

No.156

MILLING • DRILLING • TURNING • GRINDING

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

AUTUMN 2009

MAKE A TANGENTIAL TOOL HOLDER

LEARN HOW TO

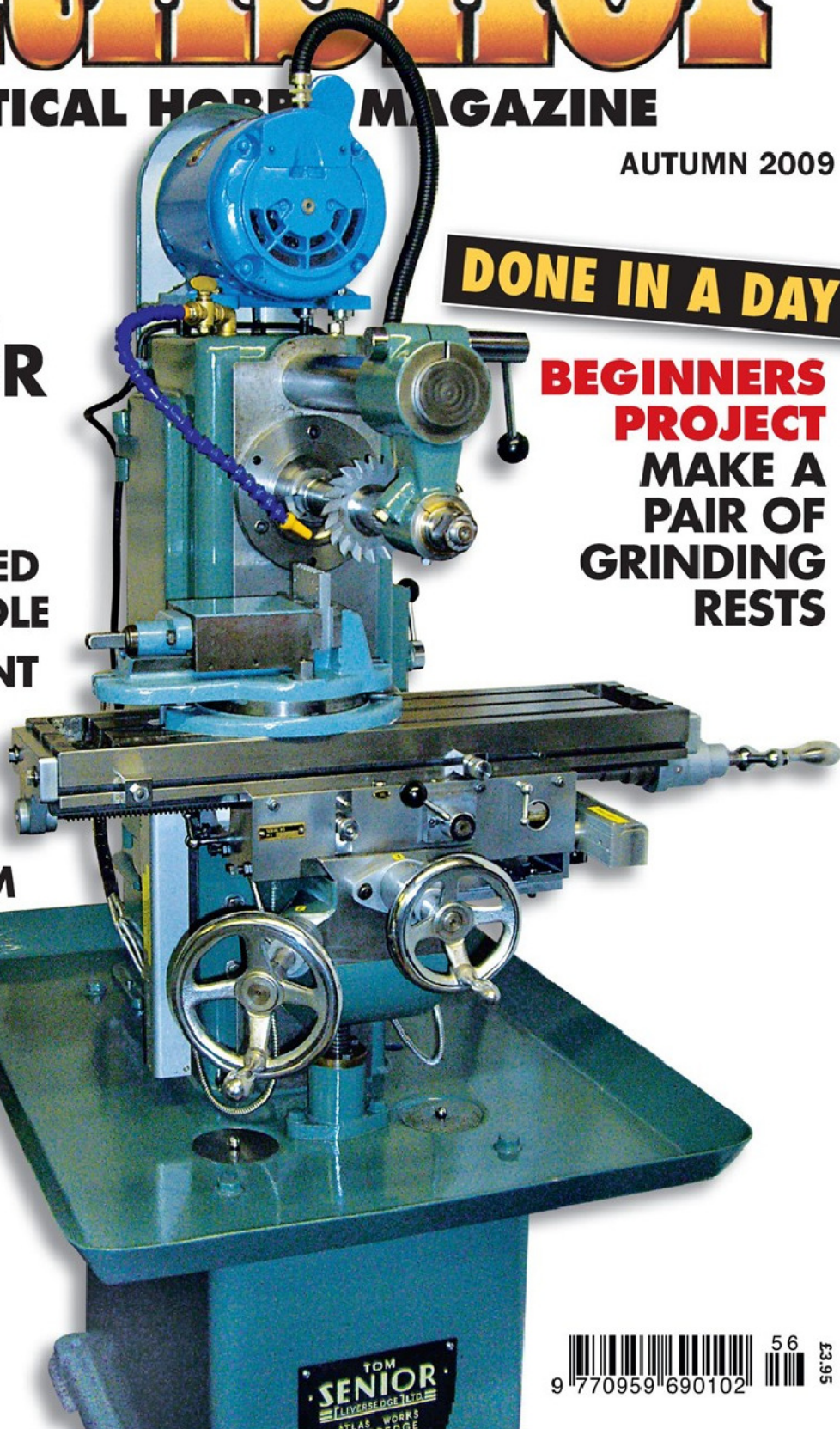
- MAKE A HIGH SPEED ENGRAVING SPINDLE
- MAKE REPLACEMENT MACHINE LABELS
- MAKE D BITS AND FORM TOOLS
- ANODISE TITANIUM

MACHINE TOOLS

- REBUILD A TOM SENIOR MILLING MACHINE
- INSTALL A ONE SHOT LUBRICATION SYSTEM

DONE IN A DAY

**BEGINNERS
PROJECT
MAKE A
PAIR OF
GRINDING
RESTS**



9 770959 690102 56 £3.95

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

Pro Machine Tools Ltd

Precision Machines Made in Germany

"For the discerning engineer."



F1200E

**5 Year
Warranty**



Hi Speed

CC-F1200E

With safety machine cabin and integrated coolant unit, ballscrews and base cabinet. Dual purpose manual or CNC operation.



CC-F1200E

Wabeco produce precision made machines by rigorous quality control and accuracy testing. All lathes and mills are backed by an extensive range of tools and accessories. Wabeco machines are quality rather than far eastern quantity.

All mills and lathes can be supplied fully fitted for CNC machining or can be retro fitted at a later date.

See our web site for details.



emco
Hobbiymaschinen

GOL®matic



F1410LF



Linear guideways - all 3 axes

X axis 500mm

Y axis 200mm

Z axis 280mm

Main Motor 2Kw(3HP)

Speed range 100-7500rpm

Spindle 2MT(or3MTorISO30 options)

Quill Stroke 50mm

Machine bed 700 x 180mm

Pro Machine Tools Ltd

17 Station Road Business Park
Barnack
Stamford
Lincolnshire
PE9 3DW

Tel: (01780) 740956

Fax: (01780) 740957

Sales@emcomachinetools.co.uk

www.emcomachinetools.co.uk

MODEL ENGINEERS' WORKSHOP

Published by MyHobbyStore Ltd.
Berwick House, 8-10 Knoll Rise,
Orpington, Kent BR6 0EL
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) 732 424 7811

Email: subs@ewamags.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: Gary Davidson-Guild

Head of Events & Retail: Daniel Webb

Subscriptions Director: Rebecca Blighton

Chief Executive: Owen Davies

Chairman: Peter Harkness



myhobbystore
media

© MyHobbyStore Ltd. 2009

All rights reserved ISSN 0959-6909

The Publisher's written consent must be obtained before any part of this publication may be reproduced in any form whatsoever, including photocopies, and information retrieval systems. All reasonable care is taken in the preparation of the magazine contents, but the publishers cannot be held legally responsible for errors in the contents of this magazine or for any loss however arising from such errors, including loss resulting from negligence of our staff. Reliance placed upon the contents of this magazine is at reader's own risk.



When you have finished with this magazine please recycle it.

Paper supplied from wood grown in forests managed in a sustainable way.

Contents

11 ON THE EDITOR'S BENCH

Dave Clark's commentary.

12 MAKING A TANGENTIAL TOOL HOLDER FOR THE LATHE

Peter Boonham makes a small version of this useful tool.

15 USING O RINGS IN THE HOME WORKSHOP

Harold Hall takes a look at O rings.

17 MAKING REPLACEMENT MACHINE LABELS

Mick Whittingham adds the finishing touches to any machine rebuilding project.

20 INSTALLING A CENTRAL LUBRICATION SYSTEM ON THE SIEG SUPER X1L MINI MILL

David White makes his mill run smoothly.

26 MAKING AND USING D BITS, FORM TOOLS AND SPADE DRILLS

Mick Nights shows you how to make and use form tools.

32 FIRST STEPS IN 3D DESIGN

Linton Wedlock continues his series on basic 3D design.

38 HOW TO REFURBISH A TOM SENIOR MILL

Mick Whittingham refurbishes a British machine tool.

44 MAKING A HIGH SPEED ENGRAVING SPINDLE

Dave Fenner does some fancy engraving.

47 IMPROVING A CHEAP OFFHAND TOOL GRINDER

Dyson Watkins improves his grinder.

48 HOW TO ANODISE TITANIUM

Tony Jeffree experiments with some clock parts.

52 LIVING WITH THE STENT TOOL AND CUTTER GRINDER

Charles Woodward updates us on his cutter grinder.

54 MODEL ENGINEER EXHIBITION ENTRY FORMS

56 SCRIBE A LINE



ON THE COVER

A refurbished Tom Senior milling machine. See article on page 38. Photo by Mick Whittingham



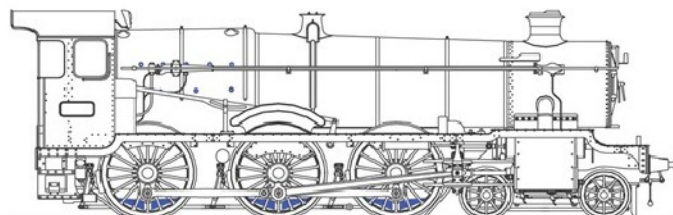
Subscribe today and **SAVE** up to 18%

See page 10

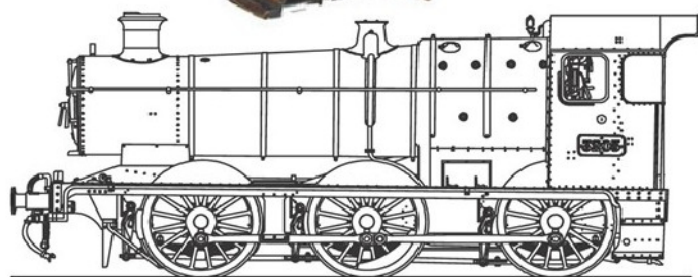
POLLY Model Engineering Limited

Fine Scale Model Locomotive Designs for the 21st Century

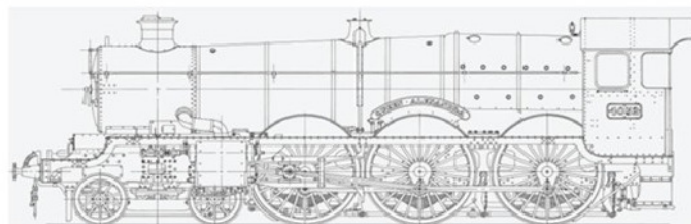
Penrhos Grange designed by Neville Evans, the model which brought a new approach to fine scale modelling. Whilst not a kit, but with a range of high quality laser cut parts, lost wax castings, precision sand castings and some machined parts available, the timescale and/or skill requirement to build this fine model can be reduced bringing it within the scope of the novice – ‘**Practical Scale**’.



Tenders made easy - platework CNC cut, drilled and scored for bending, with flairs and corners pre-formed. Laser cut frames, lost wax castings, wheel castings, etc for **Collett 3500 or 4000** gallon and **Churchward 3500** gallon in 5" gauge. 7 1/4" gauge tenders in development.



GWR Collett Goods in 7 1/4" gauge. A fine scale design incorporating the full detail of the prototype, developed in collaboration with David Aitken, currently serialised in EIM. As with Penrhos Grange, many parts are available to facilitate a fast build of a superb model.



We are also pleased to be able to offer the designs of **Pete Rich** including the soon to be published designs for his **Dean Single** and **Armstrong 4-4-0**. The drawings contain a wealth of information invaluable to the fine scale model builder.



H.R. Jones
Goods in 5"
gauge



S.R. Schools 4-4-0 recently serialised in ME



H.R. Loch
in 5" gauge

Our Latest Model: **S.R. Q1**, for 3 1/2" gauge designed by Nick Feast. This simple model currently serialised in ME, complements our more ambitious models and is well suited to beginners. A full set of drawings is now available (price £65 inc VAT) and castings and laser cut parts are also available.



Something for everyone – and don't forget our kit build locos!

Lists available for these models or request our catalogue, with details of comprehensive stocks of model engineers supplies plus drawings and castings for stationary engine models and kit build locomotives.

By post £1.75 (UK) \$5 overseas, or visit our webpage.

Polly Model Engineering Limited

Bridge Court, Bridge Street, Long Eaton, Nottingham, NG10 4QQ

Tel: 0115 9736700 Fax: 0115 9727251

WWW.pollymodelengineering.co.uk

Email: sales@pollymodelengineering.co.uk

Arc Euro Trade

Unbeatable Value Engineering Products by Mail Order

Special Offer for October 2009*

SIEG X3 Small Mill Bundle

Buy an X3 Small Mill and get a

42pc Clamping set FREE (worth £42.95)

* Offer Subject to availability



X3 Small Mill Specifications:

Drilling Capacity:	25mm
End Milling Capacity:	25mm
Face Milling Capacity:	50mm
Spindle Stroke:	80mm
Throat:	232mm
Spindle Taper:	Choice of MT3 or R8
Spindle to Table Distance:	
MT3 Spindle (approx.):	105-400mm
R8 Spindle (approx.):	85-380mm
Spindle Speed High gear:	100-2000 rpm $\pm 10\%$
(Variable) Low gear:	100-1000 rpm $\pm 10\%$
Table Cross Travel:	145mm
Table Longitudinal Travel:	360mm
Table Size:	550x160mm
Effective Table Size:	475x204mm
T-Slot Size:	12mm (M10 T-Nuts)
Table Drain Hole Thread:	M16x1.5
Motor Output:	600w DC
Overall Dimensions (W/D/H):	765x670x970mm
	(850mm to top of column)
Weight (Net/Gross)	135kg/160kg

Standard Equipment: 16mm Drill Chuck and Arbor, Drawbar

(Note: Quill Digital Readout or Attachment Kit are not included as standard)

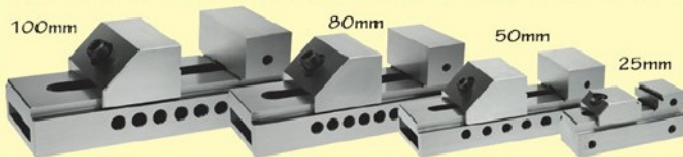
*Tallest Column,
Longest Table
To Date*

*Travel
X Axis: 360mm
Y Axis: 145mm
Z Axis: Up To 400mm*



080-030-00600	Model X3 Small Mill R8 Imperial Factory Assembled	£751.00	+£60.00 Carriage to most UK Mainland Destinations
080-030-00650	Model X3 Small Mill MT3 Imperial Factory Assembled	£751.00	
080-030-00700	Model X3 Small Mill MT3 Metric Factory Assembled	£751.00	
080-030-00800	Model X3 Small Mill R8 Metric Factory Assembled	£751.00	
080-030-00803	Model X3 - Arc Preparation Service *	£255.00	Skill Rating

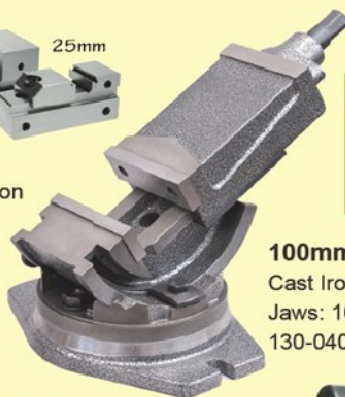
* See page 23 in catalogue 6 for details or download the full X3 Preparation Guide from our website.



Precision Tool Vices

Made from high quality alloy steel. Hardened and precision ground for parallelism and squareness to a high finish.

130-040-01000	26mm	£18.95
130-040-01100	50mm	£38.95
130-040-01200	80mm	£53.95
130-040-01300	100mm	£68.95



100mm Radial Vice

130-040-00800 **£58.95**

**All Prices
Include
VAT**

100mm Tilting Radial Vice

Cast Iron construction. Swivels 360° and Tilts 0-90°
Jaws: 100mm wide, 80mm opening, Height: 148mm
130-040-01600 **£88.00**



70mm Precision Universal Vice

Clear and precise divisions with vernier scales allows setting of accurate angles to within 3'. Made from high quality alloy steel. Hardened and precision ground for parallelism and squareness to a high finish. Swivels 360° and Tilts 0-45°

130-040-01500 **£225.00**



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

For accessories, 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

All prices include
VAT and Carriage

Online Catalogue - www.chronos.ltd.uk

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



CODE	SHANK	PRICE
XC50	6MM	£ 82.00
XC51	8MM	£ 82.00
XC52	10MM	£ 88.00
XC53	12MM	£ 95.00
XC54	16MM	£133.00

SET OF FIVE INDEXABLE LATHE TOOLS



CODE	SHANK	PRICE
XC72	1/4	£19.95
XC73	5/16	£19.95
XC74	3/8	£19.95
XC75	1/2	£26.95
XC76	5 X SPARE INSERTS 1/4	£10.00
XC77	5 X SPARE INSERTS 5/16	£10.00
XC78	5 X SPARE INSERTS 3/8	£10.00
XC79	5 X SPARE INSERTS 1/2	£10.00

INDIVIDUAL GLANZE THREADING TOOLS 60° METRIC

COMPLETE WITH ONE THREE SIDED CARBIDE
INSERT & TORX KEY

CODE	TYPE	PRICE
722100	INTERNAL 10MM SQ	£24.00
722210	INTERNAL 12MM SQ	£24.00
SIR0016	INTERNAL 16MM SQ	£28.95
775100	EXTERNAL 10MM SQ	£24.00
775118	EXTERNAL 12MM SQ	£24.00
SER16K16	EXTERNAL 16MM SQ	£28.95

INSERTS		
1116160	INT FOR 10 & 12MM TOOLS	£ 7.25
1116A60S	SET OF 10 ABOVE	£69.50
1616A60	INT FOR 16MM TOOLS	£ 7.25
161RA60S	SET OF 10 ABOVE	£69.50
11ERIA60	EXT FOR 10 & 12MM TOOLS	£ 7.25
11ERIA60S	SET OF 10 ABOVE	£69.50
A6ERAA60	EXT FOR 16MM TOOLS	£ 7.25
16ERAA60S	SET OF 10 ABOVE	£69.50



GLANZE INDEXABLE BORING TOOLS

CODE	SHANK	PRICE
XC34	6MM	£19.05 £17.50
XC35	8MM	£19.05 £17.50
XC36	10MM	£19.05 £18.50
XC37	12MM	£22.05 £19.95
XC38	16MM	£24.05 £22.00



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



GLANZE INDEXABLE LH TURNING TOOLS

CODE	SHANK	PRICE
XC83	6MM	£16.00 £14.50
XC84	8MM	£17.00 £15.00
XC85	10MM	£17.00 £15.50
XC86	12MM	£19.05 £16.50
XC87	16MM	£26.05 £22.00



GLANZE INDEXABLE RH TURNING TOOLS

CODE	SHANK	PRICE
XC43	6MM	£16.00 £14.50
XC44	8MM	£17.00 £15.00
XC45	10MM	£17.00 £15.50
XC46	12MM	£19.05 £16.50
XC47	16MM	£26.05 £22.00



GLANZE INDEXABLE PROFILING TOOLS

CODE	SHANK	PRICE
XC39	6MM	£16.95 £14.00
XC40	8MM	£17.95 £15.00
XC41	10MM	£19.95 £16.00
XC42	12MM	£22.95 £19.00



NEW - GLANZE CLAMP TYPE INDEXABLE PARTING TOOLS!

Complete with special grade alumina
coated insert - for a superior finish!



CODE	SHANK	PRICE
CGG081	8MM	£24.95
CGG101	10MM	£29.95
CGG121	12MM	£32.00
CGG122	16MM	£34.00
CGG120	20MM	£34.00
CGGSP	INSERT FOR 8,10,12 & 16MM	£ 4.25
CGGSP20	INSERT FOR 20MM	£ 4.25

NEW - GLANZE INDEXABLE PARTING TOOLS!

Complete with special grade alumina coated
insert - for a superior finish!

CODE	SHANK	PRICE
GX67	10 X 10MM	£25.95
GX68	12 X 12MM	£26.95
GX69	16 X 16MM	£28.95
GX70	20 X 20MM	£32.95
GX71	SPARE INSERT FOR 10, 12 & 16MM	£ 4.25
GX72	SPARE INSERT FOR 20MM	£ 4.25



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



NEW BRAZED CARBIDE THREADING & BORING LATHE TOOLSETS

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



CODE	SHANK	PRICE
GX1	1/4	£17.95
GX2	5/16	£18.95
GX3	3/8	£21.95
GX4	1/2	£24.95

NEW PROFESSIONAL PARTING SYSTEM

FOR UP TO 41/2 CENTRE LATHES
- THE SHANK IS ON THE SIDE AND
IS 1/2 THICK. SUPPLIED WITH A
HSS BLADE 4MM THICK, 24MM
WIDE & 150MM LONG



CODE	ITEM	PRICE
GX88	HOLDER & BLADE	£22.00
GX89	SPARE BLADE	£8.00

ALL PRICES INCLUDE VAT & CARRIAGE (UK MAINLAND)

(Prices are correct at time of going to press and are only available while stocks last)

Tel: (01582) 471900 5 Lines Fax: (01582) 471920 Web: www.chronos.ltd.uk Email: sales@chronos.ltd.uk

CHRONOS LTD, UNIT 14 DUKEMINSTER ESTATE, CHURCH STREET, DUNSTABLE, LU5 4HU



Myford-Emporium

www.myford-emporium.com • myfordemporium@aol.com

For all your Myford needs



We stock used Myford lathes, parts, accessories and paint
WORKSHOPS CLEARED & SINGLE MACHINES WANTED

We buy anything to do with Myford - CASH WAITING
PLEASE PHONE: **0844 44 11 777** (Local Rate)



TAKE A LOOK AT OUR WEBSITE

www.myford-emporium.com



Convert scanned drawings to CAD!



SCAN



CLEAN



CONVERT



EDIT

www.softcover.com

Scan[®] 2CAD
364 Milton Rd, Cambridge CB4 1LW, England. Tel: 01223 424342

TO ALL ENGINEERS

A Hegner fretsaw in your hands will tackle work that no other machine can!

★ **WORLD PATENTS** protect the critical Performance factors that make Hegner saws truly unique.

That is why Hegner are used for:

★ **CUTTING** bevels, mitres, dovetails, simple and compound angles, curves and straights, inlays etc, in:

★ **EVERY MATERIAL** from 2" hardwood to plastics, brass, precious metals, and even 3/8" steel!

And why:

★ **OVER 5000 HEGNER SAWS** are now used in British schools alone - just a small fraction of the total used by specialist wood-workers; modellers; toy and puzzle producers; clock, sign and instrument makers and others both in business and at home.

★ **MATCHLESS ECONOMY** A Hegner saw consumes less than 1p per hour in constant use! Blade life is also hugely extended over other designs. **Discover all the facts. Phone or write without delay -**

HEGNER UK UNITS 1-2, NORTH CRESCENT, DIPLOCKS WAY, HAILSHAM BN27 3JF. ☎ (01323) 442440



Contact us TODAY!

For your **FREE** information pack without obligation. Please quote ref: MEW01 Enquiries answered by 1st class return post.

TurboCAD[®]

V16 OUT NOW!



CAD Symbols

Over 30 million 2D & 3D symbols, Machine Parts, Steel construction, screws, flanges, bolts, nuts etc.

Usual price for Professional including the Mechanical Extras: **£955**

Offer Price for Mechanical & Workshop Engineer Readers: **£655**

All upgrade prices at 25% discount

Upgrade from V15	£127
Upgrade from V14	£172
Upgrade from all previous professional versions	£220
Upgrade from any Deluxe version	£300
Training courses held in Winchester start at	£184



All enquiries to Paul Tracey 01962 835 081 | ptracey@avanquest.co.uk

Over 1,000 PRICE CUTS

METAL LATHE - CL300M

- 300mm between centres
- LH/RH thread screw cutting
- Electronic variable speed
- Gear change set
- Self centering 3 jaw chuck & guard
- Power feed

ONLY £449.99 EX VAT
£517.99 INC VAT

Full range of accessories available

Machine Mart

NOW 56 SUPERSTORES NATIONWIDE

Where Quality Costs Less

NEW GET YOUR COPY NOW!

• **PHONE** 0844 880 1265

• **ONLINE** machinemart.co.uk

• **INSTORE**

ORDER ONLINE **1,000 PRICE CUTS** **450 GREAT NEW PRODUCTS**

Clarke VARIABLE SPEED LATHE CL250M

ONLY £329.99 EX VAT
£378.35 INC VAT

150w motor

- Ultra compact precision lathe
- Variable speed control 100-2000rpm

Clarke WORKSHOP CRANES

FROM ONLY £129.99 EX VAT
£149.99 INC VAT

MODEL	DESC.	EX VAT	INC VAT
CFCS00F	1/2 ton folding	£129.99	£149.98
CFCT100	1 ton folding	£139.98	£160.98
CFCT1000	1 ton large folding	£200.00	£240.35
CFCT1000LR	1 ton long reach	£179.98	£209.98
HDFC2	1 ton pro	£499.00	£573.85

- Folding & fixed frames available
- Robust, rugged construction
- Fully tested to proof load
- Overload safety valve

Clarke HYDRAULIC PRESSES

PROFESSIONAL QUALITY built for tough daily use in automotive/industrial workshops

PRICE CUT NOW FROM £189.99 EX VAT
£218.99 INC VAT

MODEL	EX VAT	INC VAT
10 ton bench	£189.98	£218.48
10 ton floor	£209.00	£240.35
15 ton floor	£329.98	£379.48
25 ton floor	£739.00	£849.85
50 ton floor	£1499.00	£1723.85

Clarke ROTARY TOOL KIT

ONLY £24.99 EX VAT
£28.99 INC VAT

CRT40

Kit includes:

- Height adjustable stand with clamp
- Rotary tool
- 1m flexible drive
- 40x accessories/consumables

Clarke CAST IRON STOVES

SAVE £££'s ON HEATING COSTS!

13 STYLES

FROM ONLY £69.99 EX VAT
£80.99 INC VAT

FLUES & ACCESSORIES AVAILABLE

MODEL	MAX. BTU	EX VAT	INC VAT	WAS	INC VAT
Pat Belly	10,000	£69.98	£80.98	£90.48	£106.98
Pat Belly XL	24,000	£159.98	£185.48	£183.98	£215.48
Barrel	20,000	£169.98	£196.98	£195.48	£226.98
Parlour	37,500	£269.98	£310.48	£310.48	£361.98
Regal	34,000	£299.98	£344.98	£344.98	£401.98
Richmond	61,000	£579.00	£666.85	£666.85	£783.85

NOW OPEN SUNDAYS

3 EASY WAYS TO BUY

IN-STORE

56 SUPERSTORES

ONLINE

machinemart.co.uk

MAIL ORDER

0844 880 1250

Clarke POWER WINCHES

NEW

FROM ONLY £69.99 EX VAT
£80.44 INC VAT

Includes remote control

Quick & easy to install, for a wide range of uses

Clarke 6" METAL CUTTING BANDSAW CBS45MD

ONLY £189.99 EX VAT
£218.99 INC VAT

12" x 7" version available only £699.00 EX VAT £803.85 INC VAT

- 1/4 Hp, 230v motor
- Horizontal or vertical operating positions

Clarke 6" METAL CUTTING BANDSAW CBS45MD

ONLY £189.99 EX VAT
£218.99 INC VAT

12" x 7" version available only £699.00 EX VAT £803.85 INC VAT

- 1/4 Hp, 230v motor
- Horizontal or vertical operating positions

Honeywell STEEL BODY FAN HEATER

ONLY £189.99 EX VAT
£218.99 INC VAT

2.5kw, 8.533 Btu/hr heat output

- Includes safety tip-over switch & overheating protection

Clarke TURBO AIR COMPRESSORS

ONLY £79.99 EX VAT
£91.99 INC VAT

8/44

Superb range ideal for DIY, hobby & semi-professional use

Clarke arm air hose

FROM ONLY £59.99 EX VAT
£68.99 INC VAT

Clarke MAGNIFYING LAMPS

ONLY £14.99 EX VAT
£17.99 INC VAT

Powerful 3 dioptre 89mm precision lens

- Adjustable spring balanced arm for exact positioning
- Quick fixing universal clamp base

Clarke MAGNIFYING LAMPS

ONLY £14.99 EX VAT
£17.99 INC VAT

Powerful 3 dioptre 89mm precision lens

- Adjustable spring balanced arm for exact positioning
- Quick fixing universal clamp base

Clarke DRILL PRESSES

• Tables tilt 0-45° left & right

• Depth gauge

• Chuck guards

B=Bench mounted F=Floor standing

MODEL	WATTS/EX VAT	INC VAT
CDP500	250/5	£49.98
CDP101B	245/5	£69.98
CDP151B	300/5	£89.98
CDP108	370/12	£99.98
CDP301B	510/12	£159.98
CDP451F	510/12	£199.98
CDP501F	980/12	£379.98

Includes 'T' slot table & worklight

Clarke BENCH GRINDERS

FROM ONLY £19.99 EX VAT
£22.99 INC VAT

6" & 8" available with light

CBG8W features 8" whetstone & 6" drystone

With sanding belt

Clarke ARC/TIG INVERTERS

• Used for ARC & TIG welding, utilising the latest technology

• Low amp operation - ideal for TIG welding, auto bodywork & thin mild/stainless steel

MODEL	DUTY	WHEEL DIA.	EX VAT	INC VAT
CBG6RP	DIY	150mm	£19.98	£22.98
CBG6RZ	PRO	150mm	£29.98	£34.48
CBG6S8	PRO	150mm	£39.98	£45.98
CBG6RWC	HD	150mm	£44.99	£51.74
CBG6RSC	HD	200mm	£47.99	£55.19
CBG8W (wet)	HD	150/200mm	£42.99	£49.44

PRICE CUT! WAS £57.48 INC VAT

Clarke MIG WELDERS

All models include:

- Gas regulator
- Earth clamp
- Face mask
- Welding torch

Pro90-151T includes CO₂ gas bottle

MODEL	AMPS	ELECTRODE	EX VAT	INC VAT
85	25/80	2mm	£149.98	£172.48
110	30/105	2.5mm	£179.98	£206.98
AT131	5/130	1.5-4.0mm	£169.98	£195.48
TIG135	30/130	3.25mm	£269.98	£310.48
155	22/140	3.25mm	£339.00	£389.85

Clarke ARC ACTIVATED HEADSHIELD

• Gives eye protection to EN379

• Activates instantly when arc is struck

• Suitable for arc, MIG, TIG & gas welding

PRICE CUT **£54.99 EX VAT**
£63.99 INC VAT

Clarke MEASURING EQUIPMENT

FROM ONLY £9.99 EX VAT
£11.48 INC VAT

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£9.98	£11.48
CM180	0-2.5mm Micrometer	£9.98	£11.48
CM145	150mm/6" Digital Vernier	£19.98	£22.98

Clarke MEASURING EQUIPMENT

FROM ONLY £9.99 EX VAT
£11.48 INC VAT

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£9.98	£11.48
CM180	0-2.5mm Micrometer	£9.98	£11.48
CM145	150mm/6" Digital Vernier	£19.98	£22.98

Clarke 12 SPD MILL/DRILL CMD1225C

Precision engineered with cast iron head, base & column

- Spindle speeds 100-2150rpm
- 1/4 Hp, 230v, 1 Ph motor
- Accessories available
- 63mm milling cutter
- 16mm chuck
- Table size 585x190mm

ONLY £699.99 EX VAT
£803.99 INC VAT

Clarke MILLING DRILLING MACHINE CMD300

ONLY £469.99 EX VAT
£540.99 INC VAT

Ideal for the compact workshop

- 470w, 230v motor
- Variable speed 0-2500rpm
- Table cross/longitudinal travel 100/235mm

Clarke ENGINEERING SWIVEL VICES

• A range of swivel base vices with top quality cast iron construction

FROM ONLY £10.99 EX VAT
£12.64 INC VAT

Red in colour & Swivel & Rotates

MODEL	JAW WIDTH x OPENING x DEPTH	EX VAT	INC VAT
CV758	75x54x55 mm	£10.99	£12.64
CV4R8	100x100x55 mm	£15.99	£18.39
CV100B	100x100x55 mm	£16.99	£19.54
CV150B	150x180x80 mm	£39.98	£45.98
CMV125	127x120x75 mm	£54.99	£63.24

Clarke TAP & DIE SETS

FROM ONLY £12.99 EX VAT
£14.99 INC VAT

High quality tungsten steel

- Supplied in metal storage case, except 16pc

TYPE	EX VAT	INC VAT
16pc Metric	£12.99	£14.94
24pc UNF/UNF/NPT	£19.98	£22.98
28pc Metric	£19.98	£22.98
33pc Metric/UNF/BSP	£29.98	£34.48
32pc Metric	£39.98	£45.98

*26pc Best Budget Buy, 33pc Recommended, Practical Classics

Clarke ARC ACTIVATED HEADSHIELD

• Gives eye protection to EN379

• Activates instantly when arc is struck

• Suitable for arc, MIG, TIG & gas welding

PRICE CUT **£54.99 EX VAT**
£63.99 INC VAT

Clarke MEASURING EQUIPMENT

FROM ONLY £9.99 EX VAT
£11.48 INC VAT

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£9.98	£11.48
CM180	0-2.5mm Micrometer	£9.98	£11.48
CM145	150mm/6" Digital Vernier	£19.98	£22.98

Clarke MEASURING EQUIPMENT

FROM ONLY £9.99 EX VAT
£11.48 INC VAT

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£9.98	£11.48
CM180	0-2.5mm Micrometer	£9.98	£11.48
CM145	150mm/6" Digital Vernier	£19.98	£22.98

Clarke CHESTS & CABINETS

PRICE CUT NOW FROM £59.99 EX VAT
£68.99 INC VAT

SAVE UP TO £23 INC VAT

HEAVY DUTY

Clarke ENGINEERS STEEL WORKBENCHES

INCLUDES SINGLE LOCKABLE DRAWER

PRICE CUT NOW FROM £149.99 EX VAT
£172.48 INC VAT

Shown fitted with optional 3 drawer unit

PRICE CUT! WAS £103.48 INC VAT NOW £91.98 INC VAT

Clarke ENGINEERS STEEL WORKBENCHES

INCLUDES SINGLE LOCKABLE DRAWER

PRICE CUT NOW FROM £149.99 EX VAT
£172.48 INC VAT

Shown fitted with optional 3 drawer unit

PRICE CUT! WAS £103.48 INC VAT NOW £91.98 INC VAT

Clarke ENGINEERS STEEL WORKBENCHES

INCLUDES SINGLE LOCKABLE DRAWER

PRICE CUT NOW FROM £149.99 EX VAT
£172.48 INC VAT

Shown fitted with optional 3 drawer unit

PRICE CUT! WAS £103.48 INC VAT NOW £91.98 INC VAT

Clarke BOLLTLESS SHELVING/BENCHES

• Simple fast assembly in minutes using only a hammer

New rolled edge uprights for extra strength

150kg and 350kg Max shelf loading available

PRICE CUT NOW FROM £29.99 EX VAT
£34.99 INC VAT

Available in red, blue, black & silver

Clarke BOLLTLESS SHELVING/BENCHES

• Simple fast assembly in minutes using only a hammer

New rolled edge uprights for extra strength

150kg and 350kg Max shelf loading available

PRICE CUT NOW FROM £29.99 EX VAT
£34.99 INC VAT

Available in red, blue, black & silver

Clarke BOLLTLESS SHELVING/BENCHES

• Simple fast assembly in minutes using only a hammer

New rolled edge uprights for extra strength

150kg and 350kg Max shelf loading available

PRICE CUT NOW FROM £29.99 EX VAT
£34.99 INC VAT

Available in red, blue, black & silver

Clarke BOLLTLESS SHELVING/BENCHES

• Simple fast assembly in minutes using only a hammer

New rolled edge uprights for extra strength

150kg and 350kg Max shelf loading available

PRICE CUT NOW FROM £29.99 EX VAT
£34.99 INC VAT

Available in red, blue, black & silver

Clarke 6 SPEED METAL LATHE WITH 12 SPEED MILL/DRILL -CL500M

ONLY £699.99 EX VAT
£803.99 INC VAT

Full range of accessories available

- 430mm between centres
- Compound slide with 4 way tool post
- Power feed screw cutting facility
- Forward/reverse lathe operation
- Clutch for independent mill/drill operation

Shown with optional floor stand & tray

ONLY £129.98 EX VAT **£149.98 INC VAT**

ALSO AVAILABLE:

CL430 - As above but without the Mill/Drill head

£599.98 EX VAT **£689.98 INC VAT**

Clarke 6 SPEED METAL LATHE WITH 12 SPEED MILL/DRILL -CL500M

ONLY £699.99 EX VAT
£803.99 INC VAT

Full range of accessories available

- 430mm between centres
- Compound slide with 4 way tool post
- Power feed screw cutting facility
- Forward/reverse lathe operation
- Clutch for independent mill/drill operation

Shown with optional floor stand & tray

ONLY £129.98 EX VAT **£149.98 INC VAT**

ALSO AVAILABLE:

CL430 - As above but without the Mill/Drill head

£599.98 EX VAT **£689.98 INC VAT**

VISIT YOUR LOCAL SUPERSTORE

OPEN MON-FRI 8.30-6.00, SAT 8.30-5.30, SUN 10.00-4.00

BARNESLEY Potentra Rd, Barnsley, S71 1EZ 01226 732297

B'AM GREAT BARR 4 Birmingham Rd, 0121 358 7977

BYHAM HAY Mills 1152 Coventry Rd, Hay Mills 0121 7713433

BOLTON 1 Thynne St, 01204 365799

BRADFORD 105-107 Manningham Lane, 01274 390962

BRIGHTON 123 Lewes Rd, BN2 30B NEW 01273 915999

BRISTOL 1-3 Church Rd, Lawrence Hill, 0117 935 1060

BURTON UPON TRENT 12a Uchfield St, 01283 564 708

CARDIFF 44-46 City Rd, 029 2046 5422

CARLISLE 85 London Rd, 01228 591666

CHESTER 43-45 St. James Street, 01244 311258

COLCHESTER 4 North Station Rd, 01206 762831

CONVENTRY Bishop St, CV1 1HT, 024 7622 4227

CROYDON 423-427 Brighton Rd, Sth Croydon, 020 8763 0640

DARLINGTON 214 Northgate, 01325 380841

DEAL (KENT) 182-186 High St, 01304 373 434

DERBY Derwent St, DE1 2ED, 01332 290 931

DONCASTER Wheatley Hall Road, NEW 01302 245 999

DUNDEE 24-26 Trades Lane, 01382 225 140

EDINBURGH 163-171 Piersfield Terrace, 0131 659 5919

GATESHEAD 50 Lobley Hill Rd, 0191 493 2520

GLASGOW 280 Gt Western Rd, 0141 332 9231

GLoucester 221A Barton St, 01452 417 948

GRIMSBY Ellis Way, DN32 9BD, 01472 354435

HULL 8-10 Holderness Rd, 01482 223161

ILFORD 746-748 Eastern Ave, 0208 518 4286

LEEDS 227-229 Kirkstall Rd, 0113 231 0400

LEICESTER 69 Melton Rd, 01522 561 0368

LINCOLN Unit 5, The Pelham Centre, 01262 543 036

LIVERPOOL 80-88 London Rd, 0151 709 4484

LONDON 6 Kendal Parade, Edmonton N18, 020 8803 0861

LONDON 503-507 Lea Bridge Rd, Leyton, E10, 020 8558 8284

LONDON 100 The Highway, Docklands, 020 7485 2129

MAIDSTONE 57 Upper Stone St, 01622 769 572

MANCHESTER 71 Manchester Rd, Altrincham 0161 9412666

MANSFIELD 169 Chesterfield Rd, South, 01623 622160

MIDLESBROUGH Mandale Triangle, Thornaby 01642 677881

NORWICH 282a Helgham St, 01603 766402

NOTTINGHAM 211 Lower Parliament St, 0115 956 1811

PETERBOROUGH 417 Lincoln Rd, Millfield, 01733 311770

PLYMOUTH 58-64 Embankment Rd, 01752 254050

POOLE 137-139 Bournemouth Rd, Parkstone 01202 717913

PORTSMOUTH 277-283 Cognor Rd, Cognor, 023 9265 4777

PRESTON 53 Blackpool Rd, 01772 703263

SHEFFIELD 453 London Rd, Heeley, 0114 258 0831

SIDCUP 13 Backlen Parade, Blackfen NEW 0203 3042069

SOUTHAMPTON 516-518 Portswood Rd, 023 8055 7788

SOUTHEND 1139-1141 London Rd, Leigh on Sea 01702 483 742

STOKE-ON-TRENT 382-396 Waterloo Rd, Hanley 01782 287321

SUNDERLAND 13-15 Ryhope Rd, Grange Park, 0191 510 8773

SWANSEA 7 Samlet Rd, Llansamlet, 01792 792969

SWINDON 21 Victoria Rd, 01793 491717

TWICKENHAM 83-85 Heath Rd, 020 8892 9117

WARRINGTON Unit 3, Hawley's Trade Pk, 01925 630 937

WOLVERHAMPTON Parkfield Rd, Bilston, 01902 494186

WORCESTER 48a Upper Tything, 01905 723451

Maximum call charges from a BT landline are 5p/min to 0844. Calls from mobile & other networks may vary.

