speed Range

Table Size	500 x 140mm
Spindle Taper	MT2
Speeds	Variable 50-2500rpm
Motor	600w
Weight	90kgs

Shown with optional stand

DB11VS

ZCentre Distance	700mm
Swing over Bed	280mm
Spindle Bore	26mm
Motor	1200w
Spindle Speeds	125-2500rpm
Net Weight	180kgs

FEATURES
Digital Speed Readout • Variable Spindle Speed • Metric & Imperial Thread Cutting

STANDARD ACCESSORIES
3-Jaw Chuck • 4-Jaw Chuck • Coolant Tray • Rear Splash Guard

£1120.00 +vat

Shown with optional stand

3-Jaw Chucks from £47.00

Mag Base and Dial Gauge £21.00

4-Jaw Independent Chucks from £43.00

6" x 5" x 41/2" Open Angle Plate £17.00

Quick Action Vice Low Working Height £28.00

T1 Quick Change Toolpost and 5 Holders £95.00

D13 DRILL PRESS / D16 DRILL PRESS

Quality Castings
Keyless drill chuck
N.V.R Switchgear
Ergonomic Handles
High Grade Motors

D13: £55.00 +vat

Drilling Capacity	13mm
Chuck Size	1-13mm
Table Size	165x160mm
Speeds	600-2500rpm
Motor	250w
Net Weight	17kgs

D16: £129.00 +vat

Drilling Capacity	16mm
Drill Chuck	3-16mm
Table Size	300mm Dia
Speeds	210 – 2580rpm
Motor	550w
Net Weight	42kgs

PRE ORDER TOOLING NOW FOR COLLECTION AT ALEXANDER PALACE MEX AND RECEIVE A SPECIAL 20% DISCOUNT FROM CATALOGUE PRICES**

** COLLECTION FROM ALEXANDER PALACE SHOW ONLY, SUBJECT TO AVAILABILITY, EXCLUDES MACHINERY.

Economy Live Centre MT2 £13 MT3 £15

Magnifier Lamp £30.00

V Blocks and Clamps 1" Capacity £8.00

Machine Angle Level £47.00

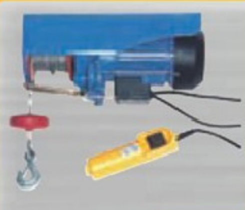
Centre Punch Set £3.90

5" Bench Hand Shears £30.00

6" Bench Hand Shears £39.00

Disc Size	6"
Belt Size	4"x36"
Table Size	216 x 146mm
Motor	370w
Net Weight	25kgs

4" x 8" Belt and Disc Sander £73.00



Hoist 400kgs £77.00

ALL PRICES EXCLUDE VAT AND DELIVERY

Chester Machine Tools, Clwyd Close, Hawarden Industrial Park CHESTER CH5 3PZ
T: + 44 (0)1244 531631 F: + 44 (0) 1244 531331 www.chestermachinetools.com email: sales@chestermachinetools.com
Midlands Showroom: Unit 4 Plant Lane Business Park, Plant Lane, Burntwood, Staffs, WS7 3JQ **Tel** 01543 448940
Southern Showroom: TPH Machine Tools, Fairview Industrial Park, Rainham, Essex, RM13 8UA
T: + 44 (0)1708 523916 email: machines@tphmachines.co.uk

ME4367/MEW159