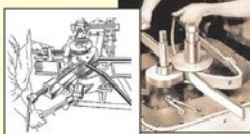
For security reasons, calls may be monitored. All prices correct at time of going to press. We reserve the right to change products & prices at any time. All offers subject to availability. E&OE.

MORE GOOD READING and HIGH QUALITY INFORMATION



Forming Methods Vol. 1 • Circa 1942 • £ 9.70

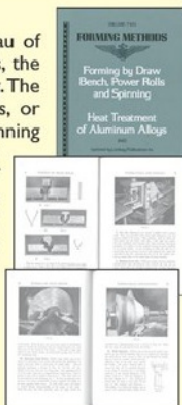
Lindsay and ourselves really shouldn't be offering you this book on shaping, bending and working metal for aircraft, as the Navy Department, Bureau of Aeronautics marked the originals "Unauthorized circulation of this pamphlet by anyone is prohibited", but before we all get thrown into clink, here is an excellent book on the subject from the early 1940s. In fact you get two booklets, the first being *Forming by Section and Tube Bending*, which is probably the one which will be most useful to readers, as the second booklet, *Forming by Press Brake*, is more concerned with power forming using dies in presses - which doesn't mean it isn't useful, but probably reduced in scale. 80 pages, heaving with useful, and prohibited, information. Softcover.



Forming Methods Vol. 2 • 1943 • £ 9.70

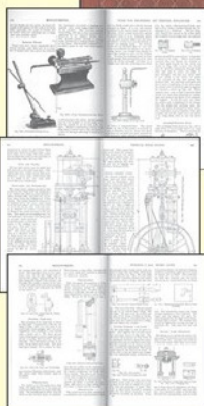
More forbidden fruit from the Navy Department, Bureau of Aeronautics! This volume again comprises two booklets, the first being *Forming by Draw Bench, Power Rolls and Spinning*. The first two of these processes, involving the use of dies, or special contouring rolls, are very much industrial, but spinning is a hand process, and is well dealt with here, albeit in only nine pages. The second booklet here is *Heat Treatment of Aluminium Alloys*, a subject we haven't come across before, and whilst it is described here as an industrial process, we think the home engineer might be able to do this on a small scale, if he feels so inclined. 84 well illustrated pages. Softcover.

It really doesn't matter if you need to make some parts for that *Flying Fortress* the wife insists you fly out of the back garden this instant, or you just want really good, clear and concise books on bending and shaping metal sheet, section and tube - you will find these excellent.



Metalworking - tools, materials & processes for the handyman • Hasluck • £ 34.20

Every model engineer should have a copy of this! Hasluck was British, but this reprint is from a 1907 American edition. There are 760 pages and 2206 illustrations here covering, in the first section on general metalworking: foundrywork, Smiths' Work (meaning decorative iron work - how to do it and all the tools involved, 274 illustrations here alone), Forging or blacksmithing, Sheet Metal Work (177 illustrations), Decorative embossing of Sheet Metal, Brass Work, Lathes and tools (237 illustrations) etc, etc. You get designs and building instructions for: a 4 1/2" lathe with a 4'6" bed, an eight day, 18" high skeleton clock, a 2' x 4 1/2" horizontal steam engine, a 1 1/2" x 2 1/4" vertical steam engine, three different boilers from a 7" dia and 13" long horizontal to a 8' high vertical, a 2 1/2" x 2 1/2" gas engine and an 18" dia water wheel. You also learn about silver, copper and gold plating and brass gilding in the electroplating section - and there is a wire working chapter that shows how to do fancy wire screening of different lattices. Then there is the electric bell, the microscope, a four-draw telescope etc. & etc! 2206 illustrations 760 pages. Hardbound.



How to Run a Lathe • 1942 • South Bend • £ 8.30

For years we sold 1000s of copies of the 1966 edition of this great book - then "South Bend" put the price through the roof.... But Lindsay has reprinted the 1942 edition, and it costs less! There are differences between the two editions, but the main text is identical - most of the changes are in the photos, with different hairstyles, and sometimes lathes. As a book to keep by your lathe for everyday use, this has no equal - buy a copy. 128 page illustrated paperback.



Prices shown INCLUDE U.K. Post & Packing

BUY two or more items and SAVE ON POSTAGE - automatically calculated if you order on-line, or contact us for the exact savings.
Overseas postage worldwide is automatically calculated on-line; aren't computers wonderful!

Mail Order (no stamp required in the U.K.) to:-

CAMDEN MINIATURE STEAM SERVICES

FREPOST (BA 1502) Rode Frome Somerset BA11 6UB

Tel: 01373-830151 Fax: 01373-830516



Secure on-line ordering: www.camdenmin.co.uk



MIDLANDS MODEL ENGINEERING EXHIBITION

**Friday 16th - Tuesday 20th
October 2009** 10am - 5pm daily

Last admission one hour before closing. Closes at 4pm on final day.

Warwickshire Exhibition Centre

Fosse Way, near Leamington Spa
on the junction of the A425/B4455
SAT NAV CV31 1XN



Meet the clubs
See the models
Learn from the experts
Buy from specialist suppliers
Enter your work - competition classes

THE Show For Model Engineers

Sponsored by **Engineering
in Miniature**

Enter your work - be part of THE show!

Individuals can enter their
work in competition
or display classes.

Call 01926 614101 or see our
website for an entry form

Admission:
Adults £9.00
Seniors £8.00
Children £5.00
Family £14.00
(1 adult 3 children)
Family £23.00
(2 adults 3 children)

SAVE £££'S

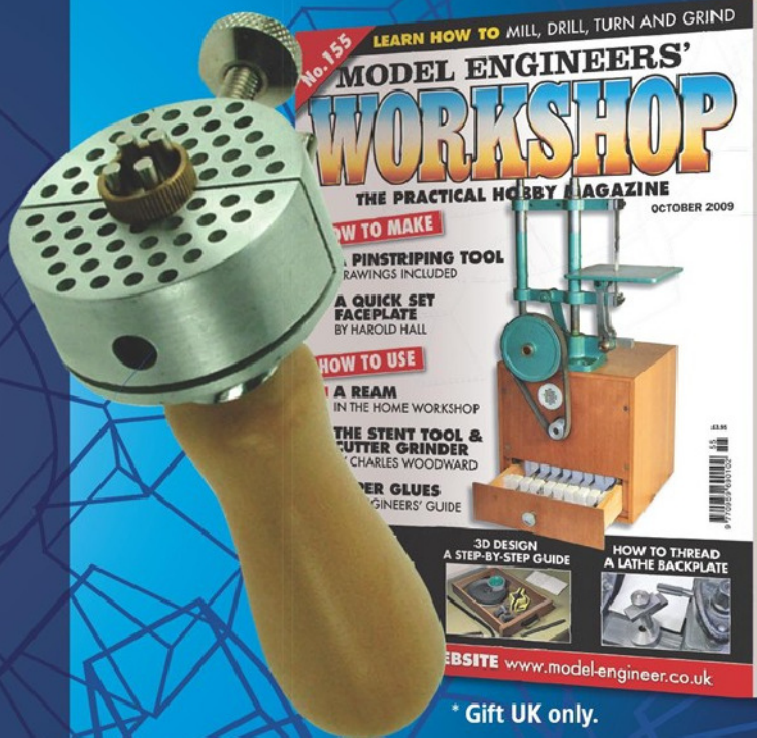
BY BOOKING IN ADVANCE BEFORE 25th SEPTEMBER 2009

FOR FURTHER INFORMATION OR TICKETS VISIT
www.midlandsmodelengineering.co.uk

Organised by Meridienne Exhibitions Ltd, The Fosse, Fosse Way, Leamington Spa,
Warwickshire, CV31 1XN Tel: 01926 614101 Fax: 01926 614293
Info@meridienneexhibitions.co.uk www.meridienneexhibitions.co.uk

FREE UNIVERSAL WORK HOLDER when you subscribe to MODEL ENGINEERS' WORKSHOP

- FREE UNIVERSAL WORK HOLDER *
- 13 ISSUES OF MODEL ENGINEERS' WORKSHOP A YEAR
- ACCESS TO SUBSCRIBER ONLY CONTENT
- DELIVERED STRAIGHT TO YOUR DOOR



The Universal Work Holder is ideal for holding small and odd-shaped parts for filing, painting, engraving, sawing, shaping etc. The four steel pins can be placed anywhere around the head and are also useful for bending and forming wire around. The handle can be removed and the head can then be locked in a bench vice.

* Gift UK only.

BY PHONE: 08456 777 807 quote ref. SG34 **ONLINE:** www.model-engineer.co.uk/subscribe
Alternatively, you can complete the form below and return, with payment, to the address provided.

UK ONLY SUBSCRIPTIONS:

I would like to subscribe to *Model Engineers' Workshop* for 1 year (13 issues) with a one-off payment of £44.50, **SAVING 13%**

OVERSEAS SUBSCRIPTIONS:

I would like to subscribe to *Model Engineers' Workshop* for 1 year (13 issues) with a one-off payment: **Europe (incl Eire) £50.40** **ROW Airmail £52.80**

For all Canadian, North and South American subscriptions please call 001 732 424 7811 or go to www.ewmag.com

PAYMENT DETAILS:

☐ Postal Order/Cheque ☐ Visa/Mastercard ☐ Maestro

Please make cheques payable to MyHobbyStore Ltd and write code SG34 on the back

Cardholder's name.....

Card no: (Maestro)

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

Signature Date

YOUR DETAILS:

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

Address

Postcode Country

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

E-mail D.O.B.....

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY):

CODE SG34

I would like to subscribe to *Model Engineers' Workshop* paying £42.00 for 12 months by Direct Debit, **SAVING 18%**

BIGGEST SAVING!

Please complete form below

Instructions to your bank or building society to pay by Direct Debit.

Originator's reference 422562



Name of bank.....

Address of bank

Postcode

Account holder.....

Signature Date

Sort code Account number

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

Reference Number (Official use only)

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

Terms & Conditions: Offer ends 30th October 2009. Subscriptions will begin with the first available issue. Please continue to buy your magazine until you receive your acknowledgement letter. Refund requests must be in writing to the Publisher and will not be given on accounts with less than £20 credit. A £5 admin charge will apply and will be deducted from any refund. Refunds will only be given at the Publisher's sole discretion. We will use the contact details supplied to communicate with you regarding your Model Engineers Workshop subscription. By supplying your email / address / telephone / mobile number you are happy to receive information and/or products and services via email / telephone / post from or in association with MyHobbyStore Ltd or its agents who may mail, e-mail or phone you with information and/or products and services reflecting your preferences. Tick if you don't want offers from us ☐ and/or third parties ☐

SEND TO: MODEL ENGINEER WORKSHOP SUBSCRIPTIONS, TOWER HOUSE, SOVEREIGN PARK, MARKET HARBOUROUGH, LEICS LE16 9EF



David Clark

ON THE EDITOR'S BENCH

An apology

I would like to apologise to Phillip Bellamy about my publishing the letter in issue 155. Perhaps we could work forward now and rather than Mr Bellamy offering criticism, perhaps he will consider giving us some of his experience by writing the occasional article for the benefit of all. I have had several readers contact me about this, mainly complaints as was to be expected.

The world gone mad

I read in the paper that the government is considering forcing cars that are kept off road to be insured even if they are in a garage. This is to stop the several million uninsured cars that are apparently on our roads. I wonder if this includes that car you have in pieces that you are slowly restoring?

Someone phoned me up last week and in the course of conversation, mentioned that the EEC was considering banning kettles and making us all use individual cup heaters. Crazy I thought and I decided to do a quick search on the internet to see if it was true. I still don't know if it is because I found so much more that I got engrossed in reading it.

For your education and possibly amusement if it was not so serious, I have found the following, (the titles are mine.)

Rocking horse c**p

Britain's tradition of rocking horse manufacture, which has its roots in knights practising their jousts, could be crippled by new European safety regulations (CENLEC). According to the new standards, "activity toys" cannot have a height from saddle to floor of more than 60cm, less than two feet. That effectively rules out all but the smallest rocking horses, say craftsmen in the cottage industry's 60 or so firms who comprise the £35m per annum industry.

A sit down job

Thousands of farmers and other workers are to be banned from driving tractors, lorries and dumper trucks for much of the working day under an EU directive on vibrating machinery. The restrictive limits of the EU Physical Agents (Vibration) Directive were agreed in Brussels yesterday and will be published this summer. The directive was immediately condemned by the National Farmers' Union as a "masterpiece in madness". The NFU led opposition to the directive

because it meant farmers would have been forbidden from driving a tractor for more than three to four hours a day. That limit was roughly doubled yesterday and farmers were given a five-year extension to convert existing tractors and machinery to comply with the directive. Any restriction on the time farmers can spend at the wheel of their tractors will have big cost implications, particularly at harvest time.

Incompetence

When Chris Baker, an electronics engineer was asked by the RSPB to install a TV camera to watch a pair of golden eagles he was watched by various officials, one asked if he had a Certificate of Competence in tree-climbing. When he said no, a fully-certificated tree-climber had to be brought from far away. In order to qualify for such a certificate an "EU standard tree" has to be used. (Sunday Telegraph 10/6/01)

A sweet problem

Late last year I went to a local country fair, and I wanted to buy some candy-floss. The vendor made it for me, and started to put it in a plastic bag. I said no, I wanted to eat it now and I wanted it on a stick. He said that he wasn't allowed to do that any more because of EU regulations, a stick could injure somebody's throat. So I bought it in a bag and ate it with some difficulty from the bag. When I had finished, just to experiment, I pulled the plastic bag over my adult head, and it went over easily. So small children can now suffocate themselves on a candy-floss plastic bag! The final part of this story is that I have just had a short holiday in Paris, and all the street vendors selling candy-floss are selling it on sticks! (Personal communication Mr T Foy April 12, 2000)

Fire Fighters outlawed

Fire fighters in the Bristol area are set to be banned from washing and repairing their own kit - on the orders of Euro officials. Traditionally, many fire fighters have taken home their tunics, trousers, gloves and boots and spruced them up ready for the next day's duties. They have also carried out running repairs for free. Now the Authority is being recommended to contract out the repair and maintenance of kit at a cost of nearly £280,000 a year. EC rules will outlaw repairs and washing by "untrained people" and will force the

authority to put a quality control system into place. The rules will also order the authority to replace tunics after five years - some are eight years old. [Bristol Evening Post, 15.12.99, p.22]

The men in white coats

According to EU regulations salesmen in the Billingsgate fish market have to wear white coats. Failure to do so is a criminal offence. (BBC 1 TV Inside Story 20/1/99)

Not child's play

The Royal Society for the Protection of Accident's playground office telephone has become red hot with calls from small local councils as playground owners become increasingly worried about the implications of the new European Standards covering playground equipment and surfacing. Much of the equipment now installed on children's playgrounds will fail some of the requirements of the new standards. (Local Council Review January 1999). The response by councils to the new EU standards for playgrounds is to close them. Caerphilly Council has closed 95; Swansea is closing 25. They say that they are now open to litigation if there is an accident and they have not implemented the new regulations. New rules include an instruction that all slides have to face away from the sun, new safety surfaces are required and equipment must not exceed a maximum height. The result is that children are forced to spend more time on the streets. (BBC Today programme 27/1/00).

Dying banned

ESSO blue banned. An EU directive has banned the use of blue dye used to identify domestic paraffin. This is to make it less attractive to children, who might be tempted to drink it. (Daily Telegraph letter 8 March 1999) Will they ban red diesel next?

Flight of fancy

The Red Arrows, the RAF acrobatic team, will have to comply with EU safety rules and perform their displays away from the watching crowds. In many instances this means out of sight most of the time. (BBC R4 News 5/4/98)

Although most of the above are not that recent, I expect some of the more recent directives are equally as stupid. Although this is not a political magazine I thought you might like an insight into the crazy world we live in.

MAKING A TANGENTIAL TOOL HOLDER FOR THE LATHE

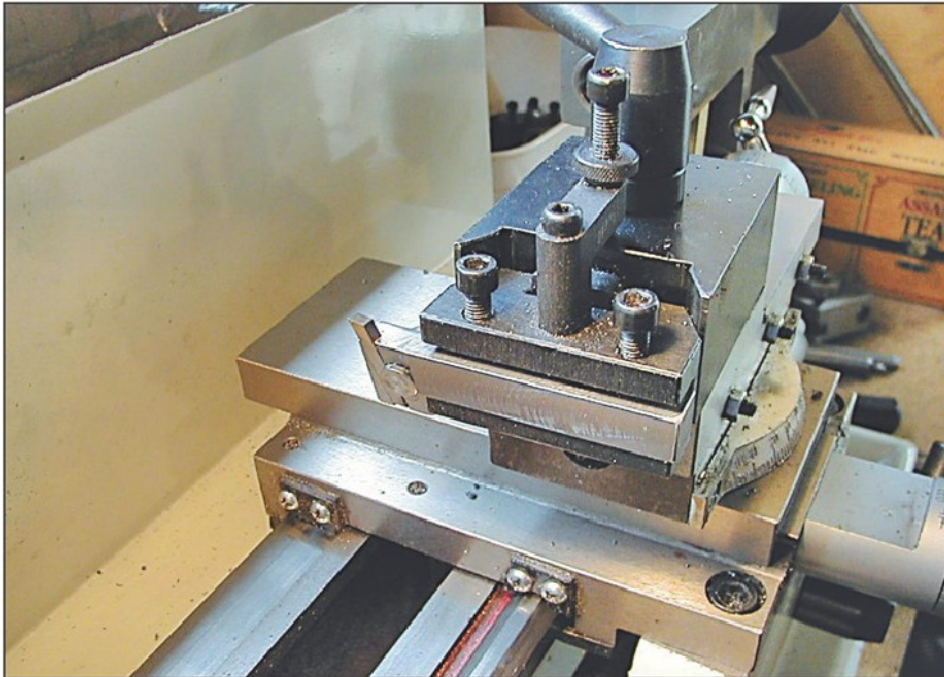


Photo 1. The tool mounted in the lathe QCTP.

Peter Boonham improves his turning equipment

Background

After seeing an advertisement for a tangential tool holder, I decided to research the subject on the Internet. Tangential type tools in various forms appear to have been around since the 1940's. To me, the idea of using a high speed steel tool bit vertically, tilting it forward and left and sloping the top of the bit opposite to these tilts in a diagonal direction, so that in plan view it presented an angle of less than 90 degrees to the workpiece was intriguing. Turning and facing without moving the position of the tool and easy tool bit resharpening using a simple jig were obvious advantages. It was something I just had to try. Buying a tool to try was out of the question so it had to be home built, **photo 1** but where to start and what angles to use? I found a website - <http://www.gadgetbuilder.com> - which describes a tangential tool built into a QCTP toolholder and also provides information on the tool angles used. I didn't have a piece of steel large enough to make another complete QCTP holder incorporating the tangential tool so I considered making a tool bit holder from available material to fit one of the spare QCTP holders supplied with my lathe.

I took some measurements on the lathe with a QCTP spare holder fitted and sketched a design using $\frac{3}{8}$ in. x $\frac{3}{4}$ in. BDMS for the tool holder body, **Fig. 1**. The BDMS flat body material, a piece of $\frac{1}{8}$ in. square HS tool steel and M5 socket head cap screws were all to hand so manufacture was started.

Manufacture

A Mini Mill was used for the tool holder body manufacture. After squaring the ends, the piece of $\frac{3}{8}$ in. x $\frac{3}{4}$ in. flat was held in the milling vice as shown in **photo 2** and was tilted at an angle of 12 degrees. Since the angle is not all that critical it was thought sufficient to use an angle gauge carefully made from thick card. The radial

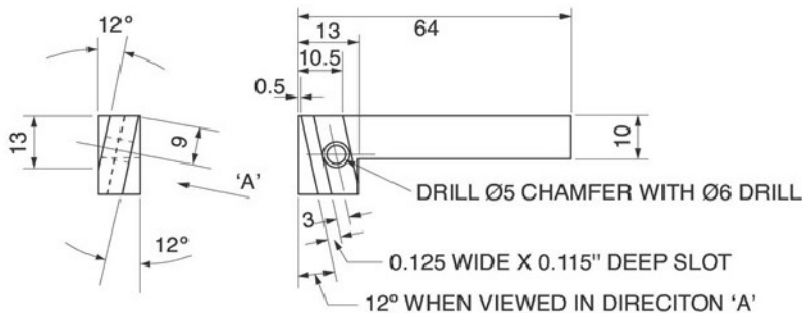


Fig. 1 TOOL HOLDER BODY MATERIAL – $\frac{3}{8}$ x $\frac{3}{4}$ BDMS FLAT

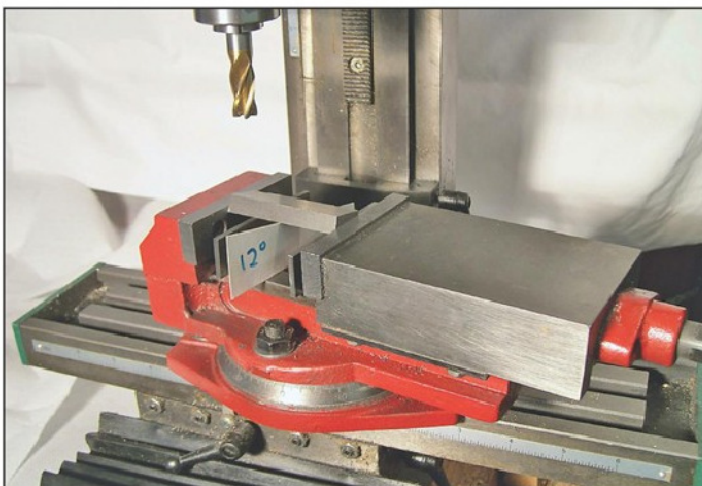


Photo 2. Setting up in the milling vice.

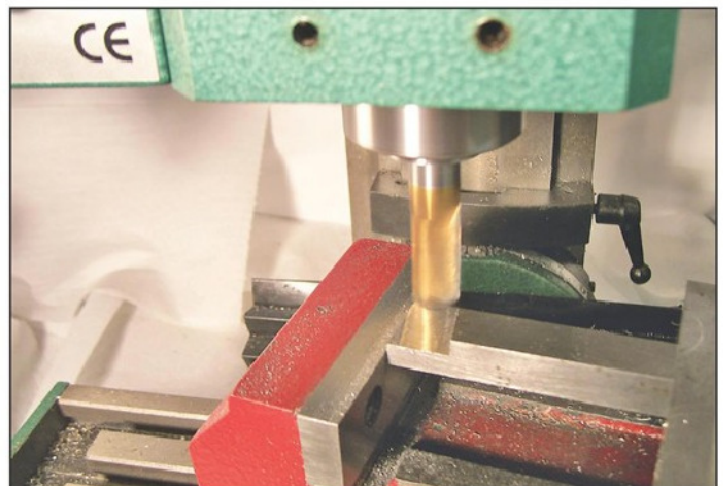


Photo 3. Milling the 12 degree flat.

vice is rotated to an angle of 12 degrees. A vice without a radial base could be used, set at the required angle on the milling machine table. **Photo 3** shows the milling of the 12 degree flat.

In **photo 4** the slot for the tool bit is being milled with a $\frac{1}{8}$ in. diameter cutter. Care has to be taken not to run the cutter into the vice jaw at the end of the traverse. One way of avoiding this is to start with a slightly longer piece of material, adjusting the 0.5mm and 10.5mm dimensions and finally milling back the end to the 0.5mm dimension. The depth of the slot needs to be about 0.010in. less than the thickness of the tool bit.

The position for drilling the 5mm diameter hole was established using a sharp point wiggler and carefully measuring the 9mm and 3mm dimensions with a rule, followed by spotting lightly with a centre drill and then rechecking the measurements before drilling through with a 2.5mm drill, followed by a 5mm drill. The hole is lightly chamfered using a 6mm drill.

Photo 5 shows the drilling operation. I found that a 5mm drilled hole gave adequate clearance for the M5 capscrew which measured 4.85mm diameter.

The next operation, which is shown in **photo 6** is to turn the body over with the 12 degree flat supported on parallels and mill a seating for the M5 nut.

A fair amount of metal needs to be removed to achieve the 10mm shank dimension; I used a hacksaw to cut away most of the metal and then finished by milling as shown in **Photo 7**.

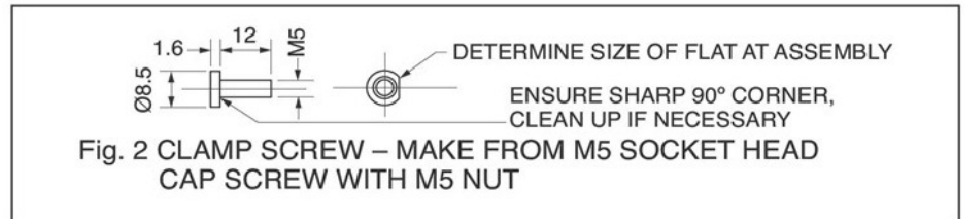


Fig. 2 CLAMP SCREW – MAKE FROM M5 SOCKET HEAD CAP SCREW WITH M5 NUT

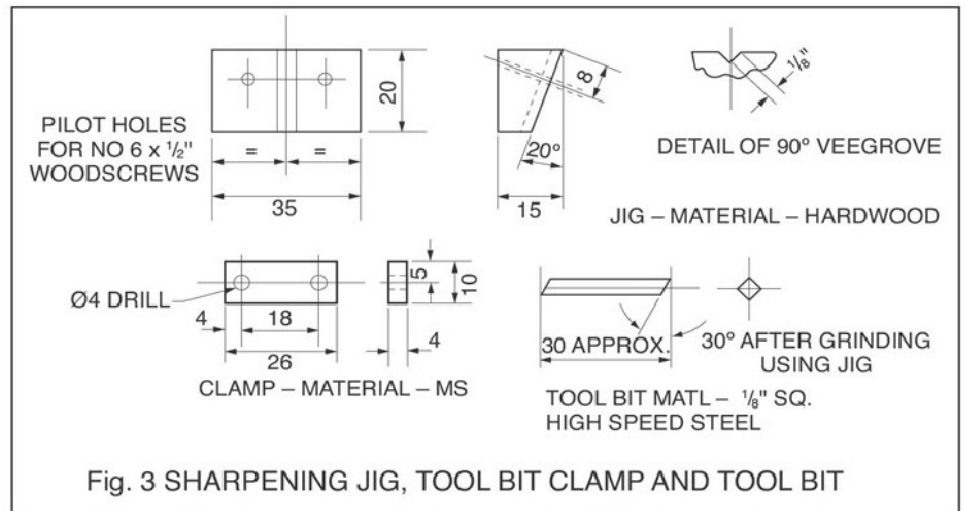


Fig. 3 SHARPENING JIG, TOOL BIT CLAMP AND TOOL BIT

The tool bit clamp screw is made from an M5 socket head cap screw, **Fig. 2**. The work involves shortening the head and ensuring that the underside of the head is square with a sharp corner. The reduction in head length is to avoid contact with the

workpiece when facing diameters larger than about 25mm. **Photo 8** shows the finished tool holder.

The sharpening jig is designed to produce a diagonal tool bit angle of about 30 degrees when used with a

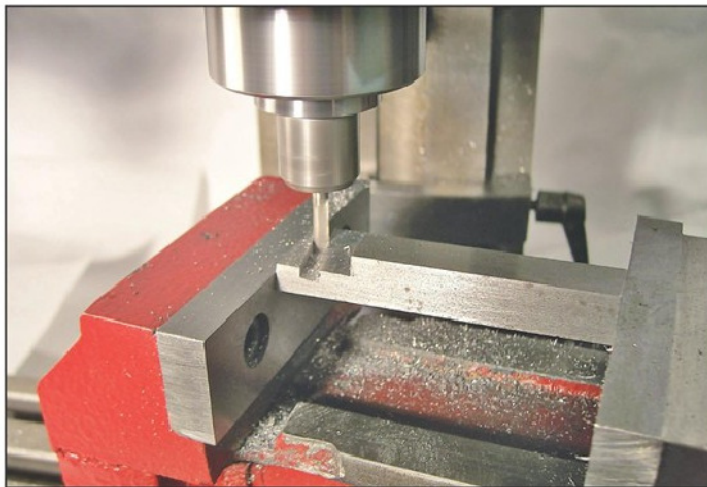


Photo 4. Milling the tool bit slot.

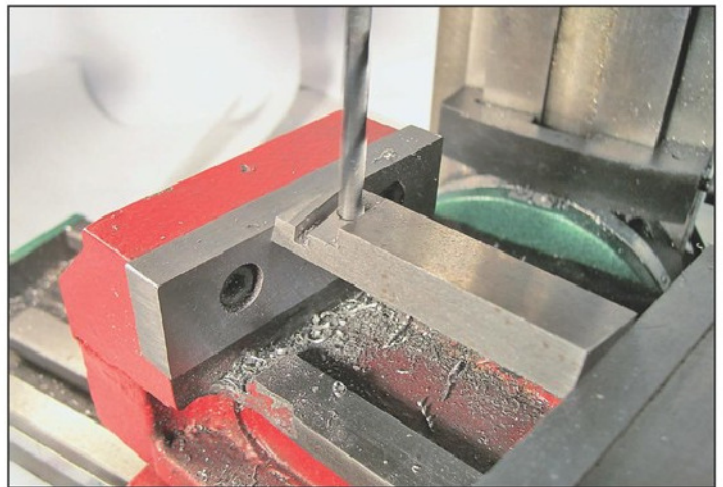


Photo 5. Drilling the hole for the clamp screw.

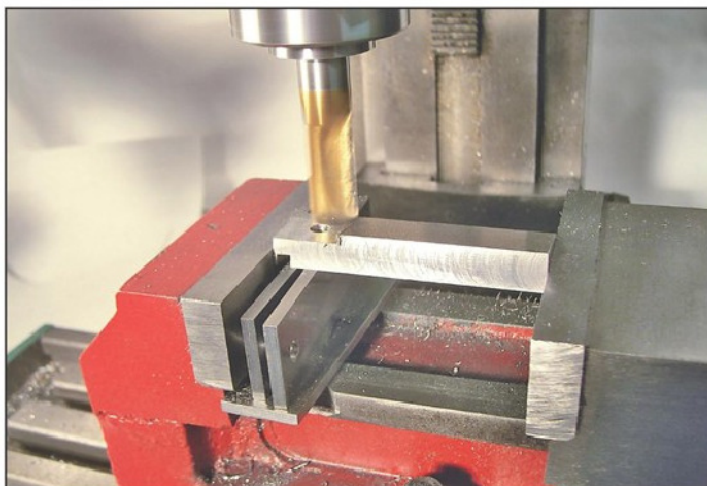


Photo 6. Milling the seating for the nut.



Photo 7. Finishing the tool shank.



Photo 8. The finished tool.



Photo 9. The sharpening jig on the grinder.

150mm diameter grinding wheel and sitting on a support table which is on the centre line of the wheel. The tool bit should project about 6-7mm from the front edge of the jig.

In operation the tool bit is gently stroked across the face of the grinding wheel using light hand pressure. Any slight grinding burrs can be removed by gently rubbing the tool bit faces on a fine diamond hone. The front corner of the tool bit can be slightly rounded with the hone for finishing cuts.

As I was eager to test the tool the jig was made quite quickly from a scrap of hardwood as you can see from **photo 9** and **Fig. 3**, (the eye guard was raised to take the photograph). I chose hardwood for other reasons, first it made it possible to use a pointed 90 degree woodwork countersinking bit as a milling cutter to make the groove, and second it would have been easier to adjust the basic jig angle had it proved necessary. There is no reason why it should not be made in metal once the optimum tool bit angle has been established.

Conclusion

A turning and facing test on a scrap piece of mild steel bar of unknown quality showed promise. A 0.5mm deep cut producing good metal removal with curly swarf and a good finish. Unfortunately I have not had the opportunity to carry out extensive testing. It was well worth spending a few hours designing and making the tool. A major advantage is the ease of sharpening the tool bit which can also be double ended and spare tool bits can be produced quite cheaply. ■



Eccentric Engineering

The Diamond Tool Holder

Designed and manufactured in Australia since 1985, the Diamond Lathe Tool Holder is unique in that it holds any standard piece of 1/4" square or round High Speed Steel at a tangential angle to the work piece.



Due to its design, all the clearance angles for general purpose cutting are pre set; only the top face is sharpened. This is simple to achieve on any bench grinder using the grinding jig that comes with each tool.

Four sizes are available, from mini lathes up to full size tool room lathes. All holders come complete with grinding jig, hex key, one square HSS tool blank and detailed instructions.



Grinding Jig

For more information and ordering, visit our website at eccentricengineering.com.au

- Versatile and easy to use
- Simple sharpening
- Roughing and finishing cuts
- Square shoulder facing
- Round nose work (using round HSS)
- Point radius
- No special cutting tips needed
- 55° & 60° Thread cutting (using same jig)
- Tool bits easy to replace

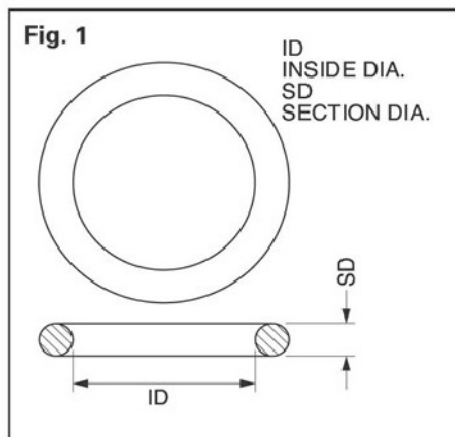
USING O RINGS IN THE HOME WORKSHOP

Harold Hall looks at this useful item

For something as outwardly simple as an O ring, **photo 1**, it may come as a surprise to the reader just how complex an item it is. They are made in a wide range of sizes, some much larger than those in the photo. For many, the most prominent use of an O ring is the seal used on garden hose fittings, **photo 2**, but their use goes far beyond this simple application.

Sizes

Fig. 1 shows that there are just two dimensions that define the O ring, the Inside Diameter ID and the Section Diameter SD. There are though within this format a very wide range of sizes, both imperial and metric.



In the case of metric rings Section Diameters of 1.6, 2.4, 3.0, 5.7 and 8.5mm are available. Inside Diameters range from 3 to 499mm with increments from 1mm to 20mm depending on Section and Inside Diameters. Typically, at an SD of 1.6mm increments of around 1mm to 3mm and at 5.7mm increments of around 2mm to 20mm with the larger increments obviously at the large inside diameters. Unfortunately, the increments are somewhat irregular and cannot be detailed without publishing the list fully.

Standard Inside Diameters

SD	ID Range
1.6	3.1 to 37.1
2.4	3.6 to 69.6
3.0	19.5 to 249.5
5.7	44.3 to 499.3
8.4	144.1 to 249.1

Imperial rings are still being made and with SD sizes of 0.070, 0.103, 0.139, 0.210 and 0.275in. but with many more and much larger ID values. These go up to 25in. Of course, there is no reason why imperial rings cannot be designed into metrically dimensioned assemblies, or visa versa.

Materials

Rings are made in a very wide range of materials, each having characteristics that make them suitable for very specific applications. Typical materials used are,

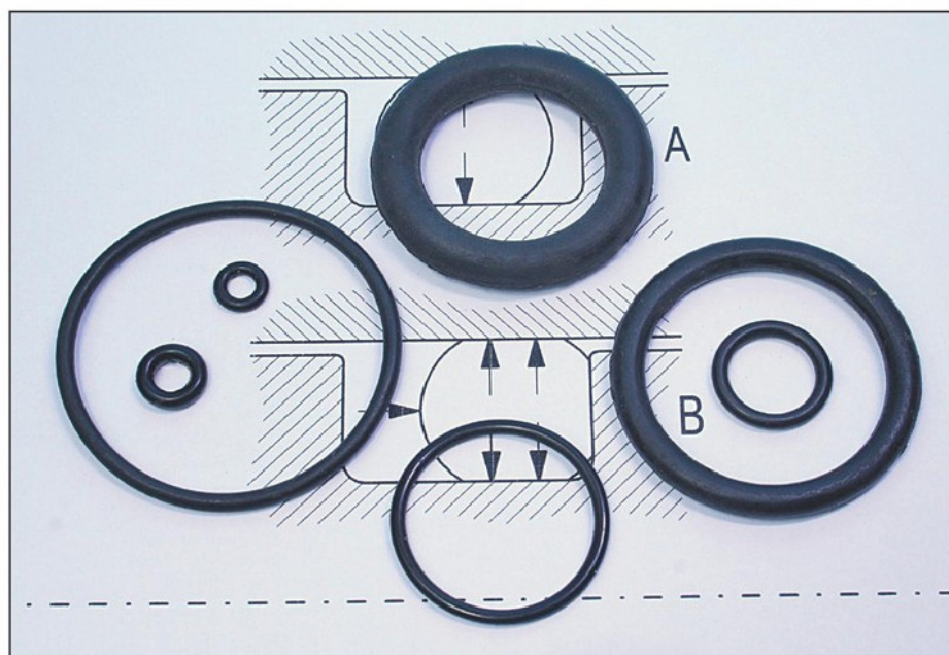


Photo 1. A selection of O rings.

Ethylene-propylene, Natural rubber, Nitrile - acrylonitrile-butadiene, Polyurethane and Silicone, a list that is far from exhaustive and in any case there can be different grades even within a particular material type.

The differing material types are required to cope with such requirements as high temperature, low temperature, resistance to particular chemicals, ability to work in dynamic applications, that is, rotating or reciprocating spindles. Polyurethane rings are often also used as drive belts in transmission systems.

Unfortunately, O Rings are almost always black and devoid of any marking making it impossible to determine the material used. This can be a problem when obtaining rings as replacements for existing equipment. If you do purchase some O-Rings do store any surplus rings with the full details of their specifications. A very small number of rings are supplied in other colours to minimise the problem.

Dynamic applications

Not all sizes of rings are considered suitable for reciprocating applications with only a limited range of the smaller ID's being recommended for such duty at each section diameter. The following details sizes that are considered acceptable though some manufactures do list a slightly wider range with a few larger diameters in the case of 3.0 and 5.7 rings. The rings listed can of course be used for static applications also.

SD	Range
1.6	None
2.4	3.6 to 18.6
3.0	19.5 to 42.5
5.7	44.3 to 119.3
8.4	144.1 to 249.1

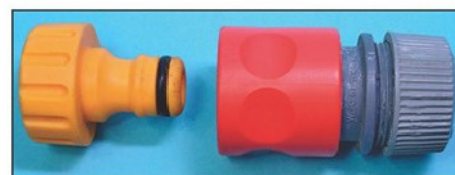


Photo 2. A garden hose connector is a typical use for an O ring.

All ring sizes are regarded as acceptable for low speed rotating applications with the peripheral speed being the limiting factor. Therefore, rings having a smaller ID can run at higher speeds than those with a larger ID.

The material from which the ring is made together with the surface finish of the mating parts will though govern what is permissible.

Design considerations

Fig. 2 at "A" has the ring in its assembled but unloaded state and shows that the width of the groove in which it sits is

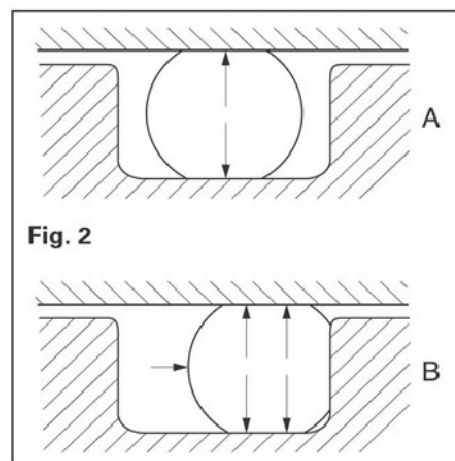
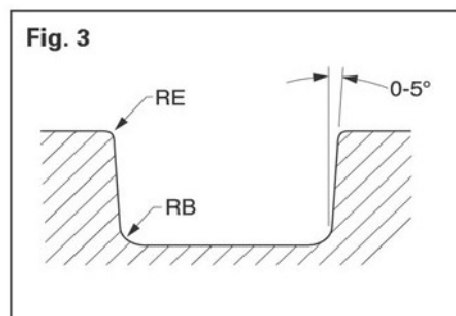


Fig. 2

wider than the Section Diameter of the ring. "B" shows that when loaded by the media pressure the ring will be forced against one wall of the groove causing it to attempt to expand thereby increasing the pressure as indicated by the double arrows, further improving the seal. This last comment though assumes that the initial compression at (A) is sufficient to prevent the working pressure being able to bypass the ring.

Groove Features

Rather than the groove in which the ring sits being a simple rectangle there are other features included. Most essential is the radius RE that ensures that the ring is not damaged as it drops into the groove that could easily happen if the edge was left sharp, Fig. 3.

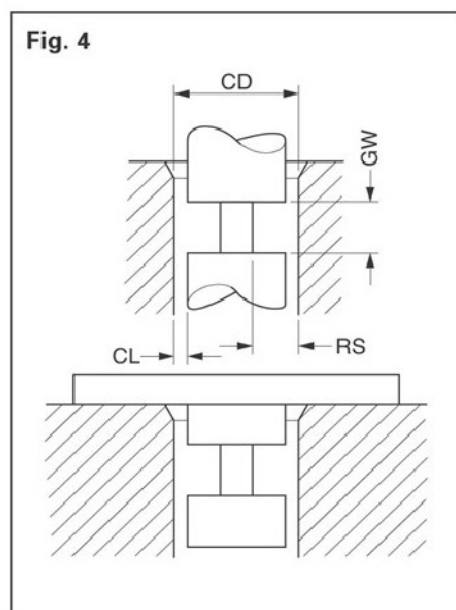


Radius RB is perhaps a little less important but avoids the cutting tool having to have a sharp corner that may chip. In very arduous applications a sharp corner could result in there being a fracture point, the radius of course considerably reduces this possibility.

The slope to the side of the groove of up to 5deg. is optional.

Groove RE max.	Radii RB max.	Section SD
1.6	0.2	0.20/0.40
2.4	0.5	0.20/0.40
3.0	1.0	0.20/0.40
5.7	1.0	0.20/0.40
8.4	1.0	0.20/0.40

For simplicity the radii and sloping sides have been omitted from the remaining sketches.



Ring in Spindle/Piston

Fig. 4 shows what is probably the most common format for the use of an O Ring. That is, a parallel cylinder, with the ring fitted in a groove in the spindle/piston. For clarity Fig. 4 and those that follow, show the assemblies without the ring being fitted.

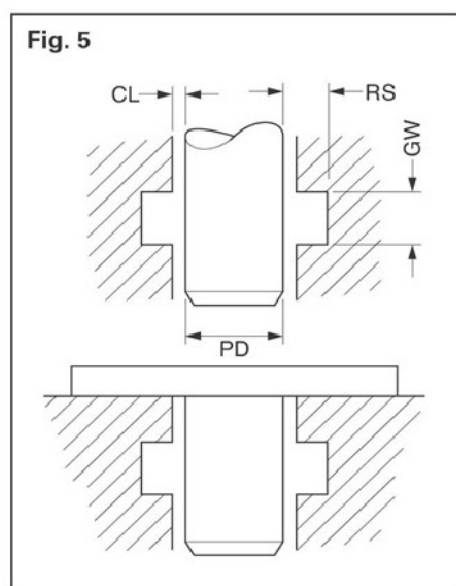
Do take note that the Ring Space (RS) is not the depth of the groove in the spindle but includes the Clearance (CL). The depth of the groove in the spindle will vary depending on the chosen clearance.

Section Groove Depth Clearance

SD	GW	RS	CL max.
1.6	2.3/2.5	1.18/1.25	0.06
2.4	3.2/3.4	1.97/2.09	0.07
3.0	4.0/4.2	2.50/2.65	0.08
5.7	7.5/7.7	4.95/5.18	0.09
8.4	11.0/11.2	7.50/7.75	0.10

Ring in Cylinder

The comments and dimensions for the Ring in Spindle also apply to this arrangement, Fig. 5.

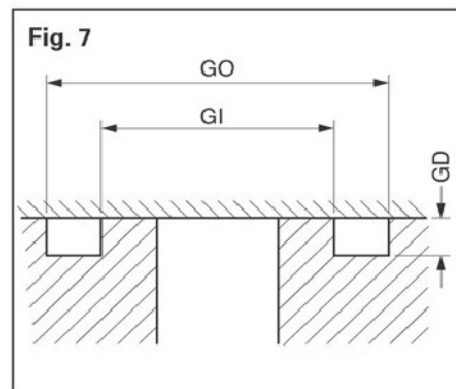
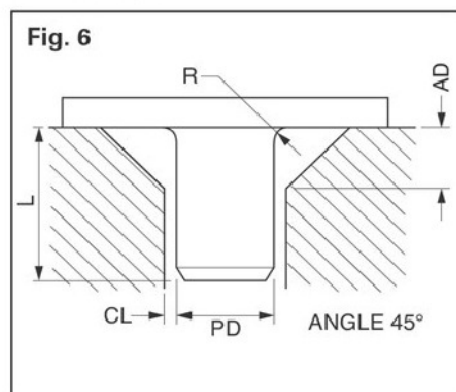


Ring in Triangular Groove

Section Clearance Triangular Groove.

SD	CL	AD	R	L
max.	min.			
1.6	0.06	2.20/2.32	0.8	4
2.4	0.07	3.30/3.42	1.3	5
3.0	0.08	4.20/4.32	2.0	6
5.7	0.09	7.80/7.92	3.0	10
8.4	0.10	11.50/11.62	4.0	14

Difficulty in making the chamfer accurate enough to ensure a reliable seal makes this a method that should be adopted with caution, Fig. 6.



Ring in Flange

This arrangement, Fig. 7 is more complex than those above as the dimensions depends on whether the higher pressure is inside or outside of the cylinder. If inside, then the ring will be forced against the outside diameter of the groove whereas if outside the reverse will be the case.

SD	GD
1.6	1.2/1.3
2.4	1.7/1.8
3.0	2.2/2.3
5.7	4.4/4.5
8.4	6.6/6.7

ID Dependant

The details given so far are independent of the ID of the ring being used but such items as cylinder diameter, shaft diameter, etc. do of course relate to the size of the associated O ring. With so many different sizes of ring it is quite impossible to list every one but fortunately the relationship between the ring and its mating part is a constant except with very small and very large diameter rings. Even here the variations are very small and therefore, except for critical applications, the following approach should be adequate.

The following list quotes just a single ID size for each O ring SD together with the required dimensions for that particular size. To arrive at dimensions for other diameters, typically say using a ring 20mm larger in diameter than that listed then increase all dimensions by the same margin, if say 5mm smaller, then reduce each dimension by this amount.

Flange groove diameters

Pressure

SD	Internal External				
	ID	GI	GO	GI	GO
max.	min.				
1.6	22.1	21.0	25.3	22.5	26.5
2.4	20.6	18.5	25.4	21	27
3.0	21.5	19	27	22	30
5.7	44.3	41	55	45	59
8.4	144.1	140	160	145	165

Shaft/Cylinder diameters

SD	ID	PD	CD
1.6	22.1	22.5	25
2.4	20.6	21	25
3.0	21.5	22	27
5.7	44.3	45	55
8.4	144.1	145	160

Assembly

Some of the drawings show a chamfered end to the shaft the purpose of which is to aid assembly and prevent the ring becoming damaged as it may be if it were forced onto a spindle having a sharp edge

to its end. Similarly, where the ring is first assembled into a groove on the side of a cylinder this also has a chamfered entry for the same reasons.

The angle of the chamfer should be in the region of 15 to 20deg. and if on the end of a shaft the smallest end should be a little smaller than the inside diameter of the ring being fitted. When being fitted into a cylinder the larger end should be a little larger than the ring's outer diameter.

Giving the ring a light coating of a lubricant will also make assembly easier but do ensure that the lubricant is compatible both with the material that the ring is made from and with the assemblies ultimate purpose. Makers of O rings do supply suitable lubricants.

Where the ID is less than three times the SD, damage to the ring is possible if it is attempted to fit the ring into a conventional groove due to the difficulty of expanding the ring sufficiently. In this case the component would need to be made in two parts being split at the ring's housing. This is obviously not that easy and the situation should if possible be avoided.

Standards

Metric rings, as discussed above are to British Standard BS4518: "Metric dimensions of toroidal sealing rings (O rings) and their housings".

Imperial sized rings are also being made and are to BS1806: "Dimensions of toroidal sealing rings (O rings) and their housings (inch sizes)".

Within the imperial specification, SD sizes of 0.070, 0.103, 0.139, 0.210 and 0.275in. are listed but with a very much larger number of ID sizes than in the metric standard.

In terms of listed sizes BS1806 is very similar to SAE AS568A: American National Standard Aerospace size standard for O rings.

Readers in the UK wishing to view British Standards are likely to find that local libraries will have access to them via the Internet. However, British Standards do not provide this service directly to individuals. For details of where the standards can be viewed local to you contact the British Standards on 020 8996 9001 but first ask at your local library.

Further reading

The above should give the reader an initial insight into the important factors when designing an O ring assembly. However, when involved in critical applications advice should be sought from the ring manufacturers. Some do produce quite detailed manuals as to their use. These can often be downloaded via the Internet. Two typical suppliers are ■

James Walker & Co. Ltd, Customer Support Centre, 1 Millennium Gate, Westmere Drive, Crewe, Cheshire CW1 6AY.

Telephone 01270 536000

E-mail: csc@jameswalker.co.uk

Web Site www.jameswalker.co.uk

James Walker also have offices in many of the major countries

Wyko Industrial Services, Marketing Department, Amber Way, Halesowen West Midlands. B62 8WG

Tel: 0121 508 6341

E-mail wid.marketing@wyko.co.uk

Web Site www.wyko.co.uk

MAKING REPLACEMENT MACHINE LABELS

Mick Whittingham adds the finishing touches to his rebuilt machines

When refurbishing machinery, during painting and refinishing operations, it is not always possible to protect the adhesive labels and information plates, which are sometimes attached.

Careful masking and covering are often not enough to save some of the delicate labels and most of the adhesive type labels I have dealt with are virtually falling off in any event.

Having identified the need to replace the labelling I set about the task of producing authentic looking substitutes that could be fitted to the machine after the final painting had been done.

There are two methods and these both use computer skills to achieve. If you don't have a computer or the skills to do this work then you will have to find some genius who will do it on your behalf.

The first way is to photograph the original label using a digital camera and import the image into your PC. Using photo editing software the image can be manipulated to the right size and cropped to make it look like a label. I can't cover all types of photo editing software here and so some playing may be in order to get the image just as you want it but after some practice you should be able to isolate the image of the label from its background.

The second method involves actually generating a label using word processing software. Again with practice and a little

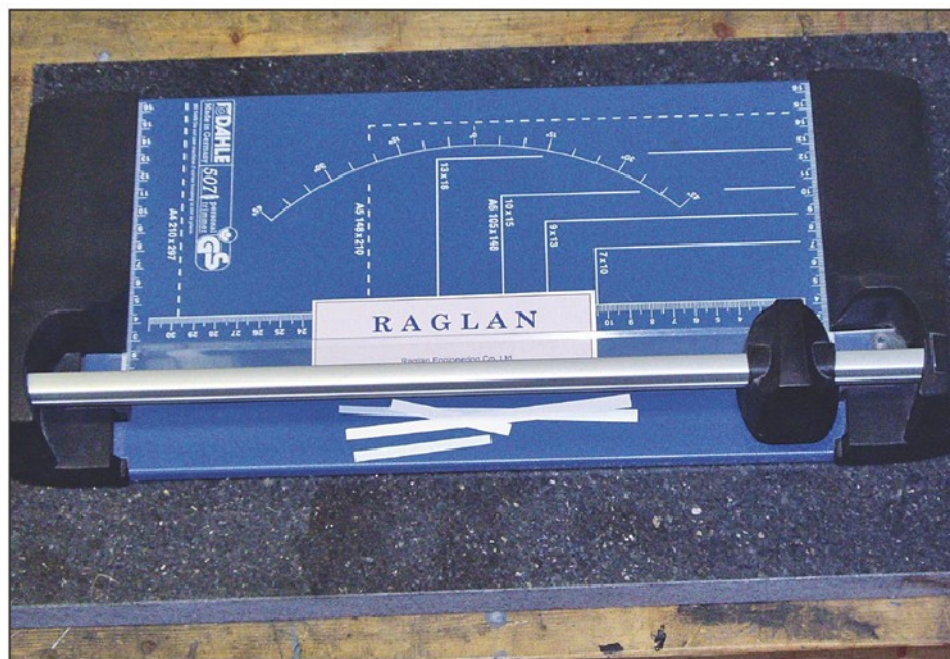


Photo 1. Trimming the label to size.

imagination a fair degree of accuracy and authenticity can be achieved.

By using the DRAW function available on most programmes it is possible to create frames and text with appropriately coloured backgrounds for most applications.

A couple of examples are included showing warning labels and speed selection plates.

Once the desired image or text is ready to print, all that is required is some specialist waterslide transfer printing paper. This is available from quite a few

outlets and I got mine from the internet. It is important that you source the right type of paper for your particular printer i.e. laser or inkjet etc.

I try to group as many objects together so that I can run off one sheet and avoid waste. Placing one label in the middle of an A4 sheet is not efficient.

After printing, cut out each label carefully to leave as little margin outside the print as possible. Following the instruction with your particular paper, the label can then be attached to the machine in the requisite position.



Power feed gearbox warning label made up using Word processor software for printing on transfer paper



Warning label for belt covers. This is a made up version using text similar to that seen on other machines.

Waterslide transfers are the type included in many plastic model kits and a dish of warm water will free the transfer from its backing paper. The transfer can then be carefully lifted out with tweezers and affixed to the machine, the water film allows for some sliding and positioning of the transfer and once it is in place gently smooth out the transfer to remove wrinkles. Let the transfer dry for a long time to make sure it is properly attached.

The type of transfer I use dries to a white "eggshell" finish which looks quite artificial for this type of use. In order to rectify this the transfer needs to be neatly masked and a thin coat of oil based enamel varnish applied over it. This seals the transfer but also makes the white areas transparent so that it looks right. If you were going to varnish the whole machine then there would be no need to mask the transfer beforehand.

There is also the option to make up a label in this way and attach it to a thin metal plate, sealing it as described, and then fixing it to the machine with small button headed screws. This is especially good for data plates and warning signs.

I have had some really good results using either method and have included two images from the Tom Senior mill article on page 38. I would encourage anyone wanting to make their machines as good as new to try this way of making up transfers. ■



Photo 2. The transfers are waterslide ones.



Photo 3. Soak the transfer until it floats off.

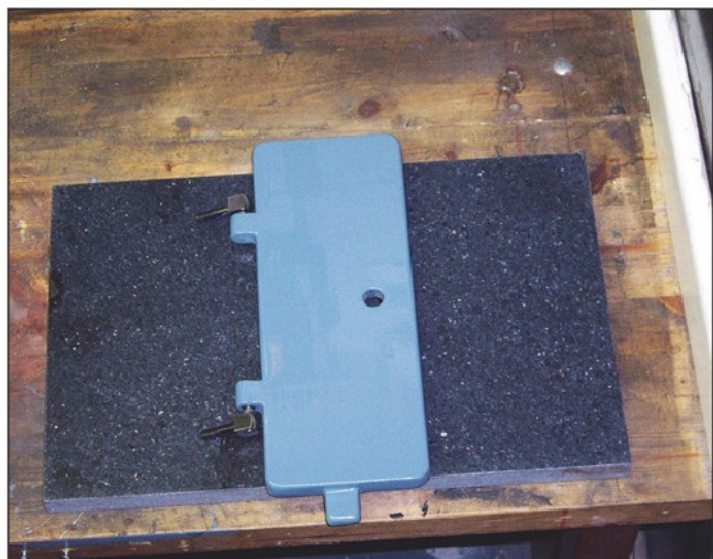


Photo 4. The finished machine cover awaiting the transfer.



Photo 5. The transfer in place.

G.L.R.'s VERTICAL BOILER KIT

Special Offer on our 4"dia. x 8.1/2" high" Vertical Boiler revised for 2009
Our popular kit of parts for this vertical boiler has been revised and now includes the following:

Fuelled by Coal, Spirit or Gas

- Boiler tube & Firebox tube - Gunmetal boiler top casting
- 25 off 5/16" x 20g boiler tubes
- Flanged plates with tube positions centred & ready for drilling
 - 2 Finished connectors for Safety valve and Steam outlet
 - 8 Threaded Gunmetal bushes.
- Ceramic fibre for boiler lagging • Copper for foundation ring
- 1" Brass tube for chimney • Stainless steel plate for door
 - Drawings & Instructions

Credit crunching price: £155.00
including vat and carriage



Finished Boiler



Complete set of fittings for above:

- Pressure gauge • Water gauge
- Safety valve • Check valve • Steam stop valve • Blowdown valve – **£99.00**



Finished Boiler

G.L.R. DISTRIBUTORS, UNIT 3, GRESLEY CLOSE, DRAYTON FIELDS, DAVENTRY, NORTHANTS. NN11 8RZ

• Tel: 01327 878988 • Fax: 01327 876396 • Mob: 07860 858717 • E-Mail: peteglr@btopenworld.com
Web site: www.modelmakingsupplies.co.uk Send 6 first class stamps for catalogue & Price List
OPEN TO CALLERS - Monday-Friday 9.00am - 5.00pm SATURDAY 9.00am - 11.00am



Welcome to **GWR Precision**
Delivering your hobby to your door



GWR Precision are Proud to be the Official UK & Eire Distributors for the CARL AERO LTD Stirling Engine range

Wilescor Now also stocking the **böhm** complete Bohm Stirling Engine range and Wilescor Steam Engines

Extensive range of Materials including: Brass, Aluminium, Steel, Silver Steel, Copper, Phosphor bronze. Round, square, flat, hexagon, angle, round tube, square tube.

Extensive range of Fasteners including: Metric, BA, UNC, UNF, BSW
Screw Head Types: Cap, Button, Hexagon, CSK, Pan, etc. Bolts, Machine Screws, Self tapping, Nuts, Washers, etc.
Materials: A4, A2, BZP, Black, Brass.

Our new online model engineering store will continue to grow over the coming months. If there are any items that you wish to order that are not in our store, contact us via email and we can get a quotation for the items you require.



It simply requires a small temperature difference!



The Carl Aero Stirling Engine
Precision made in Germany

LTD Stirling Engine from £135

This LTD (Low Temperature Difference) Stirling Engine runs on any warm or cold surface.

These engines are a great gift for someone who likes technology or physics.

Each engine is assembled and tested by in Germany and comes in a high quality all black gift box with black foam insert.

www.gwrprecision.co.uk

Please contact: sales@gwrprecision.co.uk

GWR Precision Ash Tree Cottage, Llangedwyn, Oswestry, Shropshire SY10 9JT

Tel: **01691 828010** or **07895 000156**



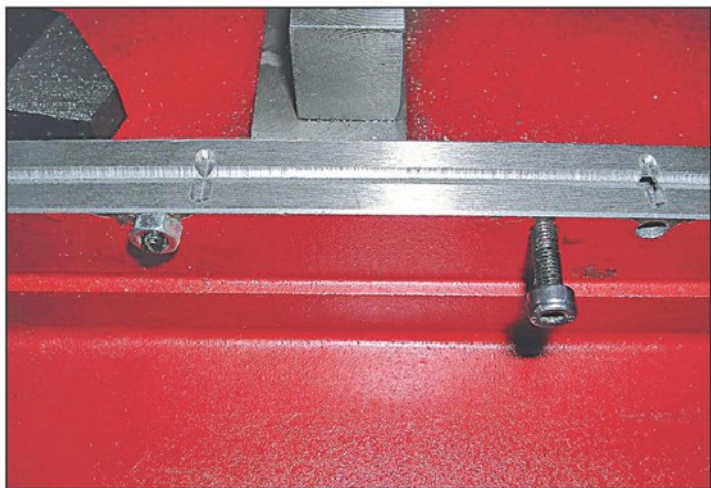


Photo 1. Y axis oil distribution hole.



Photo 2. Cutting the Y axis oil distribution channels.

INSTALLING A CENTRAL LUBRICATION SYSTEM ON THE SIEG SUPER X1L MINI MILL

David White makes light work of a repetitive chore

Keeping a milling machine well oiled reduces friction and wear on the moving surfaces of a machine as well as staving off corrosion. Effective oiling is extremely desirable for a manual mill but pretty much essential for a CNC machine, given the increased time that the leadscrews and moving surfaces spend in operation. CNC machines which are not sufficiently well lubricated are also much more prone to missing steps than those with oiling systems installed.

Milling machines intended for industrial or production use are invariably fitted with central lubrication systems sometimes also called one shot oiling systems. These are plumbed into the machine and oil is delivered simultaneously to all lubrication points using a hand or electrically operated pump. Some, but by no means all, of the medium and large manual or CNC mills intended for light production or hobby use are also fitted with central lubrication systems. In the absence of a lubrication system you need to stand over your CNC machine with an oil can judiciously squirting oil at all of the parts you can reach that need lubrication. Not an easy task given the usual inaccessibility of the X, Y and Z axes leadscrews and it is not a particularly safe task either given the speed with which the axes can move. *Editor's note: don't oil machinery while it is moving.*

Milling machines of similar size and capability to the Sieg Super X1L, manual or CNC, are rarely fitted with central lubrication systems as standard. Oiling systems for this class of machine don't appear to be available as after market add ons either. It might be assumed that this is simply

because the oiling system is too expensive in relation to the price of an entry level milling machine. This is true to a degree, but the main reason is much more prosaic. The smallest standard oil system fittings, studs, banjos, elbows, manifolds, non return valves, etc., available from Chinese, European, or American manufacturers are simply too large, 8mm or 1/4in. bsp, to fit on small milling machines. A central lubrication system for small mills must therefore incorporate expensive custom made fittings, or be adapted from low cost components originally intended for another purpose. The system described here uses both options; 4mm push fit fittings and tubing originally intended for use with compressed air, plus a number of shop made components. These fittings mate the 4mm outside diameter tubing to M5 threaded components and are small enough to fit onto the X1 mill. The fittings are widely used in many hobbies such as robotics, hydroponics, fish keeping, airbrushing, etc. and are therefore widely available at reasonable cost.

It is possible to make a system completely from bought in 4mm to M5 compressed air fittings and a commercially available lubrication pump. However, even the cost of the necessary non return valves and pump would add to a significant proportion of the total cost of a Super X1L mill. Making small numbers of custom components would be prohibitively expensive for a manufacturer but is meat and drink to hobbyists.

The system to be described here lubricates the ways and leadscrew nuts of all three mill axes. This involves drilling and tapping a few holes into the body of the Super X1L as well as small modifications to the leadscrew nuts. The system works best if oil distribution channels are milled into the sliding surfaces of the mill, as described later, but this is optional. If you don't have

Editor's note: Since receiving this article, Arc Euro Trade has introduced a range of fittings so the average reader can install a lubrication system to their lathe or mill. This is a comprehensive range of components that includes four different metering valves that would be ideal to replace the homemade check valves in this article. Arc also does a quality pull handle oiler that would replace the oilcan used in this article.

access to a second mill, or aren't brave (rash?) enough to mill the oil channels, then omit this step. The system works almost as well without the oil channels. Although the one shot oiling system described here is aimed at small milling machines such as the Super X1L it can obviously be fitted to much larger machines as well.

Modifications to the Super X1L base

It is usual to cut the oil channels for both the X and Y sliding surfaces into the saddle and this is certainly recommended for a larger mill with much more space available for fitting the lubrication system. I chose to cut the oil channels and drill the oil delivery holes into the base of the Super X1L for the Y axis because it hugely simplified mounting of the elbows, manifold, and tubing required to distribute the oil.

The construction of the one shot oiling system begins with drilling and tapping the oil delivery holes into the X1 base dovetails and optionally milling oil distribution channels. Begin with the base and drill a 3 mm horizontal hole 8 mm deep into the side of the dovetail. Unless you have access to a large enough pillar drill this hole will have to be made with a hand held

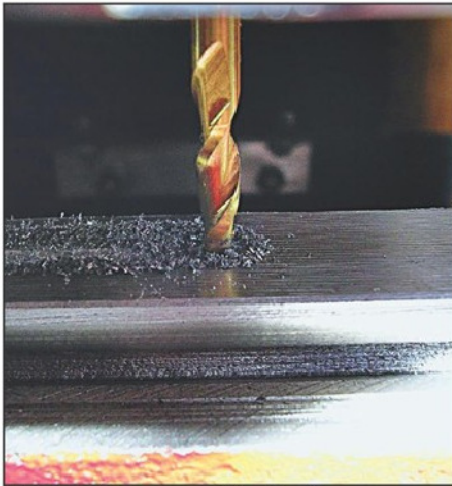


Photo 3. Close up of Y axis oil distribution channel being cut.

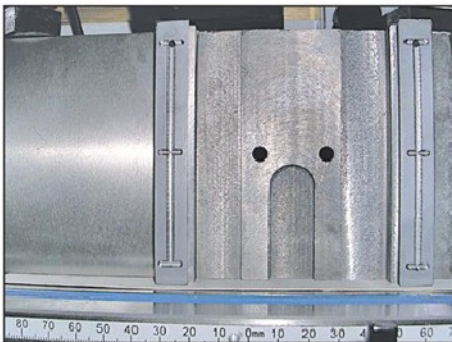


Photo 5. Finished X axis oil distribution channels in saddle.

electric drill. The hole should be drilled so that its centre is 0.5mm below the centre line of the dovetail adjusting screws. The position of the hole in the Y direction isn't critical but it should be around 15mm behind the Y axis locking screw. Enlarge a 5mm deep section of the hole from 3 to 4.2mm diameter and tap it M5. The M5 tapped holes will accommodate the M5 to 4mm push fit elbow fittings. Notice that these elbow fittings will still swivel even after being screwed into position. Now drill a 3mm hole vertically through the centreline of the 15mm wide sliding surface so that it intersects the previously drilled 3mm horizontal hole at right angles as shown in **photo 1**. Repeat this process for the other Y axis dovetail directly opposite the first one. If you intend milling the oil distribution channels then drilling of the vertical holes can wait until the base of the Super X1L is mounted on the table of the larger milling machine.

I mounted the Super X1L base on the table of my other mill and clocked it up so that the dovetails on the Super X1L base were parallel to the Y axis of the other mill. The oil channels were milled with a 3mm ball nosed cutter. The pattern of cuts is illustrated in **photo 2** which shows one set of channels complete and cutting of the other set in progress. These small ball nosed cutters are quite fragile so treat them gently. A spindle speed of 550rpm and multiple passes at 0.2mm depth of cut worked for me. Higher spindle speeds are ok but don't be tempted to push the cutter because the mill will either bend, leading to an irregular cut, or snap. Take it easy on the feed rate too - it's easy to feel when the cutter is labouring with a manual mill.



Photo 4. Finished Y axis oil distribution channels in base.

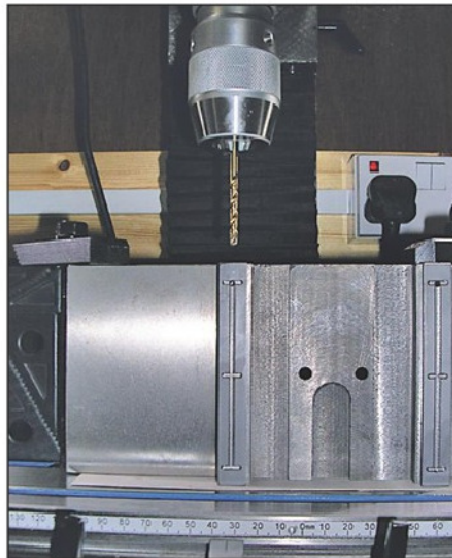


Photo 6. X axis oil distribution holes being drilled in saddle.

Photo 3 shows cutting in progress. Use the shop vacuum cleaner to suck away the cast iron dust as often as possible as it's the last stuff that you want on the ways of your milling machine. The final depth of the oil channels isn't critical but 1.5 - 2.0 mm is certainly more than adequate. If your mill is exceptionally rigid for its size, climb milling, as illustrated in the Photo, is not a problem; I cut on both the forward and return travel of the table. If you have any doubts about your mill just stick to

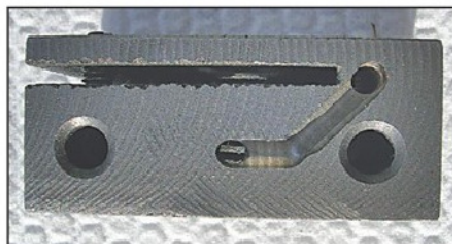


Photo 7. First attempt at oil distribution channel in leadscrew nut, top view.

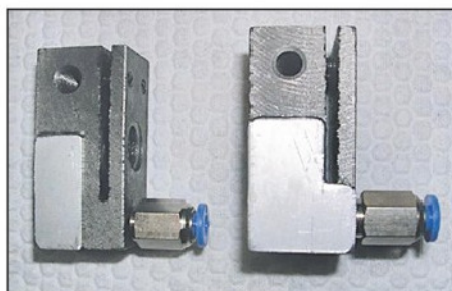


Photo 9. Oil distribution channels in X and Y axis leadscrew nuts, top view.

conventional milling; it will take twice as long but there won't be any nasty dings in the sliding surfaces of the Super X1L dovetails either. **Photo 4** shows a view of the Super X1L base with all of the oil channels cut. If you look at it closely you can spot the point at which my attention wandered slightly.

Modifications to the Super X1L saddle

In order to distribute oil to the X axis, oil delivery holes need to be drilled and tapped into the saddle. Optionally oil distribution channels can be milled into the X axis sliding surfaces of the saddle. I fixed the Super X1L saddle to the table of my mill and milled the oil distribution channels as shown in **photo 5**. These were milled in exactly the same manner as the Y axis oil distribution channels. The best place for the oil delivery holes is in the end of the dovetails, rather than in the centre as for the Y axis, and so the SuperX1L saddle was reoriented on the mill table and the oil delivery holes drilled as shown in **photo 6**.

This completes most of the work on the Super X1L table and saddle so attention was turned to the leadscrew nuts. The idea is to make oil delivery channels in the nuts without weakening them. The first attempts are shown in **photos 7** and **8**.

The idea is that an aluminum plate will be fixed over the channel with epoxy adhesive to retain the oil so that it can only drip down on to the leadscrew. While this works, the vertical oil channel is uncomfortably close to the slit of the leadscrew nut backlash adjusting mechanism. This leads to the possibility of the nut cracking after a period of use. Belatedly (isn't it always?) I realised that the cap head screws fixing the nuts to the Super X1L only engage the bottom 10mm or so of thread and that the upper portion of the threaded holes can be used for oil delivery. The topmost oil delivery channels now run straight across to the threaded holes, avoiding the backlash mechanism. A hole drilled and tapped M5 into the front of the nuts intercepts one of the nut fixing holes and allows oil delivery via a 4mm to M5 push fit stud as shown in **photos 9** and **10**.



Photo 8. First attempt at oil distribution channel in leadscrew nut, front view.

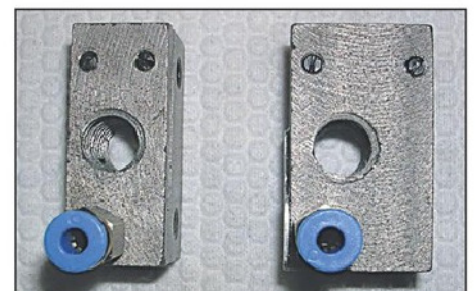


Photo 10. Oil distribution channels in X and Y axis leadscrew nuts, front view.

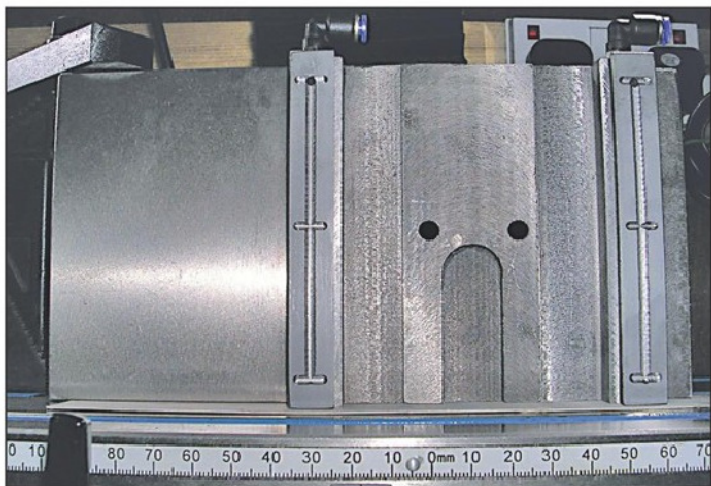


Photo 11. Push fit elbows fitted to oil distribution holes in saddle.

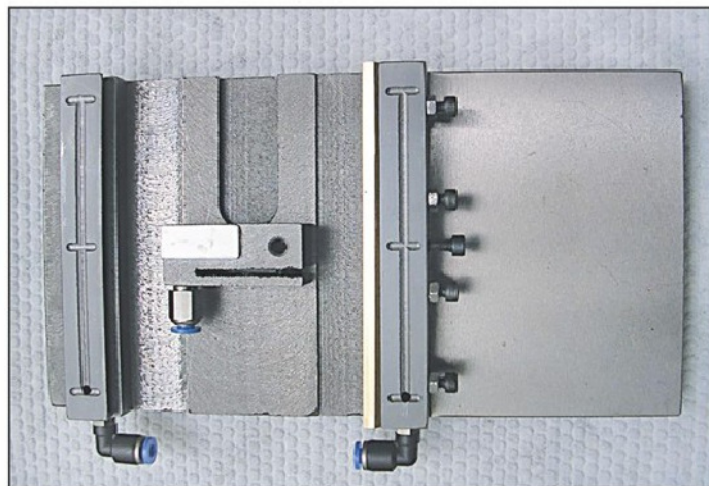


Photo 12. Push fit stud fitted to oil distribution hole in Y axis leadscrew nut.

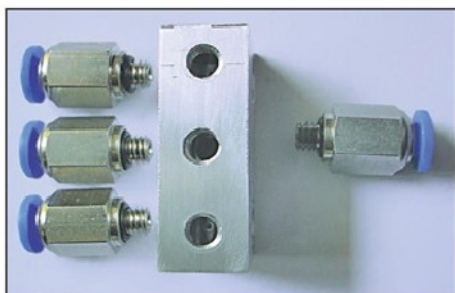


Photo 13. Top view of Y, Z and oil can manifolds.



Photo 14. Bottom view of Y, Z and oil can manifolds.



Photo 15. Front view of Y, Z and oil can manifolds.

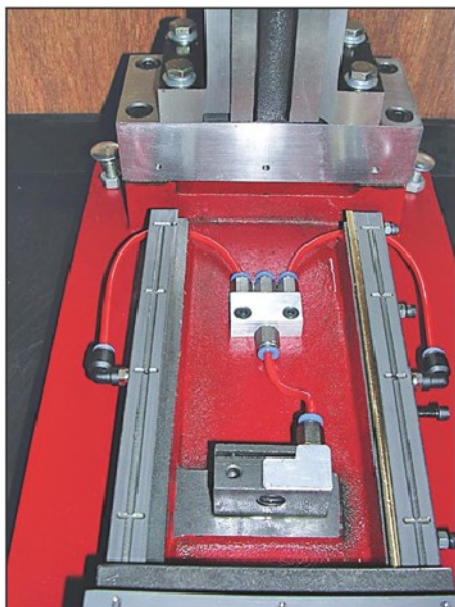


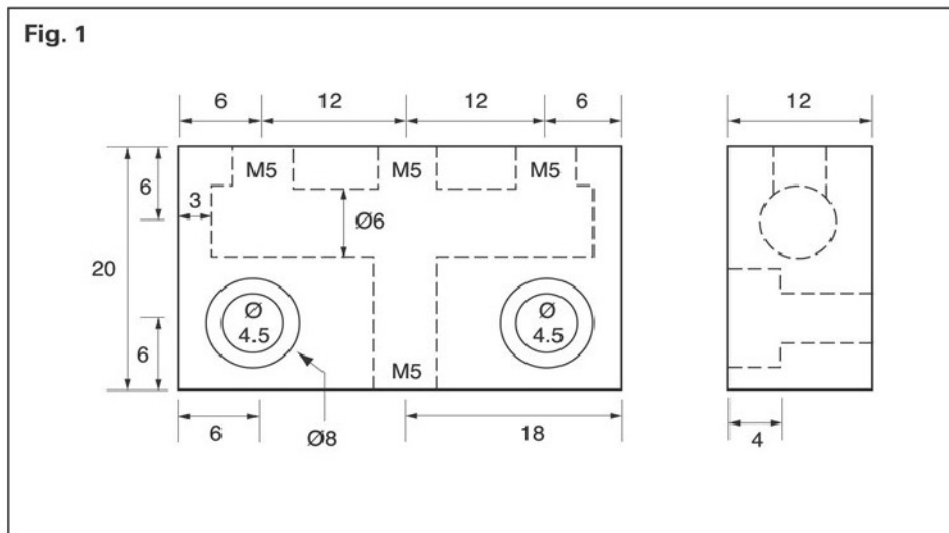
Photo 16. Y axis manifold fitted.



Photo 17. Top view of X axis manifold.



Photo 18. Top view of X axis manifold with push fit studs in place.



Photos 11 and 12 show the push fit elbows and studs fitted to the X axis dovetails and leadscrew nut, although this arrangement was modified a little as construction progressed. The 4mm push fit fixings were attached to the Y axis oil delivery holes in the same way as for the X axis.



Photo 19. Front view of X axis manifold with push fit studs in place.

Manifolds

In order to reduce the amount of oil delivery tubing required a "one in - three out" manifold was made for each axis. The Y and Z manifolds are identical but the X axis manifold is different for reasons that will be discussed later. All of the manifolds are straightforward to make from aluminium stock. The Y and Z axis manifolds are shown in Fig. 1 and photos 13, 14 and 15.

The 6mm hole linking the three outlets is plugged at its open end by forcing in a short length of 6.1mm diameter aluminium rod. This is easily made by turning down a short length of .25in. aluminium rod. Be careful not to force the plug so far into the manifold that it obstructs the oil outlet hole. Any plug left protruding from the manifold can either be

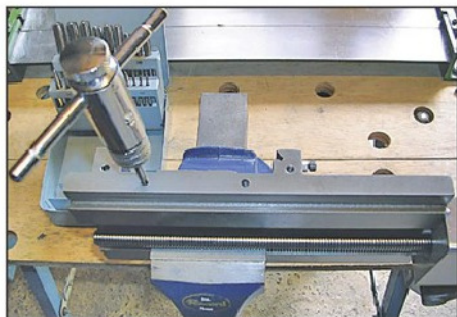
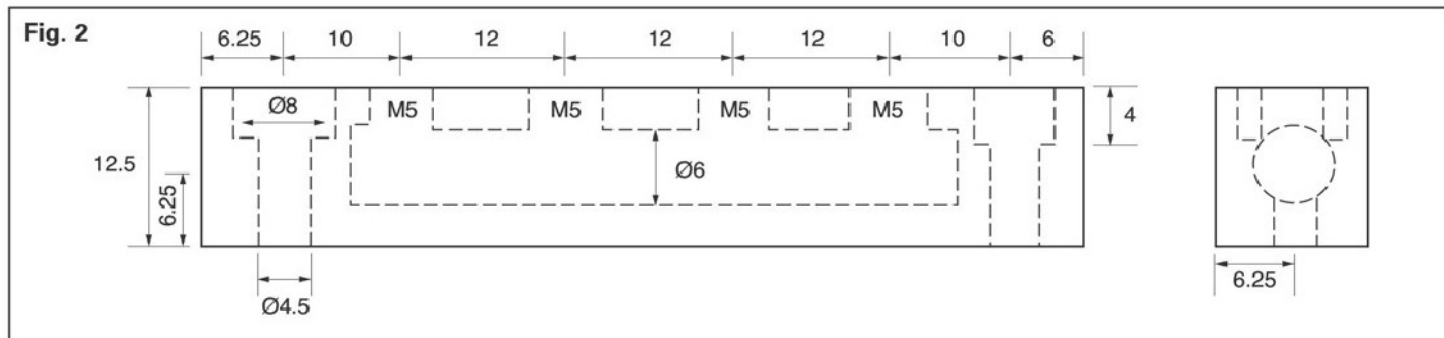


Photo 20. X axis manifold mounting holes in saddle being tapped M4.

filed or milled flat to give the desired cosmetic finish. The 4mm to M5 push fit studs can then be screwed into the manifold. It is necessary to drill and tap two M4 holes into the base of the mill so that the manifold can be fixed in position. The first such hole was completed with no

problem but when attempting to drill the second I encountered a patch of extremely hard cast iron. A cobalt drill and plenty of pressure solved the problem - eventually! In retrospect I should have mounted the X1 base on my "big" milling machine to make the holes rather than attempting to save time by using a hand power drill. When the manifold is fixed in position it can be "wired up" with 4mm nylon tubing as shown in **photo 16**. The nylon tubing is available in a range of colours and red was chosen to make it least visually obtrusive when viewed against the machine. On the other hand the position of the oil is easily seen through transparent tubing.

Having dealt with the Y axis attention can now be turned to the X axis. A similar type of manifold and mounting position as used for the Y axis, cannot be used for the X axis because the manifold would foul the X axis leadscrew. Instead a manifold was constructed according to **Fig. 2** and is shown in **photos 17, 18** and **19**. The open

end of the manifold oil channel is plugged in the same way as for the Y axis manifold. Note that the 4.5mm mounting, obscured after the plug is inserted, will have to be partially redrilled. The manifold is mounted on the end of the saddle at right angles to, and below, the X axis leadscrew. **Photo 20** shows one of the manifold mounting holes being tapped into the X1 saddle. Notice that the manifold mounting holes are at the same end of the saddle as the oil delivery holes. Once its mounting holes have been drilled and tapped the manifold can be fitted to the saddle and the 4mm to M5 push fit studs fitted as shown in **photos 21** and **22**.

When the manifold has been installed then the 4mm push fit nylon tubing can be fitted as shown in **photos 23** and **24**.

Notice that so far there has been no mention of non-return, or check, valves. The purpose of these is to prevent oil siphoning back down the tubing to pool at the lowest point in the system. In the absence of check valves this does indeed happen with this system, but only very slowly because the entry points for air into the system are very constricted and usually sealed with a layer of oil. The system is therefore perfectly usable without any check valves. It might be thought that check valves will prevent oil puddling on and around the machine, but this is not so. The oil is pumped into the system under pressure and quickly overflows the dovetails and leadscrew nuts to a small degree. Some of this oil will end up puddling at the bottom of the machine regardless of whether check valves are used or not. The check valves simply reduce the amount of waste oil. Given that the total amount of oil involved is only a few ml in either case, check valves can be dispensed with if desired. None the less I decided to explore the possibility of using check valves.

Check Valves

It is possible to buy off the shelf 4mm push fit check valves but they are expensive at £5-7 each. Given that twelve valves are needed this becomes an

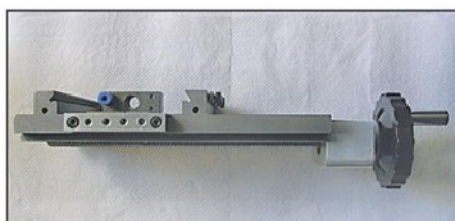


Photo 21. X axis manifold fitted to saddle.

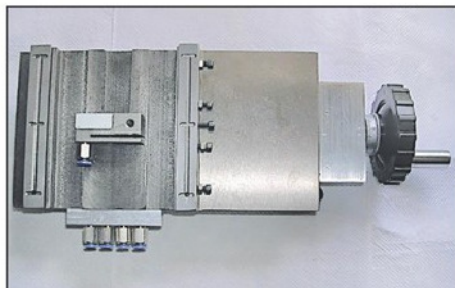


Photo 22. X axis manifold and leadscrew nut with push fit studs in place.

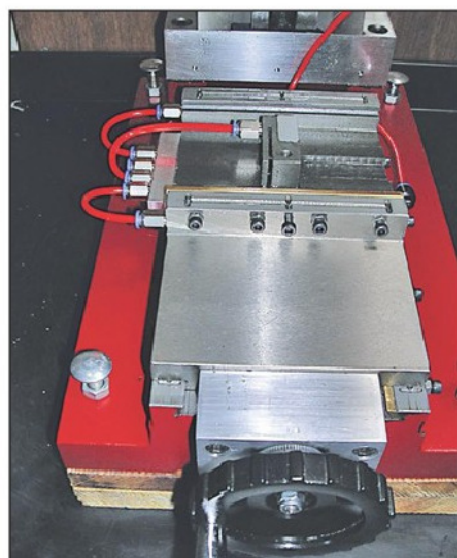


Photo 23. X axis oiler components "wired up" with red 4mm od tubing.

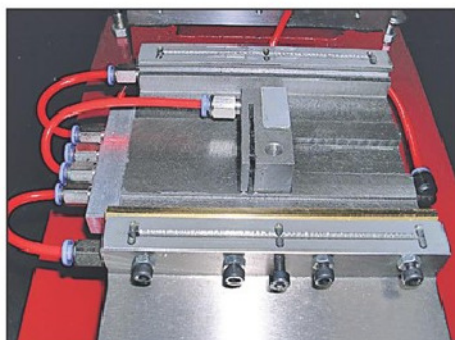


Photo 24. Close up of X axis oiler components "wired up" with red 4mm od tubing.



Photo 25. Side view of check valve body.

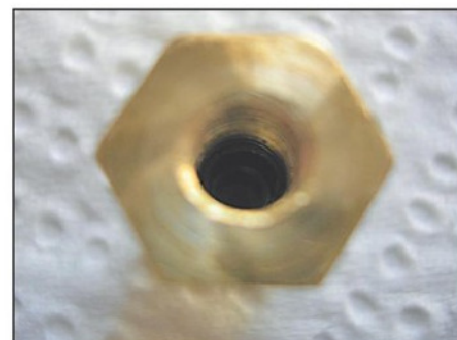
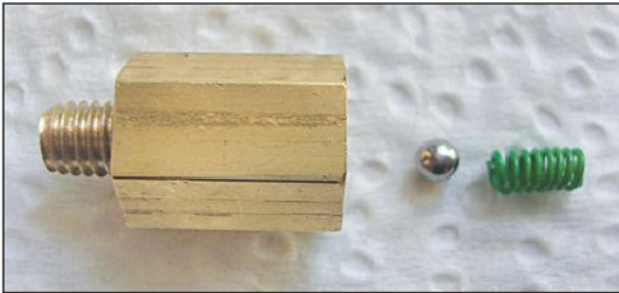
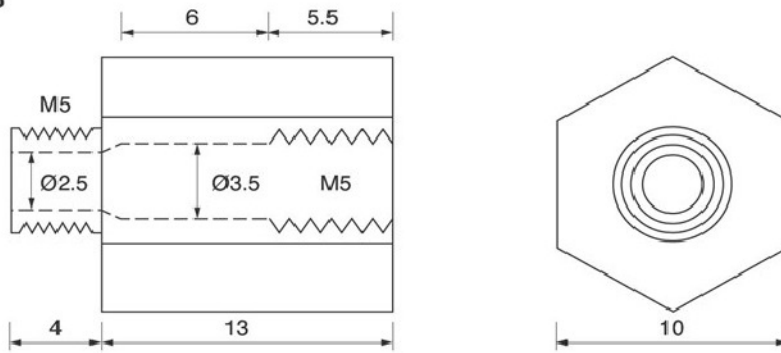


Photo 26. Top view of check valve body.

Fig. 3*Photo 27. Check valve components.**Photo 28. Close up of check valve spring.*

expensive proposition for a small low cost mill like the Super X1L. Technical data on these valves is a bit sparse too and I could find no mention of cracking (i.e. opening) pressures, only operating pressure ranges. Check valves with as low a cracking pressure as possible are desirable, because it is then possible to use a simple low pressure oil pump. The check valves used in aquarium air line systems use a simple flap valve made from silicone rubber and this cracks at very low pressure. Unfortunately these valves are quite bulky and have push on connections which would be difficult to mate with 4mm od nylon tube. *Editor's note: silicon rubber will disintegrate fairly quickly in an oily environment.* This leaves the possibility of making the check valves from scratch. Experiments were made with small check valves the same size as the 4mm to M5 push on studs and made from 10mm AF aluminium bar. These turned out to work quite well but the male threads were a bit soft for repetitive insertion and removal from the manifolds during the experiments. Accordingly a

batch of ten valve bodies were made from 10mm AF brass bar according to **Fig. 3** and one of them is shown in **photos 25** and **26**.

The components of a complete valve - body, ball bearing, and spring are shown in **photo 27**.

A fair amount of experimentation was required in order to find a workable spring. All the "off the shelf" springs in my spares box were too stiff so it was a case of wind your own. Eventually it was found that 30awg wire wrap wire wound on a 2.5mm former (drill shank) made ideal weak springs. The ends of each spring were wound into flat spirals as I have attempted to show in **photo 28**. This stops the ball bearings or the ends of the 4mm to M5 studs from wedging into the spring.

The check valves are screwed into the outlets of the manifolds, and a 4mm to M5 stud screwed into the valve body to retain the ball bearing and spring. The X and Y axes with check valves fitted are shown in **photos 29** and **30**.

The inlets to the X, Y and Z manifolds are in turn connected to the outlets of a final manifold, identical to the Y and Z

manifolds, which is driven by the oil pump as shown in **photo 31**. The oil can manifold is bolted to the side of the Z axis riser block. It can be fitted in a similar location on an unmodified Super X1L mill. The Z axis had not been completed at this point so its output from the manifold has been plugged. Notice that what I have described as an oil pump is actually an oil can!

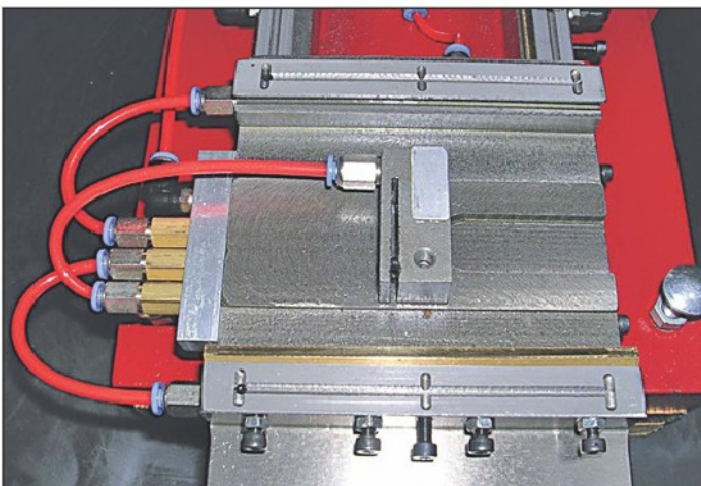
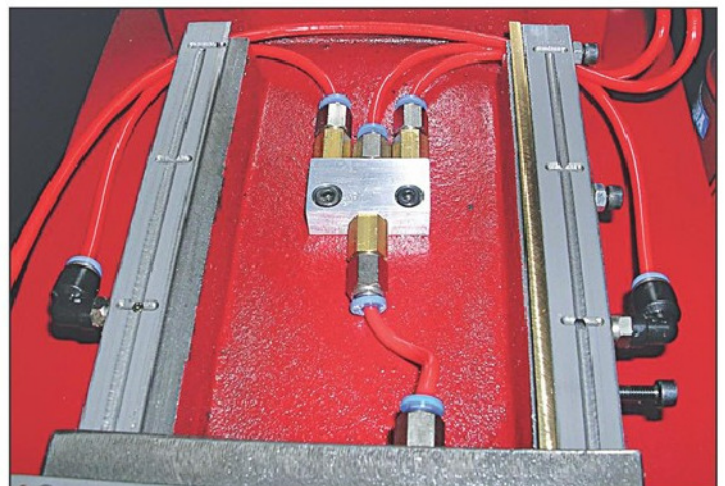
Oil pump

One shot oil pumps are available from a number of suppliers and can be used in conjunction with the components described above. However, the cost of these pumps is quite high relative to the cost of an X1 mill and the other oiler components used in this project. The search was on for a cheaper alternative. The 500ml metal oil cans sold by almost all UK tool suppliers at around £2-3 looked a good place to start. These have very robust cylinders and actuators with a very primitive check valve built into the flexible plastic spout using a length of steel wire with rounded ends. The flexible spout, wire and nozzle are removed to leave the oil can looking like **photo 32**.

Unscrew the brass fitting from the oil can and enlarge the hole in the barbed end out to 3.3mm. Drill this hole only to the depth of the original hole, if you drill right through there will be nowhere for the ball bearing to seat. Drop a 3mm ball bearing down the 3.3mm hole followed by a suitable small spring. The spring is retained in position by two small blobs of solder on the inside top of the 3.3mm hole. The spring should be around 2.5mm in diameter and not too strong; just enough to hold the ball bearing in position. I found a suitable spring in a selection pack that I bought years ago but such packs are still readily available from model engineering suppliers. The components of the check valve are shown in **photo 33**.

Note that the parts are not shown in assembly order - lack of concentration when setting up the photo! The ball bearing goes into the barbed end of the brass fitting, followed by the spring, which is then soldered in place. Screw the brass fitting into the oil can and push a length of suitable transparent plastic tubing onto the barbed end of the brass fitting as shown in **photo 34**.

The transparent tubing that I had to hand was 0.25in. outside diameter and 3.5mm inside diameter. No doubt metric tubing with a 6mm outside diameter would be

*Photo 29. The X axis "wired up" with check valves.**Photo 30. The Y axis "wired up" with check valves.*

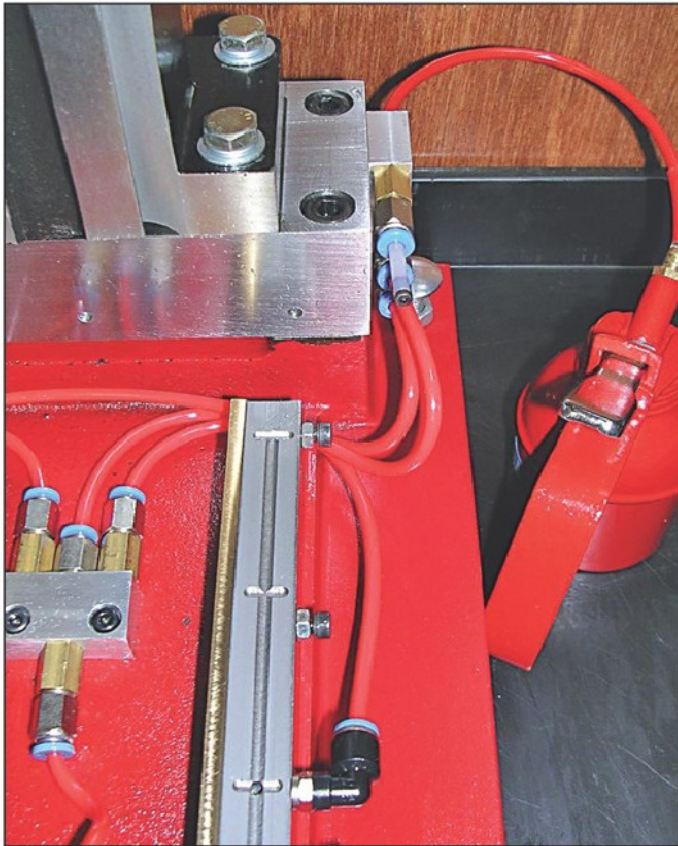


Photo 31. The oil pump (can) manifold and oil pump (can).



Photo 32. The oil can with all unnecessary parts removed.

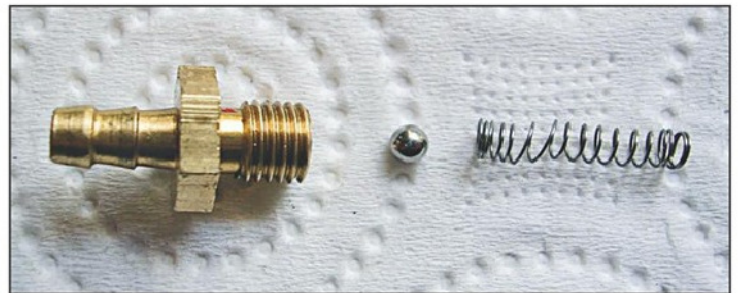


Photo 33. Components of the oil can check valve.

equally suitable. Hold the plastic tubing well above the level of the oil can and pump the oil can handle a couple of times. The oil should rise up the tubing and not fall back when pumping is stopped. The oil pump is now ready for use. It turns out that the 4mm red nylon tubing used for most of the "plumbing" is a tight push fit into the 0.25in. transparent tubing and so a short length of this fitted to the oil can as you can see in **photo 31**. This push fit connection has proved to be very robust and there are no plans to make a metal reducer fitting. The completed X and Y axes are shown in **photos 35** and **36**.

Adjustments

The springs that were made for the check valves will not be 100% identical no matter how careful you are so they might need a bit of elongation or compression to get them just right. The check valves were tested during fabrication as follows. Wash the check valve thoroughly in hot soapy water, rinse, and dry. Assemble the check valve and screw in a 4mm to M5 stud. Shake the assembly to make sure that the ball bearing doesn't rattle. If it does then remove the stud, stretch the spring a little,

reassemble, and try again. Push a short length of clean 4mm tubing into the stud and blow down it. No air should pass. Now blow down the male threaded end of the check valve body. The valve should open with a moderate amount of "puff". If it doesn't then compress the spring a little and try again. The whole process of adjusting the check valves takes only a couple of minutes each.

As each axis of the oiler is assembled it is a good idea to connect the manifold to the oil pump and give it a couple of shots to make sure that oil comes out of the dovetails and leadscrew. If it doesn't then disassemble the offending check valve and compress the spring a little. Similarly

when all three axes are connected to the oil can manifold make sure that oil exits at all the required points. It wasn't found necessary to vary the construction of the check valves to deliver different amounts of oil to each lubrication point. Each valve delivers the same amount of oil to each point for every push of the oil can handle and this works admirably in practice.

Conclusion

The total cost of the components for this project were under £15. Construction of the first version took around 2-3 months, mainly because of the amount of experimentation involved. Replication, given the information detailed above, should take only 2-3 days of workshop time. Although this one shot oiling system was designed for the Sieg Super X1L micro mill it will work equally well on much larger milling machines.

Editor's note: some readers have asked the difference between the X1 mill and the Super X1L mill. As far as I know the Super X1L mill is only available from Arc Euro Trade and has a longer travel to the table. ■



Photo 34. The finished oil pump (can) with quarter inch tubing fitted.

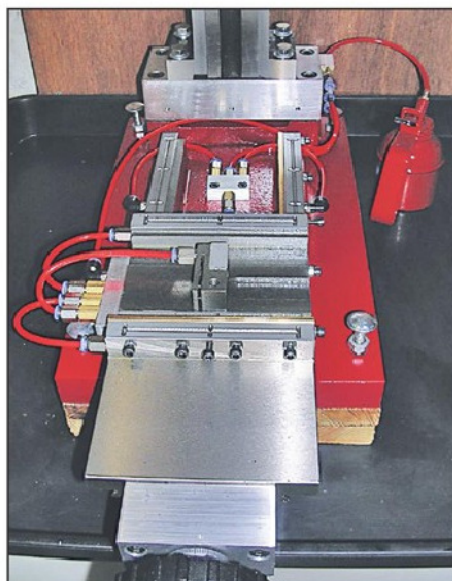


Photo 35. Wide angle view of finished X and Y axis oiling systems with oil pump.

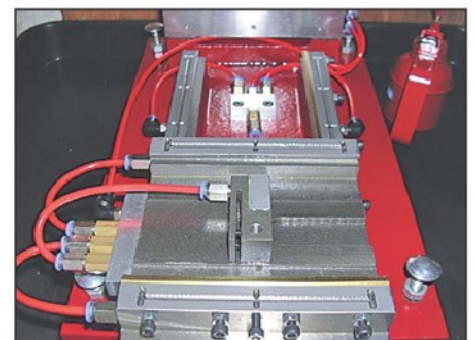


Photo 36. Close up of finished X and Y axis oiling systems with oil pump

MAKING AND USING D BITS, FORM TOOLS AND SPADE DRILLS

Mick Knights makes his own form tools

Last time we looked at the more popular types of reamers and the reaming process. Now it's time to unlock some of the secrets behind form drilling.

Form drills fall into three distinct categories: Form or step drills, D bits and spade drills. The most popular of these is still the D bit so called as in profile the tool resembles the letter D. These are cheap, quick and easy to produce. It should be stated from the outset that a surface grinder is an essential piece of kit in the manufacture of all form drills and D bits made from HSS tool bits. It's also the machine of choice for finishing any D bit but I will demonstrate that D bits can be made by using basic machine tools. This is achieved by carefully milling to the centre line leaving a couple of thou for stoning out any machining marks after hardening. In this way a satisfactory result can be obtained, **photo 1**. The finished D bit needs to be machined spot on the centre line, to produce a smooth

and parallel flat face. Smaller diameter D bits may require surface grinding, as too much vibration and tool deflection can occur if milling to the centre line is attempted.

D bits can be made from either silver steel, **photo 2** which is by far the easiest, or from a round HSS tool bit, **photo 3**.

I have to confess, that at the moment I don't have access to a surface grinder, so I can't include any pictorial accompaniments by way of illustration, but along with some examples I have dredged out from the bottom of my tool box and some explanatory sketches, the basics can be adequately explained so that any machinist with a rudimentary knowledge of surface grinding could confidently tackle grinding a form drill.

Producing a D bit from silver steel has many advantages, not least is the fact that they can be produced on the lathe where it is straightforward to incorporate several shoulder depths and blend angles. Radial and conical forms can also be turned using templates for reference, **photo 4**. To cut this form to 0.532 radius using the example shown would take more horse power and rigidity than the normal hobby lathe could supply but is included to

demonstrate what can be achieved when machining with "D" bits.

Even if the cutting diameters to be produced are small, it's good practice to turn from a larger diameter piece of silver steel, as this will give the tool extra strength when performing the cutting operation.

When producing a form or stepped bore in a soft material such as brass, a D bit can be plunge cut directly into a workpiece, as the 120 degree lead acts as a centre drill. In this situation the workpiece needs to be securely clamped to a machine table, or held in a chuck on the lathe. In tougher materials, mild steel etc. a centre drilled location is needed to avoid any deflection. A smaller diameter pilot hole drilled to the required depth may also be needed to act as a guide for the lead angle.

Form and step drills

It is quite a simple process to grind a pilot diameter on an ordinary jobber drill, thereby producing a square cutting shoulder, which is particularly useful as a counterbore. There are purpose made grinding fixtures, which pull down on the surface grinder's magnetic chuck, that are ideal for spinning down drills. These



Photo 1. Silver steel "D" bit, milled to centre line, hardened and stoned to achieve smooth cutting edge.



Photo 2. A range of silver steel "D" bits.



Photo 3. D bits ground from round HSS.

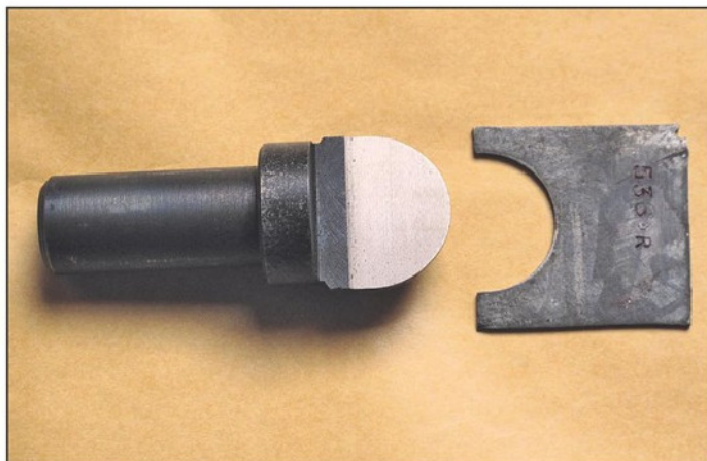
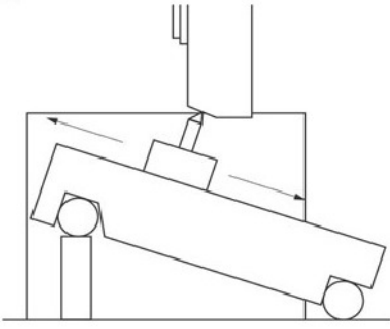


Photo 4. Radial form "D" bit with template.

Fig. 1



Diamond dressing an angle on a grinding wheel.

fixtures were designed to regrind the first, second and plug tapers on taps and so come with a range of collet sizes. These fixtures are equally useful for grinding step drills and D bits, as they can be easily indexed to any angle thus avoiding the need to dress the grinding wheel to achieve desired angles, Fig. 1.

In the home workshop, the same result can be obtained by lightly clamping the drill in an old Vee block and attaching a spinning handle to the back of the drill shank, **photos 5 and 6**. If the step drill is to be used as a counterbore, then the pilot diameter should be left as ground. Carefully back off of the diameter by hand following the helix angle of the drill against the grinding wheel leaving a witness of the original ground diameter, to produce a cutting land, **photo 7**. The pilot diameter can then be used as a drill, for machining a double diameter hole. In this case the web will also need to be reduced to the web thickness a drill of the pilot's diameter would normally have. This is achieved by holding the drill web at 45 degrees to the corner of the grinding wheel and carefully grinding a relief down the helix for a short distance, **photos 8 and 9**. The shoulder cutting faces also need to be carefully backed off by hand, leaving only a witness of the original grinding remaining.

If a taper is required, rather than a square shoulder, the front face of the grinding wheel needs to be dressed at the desired angle. Freehand dressing, using a diamond, or any other type of dressing stick, is definitely not advised, as any uneven surfaces generated will be transferred to the workpiece when machined. Some well equipped workshops may have special wheel dressing attachments for this purpose. The other most common method needs a steady hand. The block mounted diamond is slid up and down on a sine bar. Rather than expose slip blocks to magnetism, a spacing block could be used to achieve the stack height. Usually the sine bar would be clamped against an angle plate and the vertical face of the angle plate will also act as a sliding face for the diamond block. Depending on the style of grinder, the table or wheel head is gently advanced after each pass of the diamond, until the required taper flank is achieved, **Fig. 1** For all these applications the front vertical face of the grinding wheel also needs to be dressed at regular intervals, to produce a smooth ground shoulder flank.

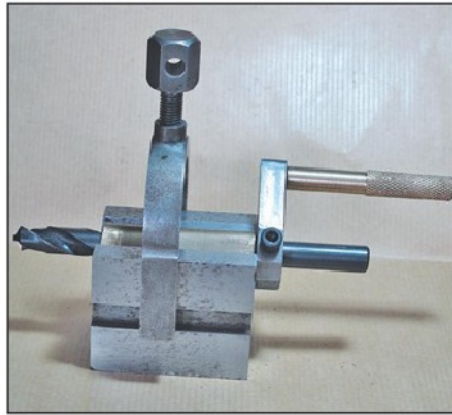


Photo 5. Spinning fixture for form drills and HSS tool bits.



Photo 6. Another view of the spinning fixture.

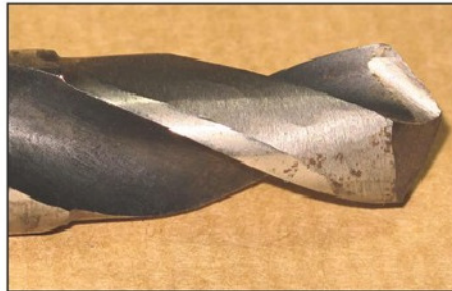


Photo 7. Double diameter drill, showing hand ground backing off, to leave a cutting land. The web thickness has also been reduced.



Photo 8. Drill before the web thickness reduction.



Photo 9. Drill after the web thickness reduction.



Photo 10. Spinning fixture handle parts.

Making a spinning fixture for use on a surface grinder

It's always good practice to use an old Vee block as a base for the spinning fixture, **photos 5 & 6** as continual rotating of drills and tool steel may generate slight radial indentations in the side of the Vees. The overall dimensions of the spinning crank will depend on the Vee block selected. For comfort, the rotating handle should freely move around the securing cap head screw, as the drill needs to be spun at the same kind of speeds a workpiece would turn on a cylindrical grinder, say about sixty rpm. Slow rotation causes the grinding wheel to over heat the drill, which can result in burning the ground surface. These are known as check marks.

The clamping plate, which holds the drill in the block, is produced by bending a piece of sheet brass at 90 degrees, producing a Vee form to oppose the form in the block. The Vee block clamp is then tightened gently by hand, until the drill will rotate freely, but has no up and down movement. The spinning crank is made from any convenient piece of steel to hand. The centres for the drill clamp and rotating handle will depend on the height

of the Vee block. As the largest drill, with a plain shank, is likely to be 13mm the clamping hole needs to be 13.5 dia. which can then accept a range of drill sizes.

Any convenient small diameter cap or grub screw can be used for clamping the drill shank. Larger diameter Morse mounted drills can also be spun down, but this would require a different crank, which would clamp on the tang of the drill. The rotating handle needs to be longer than the length of drill shank protruding from the block; this is to enable unimpeded rotation. A cap screw is the ideal means of securing the handle to the crank, but as not everybody has a bottomless tool box of odd screws, studding and a couple of lock nuts make an acceptable alternative, **photo 10**. When set up, the spinning crank needs to rotate against the back face of the Vee block. This will act as a check face to keep the shoulder position with the grinding wheel constant.

Grinding a step drill

Both horizontal and vertical faces of the grinding wheel need to be dressed and ideally the grinder kept running during the set up to keep the bearings warm. On

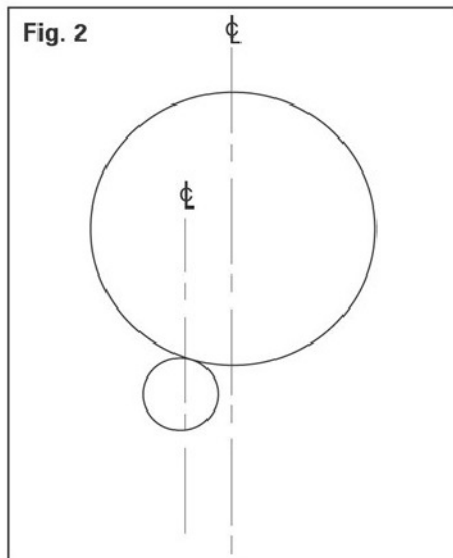


Fig. 2
Position of drill in relationship to the grinding wheel.

some smaller grinders, this may prove to be impractical. The diamond should remain clamped to the chuck as the wheel may require further dressing during machining. Due to old age, misaligned magnets etc. not all magnetic chucks pull down securely so the spinning fixture should be securely positioned between two parallels or pieces of flat stock, as this will prevent any sideways movement when spinning. If the magnetic chuck has been set parallel to the machine spindle, then the fixture can be set against the chuck's back rail. If not, then a square should be used against a stationary grinding wheel to achieve orientation.

The drill should be positioned slightly to the left hand side of the grinding wheel centre line, **Fig. 2**. Once the length of the pilot diameter has been achieved, a DTI, clamped on the chuck should be zeroed against a convenient flat surface on the grinder. This will act as a visual stop when the wheel is approaching the shoulder during grinding. As in all grinding operations only light feed cuts should be used. No more than a couple of thou on the depth and twenty to thirty thou cross slide advance per revolution.

It is then quite a simple machining operation to grind the pilot to the required diameter. A smooth action is needed during machining when rotating the drill and advancing the cross slide, obviously using both hands.

Any uncoordinated movements will result in check marks and burning. If the grinder has coolant, then this should be employed during machining.

All that is then required, is to reduce the web thickness, grind relief faces to the pilot and back off the shoulder faces, as discussed at the beginning of this introduction, **photos. 11, 12 and 13**

Spade drills

As it is extremely unlikely that the home engineer would possess, let alone feel the need to use a spade drill, I will only touch lightly on their use, although the history of cutting tools can be an interesting subject in itself.

Until the advent of the twist drill, spade drills were the only means of machining a hole in metal. These tools were forged

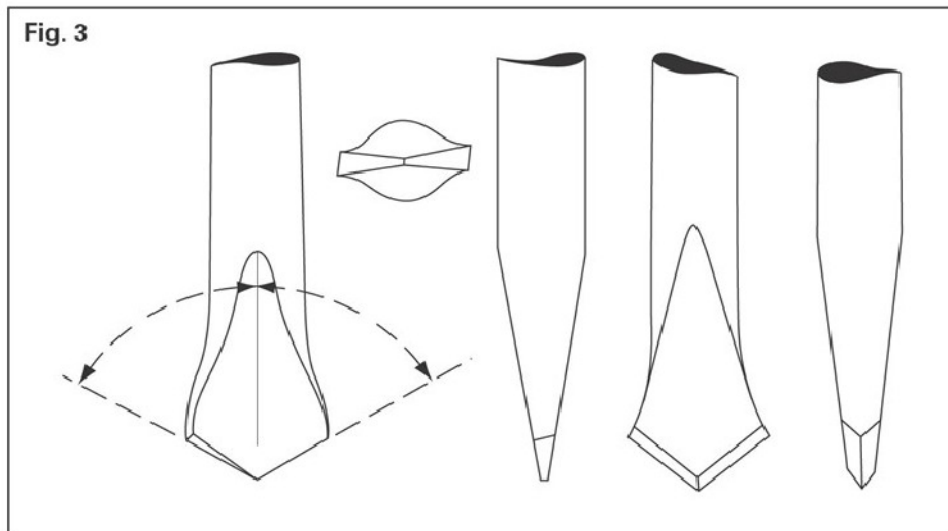


Fig. 3
Spade drill chart from an old book.



Photo 11, a double diameter form drill, with 45 degree blend face.



Photo 13. Web thickness reduction.

from a smaller diameter round carbon steel bar and then ground up by hand. The holes produced were neither round, parallel or straight. Today, spade drills are still popular for wood workers, as a cheap and effective method of producing larger diameter holes.

The examples I've included show how things used to be for our forebears. Today, spade drills can still be found in some production environments. The negative form makes them very robust in high speed machining. The geometry of these drills is quite complicated and therefore unsuitable for producing in the home workshop.

The first examples are from a wonderful old book called *The Amateur Mechanic*. Although twist drills were available at the time, these examples show what a forged spade drill was like at the turn of the 20th century and also goes some way to explaining why the old boys who were still around when I was in my apprenticeship, had one or more fingers missing, **Fig. 3**.

The second is a left hand cutting spade drill, which was produced for a boring operation on an multi spindle auto lathe.



Photo 12. Cutting face backed off.



Photo 14. Left hand cutting spade drill.

Note the negative rake angles, **photo 14**. (I hope at some stage to be able to write about left hand cutting on the lathe, the reasons behind it and useful applications.)

Making a simple D bit

A D bit needs to be produced to machine a 0.1875in. diameter hole with a 60 degree cone blending into a 0.375in. dia bore. The cone is to act as a non-return valve and needs to have a good clean surface finish. The material selected is 0.375in.dia. Silver Steel.

If there are no collets available for the lathe, time should be taken to ensure the sliver steel is running perfectly true in the chuck. Failure to do so may result in eccentric drilling and an oversize hole in the workpiece. If the stock is only running out by a few thou, then a quick method of correction is to gently tap the top of the chuck jaw opposite to the DTI plus reading

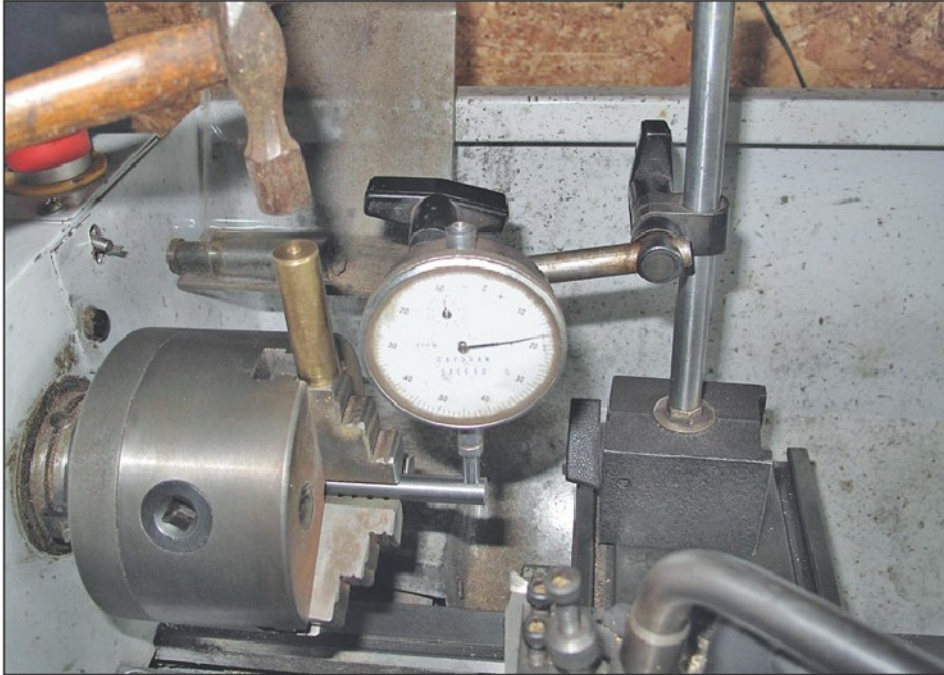


Photo 15. Set stock true, by gently tapping chuck jaws.

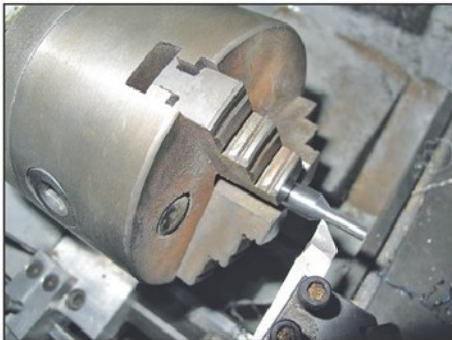


Photo 16. Turning 60 degree angles to D bit.

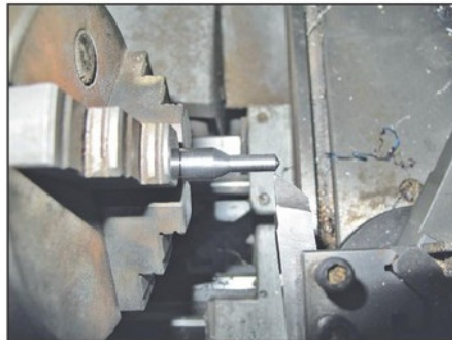


Photo 17. Turning 120 degree angles to D bit.

with a piece of brass or similar soft metal while watching the effect on the DTI, **photo 15**.

A reading should be taken close to the chuck jaws and a second near to the end of the bar. The readings must be identical to insure the silver steel is running completely true.

Being a carbon steel, silver steel is tough to machine so whether using an inserted tool, or a hand ground HSS tool bit, light cuts are recommended. If the machine doesn't have coolant, then a little soluble

oil applied with a brush can only help.

Once the diameters and shoulders have been turned, any angles can be machined. In this case a 60 degree included angle to act as a seat for a ball bearing. The lead angle needs to be 120 degrees included angle, the same as a standard jobber drill, **photos 16 and 17**.

The turned diameters need to be dead size. The finished bore size, produced by the D bit WILL be the same as the turned diameter. If turning has resulted in poor surface finish, then a couple of thou

should be left on for polishing to finished size. Wrapping emery tape around the turned diameter and pulling it backwards and forwards will only result in two things. Polishing any turning marks deeper into the surface or getting your finger trapped between emery tape and the job. Both should be avoided!

A better method is to tear the emery tape, about 150 grit in a 3/8in. strip, and hold it on a polishing stick. Then with a filing action polish the diameter to size. As with filing, always cut on the forward stroke and lift off, so always cutting in the one direction only. All machining marks can then be removed, leaving a smooth surface finish.

Once a good surface finish has been achieved, the D bit needs to be sawn or milled, to produce the semi-circular form prior to hardening and finish grinding.

Smaller diameters need to be carefully hacksawed, leaving roughly 0.060in. for finish grinding. Being more robust, larger diameters can be milled, leaving 0.030in. grinding allowance.

In this case, the D bit was milled to a couple of thou above half distance for stoning to finished size after hardening and tempering. This process should only be attempted by using a sharp end mill, along with liberal amounts of cutting compound, such as RTD, which is applied during machining, **photo 18**. To ensure the flat is machined completely parallel, the D bit was held in a toolmaker's vice gripped by freshly machined registers in aluminium soft jaws. It is also recommended to have a digital read out on the Z axis as tweaking a thou or two on the last cuts can't generally be guaranteed by reading off machine dials, especially taking any backlash into account, **photo 19**.

After touching on, the cutter was fed down in 0.010in. increments until the milled flat was 0.010in. above the centre line. The final 0.010in. was removed in three passes. The effect of the previous pass was measured and any deviation from the depth of cut applied was noted. Any deviation was compensated for on the next pass. That is to say, if a 0.004in. deep cut was made, but due to deflection, or slight movement against the cutter, 0.005in. was removed, then 0.003in. would be applied on the next pass to avoid machining below the centre line. The final cut produced a flat measuring 0.002in. above centre, **photo 20**.

Silver steel is a water hardening carbon steel, which needs to be quenched in clean,

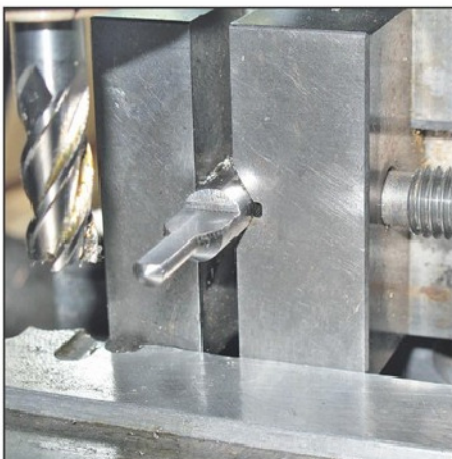


Photo 18. Milling D bit to centre line.



Photo 19. Z axis digital read out.



Photo 20. 0.1875in. diameter milled to centre line, leaving 0.002in. for finish stoning.



Photo 21. Tempering colours run from heat source at the base. Cutting faces achieving light straw colour.

cold water. The book states that silver steel needs to be heated evenly to a cherry red. As this is to be a cutting tool, rather than a hardened component, I tend to heat it to a brighter red. To achieve an even heat, roll the "D" bit backwards and forwards across a fire brick, while playing a blow torch along its length. Care should be taken not to overheat the D section of the bit as burning can affect the surface finish. When the silver steel has taken on an even, bright red colour, hold the bottom of the shank with a pair of pliers and quickly quench, by plunging vertically into the water and cool with a circular motion.

Before tempering, the silver steel needs to be polished back to natural colour. Place the "D" bit vertically on a fire brick and play the blow torch around the base of the shank. When heat has built up, a spectrum of colours will start to travel up its length. At this point, stop heating the tool and watch the colours run. When the business end of the D bit has achieved a light straw colour, quench vertically in water, **photo 21**.

The final 0.002in. can then be stoned off the flat, by holding the D" bit against a fine oil stone and moving it in a circular motion. A little oil will assist the honing, **photo 22**.

For finish grinding, the D bit needs to be carefully set in a Vee block or toolmakers vice and presenting the flat as horizontally true as possible. Gently feed down the grinding wheel to establish contact. Then surface grind to the centre line.

The two cutting faces, 120 and 60 degrees, now need to be carefully backed off by hand, leaving only a witness of the original machining. The two bore diameters should not be backed off, **photo 23**.

All that remains now is to prove the tool by plunge cutting into a piece of brass. Setting the D bit at an angle in the drill chuck will help the swarf to clear. Running the lathe at a speed of 1500 rpm. commence machining, **photos 24 & 25**. Machine as if conventionally drilling a hole by clearing at regular intervals. In brass, the operation can be run dry although if coolant is available it's always best to be used. For all other materials coolant or a cutting compound



Photo 22. Stoning to final size.



Photo 24. Proving D bit by plunge cutting



Photo 23. Backed off cutting faces.

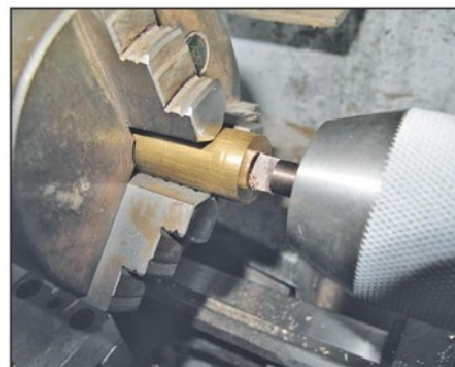


Photo 25. D bit plunged to full cutting depth.

should be applied during machining, to maintain surface finish.

To check bore finishes, the test piece was milled to the centre line, **photos 26 and 27**.

By using D bits, complicated bores can easily be produced in the home workshop. This method is especially useful when a number of identical components need to be produced.

D bits are also useful counterbores for flat bottoming pre drilled holes for cap head screws etc. Turn the silver steel to the diameter of the hole and face off square. Split to the centre line. Harden and temper as normal. Only the front face needs to be backed off to produce the cutting edge. The benefit of using a D bit, as opposed to a flat bottomed drill, is that the D bit is more rigid. It also fits the bore snugly and does not tend to cut into the sides of the hole. ■

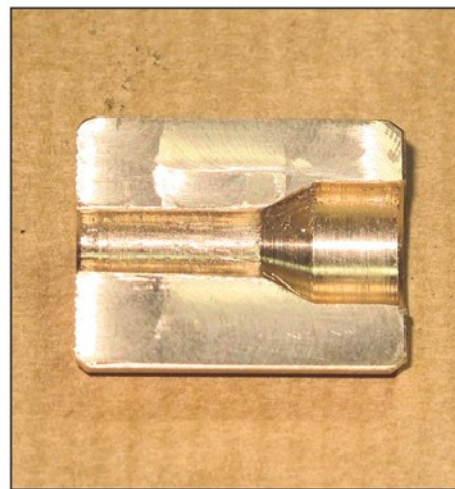


Photo 26. Sectioned view of plunged cut.

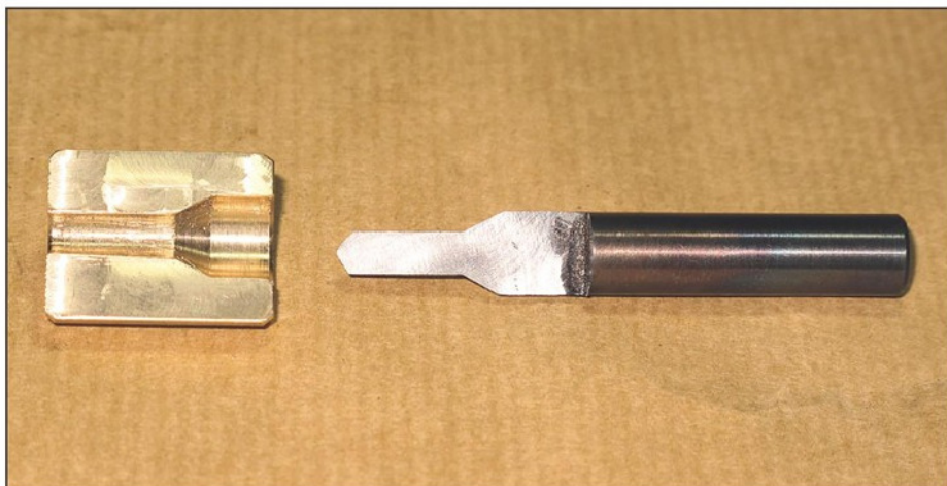


Photo 27. The sectioned cut with the cutter that made it.

transwave@powercapacitors.co.uk • www.powercapacitors.co.uk

The components built in part five. Well, ok, not the coffee mug!



From the flywheel clockwise the modes are: wireframe only, solid object, Solid plus wireframe, transparent plus wireframe, and transparent object only. When you have finished setting the object modes, the Selector Context Toolbar can be hidden by right-clicking the Object Selector again.

Multiple object copies

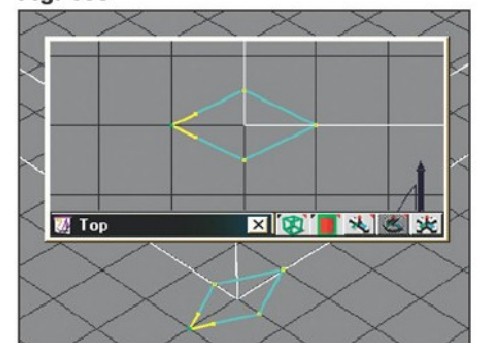
Sometimes a model requires tens or even hundreds of copies of a single object. While it is possible to add these to the scene with the [Copy] function, it's likely to be a tiresome process. As an alternative, trueSpace has three tools for quickly creating multiple copies of objects and manipulating them as groups. The three tools are [Create Grid Array of Objects], [Create Radial Array of Objects], and [Create Spline Array of Objects]. I'll just give examples of using the first two of these tools, as they're likely to be used the most in engineering models. If you are interested in Spline Arrays (multiple copies along a spline path), these are explained in section 4.14.3 of the Help File.

Grid arrays

This array type is a group of identical objects arranged in a straight line, or in a 2D rectangular grid, or in a 3D lattice. Here's an example of how such an array can simplify the task of building a lapping plate:

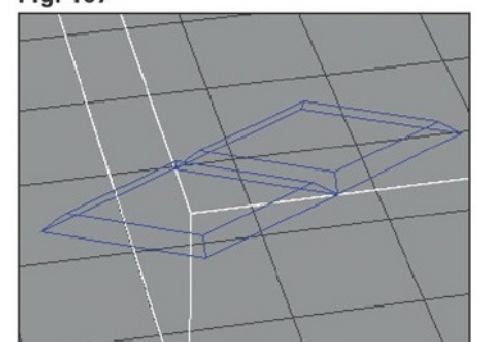
Click [Create New Scene], turn on grid-snapping, and set the values in the Grid Panel to 0.5. Click [Cube], and type [XS20/YS16]. Using a subsidiary **Top View**, zoom into the lower-left corner of the cuboid. Use [Add Polyline] to create this closed shape:

Fig. 106



Click [Bevel], with **Bevel:0.15** and **Angle:30**, then [Object Tool]. Type [ZL2.0]. [Copy] this object and type [XL9.0/YL7.5], or move the object to this position using the mouse. You should have two shapes like this on the top surface of the cuboid:

Fig. 107



FIRST STEPS IN DESIGN 5



Creating multiple object copies, and a look at the trueSpace fillet, chamfer and shell tools

To end the first stage of this series, part five has a round-up of several more trueSpace functions. Together with the methods shown in parts one to four, this should enable you to do a considerable amount of 3D modelling. I've found that this core range of techniques even though using perhaps only one-fifth of trueSpace's functionality, is sufficient to construct at least 90 percent of engineering components.

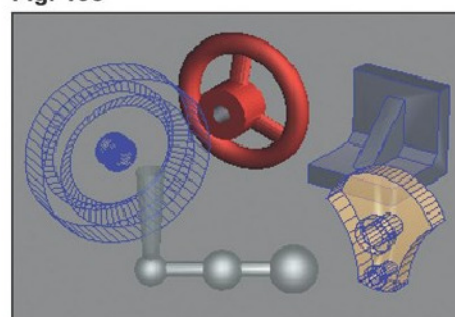
Before looking at some more modelling tools, first here's a small digression on the alternative ways that objects can be displayed in trueSpace.

TrueSpace draw modes

So far in this series, all objects have been displayed as wireframe models in the Wireframe Display Mode, or as solid objects in the Direct 3D Solid Render Display. In this latter mode, however, there are alternative ways in which trueSpace can draw objects. Select [Direct 3D Solid Render Display], and put any objects you want into the scene. Click any of the [Draw objects as . . .] icons in the View Aspect Toolbar, Fig F, to see how the display changes (note that the Radiosity mode will take a couple of minutes to display).

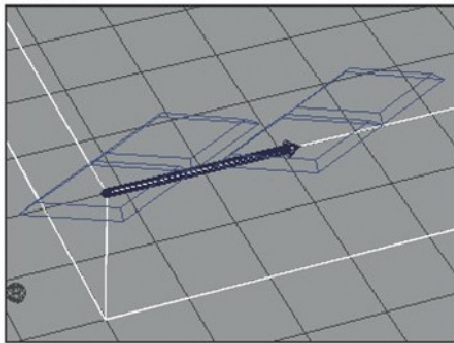
As well as the global drawing modes just mentioned, every object can have its own **individual drawing mode** setting which overrides the global setting. Right-click the **Object Selector** in the Object Navigation Control, Fig E, and the **Selector Context Toolbar** will appear. The second icon in the toolbar, [Object Mode Off], is active, and because of this the currently selected object is drawn as specified by the global drawing mode. Click and drag this icon, and choose another icon to set an individual drawing mode for the current object. Here are five objects, each displayed in a different drawing mode.

Fig. 105



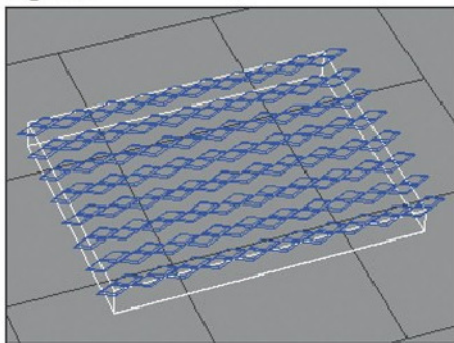
Group these two shapes together by selecting the first shape, clicking [**Glue As Sibling**], then picking the second shape, and [**Object Tool**] to finish. Next, this combined object will be copied many times in an array to build the top surface of the lapping plate. First, adjust the Perspective View so that you can see the whole of the cuboid, then click [**Create grid array of objects**], **Fig B**. A control arrow will be displayed (coloured yellow and red if you're using Solid Render Mode). Click and hold down the left mouse button, and a duplicate object at the arrow-head will appear. As you move the mouse around, the distance of the copied object from the original will vary. Usually, the angle between the two objects can also be freely modified, but because grid-snapping is on, the angle is constrained to 90° increments. Move the arrow and copied object so that it is similar to the next image, and release the mouse button; the exact position of the shape is not important as this will be set later.

Fig. 108



The next step will now create a two-dimensional array of objects using the spacing and angle that were set in the first step. Click and hold the left mouse button again, and move it around to see how the size of the 2D array changes. Adjust the array so that it covers the top surface of the cuboid (the exact size is again not critical), and release the mouse button.

Fig. 109

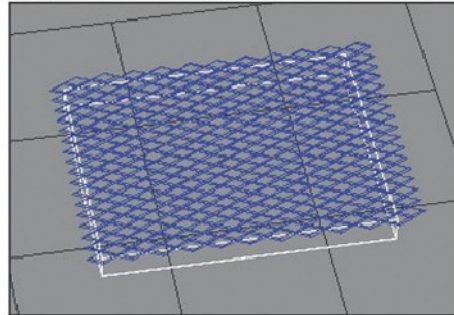


At this stage it would now be possible to turn the 2D array into a 3D array (see the Help File, section 4.14.1, for the method); this would add copies of the 2D group layer above the current layer. For the lapping plate, however, this is not needed.

So far, this example has demonstrated how easy it is to create an array of objects in a freehand way by using the mouse. The objects, though, are not yet arranged with any precision, but this can be corrected as follows: Right-click the

[**Create Grid Array of Objects**] icon, and an Options Panel will appear. Experiment by typing in values into the panel to see how they affect the array. If you type a number in the Z '# Items' box, additional layers will be added to the array (use small Z values, or trueSpace will take a long time to respond). For the lapping plate, use the '**Keep Spacing**' option and set these values: # Items - X:11, Y:17, Z:1, and Space - X:2.0, Y:1.0 (Z not used). The objects in the array should now cover the cuboid and have no gaps between them.

Fig. 110



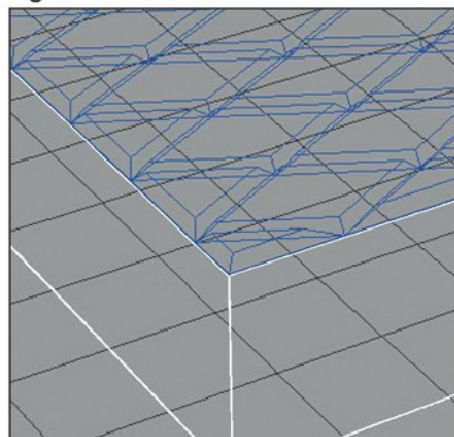
For the next construction stage, the array group must first be converted into a normal trueSpace group. Do this by clicking [**Convert an array to a group of objects**], **Fig B**. The size of the group is next trimmed so that it fits precisely on the cuboid. Select the cuboid, click [**Point Edit: Faces**], then pick the cuboid's top face. This face is now copied (leaving the cuboid intact) by using the [**Separate selected part of object**] tool; its icon is the third-left in the Point Edit Panel:

Fig. 111



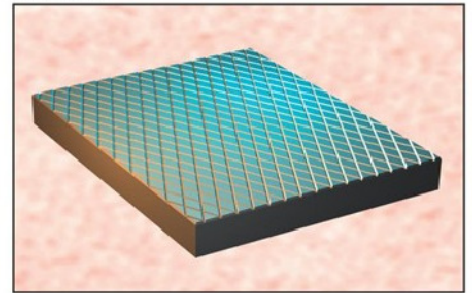
Turn this new 2D shape into a 3D object by clicking [**Bevel**], then [**Object Tool**] (the Bevel and Angle values should still be as they were when the function was used on the original 2D Polyline shape, i.e. 0.15 and 30 respectively). Select the multiple object group, click [**Object Intersection**], then pick the bevelled object, and [**Object Tool**] to finish (by the way, I found that intersecting the objects in the reverse order to that just described doesn't work). You should have a neatly bevelled group positioned on the cuboid's top surface.

Fig. 112



Finally, to finish the lapping plate, [**Object Union**] the cuboid and the top surface group together.

Fig. 113



At this point I wanted to include another grid array demonstration, this time for a 3D array with several Z layers. Unfortunately, I couldn't think of a suitable engineering example! Perhaps you know of such a component or piece of equipment that you would like to model with the Grid Array tool.

Radial arrays

This tool is similar to the Grid Array tool except that it creates multiple copies along a circular path. The tool is quite powerful because the copied objects can be distributed over a full circle, or an arc, or over spiral and helical curves. The Radial Array tool is most likely to be used to create simple circular groups, so I'll show these in the following examples. Further information on the tool is in the Help File, section 4.14.2

Fluted column

This component will be made from several polyhedron types, and the fluting created by subtracting a radial object array. The model is simplified a little compared with real columns found on some steam engines because its sides are straight rather than gently curved.

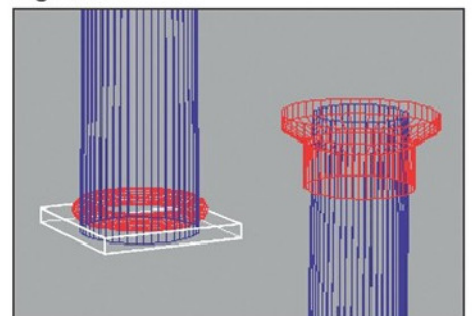
Start with a [**Cube**] and [**ZL0.1/ZS0.2**]. Next, add a [**Torus**] with LAT:16, LNG:48 and Inner Radius:0.7. Modify the torus with [**ZL0.3/XS1.8/YS1.8/ZS0.25**]

Click [**Cylinder**] using LNG:48, and type [**XS1.6/YS1.6**]. Using [**Point Edit: Faces**], pick the cylinder's top face. Type [**ZL18/XS1.2/YS1.2**], then [**Object Tool**]. Add a new [**Cylinder**] and [**ZL17.3/XS1.4/YS1.4/ZS0.6**]

Click [**Point Edit: Faces**], pick the cylinder's top face, [**Sweep**], and [**ZL17.8/XS2.0/YS2.0**]

Click [**Sweep**], [**XS2.0/YS2.0**] and [**Object Tool**] to finish. Here are top and bottom views of the column showing the four separate objects.

Fig. 114

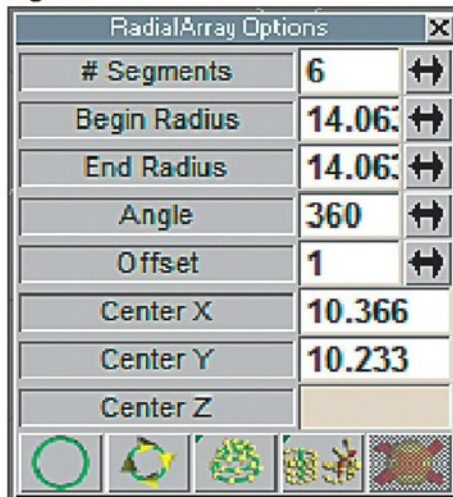


To make a subtraction object for the fluting, use [Cylinder] with **LNG:12**, and **[XL0.72/ZL8.7/YR0.7/XS0.18/YS0.18/ZS16.1]**

Adjust the viewpoint to look at the top of the cylinder, pick its top end face with [Point Edit: Faces], and type **[XS0.14/YS0.14]**. With the top face still selected, move the viewpoint and pick the lower end face as well (by holding the Control Key down). Use the [Bevel] tool with **Bevel:1.2** and **Angle:30**, then [Object Tool]. (A better way to create smoother rounded ends on the shape is to use the Fillet tool described later in this article).

Next, this modified cylinder will be copied 18 times in a Radial Array. With the cylinder selected, click [Create Radial Array of Objects], Fig B. At this point, the array could be set-up with the mouse, using a technique similar to the one described for Grid Arrays. This time, however, I'll use numerical values only. Click once in the workspace - this starts the array creating procedure by setting the centre position of the copies (the location is unimportant as it will be changed shortly). Right-click [Create Radial Array of Objects] to get this panel:

Fig. 115



Click the bottom-left icon in the panel so that it is depressed - this copies the objects in a circle (rather than a spiral). Also click the next icon along. This option rotates the original object as it is copied; if the button was not pressed in, the copies would retain the orientation of the original object, and in this case they would not be aligned with the column. Type in these values **Segments:18**, **Angle:360**, **Offset:0**, **Center X:0**, and **Center Y:0** (the Begin Radius value will be set automatically). Before subtracting this array from the column, it must first be converted to an ordinary group with [Convert an array to a group of objects]. Now select the column's tapered cylinder and **Subtract** the grouped cylinders. Finally, [Object Union] the four objects together.

Fig. 116



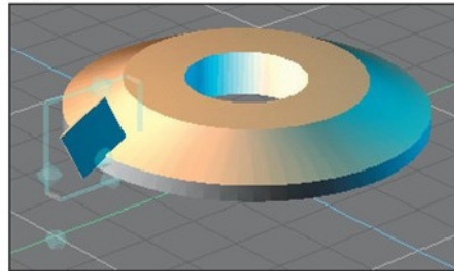
Graduated dial

Clear the workspace, and [Reset View]. Click [Cylinder] with **LNG:100**. [Copy] the cylinder, and **[XS6.0/YS6.0/ZS0.3]**. Select the top face of the copied cylinder with [Point Edit: Faces], then [Sweep] and **[XS4.0/YS4.0]**. Click [Object Tool], and Subtract the first cylinder.

To make a graduation subtraction object: [Cube], [Axes], [Normalize Location], [Axes] and **[XL3.0/ZL1.1/YR-26.6/XS1.0/YS0.04/ZS1.0]**

In Solid Render Display Mode, you should have this:

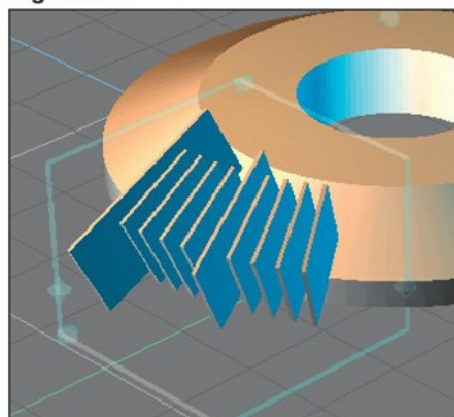
Fig. 117



There will be 100 divisions in the graduated dial. This could be done with one large radial array of 100 objects, but I'll do the construction in two stages, creating graduations with different lengths. Click [Create Radial Array of Objects], then click once anywhere in the workspace. With the first two buttons in the Radial Array Options Panel still depressed, type **Center X:0**, **Center Y:0**, **Angle:36** and **Segments:10**. This creates a group for one-tenth of the dial (36°), and each object is rotated by one-hundredth of one revolution. If you look at a Top View in wireframe mode, you can see that there is one graduation subtraction object for each of the faces in the bevelled section of the dial.

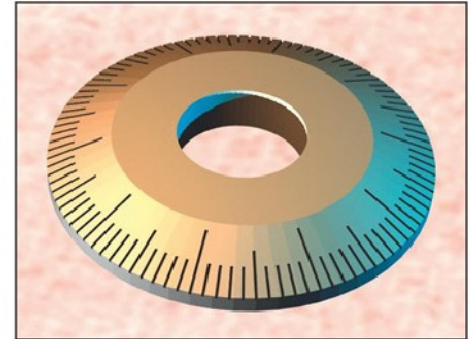
The radial array will now be edited to change the size of some of its objects. While the group is still an array, though, if one of its objects is changed, all the other objects will change too so that all the constituents are identical. The array must therefore first be changed to an ordinary group by clicking [Convert an array to a group of objects]. Now press the Down Arrow Key, and modify the first object in the group by typing **[XS2.0]**. Press the Right Arrow Key five times and resize the current object with **[XS1.5]**. Press the Right Arrow Key another five times, then press Delete. (This last object is not needed - and also the later [Object Subtraction] operation would fail if it was left in. The radial array could have been created with fewer elements, but the method shown simplifies the calculation of the array's Angle value). Reselect the whole group by pressing the Up Arrow Key. You should have this:

Fig. 118



For the second construction stage, click [Create Radial Array of Objects], then click the mouse once. In the Radial Array Options Panel, type **Center X:0**, **Center Y:0**, **Angle:360** and **Segments:10**. Click [Convert an array to a group of objects], then select the dial and Subtract the group to give:

Fig. 119



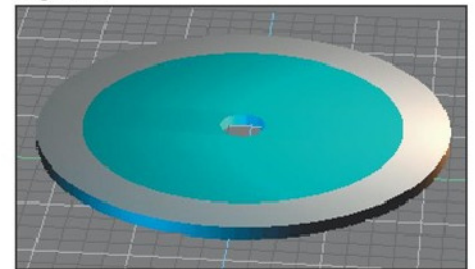
If you like, you can also subtract some 3D text shapes to make a numbered dial as shown on page 32.

Division plate

The value of object arrays can be seen when building components such as division plates which contain hundreds of regularly spaced holes. Such a component is shown next, and under normal circumstances it would be straightforward to construct the example plate by subtracting multiple cylinder arrays from a single disc. Although this method worked when I tried it, the resulting object would not render correctly - some of the holes appeared as if they were filled in. This can sometimes be a problem with TrueSpace when complex objects are modelled. One solution to this problem is to construct a complex object in several simpler parts and keep them together in an object group. This is the method I've adopted in the construction steps that follow.

Begin with [Create New Scene]. For the disk, which will be split into two parts, start by clicking [Cylinder] with **LNG:100**. [Copy] the cylinder and type **[XS18/YS18/ZS0.6]**. Click [Copy] again, and **[XS14/YS14]**. Using the **Keep Drill** option, **Subtract** the middle-sized disc from the large disc, to leave a ring shape. Select the middle disc, **turn off Keep Drill**, and **Subtract** the first small cylinder. (The two parts of the disc have different colours in the next image so that they're obvious).

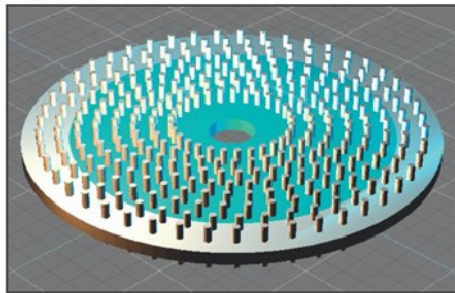
Fig. 120



To make a radial array of hole subtraction objects, use [Cylinder] with **LNG:12**, and **[XL8.2/XS0.3/YS0.3]**. Click [Create Radial Array of Objects], and click once near the centre of the disc. Set these Options:

Center X:0, Center Y:0, Angle:360 and **Segments:47**. The array is next copied in its entirety with **[Copy]**. Reduce the radius of the new array by typing **-0.8 Enter** after the **Begin Radius** value (the radius is reduced by 0.8 centimetres to give 7.4 centimetres), and make the **Segments** value **46**. **[Copy]** again, reduce the **Begin Radius** value by another 0.8 centimetres, and make **Segments:43**. Repeat this procedure another **five** times, each time reducing the **Begin Radius** value by 0.8, and use these **Segment** values: **42, 41, 37, 31, and 29**. This should be the result:

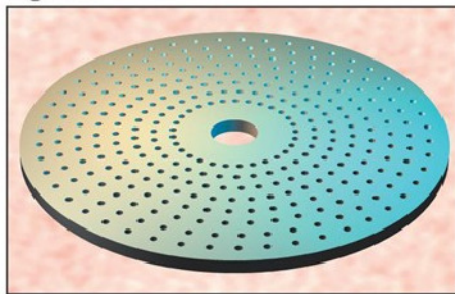
Fig. 121



Click **[Convert an Array to a Group of Objects]**, press the Left Arrow Key to move to the next outward array, and use **[Convert an Array to a Group of Objects]** again. Continue doing this until all eight radial arrays are converted to plain trueSpace groups.

Using a Top View, select the innermost part of the disc, and **Subtract** each of the six rings of cylinders that intersect it (Keep Drill off). Now select the ring object, and **Subtract** the remaining two cylinder rings. To finish, combine the two parts of the division plate with the **[Glue as Sibling]** tool.

Fig. 122



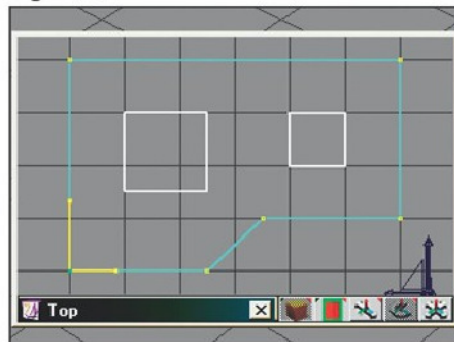
While writing this article, I recreated the division plate about five times using the method just described, and on two occasions I still managed to produce an object which had 'filled in' holes when rendered. Unfortunately, I'm not sure what caused this. It could be that trueSpace was 'upset' when I made a trivial mistake which was then corrected with **[Undo]**. Also, on one occasion I forgot to convert one of the arrays to a group before subtracting it (the program displays a warning message when this happens). You may encounter similar problems, but please try the method again if it doesn't work first time. It can sometimes be frustrating and time consuming to overcome modelling problems like the one just described, but looking at it positively, conquering such challenges can only improve your modelling skills.

The Fillet tool

This useful tool is handy for rounding over edges and for creating fillets between surfaces.

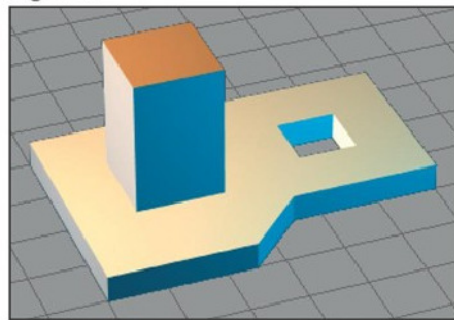
Clear the workspace, and with the grid mode on, and in a Top View, draw three **Polylines** similar to these:

Fig. 123



For each shape in turn, pick the shape, then **[Sweep]** and **[Object Tool]**. Pick the larger of the inner cuboids, and type **[ZS3.0]**. Select the largest shape, **Subtract** the small cuboid, then **[Object Union]** the large object with the remaining cuboid to produce:

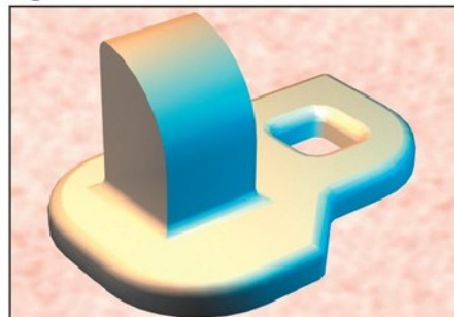
Fig. 124



With the object selected, left-click **[Fillet tool]**, **Fig B**, then right-click the same icon to display the **Fillet Options Panel**. Type **Radius:0.2** and **Division Angle:22.5** in the panel. Now, as you move the mouse pointer over the object's edges, they will change colour. Click some external edges, and they will be rounded over. Similarly, rounded fillets will be formed between faces if you click internal edges. Experiment with the tool to see how it works on adjoining edges - fillets can be removed by clicking the edges a second time. Also try changing the **Radius** and **Division Angle** properties.

Generally, all filleting should be done on an object in one go, because the filleting is fixed when you exit the tool. If the Fillet tool is later used again on the same object, you will be unable to manipulate or interact with the previously created fillets. An exception to this, however, is if you wanted one object with fillets with differing radii (as in the object below); this would have to be done in several sessions.

Fig. 125



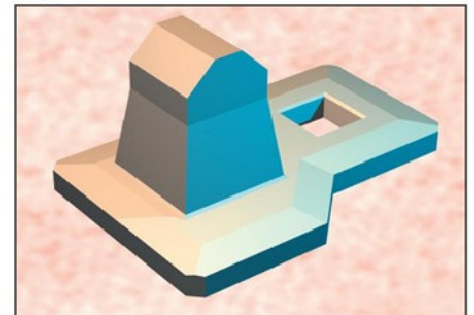
It is also possible to fillet several connected edges in one operation. When the tool is active, there is a pop-up toolbar, with one icon, visible on the screen. Click and drag this icon to select **[Edge Chaining: using two edges]**. With this option, if you pick two adjoining edges, all edges in the 'loop' will be filleted in one go; on complex objects, this is quite a lot quicker than filleting many individual edges.

Altogether, the Fillet tool and the Chamfer tool (to be described next) can quickly transform simple shapes into complex, yet still precise objects. It is worth practicing with them because they can be used in many more situations than their names suggest.

The chamfer tool

I won't describe this tool in any depth because its use is very similar to the Fillet tool, but instead of rounded edges, it produces a single bevelled face. The bevel can be specified in three different ways, by changing the 'Type' parameter in the Chamfer Options Panel. A few more details on the Fillet tool (and Chamfer tool) are given in section 4.9.6 of the help File. Try experimenting by chamfering a shape to see the possibilities it can give. The object below was created with the same starting shape as was used previously, and by applying the chamfer tool in five separate sessions.

Fig. 126



The shell tool

This function creates thin-walled objects from 'solid' polyhedrons. It is ideal for building components like **boilers**, so I'll start immediately with an example of one of these. The boiler is similar to that in 'Polly' from Tubal Cain's 'Building Simple Model Steam Engines'. I have however, simplified the modelling a little, and adapted it slightly to give metric dimensions.

Begin by clearing the workspace, and use **[Cylinder]** with **LNG:80**. Type **[ZL4.0/XS4.62/YS4.62/ZS8.0]**

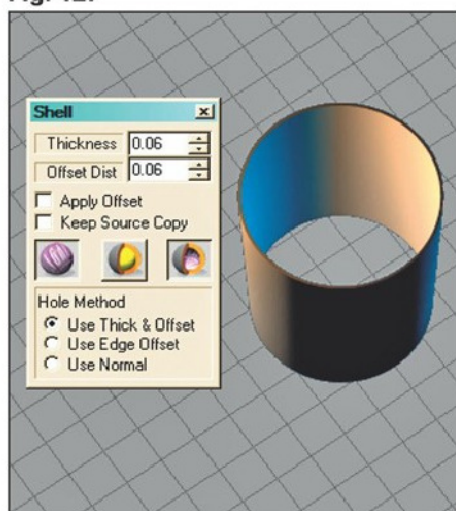
This object will be used to form the boiler's sides. The value of 4.62 is for a 45 mm internal diameter plus an allowance of two wall thicknesses of 0.6 mm.

Now, right-click **[Shell]**, **Fig B**, to see the **Shell Options Panel**. Make the **Thickness 0.06** (0.6 mm - approximately 24 SWG). Click the middle button ('Keep Shelled Volume') in the panel, turning this option off.

Next, when the object is shelled, the ends of the cylinder will not be required in the completed part, so click **[Point Edit: Faces]**, pick the top cylinder face, move the viewpoint to look at the bottom end of the cylinder, and hold the Control Key down as you select this lower end-face.

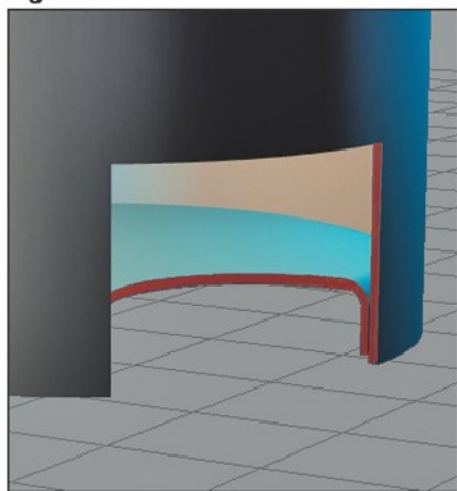
Click [Shell], and with [Render Object] you should have this:

Fig. 127



To make a boiler end-plate, add another **Cylinder** with [XS4.5/YS4.5]. Left-click and right-click [Fillet], set **Radius:0.2** and **Division Angle:15**, then pick the whole of the cylinder's top perimeter edge using [Edge Chaining: use two edges]. Click [Object Tool] to exit the Fillet function. The bottom face of this object will not be included in the next Shell operation, so select it using [Point Edit: Faces]. Type a **Thickness** of **0.07** in the Shell Panel (0.7 mm - approximately 22 SWG), and click [Shell]. Now, click [Cube], and type [ZL0.5/XS5.0/YS5.0]. Select the shelled object and Subtract the cuboid. Click [Object Tool], and type [ZL-0.45]. In the next image, a section has been cut away (by subtracting a cylinder) to show the two boiler parts clearly.

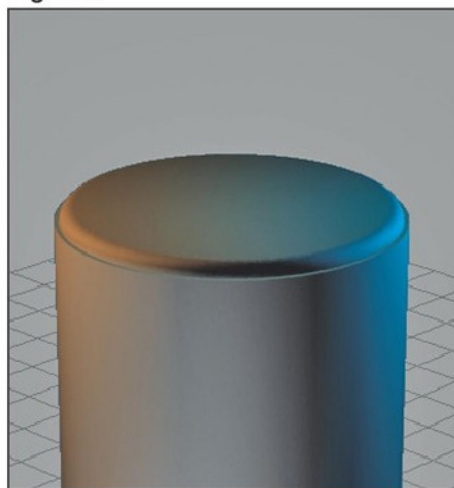
Fig. 128



By the way, if you thought that the steps needed to construct the boiler's end-plate seemed unnecessarily complicated, you're right! Unfortunately, if the top face of a 5 mm high disc is filleted and the object then shelled, the resulting object does not have a uniformly thick wall (try it if you like). This is only noticeable by looking closely at the under surface of the object, so perhaps I'm just being over-fussy!

Make the top end-plate with [Copy] and [ZL7.2].

Fig. 129



To make the chimney, use [Cylinder] with **LNG:30**, and [ZL7.6/XS1.3/YS1.3/ZS14.4] **Subtract** this shape from both end-plates (use Keep Drill), to make holes in them.

Use [Point Edit: Faces] to pick the top end face of the chimney, then click the [Separate selected part of object] icon in the Point Edit Toolbar. Click [Sweep], [Object Tool], and [XS2.4/YS2.4/ZS0.02]

[Object Union] this object with the main part of the cylinder. Zoom-in to look at the underside of the thin disc part at the top of the chimney. Right-and-left click the [Fillet Tool], set **Radius:0.55** and **Division Angle:10**, and using the Edge Chaining selection method, pick the loop of edges at the junction of the two parts of the chimney. This should produce a flared chimney top like this:

Fig. 130

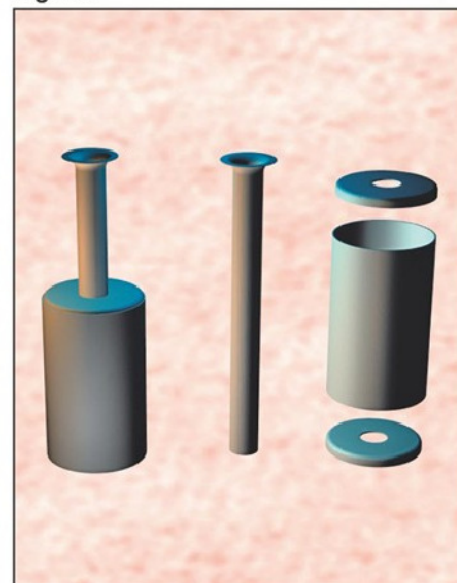


The Shell Tool could now be used to turn the solid chimney shape into a thin-walled object, but unfortunately the results are less than perfect. Here is an alternative method: With the chimney selected, use [Copy] and [ZL14.85/XS2.2/YS2.2/ZS14.6] Select the original chimney object, and **Subtract** the smaller copy.

Although this technique of subtracting a smaller version of an object from the object itself cannot always be used, and in most cases the resulting wall thickness will not be uniform, the method may occasionally produce better results than the Shell tool.

Here is the finished boiler, and its four parts separated:

Fig. 131

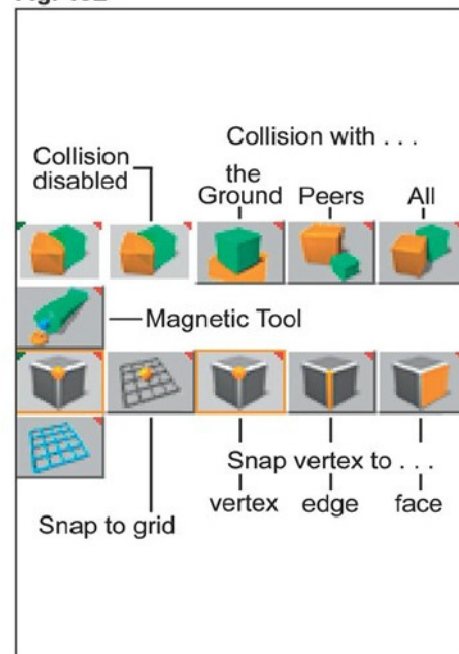


Precise mouse control

TrueSpace has several functions which enable objects to be moved, rotated, and scaled with precision when using the mouse. These can be used sometimes as an alternative way of manipulating objects instead of typing values in the Object Info Panel. You have already been using one such function - the Grid Mode Snap Tool. A second set of functions are the **Vertex Snap Tools**. These tools allow you to move an object so that one of its chosen vertices is snapped to a grid position, or to an entity on another object. The entity can be a vertex, an edge or a division point on an edge, a face or a face centre.

Here is a simple example: In the cleared workspace, and in Solid Render Display Mode, click [Cube] twice. Move one cube away from the other so that they do not touch. Now, hold down the left mouse button on [Toggle Grid Mode], and this pop-up (shown fully expanded here) will appear:

Fig. 132

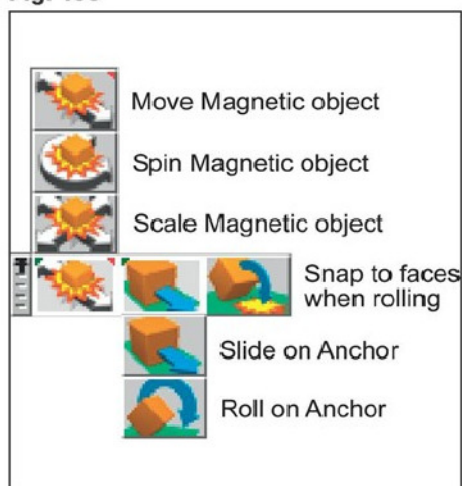


Click [**Snap vertex to vertex**], and move the mouse pointer near a vertex on the currently selected cube so that it turns green. (If the vertex you are selecting is close to the Object Navigation Control, take care not to move the mouse too near to the control, i.e. when part of it turns yellow). Hold the left mouse button down and drag the cube so that the selected vertex is near a vertex on the other cube. The dragged cube will snap position so that the two vertices become coincident. The snapping occurs when any two vertices appear close together on the screen (not necessarily when they are close in the 3D workspace). This allows the dragged cube to be aligned in the Z direction as well as the X and Y directions.

The other tools for snapping a vertex to a grid position, or to an edge or face, behave in a similar way. Their icons are in the image above, and the Help File, section 4.9.11, has further information on them.

The next function - the **Magnetic Tool** - allows you to position an object so that one of its faces is aligned with a face on another object. Try this: clear the workspace, add a [**Cube**] and a [**Cylinder**], and move them apart. Click [**Magnetic Tool**], and select a face on the cylinder. Next, select a cube face, and the cylinder will change position so that the two selected faces touch each other. If you now drag the mouse, the cylinder will stay aligned with the cube, but will slide over the cube's surfaces. You can also roll and spin the cylinder on the cube by selecting these tools from the small three-icon toolbar that is visible on the screen, and is expanded here:

Fig. 133



Try these functions out for yourself; they're straightforward to use, but section 4.9.12 of the Help File has more details if you want them.

There is one further set of alignment functions - the **Object Collision Tools**. These prevent objects from intersecting with each other or with the 'ground' (the XY plane). The tool icons are in the top row of the pop-up toolbar shown before, and they are explained at the end of the Magnetic Tool's description in the Help File. Although useful for speedy modelling, I don't use the collision tools very often because they do add position inaccuracies. These errors are small (up to 0.01 grid squares), but I like nice round numbers!

More tools

This fifth article concludes the introductory part of this series. To some extent, the tools that have been described are a personal choice which I find the most useful for creating precision models. TrueSpace has a huge range of other tools and features which you could find useful, especially if you also want to create 'organic' or 'artistic' models. To end this part, here are some suggestions of more trueSpace tools and features that you may like to look-up if you are enthusiastic (Help File section numbers in brackets):

- Adding and Changing Geometry (4.9.4)
- Face and Vertex manipulation (4.9.5)
- Global and Interactive Replace (4.1.5)
- Mirror Modeller (4.9.8)
- Bend (4.11.4)
- Taper (4.11.5)
- Skew (4.11.6)
- Preferences (Appendix B)

For irregularly shaped objects there are: NURBS (4.7 and 4.8) and Sculpt and Deform (4.11) to name just two. In addition, there are the sophisticated functions of the trueSpace Workspace - but I'll cut short this list which would otherwise fill another page column!

Next Month: The emphasis in the rest of this series will change from basic modelling techniques using trueSpace functions, to constructing specific types of engineering component. Some articles will also look in detail at some 3D modelling topics. To start with, part six will show how a few moderately complex objects can be created with the techniques already discussed.

To be continued...

ALL STEAM ENGINES WANTED

any age, size or condition considered - any distance, any time



ALL 5" GAUGE LOCO's WANTED

Hunslett, Simplex, Speedy, BR Class 2, Horwich Crab, BR 8400 tank, Maid of Kent, Black Five, Jubilee, Royal Engineer, B1 Springbok, Torquay, Manor,

ALL 3½" GAUGE LOCO's WANTED

Tich, Juliet, Rob Roy, Firefly, Jubilee, Maisie, Doris, GWR Hall, Britannia, Hielan Lassie, etc.

ALL 7¼" GAUGE LOCO's WANTED

Hunslett, Hercules, Jessie, Romulus, Dart, Paddington, GWR Mogul 43xx, GWR King, Bridget, Holmeside, Black Five, A3, B1, etc.

ALL TRACTION ENGINES WANTED

Minnie, Burrell, Royal Chester, etc

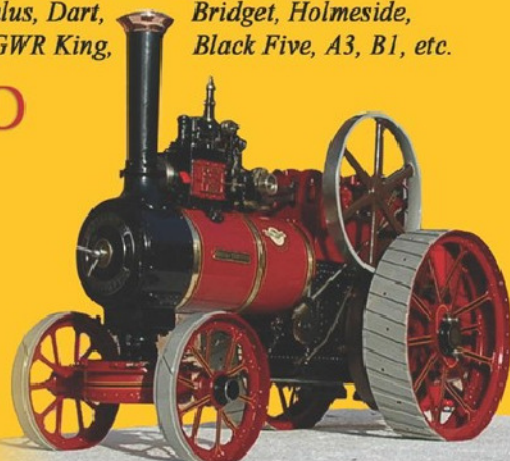
ALL PARTBUILT MODELS WANTED

Workshops bought and cleared

For a professional friendly service, please telephone:

Graham Jones M.Sc. 0121 358 4320

www.antiqusteam.com



HOW TO REFURBISH A TOM SENIOR M1 HORIZONTAL MILL

Mick Whittingham
rebuilds his mill

The Tom Senior M1 mill is a sturdy and well built British machine tool that has found great favour for hobby and light engineering for many years. Many are still available on the secondhand market, some in mint condition and others needing a little TLC to get them back to their best. This article has been written to document the process of refurbishment from start to finish and hopefully inform others of the relative ease and rewards of going to town on their own Tom Senior.

The process of completely refurbishing such a machine tool should be within the capabilities of someone who can operate machine tools to a satisfactory standard. I am at a hobby level only and feel that this work is well within my scope. The amount of time taken will depend upon the time you are prepared to put in and the degree of refurbishment you want to commit to.

A simple clean and adjust will obviously be less time consuming than a complete back to metal re-build. Decide what you want to do with your machine but if you opt for a low-level job then be prepared to deal with more serious issues you might uncover when looking beneath the surface of your machine. Worn bearings, damaged belts and leaky seals can all be addressed pretty easily. If you opt for a full blown, back to bare metal overhaul then consideration of the colour you want to paint your machine should be given.

Many people prefer to paint all their machinery the same colour and indeed most of my machines are resplendent in Machinery Blue Grey which looks the part.



Photo 2. Back at home in bits.



Photo 1. As advertised, in need of some attention.

But I wanted to be true to the original colour of my TS and so had to try and identify it. Unfortunately I could not find any information about the colour (If anyone does know the correct name or number then I'd love to hear from you) and ended up having a specialist paint firm mix up a batch just for this job. Not as expensive as it might sound, I got a perfect match back for a few pounds more than the cost of a stock colour.

If you are going to do this then try to find an area of paint on the machine that has not suffered staining or fading to get the best chance of an original colour. I took a large enough sample from behind the

large name plate which had not been disturbed since manufacture. There are several paint companies who offer such a service, I used Teamac of Hull (usual disclaimers apply) and ordered through my local Dulux paint shop who got the paint in for me to collect. Check how much of a sample they need for analysis, as it might be more than you think.

I obtained my M1 through the internet and paid the princely sum of £350.00 for it, **photo 1**. I had to collect the unit myself from Manchester and chose to transport it in my Honda Jazz hatchback! Yes it really will handle such a machine but two or three trips will be required to do it

safely and lawfully, **photo 2**. I transported the base unit and sundries first, some of the heavier parts like the table, saddle and knee next and the column as one final trip. Plenty of polythene sheeting on the boot floor, old curtains over that and squares of carpet on top protected the vehicle from knocks and spills. If you don't fancy using the family car then you could always rent a van or use a reputable machine moving service which will take away a lot of the strain and is recommended if you have any doubts about your ability to transport your new machine, **photo 3**.

My M1 is serial Number 2057 and this places its year of manufacture as 1961-62, a few years before my birth in 1965. This makes us fairly contemporary and I feel a certain kinship with my new friend, Tom, who was born a Yorkshire lad, as was I. An enamelled brass plate attached to the base proudly proclaims his place of birth at the Atlas works in Liversedge.

Before starting the strip down it is important to decide on a strategy of how you want to handle the liberated parts. Either remove each part and strip, clean, repair and rebuild them as you go, or remove everything in lumps and then start the individual stripping and refurbishing. This is a matter for you but my preferred method is the former, where I take off a part, clean and strip it before preparing it for rebuilding. This method allows me a bit more variety and makes the process more enjoyable, doing bits of different assemblies takes the monotony out of getting covered in muck while taking the machine apart.

Also make sure you are ready to deal with the parts. A variety of parts bins, bags and boxes etc. will help in storing them and a couple of marker pens to write on what they are and where they came from will be of great help. I also set up a kind of parts wash assembly line with washing up bowls of white spirit to clean the parts in. The really dirty stuff gets washed off in the first bowl and then as the part is opened up I move to cleaner spirit, this allows maximum economy with the cleaning solution. Cheap paint brushes, wire brushes and lots of kitchen roll or rags are also required for the cleaning process.

At this stage it is also a good idea to take photographs of any transfers or badges and



Photo 3. Hurried strip at factory premises.

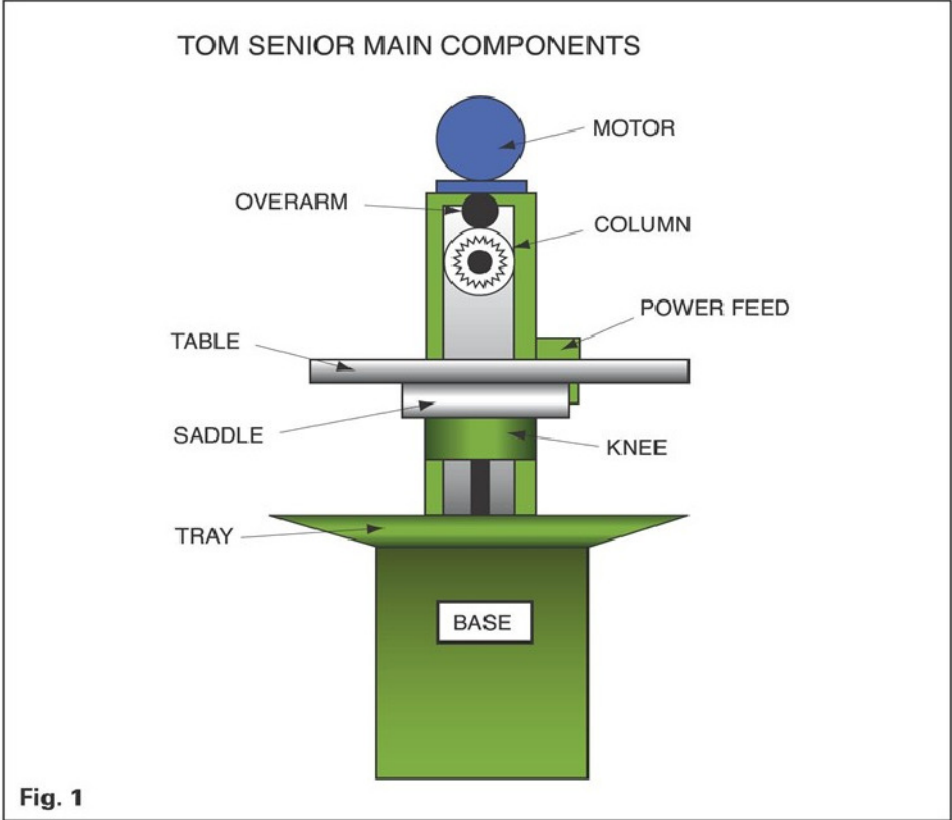


Fig. 1

information plates on the machine, as if they are damaged during cleaning you can print them off on transfer paper and replace them once the machine is repainted.

It is also important to take photos as you go to aid the rebuilding process. Bearing in mind that this might be quite a while after you strip the machine any help you can give yourself will be welcome. I take a general view of each side and then close up shots of assemblies and wiring to make life easier when the time comes to put everything back together.

I planned to completely strip my machine down to the last nut and bolt and repaint and refinish it to the best of my ability. This required plenty of space and time to accomplish so other workshop projects were put on hold till the TS was finished.

I also prepared to carry out the refurbishment by researching and finding as much information as possible before I laid a spanner on the machine. I read the manual and all sources of information until I felt I could strip the machine, but I still had a few surprises not in the manual.

To demonstrate this, my model has one type of power feed engagement lever. Other variations may be found but it should not be a problem to sort these variations out; there is but one manual covering the whole range of mills. As the manual states "SENIOR milling machines utilise a basic range of standard components and the information contained in this manual is applicable to all machines unless otherwise stated."

Starting the process

Initially stripping the machine into its larger component parts will assist in transporting the unit, as it did for me. It will also be a necessary operation before carrying out a more in depth renovation.

Firstly identifying the major parts is a necessary exercise and so the following list and diagram shown in **table 1** will assist:

Table 1 (see also fig. 1)

Base	Metal plate fabrication with integral coolant tank.
Swarf tray	Sheet metal tray with coolant drain holes.
Column	Heavy cast iron body with integral dovetail slides.
Overarm	Heavy steel bar which can be a problem to remove.
Knee	Cast iron support for the saddle assembly Z axis.
Saddle	Supports the table providing Y axis movement.
Table	Workholding Tee slotted component X axis.
Belt cover	Rear belt cover lifts off hinges first.
Gear cover	Side cover lifts off after belt cover.
Motor	Mounted atop the column and heavy.

The order of removal is fairly logical. You may choose to follow this step by step method or decide that leaving some items in place will allow you to carry out the work you want.

Descriptions of the left and right hand side components are given when facing the side of the machine you are working on. The process starts at the front with the large assemblies but you could equally choose any side and work in a logical sequence.

To completely strip the machine I followed the sequence here:

Overarm and cutter spindle

These two items project from the front of the column and removing them at an early stage will prevent much head



Photo 4. Inside the saddle at initial strip down.

bumping and the associated swearing etc. The arbor support casting has a split collar around the support bar and slackening this will allow the casting to be slid off the bar and arbor. The bearing is split and can be adjusted for wear but more about that in the section on the arbor itself. The cutter spindle is a 3 MT fitting secured by a drawbar which passes through the spindle drive and emerges as a bolt head in the centre of the spindle drive pulley. Remove the draw bar and carefully drift out the arbor taking care to support the free end.

The overarm is a 2 1/4 in. diameter steel bar some 24 in. long. The shaft should be cleaned as best you can with emery tape

both inside and outside the column casing to ease removal. The cleaner it is, the easier I found removal. The rear end of the shaft was also burred over due to previous hammering and I dressed this with a file before attempting to withdraw it. A trip to my local heavy engineer and I had the ends refaced in their lathe. The shaft itself is secured by two bronze split cotters in the top right hand side of the column. Slackening the nuts will allow the shaft to be removed and when the shaft is out remove the cotters for cleaning.

Table

Remove the left hand side table leadscrew support bracket (two 14mm bolts).

Wind the leadscrew completely anti-clockwise until it disengages with the leadscrew nut.

Unbolt the right hand side leadscrew support bracket and slide out the leadscrew complete.

Loosen all Gib strip adjusters for the table and slide it to the right and off the saddle, being careful it doesn't come all in a rush as it is very heavy, **photo 4**.

The power feed drive shaft is a sliding keyed shaft with a small universal joint on each end. It is located on the right-hand side of the saddle and connects the saddle to the power feed gearbox. It must be separated before the two components can be split and the saddle removed. The

chromed metal tube cover can be released by taking out a grub screw on the top section ball joint and sliding the outer section down. A taper pin secures the universal joint to the gearbox output shaft and this should be knocked out (make sure to identify the correct end to tap out) to allow the drive shaft to hang down on the saddle end universal joint. Removal of the lower section from the saddle is covered later.

Saddle

The saddle is next and this is a fairly easy matter. The Y axis leadscrew carrier should be unbolted and the leadscrew wound out and removed complete. An Allen CSK screw and flat washer in the base of the saddle secures the leadscrew nut but unscrewing this did not allow the nut to be removed due to the casting of a web inside the knee. It is therefore necessary to remove the slide out gib section on the left-hand side of the saddle dovetail slide. To do this, remove the gib section securing bolts beneath the left-hand side of the saddle and slide out the Vee section gib. Both the saddle and knee removable gib pieces have a loose bronze pressure pad which is used to lock them when required, take care not to lose this as you remove the gib. The saddle can then be lifted up and to the right so it clears the fixed Vee section and then removed.



Photo 5. Power feed gearbox.



Photo 6. Power feed gearbox removed.



Photo 7. View of column assembly.



Photo 8. The column showing the side door.

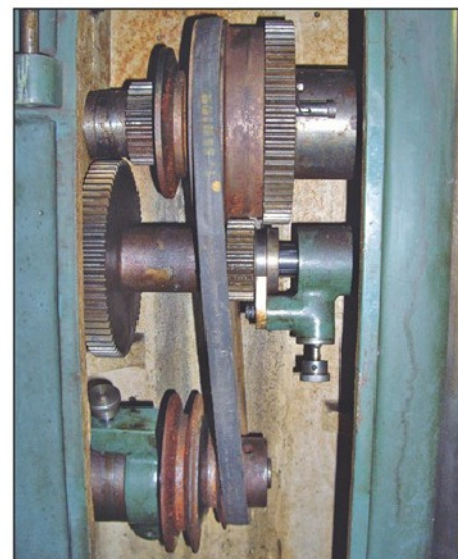


Photo 9. Inside pulleys and gears.

Knee

The knee is a substantial casting but is hollow and should be manageable for one person. If using a workshop crane or engine hoist consider slinging the knee before starting removal. The knee raising screw is secured into the knee by a socket CSK screw and bronze washer beneath a steel plate secured to the knee by three small screws. Removing this plate and socket screw allows the knee to be raised free of the leadscrew and its crown gear, which can be left in place for later removal. This makes the knee a bit easier to handle, as there is no length of leadscrew sticking out. Remove the sliding gib section in the same way as the saddle and swing the knee away from the dovetail, removing it as a unit.

Power feed gearbox

The power feed gearbox is a three speed and neutral gearbox which transfers the drive via pulleys from the main drive to the power feed worm and wheel in the saddle, **photo 5**. It is located on the right-hand side of the column and does not need to be disturbed unless you are re-painting the machine or want to remove it for servicing. It is secured by two Allen bolts into the column but is also contoured into the column with filler paste so that it looks like a cast item. Removing it will mean replacing this filler to achieve the right finish, **photo 6**.

Belt covers

The large door covering the drive belts at the rear of the machine is removed by lifting it from its hinge pins on the column, **photo 7**. A little penetrating oil on the hinge pins will help with this and take care as if you are lifting and it gives you can become unbalanced. It is not a heavy item and can be easily carried.

The gear cover door is removed in the same way but I cleaned up the hinge pins with some fine emery tape before oiling them for the lift. This door is cast iron but not too heavy, take care as before that when it comes off you have good footing, **photo 8**.

Motor assembly

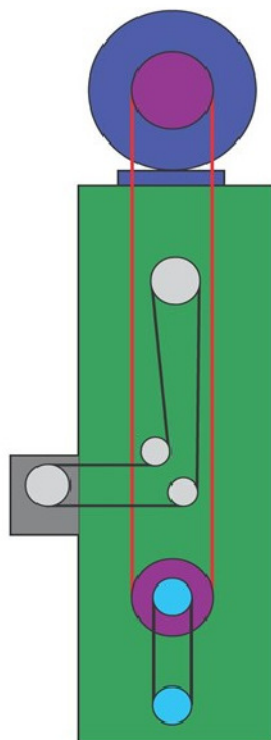
Depending on the type of unit fitted, the motor can be quite heavy and is at head height so can make for a tricky lift down. Get some help with this to make sure you don't hurt yourself or the motor. After disconnecting the electrical wiring, slacken the drive belt by swinging up the lower eccentric drive pulley; a sprung plunger secures this assembly on an eccentric housing and withdrawing the plunger allows it to swing radially about its axis. Remove the drive belt and the drive belt inside the column, **photo 9** linking the idler pulley and the spindle pulley, **Fig. 2**. Four adjusting studs tapped into the top of the column casting carry the motor and removing the securing nuts will allow the motor body to be lifted off the column. Remove the studs if you intend re-painting the column.

Column

The cast iron column contains the spindle and drive pulleys and with these in place it is a heavy item. Removing the innards prior to splitting the column from the base will make things a little easier.

Firstly remove the coolant pump from the lower end of the column. This is a

GENERAL LAYOUT OF BELTS ON REAR OF COLUMN



BELT REFERENCE NUMBERS

RED	MAIN DRIVE	A 58
BLUE	SUDS PUMP	Z 32
BLACK	POWER FEED	Z 38
	SPINDLE DRIVE (INSIDE)	B 35

Fig. 2

vane type unit, which is secured to the column by a hex-headed bolt inside the column casing. Removal of this bolt will allow the pump to be lifted free. Mine was seized solid and I will deal with this when explaining the detailed overhaul.

The lower of the three shafts carries the main idler pulley on its eccentric and I will deal with this first.

The drive pulley on the outer end of this shaft should be removed. Slacken the Allen grub screw in the three-step pulley and draw the pulley from its shaft. This exposes the countershaft eccentric bush with three Allen bolts securing it to the casing. Inside the column the eccentric bush has a large capacity oil cup and this has to be removed to allow the bush to be withdrawn from the casing. Remove the Allen bolts and the eccentric bush. This will allow the inner pulley assembly to be withdrawn from the casing by sliding it inboards, into the column void and away. Take care with this assembly as it is quite weighty and the shaft and pulley can slide out of the eccentric bush and fall into the column.

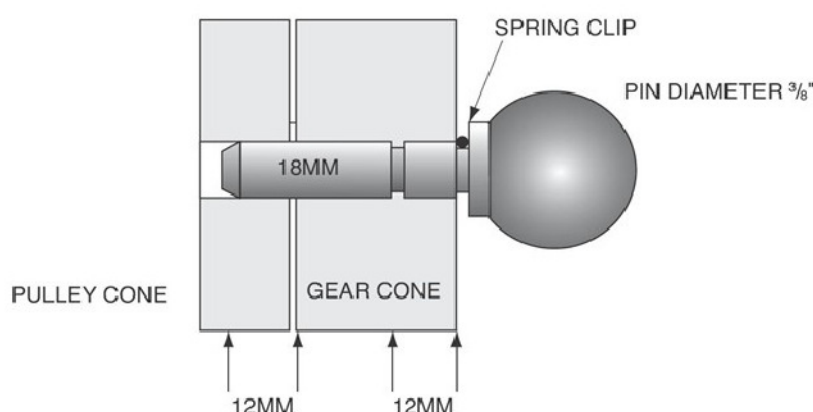
The back gear shaft can now be addressed. This passes through the rear wall of the column through the back gear assembly and emerges into the front wall of the column in the dovetail slide. On the rear aspect the shaft carries an inverted Y shape idler assembly for the power feed drive belt. Slacken the Allen pinch bolt and remove the assembly complete. A cast iron boss or anchor plate is secured to the column by a hex head bolt and this should be removed prior to slackening the Allen pinch bolt securing the boss to the shaft. The boss can then be removed from the shaft.

Inside the column the other end of the shaft carries a selector assembly to allow the axial movement of the back gear cluster. This is secured by an Allen grub screw and once this is slackened the shaft can be withdrawn toward the rear of the column, liberating the back gear selector assembly, which should be removed first. The back gear cluster can then be released by withdrawing the shaft completely. Once it is free the back gear can be eased out of the column door.

This leaves the spindle shaft assembly and this is stripped out by removing the rearmost Vee pulley on the outer end of the shaft which drives the power feed gear box. The whole of the protruding shaft may require cleaning with fine emery tape to ease its eventual removal. A steel bearing cover with three Allen bolts covers the rear bearing and this is removed next, revealing the bearing locking collar. The front bearing cover is similar in nature to the rear but larger. This should be removed to reveal the front bearing. Clean out as much grease as you can from the front and rear bearings before taking the spindle out, thus saving getting your hands caked in grease as you withdraw the shaft. The bearing locking collar has an Allen pinch bolt and requires a pin face spanner to remove properly. An adjustable type spanner is available but I manufactured a special one from steel sheet with 6mm silver steel pins silver soldered in place. *Editors note: Please temper the pins down after soldering if using silver steel.*

The bearing collar is a LEFT HAND THREAD so take care in removing it the right way. Inside the column the spindle

BACK GEAR LOCKING PIN, TOM SENIOR MILLERS



BACKGEAR ENGAGEMENT IS ACHIEVED BY SLIDING THE COUNTERSHAFT ACROSS INTO MESH BETWEEN THE PULLEY CONE AND THE GEAR CONE AND WITHDRAWING THE SPINDLE SHAFT LOCKING PIN FROM THE GEAR CONE SO THAT THE TWO CONES ARE FREE TO ROTATE INDEPENDENTLY. THE SPRING CLIP PREVENTS THE PIN FROM MOVING BY SITTING IN THE ANNULAR GROOVES CUT INTO THE PIN BODY.

Fig. 3

PLAN VIEW OF SPINDLE REMOVAL METHOD

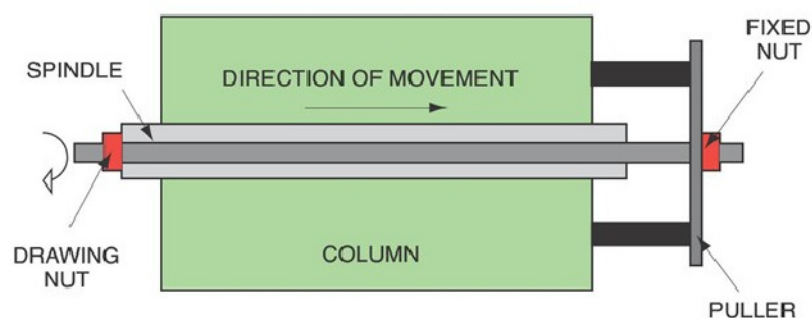


Fig. 4



Photo 10. Coolant tank cleaned out.

shaft has two Allen grub screws which must be slackened. One to release the gear cone (which is keyed onto the spindle), and one to release a collar on the left hand side which acts as a spacer between the bearing and cone pulley (the grub screw locates into a hollow on the shaft). The pulley cone, which is free to rotate on the spindle, is connected to the gear cone in direct drive by a $\frac{3}{8}$ th diameter sliding pin. Fig. 3 shows this arrangement.

I made up a drawing tool using M12 screwed rod and nuts with appropriate spacers. This was passed through the spindle and used to pull the shaft from its bearings. A diagram at Fig. 4 shows the set up for you to replicate as you see fit. The bearing was not too tight and came off relatively easily, I have known these things take some force to remove though so beware and steady as you go. Once the small outer bearing is free of its seat the components attached to the spindle shaft must be supported as the spindle is withdrawn. The column is now empty of components and can be cleaned ready for painting.

Splitting the Column from the base

The rear of the column was provided with a U shaped, cast iron shield around the coolant pump, this is secured by two Hex-headed bolts and is easily removed.

The column itself is secured to the base by four hex-headed bolts inside the bottom of the column casting. A long extension and socket will ease their removal and once they are out the column is sitting on the chip tray under its own weight. The casting is contoured into the coolant tray with body filler and this must be broken before the column will lift away. Sling through the overarm hole or re-insert the overarm and use it as a lifting aid to lift the column up out of the chip tray and down onto a soft wood board to protect the casting. Whichever way you decide to lift the column it is very heavy and care must be taken with your back and the casting. Make sure you have enough muscle to move it before trying.

Coolant tray

Four hex-headed bolts secure the coolant tray to the base unit and once these are out the tray can be lifted free. The tray is substantial, fairly heavy and awkward so a helping hand moving this will not go amiss.

After cleaning it can be stored against a wall out of the way until it is required in the re-building stages.

Base unit

Removal of the coolant tray reveals the true nature of the base unit. It is not a casting but a very well made steel fabrication, photo 10. It should also reveal a sea of soluble oil, which has dried up over many years. This must all be scooped, scraped and otherwise removed from the "sump."

Digging around in this treacle like gunk I found an Allen key, a scriber and several nuts, washers and other sundry items lost by countless engineers.

And so there you have it, a rather large kit of parts for a horizontal miller. A complex but satisfying jigsaw puzzle for the engineer to restore. **To be continued.**

WARCO

SPECIAL OFFERS THAT REALLY MEASURE UP!

WARCO
Our next exhibition
Midlands Model
Engineering Exhibition
Leamington Spa
16th to 20th October '09
See you there!

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

£780.00

Including free of charge drill chuck, arbor, live centre and 5 piece lathe tool set.

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



- 125mm. Will suit Myford, Harrison and Colchester lathes.

£42.00 Also available 160mm £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. mainland 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

MAKING A HIGH SPEED ENGRAVING SPINDLE

Dave Fenner gets up to speed

In my shop, the match maker CNC mill is a much under-used resource. It was purchased about ten years ago in non working order and then refitted with the AHHA system (near state of the art at the time) which allowed four axis control. Nowadays multi tool magazines and auto tool change are pretty well "de rigeur" in commercial CNC work, so machines such as this are unlikely to be competitive. It does nevertheless find occasional hobby uses and it was thought that some light engraving and routing work might be fun. Such applications would have less need of tool changes.

The existing motor and transmission system comprises a 2kw motor, driving a varispeed belt to a two speed gearbox, **photo 1**. This arrangement allows the selection of any spindle speed from about 300 up to 3000rpm. At model engineering shows such as those at Ascot/ Sandown and Harrogate, one regular exhibitor is J.B. Tools and when attending exhibitions, I usually make a bee line for their stand to stock up on budget carbide. They frequently have cutters such as those shown in **photo 2** and the smaller (0.125in. shank) are ideal for the uses envisaged, in that they can either be used as supplied for lightweight routing or ground with a tri-facet tip per the guidance given by Dick Stephen in MEW Issue 126 to turn them into effective engraving bits. Dick also recommended a design of spring loaded cutter holder to minimise the effect of variation in material surface height.

These cutters may be run at considerably higher speeds, and several approaches to generating high revs per minute were considered. In industry, a speed increaser using internal gears might be the chosen option, and here again, Dick Stephen described just such an accessory in MEW Issue 101. One factor which influenced my thinking was the "grown like Topsy" electrical supply arrangements on the machine. While the supply to the main spindle and coolant motors is regular three phase that to the CNC control system and computer is 240 volt single phase. Thus a second line of thinking evolved using a separate single phase

motor. A further viable variation would be one of the now popular low voltage brushless motors used in model aircraft. These have quite considerable power outputs. However, a quick look over the pile of motors in the scrap box made me think further about using something already in stock. Initially, I was drawn to the idea of using one of two ex lathe motors, each of half horsepower rating. One had been removed to make way for the Newton Tesla inverter drive system on the Super Seven, the other had been salvaged from a Myford capstan lathe when it was scrapped. However, whilst rummaging in the back of a dusty cupboard, I came across an old Singer sewing machine motor, which I vaguely remember being fitted to mother's sewing machine around 1949. Rated at about 125watts, it is physically rather larger than modern equivalents and I guess its no load speed to be towards 5000rpm. From what I can remember of Taylor-Hobson engraving machines, their motors were fairly small, and may have been about this size. The lower size and weight would allow a considerably simplified mounting.

Given that for engraving purposes, the vertical movement of the tool could be restricted to about three millimetres, I felt that a very simple round section belt drive would suffice, which would tolerate slight misalignment. The general arrangement envisaged harks back to the overhead drives used in the past for lathe accessories (but turned with the axes vertical). A 4mm diameter round polyurethane belt was chosen and sourced from R S Components - stock number 309-8173.

For this simple transmission, the motor rotation would have to be reversed. As this was a commutator motor with field windings, I anticipated having to disconnect and swap over the brush



Photo 1. Matchmaker transmission is heavyweight and better suited to slow/medium speed applications.

connections. However having opened up the assembly, I found that the brushes were mounted on a separate insulated plate, and this could be rotated 180 degrees to give the required result.

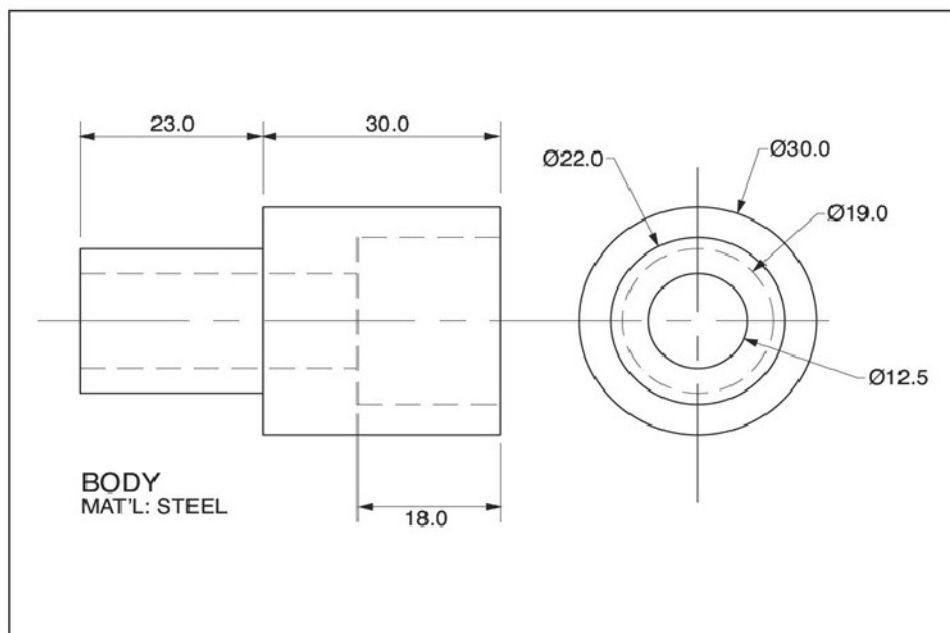
SPINDLE ASSEMBLY

Body

I chose to use a pair of 8 x 22 x 7mm ball races (code 608 available from Arc Euro Trade) clamped up together. Other options are available, for instance a pair of angular contact magneto bearings, which would have slightly greater outside diameter. The first item to be made was the static body part which would include the mounting

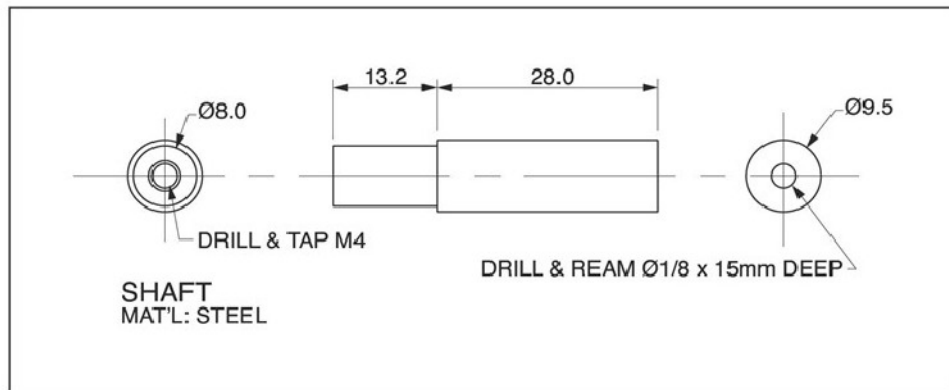


Photo 2. Selection of 6mm and 1/8in. shank carbide from J B Tools.



stub and the bearing housing. At the outset, I had considered making an integral INT 40 arbor to fit directly into the machine spindle but then thought that mounting from an existing collet chuck would be a simpler option. As the machine spindle will not rotate when the attachment is fitted, concentricity of the bearing housing (unlike that of the shaft) will not impact on the performance. To make the housing, a length of 32mm diameter mild steel bar was turned down to $\frac{3}{4}$ in. (19mm) for a length of 23mm. It was then reversed in the chuck, lightly skimmed on the O.D. for appearance, then bored out 22mm diameter by about 18mm deep, to accept the bearings, **photo 3** and drilled through 12.5mm diameter. The location bore should be carefully sized so that the bearings just slide in with no slop. Slight interference would probably be ideal. The through hole will allow the shaft and bearings to be pushed out for dismantling.

I considered several methods of bearing retention. Lociting in would have been an option but would require heating to release, with the attendant possibility of tempering the bearings. A ring nut or circlip would have been feasible, however for simplicity and ease of access, I opted for a pair of tapered M3 screws set at 180 degrees, positioned so that as tightened, the tapers would push the bearings home. **Photo 4** shows the tapping operation in progress. The locations for these are set after a trial assembly of the bearings in the housing. Here I have to admit to an error in measurement or maths, as I had to fit a wire ring behind the bearings to obtain the correct fit. **Photo 5** shows how the taper on the screws retains the bearings.



Shaft

When he described his spring loaded engraving cutter holder, Dick Stephen advocated the use of a small collet chuck, which with a selection of collets, would give flexibility as to cutter shank size. To simplify matters here, I have standardised on the JB Tools cutters having a shank diameter of 0.125in. (3.175mm). **Photo 6** shows one whose tip has been modified for engraving per the guidance from Dick Stephen. This standardisation then permits simplification of the shaft design.

For the shaft, unlike the body, accurate concentricity is paramount. If the tool point describes a small circle when rotated, then breakage is likely. At the very least, a wide engraved line will result. To ensure accuracy, turning work on this part was undertaken using a collet chuck, although careful centering in a four jaw should also give the desired result. Unless your three jaw is very good, it is unlikely to deliver the goods.

My weapon of choice was the Myford MT2 collet system which locates directly in the headstock, probably giving the highest level of accuracy obtainable in the typical home shop. A length of $\frac{3}{8}$ in. (9.5mm) free cutting steel bar was faced and the cutter location hole centred, drilled then reamed to diameter. The material was then drawn out and parted off, **photo 7**. The part was then reversed and the bearing location diameter turned down to 8mm. A hole was then drilled and tapped M4 for the bearing retention screw. Finally the part was cross drilled and tapped M3 for two cutter clamping screws.

The bearing retention washer was a simple turning exercise. The finished shaft assembly complete with pulley is shown with the body in **photo 8**. It may be noted that the direction of rotation will tend to slacken the bearing retaining screw, although this has not been a problem to date. Nevertheless, a dab of thread lock may be beneficial.

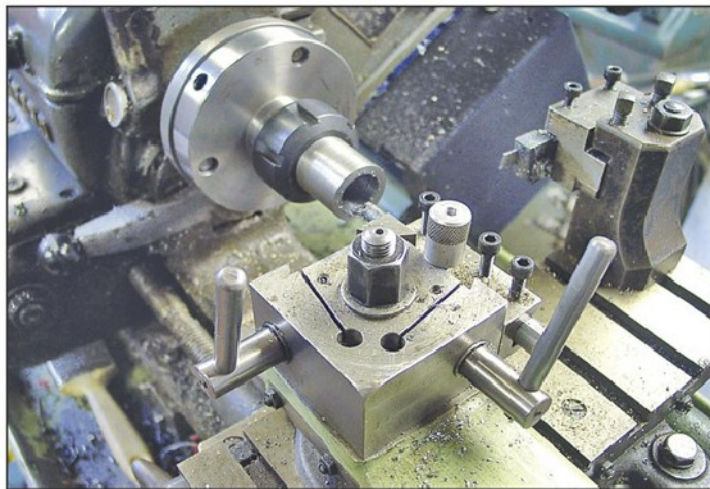


Photo 3. Boring bearing housing.



Photo 4. Tapping M3 for bearing retention screws.



Photo 5. Tapers on screws lock bearings in place.

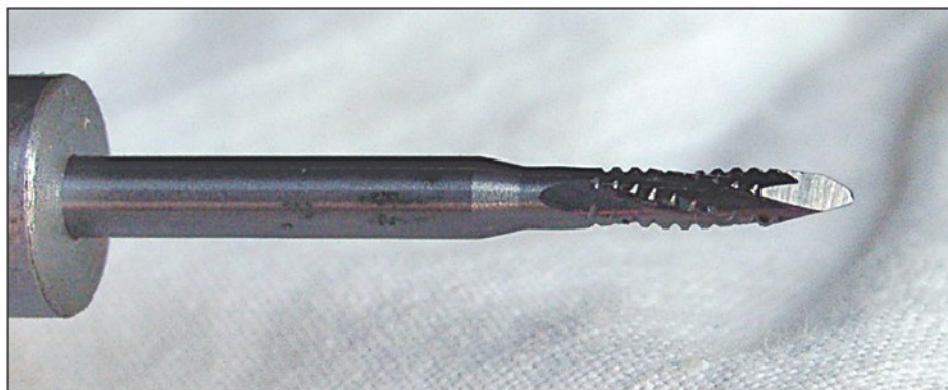


Photo 6. $\frac{1}{8}$ in. shank carbide cutter has been ground with tri facet point.

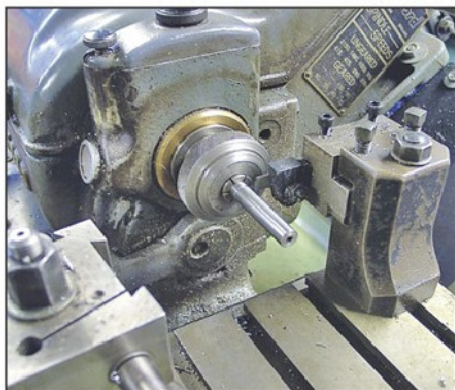


Photo 7. Parting off the embryo shaft.

Pulley

This was roughly turned, grooved with the part off tool and drilled whilst still on its parent bar, then parted/ sawn off. It was then Loctited on to the shaft and finish turned to improve squareness and concentricity, in the expectation that this would improve balance. The groove was cut with the walls slightly angled and gradually opened up until a 4mm drill would nestle comfortably in place.

Motor Pulley

Aiming for a step up of about 2 : 1, I decided on a two part construction, the hub in steel, the main diameter in MDF, the two

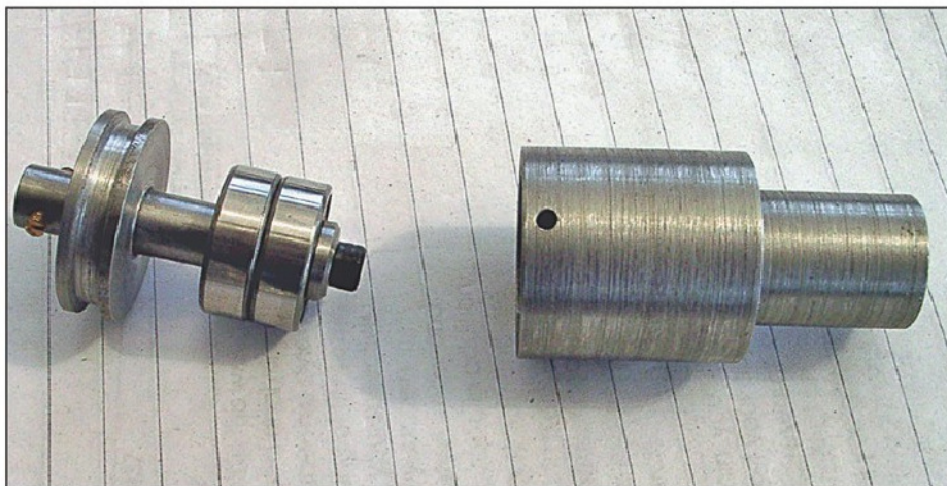


Photo 8. Shaft and bearings (left) and body (right).

joined by Araldite. The hub was produced first and then a blank was band sawn to approximate shape, then drilled to fit the hub and glued together. The assembly could then be chucked and the pulley turned to shape, **photo 9**. The groove was another approximation but appears to work well.

Commissioning

The lightweight Singer motor was simply attached to a plywood plate which in turn was hung from two M5

bolts. These are located in tapped holes which normally support the clamping set for this machine. **Photo 10** shows the set up, and **photo 11** illustrates one of a series of key fobs made for family members using "DeskEngrave" software - which was available as a free download.

No details have been given regarding the motor mount, drive pulley etc. as it is unlikely that any reader aiming to do something similar will have identical hardware. ■

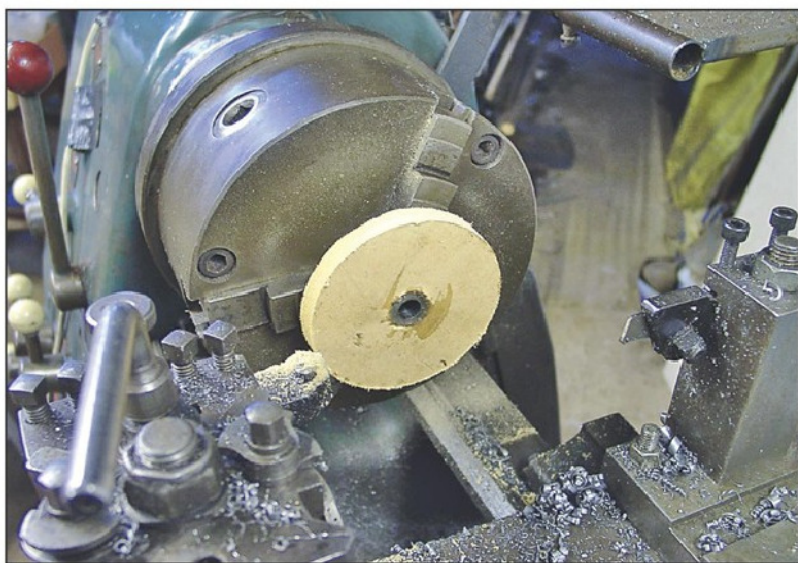


Photo 9. Truing up the MDF pulley chucked by the steel hub.

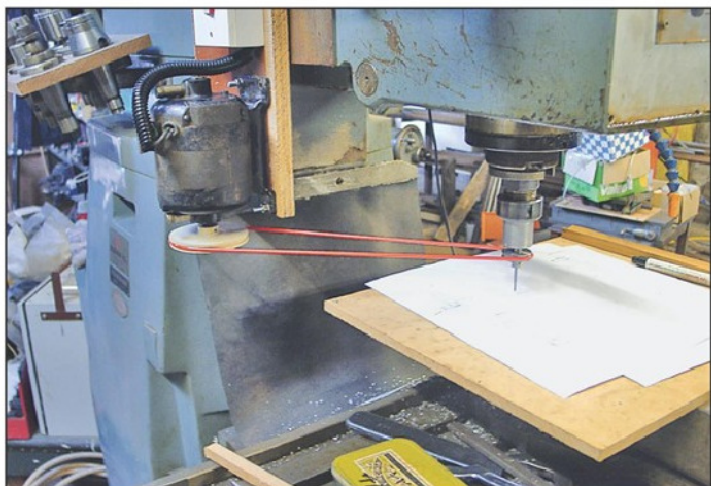
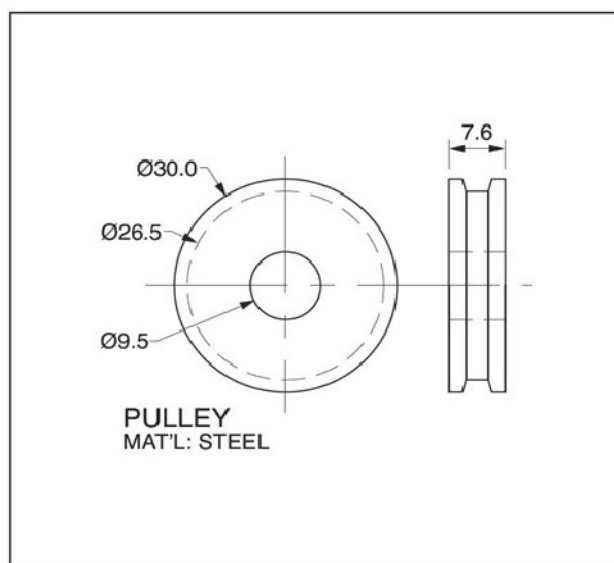


Photo 10. End result is a mixture of precision and Heath Robinson.



Photo 11. An engraved and anodised key fob, just one of the possibilities using DeskEngrave.

IMPROVING A CHEAP OFFHAND TOOL GRINDER

Dyson Watkins takes a rest

Most hobbyists, me included, find that the acquisition of a tool grinder is a necessity. The choice of type and its quality has taken place as soon as its purchase has become affordable. Reasons for the choice are various, and in my case the reason was that I had not given the choice much thought, and most importantly it was cheap, costing around £29. This meant that I could buy another tool with the cash available. Over the years, it has seen a change of wheels according to use. Its main drawback has been that the tool rests were flimsy and inconvenient to adjust and I have at last decided to replace these offending tool rests with a pair of much improved design. The advantages being increased rigidity and ease of adjustment, also adding the desirable feature of providing an adjustable angle with respect to the wheel surface. This last feature makes the task of grinding a lathe tool to give the necessary rake and clearance angles easy. The surface of each rest has been given an increase in area, so the tool being ground can be held flat and at a consistent angle, **photo 1**.

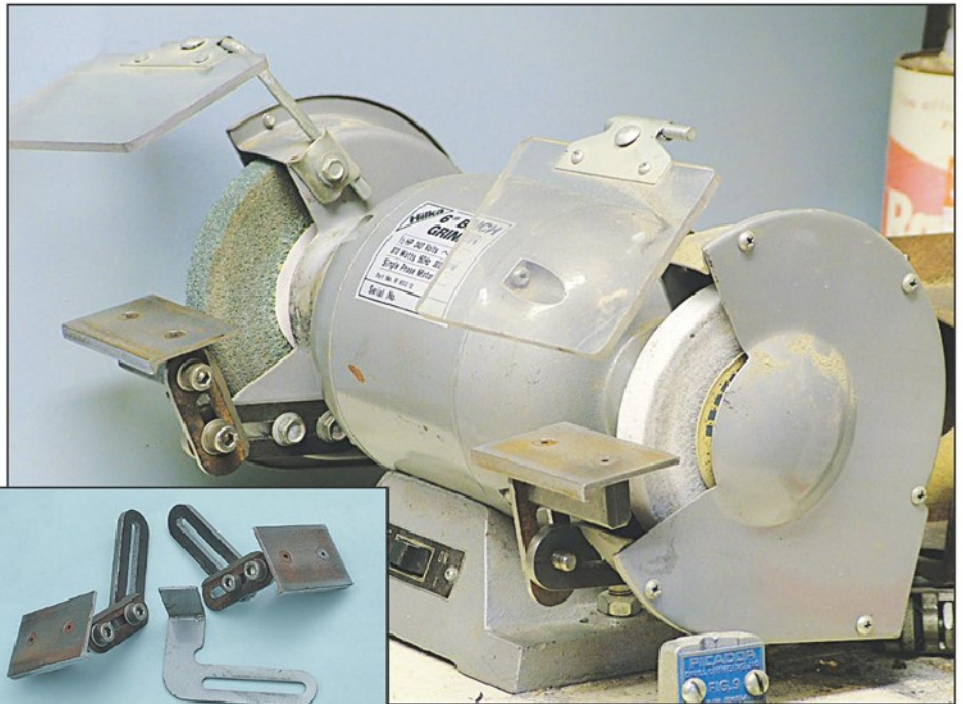
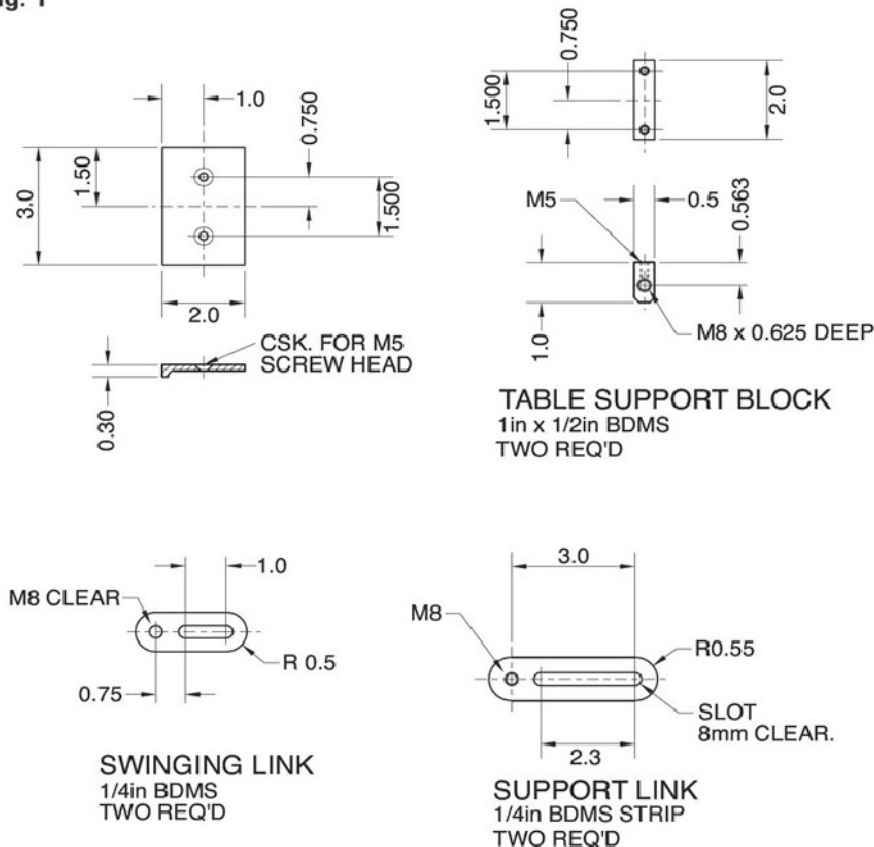


Photo 1. The grinder with new rests.



Photo 2. The new rests before fitting.

Fig. 1



Making the rest

The material used for most parts was scavenged from scraps of steel angle, the sizes as given in Fig. 1. I carried out most of the work on the milling machine but there is no problem in carrying out the work using hand tools. Slots can be made by chain drilling and cleaning out with a file. The radii on the ends of each link can also be sawn and filed to the required radius. The dimensions of the individual components can of course be modified to suit the model of individual grinder, but the principles can be the same.

A good method of ensuring that the chosen design will be satisfactory, is to cut the parts from some card and modify if and where necessary. I shall provide the dimensions used for my grinder as I have no way of making the design totally universal. I suggest that the existing attachment bracket on your machine be used to establish the dimensions of the replacement version. When this component has been finalised, the length of the table support bracket can be checked prior to making. One edge of the tool table has been kept thicker than the rest of the table because it could be a useful feature for use as a datum edge should a protractor ever be required to establish an angle for grinding. The chamfers on the table support block are there for aesthetic reasons and do not exist for any other purpose. The two brackets are assembled as right hand and left hand, but the components as drawn can be assembled either way, **photo 2**. ■

HOW TO ANODISE TITANIUM

Tony Jeffree adds a decorative finish to some clock parts

Background

This is somewhat of a departure from my recent articles in that there isn't a stepper motor anywhere in sight, but it does relate directly to the main reason that I embarked on metalworking as a hobby in the first place, and later got interested in CNC, which was to make clocks. The traditional materials for making clock parts are steel, brass, and wood. However, there are good reasons for making some of the parts of a clock as light as possible. For example, this was what led Dick Stephen to start using Titanium to make ultra-light escape wheels for some of his clocks. He found, not surprisingly when you think about the physics involved, that the power needed to drive a Titanium escape wheel was significantly less than would be needed to drive a brass escape wheel of the same dimensions. This reduction in drive power requirement means that the weights you need to drive the clock are much smaller, which can have knock-ons in terms of reducing the size of pivots and the thickness of the wheels used in the rest of the drive train. He mentioned to me that on a couple of clocks he had also used Titanium to make the hands, and that he had achieved an interesting blue colour on these hands by anodising them. A bit of investigation on the Internet revealed that blue is just one of a wide range of colours that can be achieved by anodising Titanium. You can have various blues, ranging from something close to blued steel through to a pastel turquoise, but also various yellows, greens, golds, pinks, and greys. This started me thinking about alternative decorative approaches for clock parts, and maybe the possibility of making a clock movement using anodised Titanium parts instead of the traditional brass, which might be interesting from a



Photo 1. The power supply.

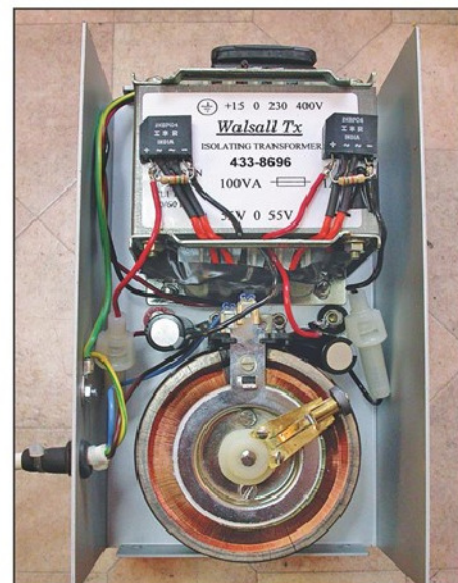


Photo 2. The insides of the power supply.

visual point of view. The Titanium clock is still mostly a thought exercise at present, but at least I have got as far as setting up the equipment needed to perform the anodising, and my daughter has already times to decorate some simple jewellery items made from Titanium wire.

The anodising process

Anodising Titanium has some similarities to anodising aluminium in that the part to be treated is placed in a bath of electrolyte connected to the positive (anode) side of a DC power supply and the negative side of the supply is connected to a cathode that is also immersed in the electrolyte. The resultant flow of current causes a thin oxide layer to form on the surface of the part being treated. At that point, the similarities in the process pretty much end.

In aluminium anodising, the primary reason for anodising is that the oxide layer provides a hard wearing, protective finish, which can also be given a colour for decorative purposes. Quite high currents, but not particularly high voltages (10-20 volts being typical) are needed in order to develop a significant thickness of oxide on the surface, and the resultant oxide layer is porous. The part can then be dipped in a dye bath to permanently colour the oxide, and finally the oxide layer is "fixed" by boiling the part in water, which seals the pores in the oxide and permanently seals in any colour. Because high currents are needed, a large power supply is needed. The electrolyte used is generally sulphuric acid (battery acid), which is potentially nasty stuff to handle.

In Titanium anodising, the oxide layer is relatively thin, and therefore not particularly durable. However, the

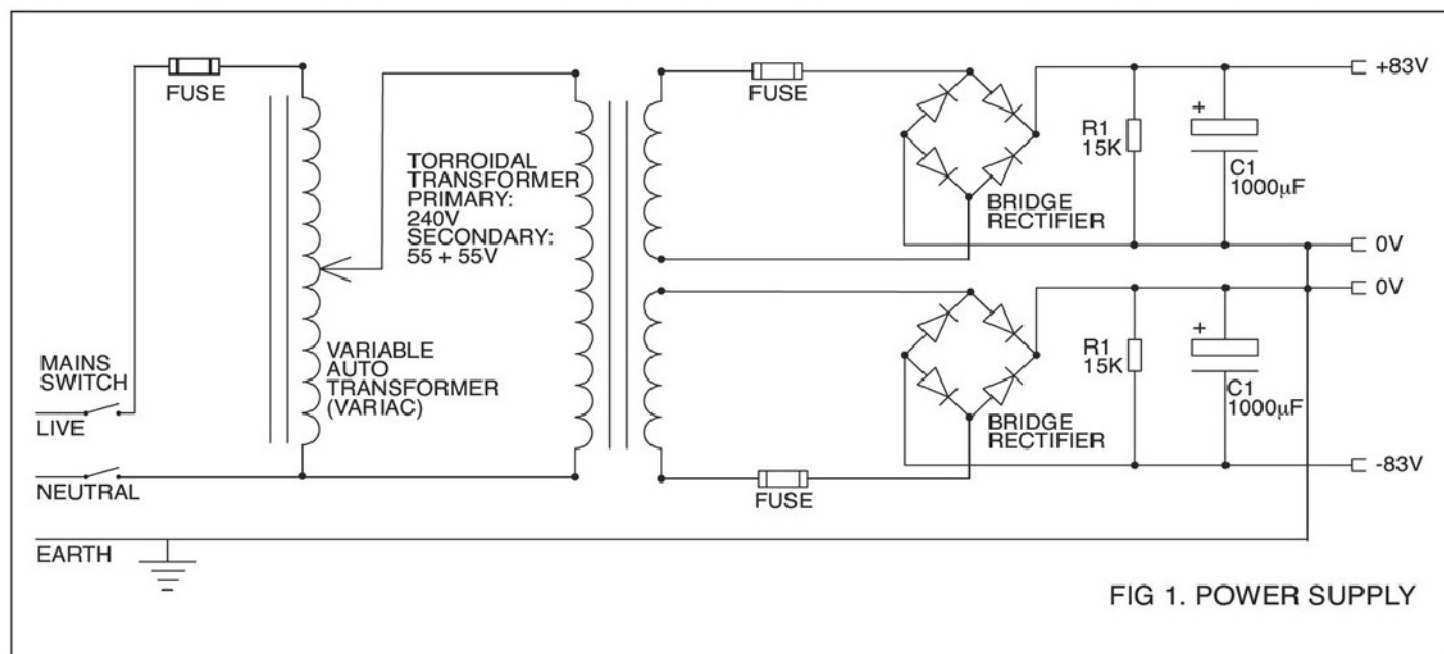


FIG 1. POWER SUPPLY

interesting feature of the oxide layer produced is that it is optically active. It is self-coloured with a colour that depends on the thickness of the oxide layer, which in turn, depends on the voltage used to create the oxide layer. Hence, the primary reason for anodising Titanium is for decoration rather than durability. The anodised surface isn't terribly resistant to abrasion, so unlike hard-anodised aluminium, it isn't at all suitable for "wearing" surfaces.

The range of voltages that produce interesting colours is roughly 20-160V DC, and the currents needed are relatively small, but it is necessary to be able to adjust the voltage in order to vary the colour produced. The electrolyte can be fairly innocuous - pretty much anything that will give a little conductivity to water will do. The electrolyte I used for the test pieces in this article was water with a splash or two of Jif lemon juice added together with Tesco's fizzy lemonade, but I have also used Cola with good results. It is also possible to use other conductive solutions, such as saline. So, with Titanium anodising, the electrolyte is much safer to handle than with aluminium anodising; however, the voltages needed from the power supply are significantly more dangerous, and potentially lethal if not handled safely.

Power supply

The power supply that I built can be seen in **photos 1 and 2**. It is fairly straightforward to construct. The first stage is a variable auto transformer, often known as a Variac, which feeds the primary of a second transformer that performs the function of isolating the DC side from mains voltages. The two secondaries of the second transformer each provide up to 55V AC, depending upon the setting of the Variac. This feeds a pair of bridge rectifiers with electrolytic capacitors across their DC outputs to give some degree of smoothing to the output voltage. There are also a pair of bleed resistors to ensure that the charge in the capacitors is bled off when the supply is switched off. Each of these resulting DC supplies will give a voltage in the range 0-83V, the top voltage being dependent on the Variac setting, and also on the actual mains voltage supplied to the Variac, which can vary from the nominal 230VAC. The + side of one DC output is connected to the - side of the other to

connect the two DC supplies in series, and this centre connection is grounded. This means that the supply can generate approximately 166V across its outer pair of output terminals, and each of these terminals is approx. 83V above or below ground potential. This means that it can be used as one or two 83V supplies if the left or right pair of terminals is used, or as a 0-166V supply if the outer pair of terminals are used. Current capability is roughly 0.7A, as the Variac is rated 0.7A and the second transformer is rated 100VA. This may well prove to be a limitation if the intent is to anodise larger pieces, as the current drawn will increase with the surface area of the anode and cathode used; however, higher current capacity components could of course be substituted.

The outputs of this power supply are to be treated with extreme caution. Voltages as high as 170V, and even significantly lower in the wrong circumstances, are potentially lethal, so don't be tempted to attach cables to the supply terminals or to workpieces, etc. etc., without first switching the supply off at the mains, and always make absolutely sure that you are not in electrical contact with the supply terminals or anything connected to them before you switch the supply on. It is a good plan to get into the habit of rotating the Variac dial to its lowest voltage before switching on the mains, and only crank up the voltage when you are sure that nothing electrical is touching your person. Also, as with all projects that involve working with lethal voltages, if you are not competent to undertake the construction safely, then find someone competent to build it for you, or take up a much less hazardous pursuit such as sky diving with a dodgy parachute.

The overall circuit diagram is shown in **Fig. 1** and the parts list at the end of the article gives part numbers and sources. In the parts list I have substituted a twin secondary toroidal 120 VA transformer for the isolating transformer that I used in my prototype version. I took some liberties with the isolating transformer in order to convert it from a 55-0-55V secondary to two separate 55V secondaries, and I wouldn't want to encourage the use of that particular approach by others. There are also a couple of detailed differences between the prototype and the circuit diagram - I didn't bother fitting an on-off switch or a fuse on the mains side on my

prototype, relying on a switched mains socket and a fused plug. Again, this is not something I would encourage others to do, and hence the additions to the diagram and parts list.

Construction is pretty straightforward, as should be apparent from the description and the circuit diagram. If it isn't, then please take to heart the advice given earlier, and find someone competent to build it for you. The metal case that I used was one that I had bought, back in the mists of time, and appears not to be available through RS any more; I have not listed an alternative box, but RS may well supply one that is suitable.

Anodising using the supply

The Variac dial has a scale that indicates the approximate AC voltage that it will output at various positions of the dial. As these don't give a direct indication of the DC voltage at the output terminals, I calibrated the dial using a digital multimeter and added a handwritten scale showing the DC voltage for the full output (0-166V) and for the half output (0-83V). In practice, these are only a guide, as the supply voltage will drop when current is drawn. I therefore use the supply with a multimeter attached, so that I can switch off the supply, dial the Variac down to minimum voltage, connect the leads to the part and the cathode, immerse the part in the electrolyte and if necessary, clamp the part so that it can't short to the cathode (if the part being treated comes into contact with the cathode, this will short the power supply out and result in blowing one or both of the output fuses), and then, having convinced myself that the setup is safe and I am not touching any part of the "live" equipment, switch the supply on and adjust the voltage up to the desired setting.

A simple anodising bath, suitable for small test pieces, is shown in **photo 3**. This is a small wide necked plastic bottle, filled with water to which I have added about a teaspoon of Jif lemon juice to make it conductive. Clearly, this is only good for small test pieces; however, other shapes and sizes of anodising bath can be improvised from suitably shaped plastic or glass containers. Needless to say, don't use metal containers for this purpose!

The cathode is at the left of the photo, and is simply a Titanium strip that is immersed in the electrolyte down to the base of the bottle, and folded over the rim of the bottle to hold it in place and to



Photo 3. The simple anodising bath.



Photo 4. The Niobium grabber.



Photo 5. Colour versus voltage.



Photo 6. Anodised earrings.

provide a connection point for the connection to the negative side of the supply, this being achieved by a small crocodile clip and a length of stranded hook-up wire. The anode in this case is a short piece of Titanium wire, again immersed in the electrolyte, connected to the positive terminal of the supply. The connection in this case uses a "Niobium grabber", shown in **photo 4**. This is a spring-loaded hook that retracts into an insulating sheath. These are commonly used in electronic testing for attaching test leads to components in a circuit. This particular one has its "hook" made of Niobium wire. Niobium, along with

Titanium, is one of the so-called reactive metals, and can also be anodised; the useful aspect of this is that if you need to completely immerse the object that you wish to anodise in the electrolyte, the end of the "Niobium grabber" can also be immersed without the possibility of contaminating the electrolyte, which could happen if other metals were used as the anode connection. This grabber was supplied by Reactive Metals Studio, Inc., contact details are in the suppliers list. An alternative would be to use a length of Titanium wire as the means of connection. If there is no problem with the anode connection being immersed,

then a simple crocodile clip could be used for the anode connection.

One thing that will be apparent when using this process is that gas is liberated at both terminals in the electrolyte bath, and the rate of liberation increases with the anodising voltage. This is due to water being electrolysed into its component gases, Oxygen and Hydrogen. Happily, unlike aluminium anodising, Titanium anodising is very quick (it takes of the order of tens of seconds) and doesn't improve greatly with prolonged treatment, so the volume of gas liberated will not be great. However, it is as well to be aware of what is happening because these gases are given off in precisely the right proportions for combustion and in any significant volumes will produce a potentially explosive mixture.

Photo 5 shows a "colour chart" created by anodising short pieces of wire at the voltages shown. This gives an idea of the range of colours that can be achieved. The surface finish of the metal has an effect on the results that are achievable. A matt finish seems to give more depth of colour than a highly polished one. **Photo 6** shows a pair of earrings that my daughter made from lengths of wire anodised using this setup.



Photo 7. The first attempt at anodising the pendulum.



Photo 8. A larger bath.



Photo 9. The second attempt at the pendulum.

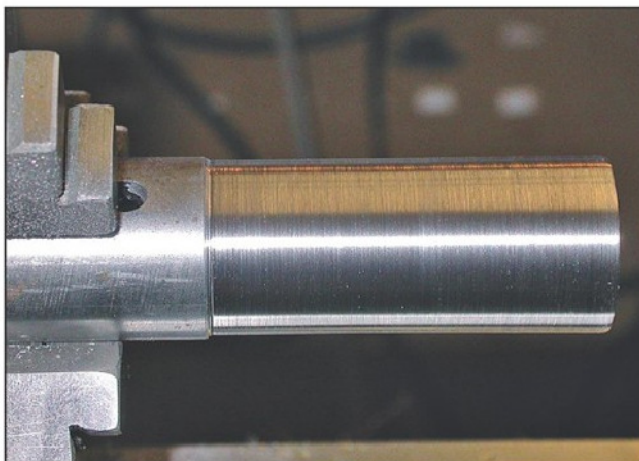


Photo 10. The finish prior to anodising.

Anodising larger pieces

I made a simple pendulum bob cover from Titanium tube - approximately 1in. diameter and 2in. long with an end cap press-fitted into one end and with an axial 6mm hole - as a try-out for the pendulum of my Titanium clock. This just about fitted in the small anodising bath, **photo 3** so I gave it a try to see how it looked with an anodised surface. **Photo 7** shows the initial result. There were a lot of things wrong with it, not least of which was that it showed up all of the imperfections in the surface finish, but also, because it was large compared to the size of the cathode plate, the anodising was very uneven. One side (shown in the photo) was coloured purple and the other side a golden yellow, which wasn't what I was looking for. This was fixed by making a rather larger cathode plate from a piece of thin aluminium and also using a rather larger plastic container, **photo 8**. Ideally, the cathode would have been cylindrical so that the distance from the part to the cathode would be the same at all points, but I found that this produced much more consistent and even results, particularly

if the part was rotated 180 degrees halfway through the process. The final result is shown in **photo 9**. The surface quality of the part being anodised has a significant effect on the appearance of the finished part. The wire I have used has an uneven, slightly rough surface, and this seems to produce a better end result than anodising a polished surface. Polished metal seems to produce more muted, less intense colours. **Photo 10** shows the surface finish on the pendulum bob before anodising. After turning the surface of the tube, I "grained" the surface with a medium grit sandpaper to give a consistent but rough surface.

A quick warning about machining Titanium

Titanium is probably the nastiest material that I have tried to machine. The first problem with it is that it work-hardens if you aren't careful. When I was drilling the hole in the 1/4in. thick end cap, all was going smoothly until the drill started to break through the back of the part. At that point, the drill started slipping in the chuck. I stopped, tightened the chuck, and had a second go at it, but the drill simply wouldn't touch the metal and all that happened was that it started to glow red. I finally persuaded the drill to go through by reversing the workpiece and having a go from the other side, first with a smaller drill and then with the desired 6mm drill.

The second problem is that Titanium will catch fire if you get it hot enough, just like Magnesium. When I was turning the tube and the end cap, I saw occasional flashes of light where the tool tip was touching the work, but nothing more exciting than that. However, after I had pressed the end cap into the tube I used a belt sander to clean up the end cap; again, I saw a couple of flashes, and thought little of it. A couple of seconds later, I had a small fire burning with an intense white flame in the axial hole - it would seem that Titanium dust from the sanding had accumulated in the hole, and had caught fire. Happily there wasn't enough of the dust to burn for long enough to start the rest of the piece burning - that would have been a bit more exciting than strictly necessary. However, it served as a warning that Titanium is potentially hazardous stuff to machine.

The problem seems to be that Titanium has poor thermal conductivity, so the heat generated in cutting and sanding isn't conducted away by the rest of the part. The result is twofold - hot Titanium work-hardens very quickly, and also, if it gets too hot, it will catch fire. Consequently, it is a smart move to use coolant when machining Titanium. Dick Stephen tells me that when he is "crossing out" his Titanium escape wheels, he has a

PARTS LIST				
Description	Specification	Quantity	Supplier	Part number
Variable auto transformer	Primary: 230/240V, secondary: 0-112% of input voltage at 0.7A	1	RS	347-3574
Torroidal transformer	2 X 0-55V secondary, 120VA	1	RS	223-8055
Bridge rectifier	2A, 400V	2	RS	395-2960
Resistor	15K, 0.6W	2	RS	148-770
Capacitor	Electrolytic, radial, 100uF, 100V	2	RS	519-4576
Fuse holder	5X20mm in-line	2	RS	414-601
Fuses	5X20mm, 2A, anti-surge	2	RS	488-8501
Grommet	Sleeved cable grommet, 6.3mm cable hole	1	RS	543-282
Terminal post	Black, 4mm	2	RS	423-201
Terminal post	Red, 4mm	2	RS	423-239
Fuse holder	Takes 20mm fuse; use 4A slow blow type	1	RS	311-0009
Miscellaneous	Mains cable, hook-up wire, croc clips, mains switch etc.		Bits box	
Box	Steel instrument box	1	Maybe RS	

water bath that clamps to the bed of the mill and he does the machining entirely under water to make sure that there is no possibility of starting a fire.

Related techniques

As with other anodising methods, it is possible to use resists on the part being anodised so that the areas of the metal covered with the resist are unaffected by the anodising. By using resists, it is possible to create more complex forms of decoration using different "layers" of anodising applied at different voltages.

It is also possible to use an "anodic painting" technique, where you don't immerse the part at all, but attach a brush to the cathode (negative side of the supply), wet it with electrolyte, and use it to "paint" anodised colour onto the part connected to the anode, varying the supply voltage to control the colour. There are some pictures of this on "How to anodise Titanium and Niobium" (weblink shown below), where you can also buy a DVD that shows how it is done. However, as it means handling a brush whose end is at a high voltage, this is a technique that should be limited to use with non-lethal voltages. **Photo 11** shows a couple of quick-and dirty test pieces. At the bottom is a scrap piece of Titanium sheet, showing that you can paint colour onto some areas and leave others uncoloured. At the top is the handle of a pair of Titanium tweezers, showing the effect of "painting" some areas at one

voltage and other areas at a higher voltage. The colour builds up quite slowly using this technique. With practice it might even be possible to produce results akin to watercolour painting.

It is possible to create a self-coloured oxide layer on Titanium just by heating the metal and letting it oxidise, in free air for example, by using a blowtorch. **Photo 12** shows an example of this technique. It is, however, far less controllable than anodising, and probably not appropriate if you wish to get consistent and even colours on the part. I also found that the oxide layer produced by this technique was very much less robust than that produced by anodising, and could be rubbed off with light handling, so this technique would only be appropriate for parts that are well protected. ■

Suppliers and other useful links:

1. RS Components. Tel: 01536 201201 Website: <http://rswwww.com/>
2. Reactive Metals Studio, Inc., 101A Air Park Rd, Cottonwood, Clarkdale, AZ 86324, USA. Voice (928) 634-3434, FAX (928) 634-6734. Website: <http://www.reactivemetals.com/>
3. "How to anodise Titanium and Niobium" video. Website: <http://artcraftworld.com/Titanium.htm>
4. "Mr Titanium's Introduction to Anodising Titanium" website: <http://mrTitanium.com/anodising.html>



Photo 11. A couple of test pieces.



Photo 12. Colours produced with a blowtorch.

LIVING WITH THE STENT TOOL AND CUTTER GRINDER ③

Charles Woodward shows us how to use this versatile machine

Wheel balancing

The necessity to balance the grinding wheels arose when I changed the plain wheel from 5in. dia to 150mm (6in.). The 5in. wheel was obtained from my workplace. I think it may have been cut down from a larger size as I couldn't find a similar wheel in the catalogues. I didn't anticipate any problems using the 150mm wheel which was only 6mm thick and much thinner than the 5in. wheel.

The wheel is mounted on a wheel nut flange, secured with 4 x M6 screws, and screwed onto the grinding spindle. When I put the 6in. wheel onto the machine, both DTI's vibrated excessively and the horizontal slide crept forward, not a good situation! What to do? I could change back to the original wheel; this was unthinkable, I had just spent £20 or so on a grinding wheel I could not use. A way of balancing the wheel would have to be found.

Fig. 15 shows a cross section of a grinding wheel assembly on a plain grinding machine. As can be seen the wheel is mounted on a wheel collet assembly. Prior to use, the wheel must be statically balanced; this is achieved by fitting the wheel and collet assembly onto a balancing arbor and parallel balancing ways; the weights are then moved until static balance is achieved. I decided to do something similar; I machined a step on the existing wheel flange and an aluminium disc with a matching step but 0.005in. shorter, Fig. 16. I drilled a circle of M6 holes in the disc and 2 x 2BA holes at the edge of the disc to clamp the disc to the flange. This disc would imitate the weights on the commercial arrangement and rotating the disc around the flange would be the same as moving weights within the balancing groove. In retrospect M6 was too large for the weights. I used one full (unmodified) screw and a lighter screw. I left the disc large enough to add smaller holes at a greater radius spaced

between the M6 holes if required in future for refining the balance.

The next thing was to balance the assembly. I had a spare spindle; originally when I built the machine I put a LH and RH nut on the spindle to secure the wheels but I grew dissatisfied with this arrangement as I realised I could not grind on both sides of the cup wheel without the cup wheel unscrewing. I assembled the plain wheel assembly (wheel flange nut with plain wheel, wheel flange, and balance weight) onto the spare spindle, rigged up parallels on the surface table after checking the levels, and statically balanced the wheel satisfactorily this way.

Subsequent to balancing I had removed the cup wheel and replaced it with a taper cup wheel for point thinning. On replacing the cup wheel I once again had out of balance wheels. This time I balanced the assembly on the machine after removing the drive belt; the bearings were free enough to allow me to do this. The next time I removed the cup wheel I marked the relationship between the wheel shaft and wheel and replaced them in that orientation without any problems. As an alternative solution for balancing, issue 42 of MEW 16 contains details of a surface grinding machine wheel which has been modified by the addition of a new wheel flange assembly, which allows balancing on a pair of knife edges.

Plain grinding

At the end of my previous article I mentioned using the Stent as a plain grinding machine. I have recently done a bit more work on the problems I encountered and plain grinding appears to be a practical proposition. When I built the machine one of the thoughts at the back of my mind was to use the machine as a plain grinding machine. I planned to motorise one of the tailstocks and rotate

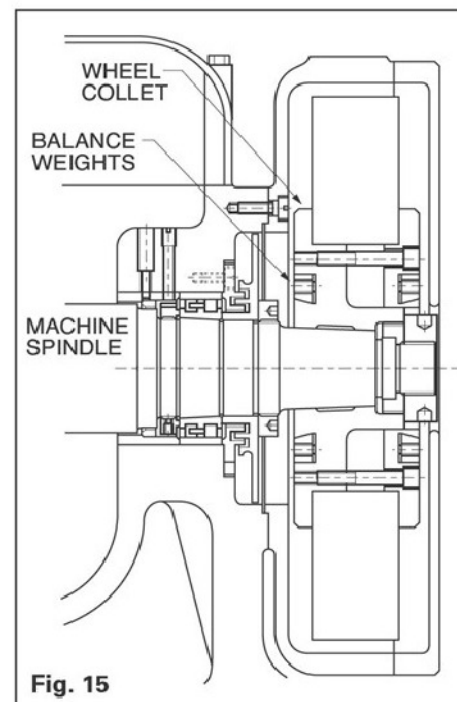


Fig. 15

the component I was grinding between dead centres. I bought a geared motor from Maplins, enclosed it in a plastic case, and attached it to the tailstock with an aluminium bracket. I had previously machined the front of the tailstock to give a bearing for a drive pulley, photo 29. I made up a couple of 1:1 pulleys from Tufnoll and used a round belt for the drive. The motor is 12 volt which I drive from the Black and Decker Minicraft controller, photo 30. When grinding a piece of 1/2in. dia x 4in. long silver steel, photo 31, I had previously had limited success, using the 5in. wheel. The component got hot, expanded, and eventually the belt slipped and stopped rotating, the finish wasn't bad but it wasn't good either. I had made a couple

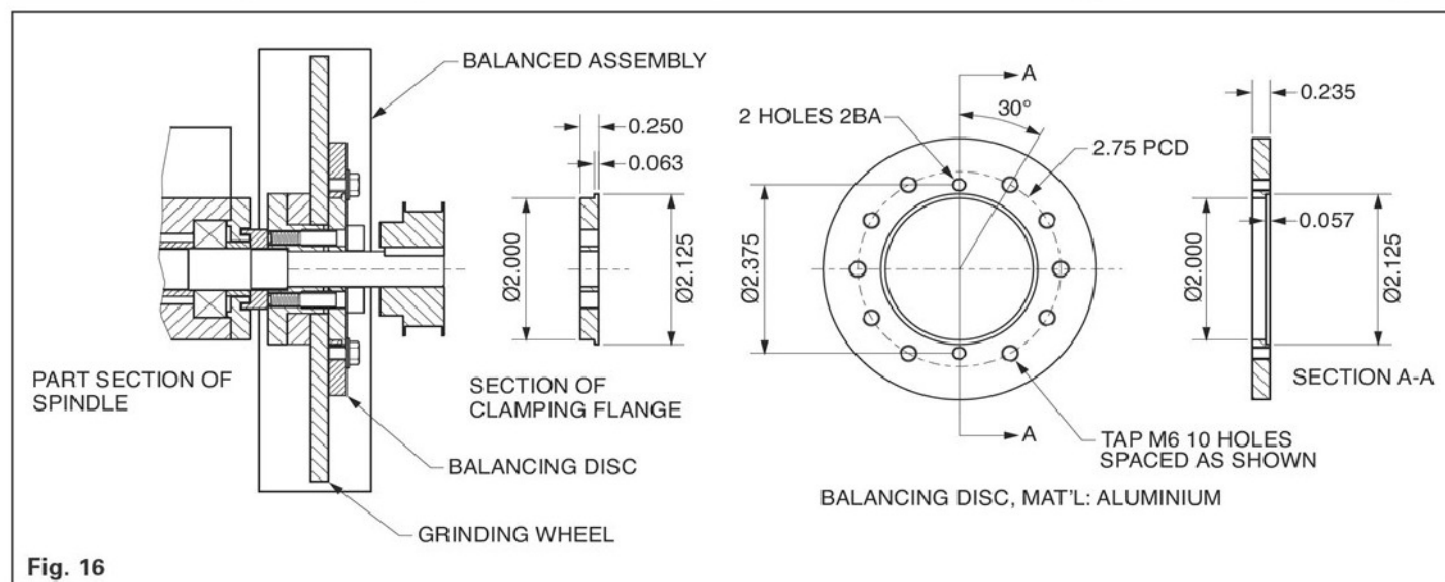


Fig. 16

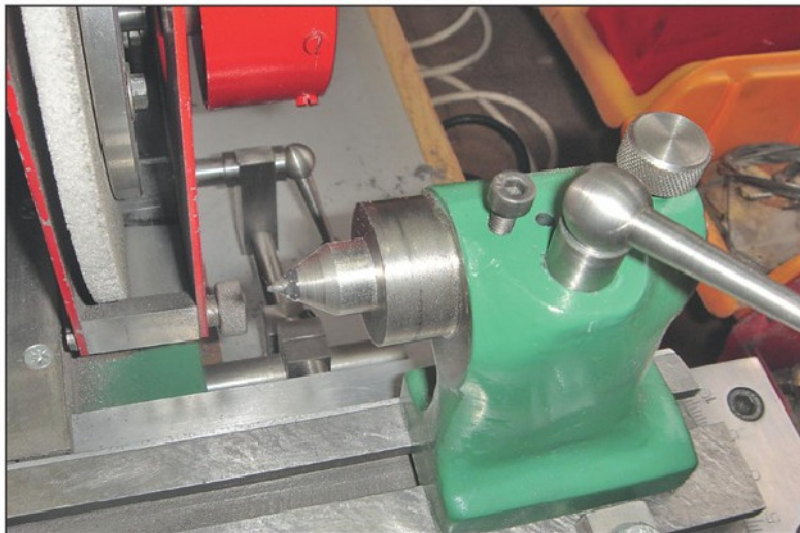


Photo 29. The tailstock has been turned to take a pulley.



Photo 30. The transformer for driving the drill.

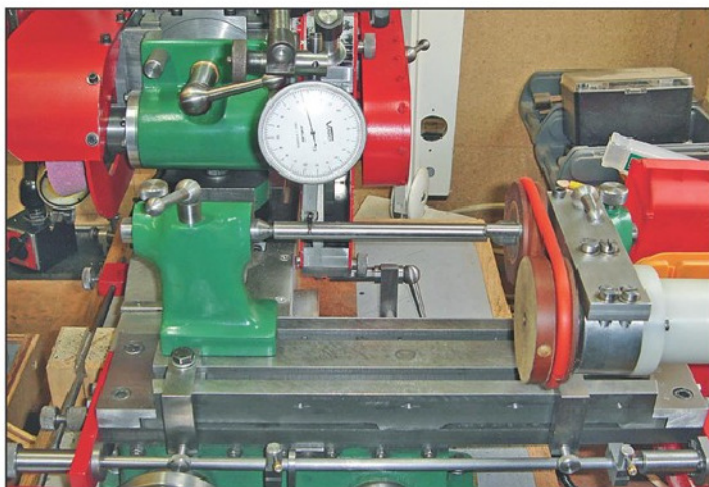


Photo 31. Grinding a length of silver steel.

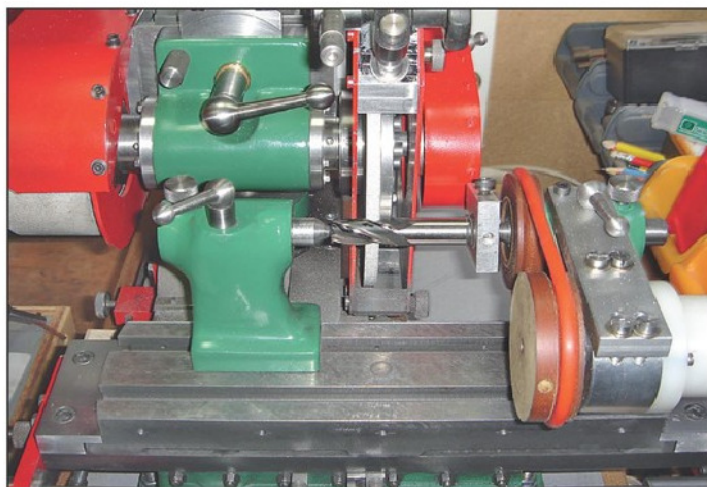


Photo 32. Spinning down a helical cutter prior to regrounding.

of brackets to attach to the table in order to easily set the taper, these can be seen at the edge of the table in the previous photo, and these seemed to work OK. When I changed to the narrower 6in. dia wheel I did not have the same problem with heat and the finish appeared to improve, this is possibly because I had not attempted to balance the 5in. wheel on my previous attempts. Marks which could still be seen on the ground surface were reduced, and when I removed the cup wheel the finish was further improved. I think the marks could be due to using a cheap single phase grinding machine to power the Stent and slight

imbalance in the grinding wheel. I don't think the finish is quite up to commercial standards, but it is quite acceptable and I have used it to grind the diameter of an end mill prior to regrounding, **photo 32**. I once had a 5in. lathe of fairly light construction. I originally ran it with a single phase motor, and on taking light cuts, would experience a spiral pattern superimposed on the surface finish. I tried all ways of removing this defect, but it only disappeared when I changed to a 3 phase motor. I think I could be getting a similar effect on my grinding tests.

Counter rotating drilling unit.

In my previous article I said if the drive unit did not work in the Stent I could use it for a counter rotating drilling unit on the lathe. As part of my hobby I do the occasional clock repair. I recently had a Westminster chiming clock with a badly worn pivot on the going train. The obvious answer to repairing the pivot was to cut it off and fit a new pivot. The pivot was .030in. dia and I wasn't sure of my ability to centre, drill and fit a new pivot on the Myford, having used small drills before I know they are very prone to wander, and I didn't fancy making a whole new wheel and pinion assembly. From my experience in industry I knew that counter rotating a drill helps to keep it in a straight line and greatly reduces the tendency to wander. Now was the time to make a counter

rotating drill unit. Casting about for a suitable spindle on which to hang my drive unit I came across a old revolving centre which I had recently converted from a male centre to female centre by removing the male point and fitting a MS sleeve which I then bored in situ to create a female revolving centre.

I made an aluminium block which went over the centre body and to which I could attach the drive motor bracket, I bored out the centre of the female centre to take an arbor on which I mounted a small drill chuck. The drive pulley fitted over the body of the female centre, and there I had a driven drilling unit which would mount into the tailstock, **photo 33**. The job was completed and the clock is now ticking away in the workshop, waiting to be put back in its case.

While I have written this article about tool grinding using the Stent I recently made, I have no great expertise in this field. I worked for a long time in engineering before retiring and I am still interested in the subject. I have loads of peripheral experience on grinding and can usually tell when a cutter is incorrectly ground. The wheels I have used are 4in. (100mm) taper cup wheel grade WA60KV. I used this for general grinding. For point thinning and grinding chipbreakers on turning tools I use a plain wheel 150mm x 6mm grade WA60K5V, and 4in. x 2in. cup wheel 38A60KVS. **To be continued...**

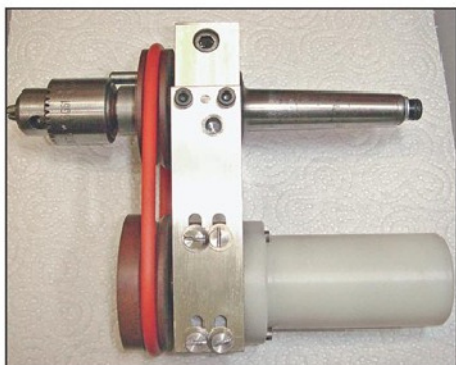


Photo 33. The counter rotating drilling attachment. This is driven by a 12 volt electric motor.

To help you get the best from The Model Engineer exhibition

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them. The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect. We look forward to seeing a sample of your work at the show!

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits – not covered by the above

Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384

- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – nonworking.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale, 12in for 1:25 scale, 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medal.

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit), scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under their own power of any type. Can be either free-running, tethered, radio controlled or slot car, but must represent a reasonable full size replica.

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of MyHobbyStore Ltd.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of MyHobbyStore Ltd., in his/her possession

until required for renovation and display at the following Model Engineer Exhibition.

4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by MyHobbyStore Ltd
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
 - (a) That exhibits are their own bona-fide work.
 - (b) Any parts or kits which were purchased or were not the outcome of their own work.
 - (c) That the model has not been structurally altered since winning the qualifying award.
7. MyHobbyStore Ltd. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date. LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.
3. Competitors must state on their form the following:
 - (a) Insured value of their model.
 - (b) The exhibit is their own work and property.
 - (c) Parts or kits purchased.
 - (d) Parts not the outcome of their own work.
 - (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of MyHobbyStore Ltd.
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by MyHobbyStore Ltd. are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy'. Past winners at any of the exhibitions promoted by MyHobbyStore Ltd. will not be eligible for re-entry into the competition unless it has been substantially altered in any way.
7. MyHobbyStore Ltd reserve the right to:
 - (a) Transfer an entry to a more appropriate class.
 - (b) Describe and photograph any models entered for competition or display and to make use of any such photographs and descriptions in any way they may think fit.
 - (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
8. Entry into the competition sections is not permitted by:
 - (a) Professional model makers.
 - (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers prior to the show.

9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
10. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
11. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

IMPORTANT NOTE: PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS MYHOBBYSTORE LTD WILL NOT ACCEPT LIABILITY FOR ANY LOSS.

CLOSING DATE 20th NOVEMBER 2009

THE MODEL ENGINEER EXHIBITION

11th – 13th December 2009

Please return completed form to:

Model Engineer Competition,
MyHobbyStore Ltd., Berwick House,
8-10 Knoll Rise, Orpington, Kent BR6 0EL

ENTRY NO.

OFFICE USE ONLY

CLASS	ENTRY NO.

ENTRY FORM - COMPETITION & LOAN MODELS

PERSONAL DETAILS (Please print)

Surname _____ Forename(s) _____ Age _____

Address _____

_____ Post Code _____

Home Tel No _____ Daytime Tel No _____

Model Club or Association _____

Have you entered before? Y ☐ N ☐

Do you purchase or subscribe to a MyHobbyStore Ltd magazine? Y ☐ N ☐

How many years have you been a modeller? _____

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

MODEL DETAILS – PLEASE TICK BOX IF MODEL IS FOR LOAN ☐

Entry Class (competition entries only) _____

Model Title (to be used for catalogue and display card) _____

Model Description _____

Model Scale _____ Length _____ Width _____ Height _____ Weight _____

Type of construction _____

Parts not made by you and commercial items _____

Have you supplied a photograph? Y ☐ N ☐

Are you supplying Judges Notes? Y ☐ N ☐

Value of Model (MyHobbyStore Ltd will not insure the model unless a value is entered) £ _____

Name and address of your local newspaper _____

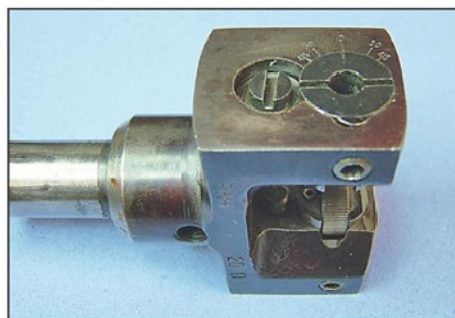
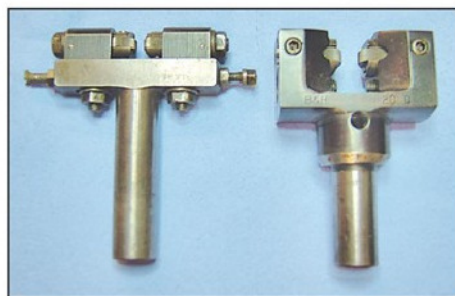
SCRIBE A LINE

Philip Bellamy

It very easy for comments and criticism to get out of hand and the uncalled for remarks expressed in your October issue of MEW concerning Philip Bellamy's item on knurling are unpleasant to witness and surely only serve to damage your reputation as an Editor as well as reflect badly on the Magazine. Whilst you use the guise of free speech to justify your editorial decisions, I'm sure you realise that freedom of speech has to be balanced against a duty of care that respects individuals, fosters understanding and doesn't encourage bigotry and intolerance.

Of course, there's no smoke without fire and whilst you and Peter King might be irritated by Philip Bellamy's manner which, admittedly, sometimes lacks due consideration of other peoples' feelings, one has to remember that none of us are perfect and we should at least try to understand where those who we find difficult are coming from. For example, one of the things that seem to upset Philip is your reluctance to acknowledge receipt of letters and articles sent in for publication. What he may not realise is that this is the way you seem to treat all contributors - whilst in the past I've been slightly irritated by this lack of courtesy it doesn't bother me that much, but I can understand that for some, it's a more important issue.

Whilst I thought Dave Fenner's article very interesting I believe clearer advice could have been given about knurl cutting, but I can see no justification for Philip Bellamy's derisory few words about David. However, the technical information provided by Philip was useful and relevant to the subject. In contrast, Peter King's bitter sounding tirade offers no useful information whatsoever. Why people should express so much antagonism over the quality of tools people have acquired over a lifetime is quite beyond me. Many of these expensive tools are available at a reasonable price on the second hand



Cover pictures

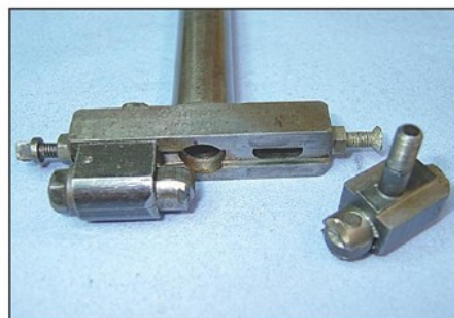
After reading about problems for cover pictures (I don't want to see motorbike pictures) I can understand people being disappointed by seeing a shaper on the cover and no article inside.

HOWEVER! I like the picture of the die filing machine on the front of MEW 155 and having thought about making one earlier, I like the design shown on your cover. So I lay down the challenge to your more able readers. If you see something good on the cover of MEW (as is the norm) submit an article on or

market and by constructively discussing their attributes in magazines like MEW, readers are able to sensibly choose between purchasing the real thing, which if you are lucky you may find in a box of supposed odds and ends in a rummage sale, or take up the challenge and make your own, as has been suggested.

Peter King may consider Philip Bellamy an armchair critic who has made nothing, but he should realise that he is an elderly gentleman who has not only spent a lifetime actively modelling but also helps others to enjoy the hobby. His skills as a model engineer have been significantly enhanced by first class degrees gained in both mechanical and electronics engineering, as well as a successful professional engineering career developing leading edge technologies. I believe we should be grateful to engineers like Philip who take the time and trouble to help widen our limited understanding.

Getting back to the subject of knurling there was an interesting article on the subject written by Allan Mackintosh in MEW back in August/September 1991 which discussed knurling and the merits of the Quick approach. Whilst it was interesting to read about John and David's experiments, readers might also be interested to know how John Slater has successfully designed and made his own version of the Quick knurler which is shown in photo 15 on page 75 of the special edition Reader's Workshops published recently. Unfortunately, John is currently very ill and whilst all his friends wish him well it will be quite some time before he'll be able to write up his designs. However, for those interested in following this path they should be aware



about it. So then your challenge can be to find something inspiring for us to respond to. A bit like fishing. So find some tempting bait & issue us with the challenge.

David Lewis

The editor replies: *The die filing machine is a good example of a cover photo that shows you how to make something. I believe the majority of readers should be able to look at that photo and be able to sketch out a simple design for a die filer of their own.*

that the set-up accuracy is quite critical and John not only used Quick knurling wheels but also the special hardened and ground steel wheel carrier bush and cap to support the knurling wheels. Quick do have worldwide agents - the UK agent is TPH Machine Tools and they provide friendly advice and good service.

Whilst Philip draws a clear distinction between cut and impressed knurls when using the Swiss tooling, it's interesting to note that the Quick system makes no such distinction and recommends that all knurls should be cut. That is not to advocate that we should throw away our more conventional knurling tools, but simply be aware of the likely problems and know when it's better to either choose a more suitable material for impress knurling or go for a cut knurl approach.

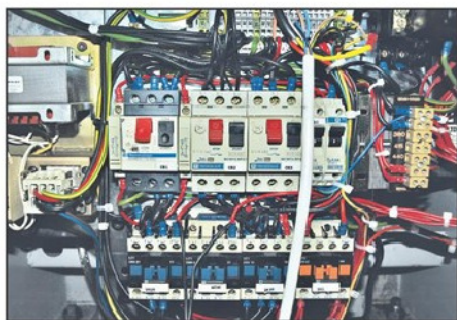
The Swiss tool does seem a more straightforward tool to make in a home workshop and the barrel shaped knurls seem readily available from J & L, but the double wheel intended for cutting seems to be more difficult to track down. ME's may be interested to see the 3 photos which show two alternative British designs using a similar type of holder to Philip's Swiss system. They both have hollow 0.75in OD spigot mounts which, I believe, are intended for mounting on a capstan, but could equally well be mounted in a lathe's topslide tool holder. Like a lot of capstan tooling they seem rather fiddly to set up as the two wheels are rigidly fixed and independently mounted. These particular tools are very old, purchased at a club sale and, as yet, I've not tried them out, but interestingly they are both fitted with straight square profiled knurling wheels! If anyone has any experience of using these particular types of tools I'd be interested to hear their views. For example, if used on a capstan turret, what sort of lead should be used on the work piece to avoid spoiling the work and/or damaging the square profiles on the knurl wheels as they engage with the work?

Stuart Walker, by email.

The editor replies: *I have apologised to Phillip in Ed's Bench. I was not aware John Slater was ill. I am sure you will join me in sending our best wishes to John for a speedy recovery.*

YOUR CHANCE TO TALK TO US!

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



M300 inverter

I am pleased that Brian Jones (Scribe a Line MEW 154) found my article on the Harrison M300 Inverter drive of interest. However, I must correct a few things. My M300 had also spent some time at East Surrey College and had also been supplied by RK International Machine Tools. They must be twins!

Having been an electronics and electrical engineer for some 47 years, the left hand pedestal interior was nothing compared with the inside of an airborne radar or surveillance pack, or indeed a mainframe computer. The only problem was accessibility (you have to sit on the floor!) and the coded connections shown on the handbook circuit diagram. However, a close look at the Din Rail mounted "WAGO" connections solved that as they are all marked with the necessary codes to identify them against the diagram. This "as finished shot" clearly shows the replacement 240Vac in transformer for the lighting together with the wiring changes made. The photo on page 22, MEW 154 does clearly show the 415Vac original transformer.

Yes all the contactors are 415V rated, but you do not have to change them as the control voltage, as I pointed out in the article, is 110Vac, and remains so in my conversion. Of course you have to change the CB1 circuit breaker, simply because the line current at 240Vac is higher than in the 415Vac version and the adjustment range of the overload device would not have been sufficient. In addition, I added a circuit breaker for my DRO. Both these items were sourced from one of my local electrical wholesalers and are "identical", manufacturer and type as the those originally supplied by Harrison. 25 Amp mains cable and suitable isolator switchgear was readily available from the same wholesaler; only a new MCB was necessary to be placed in my primary distribution box, which is ahead of all the house distribution boards involving "normal" breakers and RCD combinations.

Every one to their own choice of course, however with four machines, all run on

their own inverters, I am convinced that this was the right way to go for me. The motors have better protection, you can ramp up and down the speed without snatching at a high starting load and the slow speed jog is excellent for clocking under power. With a variable frequency control as fitted low speed thread cutting is an easy thing to do when required.

Ken Willson, by email.

Website

What a great idea to put back numbers on the website, especially for those of us who have not been subscribing for less than a year. It is great to be able to print out from them but how about an index? Is it your intention to leave them permanently on the website?

Is there any chance of more being put on with free access? This would be appreciated by those of us who are retired and therefore of limited means.

Regarding putting all back numbers on the web I am in favour but how are you planning to charge for use thereof? Again an index would be of huge assistance in tracking down articles, subject matter etc.

I think I may have mentioned this before, perhaps in articles I have sent in for publication. Is it possible to put on the web copies of relevant articles used as reference material so that readers can see what the writer is referring to?

Thanks for a great pair of magazines and for the initiatives and new ideas you are bringing to these publications. More strength to your elbow!

Ian Strickland, by email

The editor replies: There are indexes to both *Model Engineer* and *Model Engineers' Workshop* on the web at www.colinusher.info (just follow the links). I don't know whether more MEWs will be put on the web? Probably not but current additions going on the website in the near future are the complete set of

Model Mechanics magazine from the early 1980s. There are only 12 or 13 of these but they are quite interesting. Also the *Model Engineer Centennial Specials* will be put up. I have supplied the web editor with ten issues of this magazine to upload. (Does anyone know if more than ten were published?)

Also, I want to put up *World of Model Engineering*. I have about four of these but am not sure how many were published. (Again, can any reader tell me?) I would like to purchase the missing issues to put on the web. Does any reader have any copies of these magazines? I would be willing to pay £5 each including postage for the missing issues.

Website 2

Thank you for an excellent magazine. In the current issue you float the idea of making old issues of MEW available, for a fee, on your website. This is an excellent idea, as it allows those of us who didn't discover MEW until some years after its initiation to chase down articles and references where back numbers are no longer available. I very much hope it goes ahead.

As a novice model engineer (starting again about 50 years after doing metalwork at school; it is amazing how much you forget in 50 years), one of the things I am quite good at is breaking taps. I'm slowly learning how not to do this, but it still leaves me with a lump of mild steel, which took hours to machine, ruined because I've broken a 2BA tap in it. Does anyone know of a company that can remove broken taps? In one of my books (the excellent "Machine Shop Essentials") suggests the use of a "tap disintegrator" or "spark eroder", and goes on to say "many machine shops have these machines and offer this service". Do readers know of any in the UK (ideally northern England)? Contact details would be very welcome.

Vic Edy by email

Articles unaltered

Per your response below of "Articles are published as received, some imperial, some metric, some as both. We don't change systems."

My reference was your response to the letter entitled "Dimensioning consistency" in Scribe a Line, MEW No. 143, October 2008 in that "The original article used NC American threads unlikely to be unavailable (sic) in the UK..." which was your justification for the changes.

I am glad to hear that you are now maintaining all measurements as provided so that the reader may make their own substitutions.

From my side of the pond BA taps are generally unavailable. That is why I am looking for an article on what substitutions are the best.

Graham Bennett, Canada.

The editor replies: Would any reader care to take up the challenge and supply an article about the different thread systems and conversions?

WRITE TO US!

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

Write to the Editor, David Clark, Model Engineers' Workshop, MyHobbyStore Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL. Alternatively email: david.clark@myhobbystore.com

THE STAR LETTER OF THE MONTH WINS A WORKSHOP PRACTICE BOOK

SCRIBE A LINE

Domestic clutter

In the latest issue of MEW Ian Varty mentions the use of a domestic baking tray to hold clutter on the top of the headstock of his lathe. Why stop there? I have about two dozen of these for holding all sorts of half finished projects, tools, materials etc. The problem is that they can often cost as much as £5 each although Tesco often have them for 99p. Once when I bought five in one go the girl at the checkout did actually query whether I realised I had five of them.

John Florentin, by email.

The editor replies: Yes, they are a good idea and if you put one below the bed of your lathe (underneath the chuck area) it makes it a lot easier to remove the swarf.

Not up to the mark

I feel bound to point out an error in the article in MEW No155 page 12 by the excellent Harold Hall, the last thing I wish to do is gripe but as the error is fundamental, it should not go without comment.

Harold's text description of the process to obtain a .6 degree angle is correct, but the diagram is NOT. There are two lines scribed 100mm apart and if they were set against the test bar they would be correct, however it is impossible to place the left mark against the test bar as in SK1-C as there is material to the left of the line and the corner of the bar will be against the rod, at the mark this would result in a gap which will lead to error, (albeit very small - this mark should not have been drawn on the diagram).

In the text the bar is correctly measured from its end, i.e. the corner, which would be correctly placed against the bar as intended to give the angle.

For the young and uninitiated, it is important that these points are corrected otherwise they will be permanently adopted incorrectly.

Marcus I Middlehurst, Wales.

Authors wanted

The Crowood Press is one of the few remaining independently owned publishing houses. We specialise in publishing in-depth practical books aimed at the hobbies and special interests market. We are looking to expand the model engineering section of our list and we are interested in hearing from anyone who may have a proposal for new titles that they would like to submit for consideration.

We have already published a range of books in the area such as, Stirling Hot Air

Engines, Roy Darlington & Keith Strong and Miniature Internal Combustion Engines, Malcolm Stride and we are always keen to consider new aspects.

Our books are fully illustrated, practical in nature, provide in-depth guidance and insight to the reader and are intended to inspire as well as instruct.

For further details please contact: Mollie Dennis, The Crowood Press, The Stable Block, Crowood Lane, Ramsbury, Marlborough, Wilts SN8 2HE mollie@crowood.com Tel: 01672 520320 Fax: 01672 520280 www.crowood.com

Centre point

Harold Hall's centring spigot for use with the new Hemingway cross slotted faceplate is to be commended; however, there is a better, more universal way. Purchase a draw in collet (2MT for the Myford series 7) and turn a range of spigots with a common base size to fit the collet, say 12mm diameter. You now have a tool which has wide application, in fact you can also turn stub mandrels with a threaded end or internal thread and capping plate or washer to hold circular objects such as gear wheels, pulleys and loco wheel etc. You now have excellent repeatability for mounting various objects.

Also, I think that readers would be better advised to bore for and cut the thread first before the larger 1.25in. counterbore. In particular using the rough and ready threading using a tap as illustrated, setting it up and cutting down the bottom of a hole would make it difficult to see what you are doing! I fortunately use a 16NG internal full thread insert for such threads (and the smaller tapping size) but even so it is much easier to see what you are doing. Checking the fit is just the same. I also have the requisite tap set for final finishing if required. As they say on a famous children's TV program, here is one I made earlier.

Ken Willson

Engineering Development

Everything that I have ever written, drawn or made could have been improved upon. Most of it was and the rest was ignored; such is life.

Sometimes one comes across a topic that does not seem to have been adequately covered and one rises to the occasion and undertakes some original thinking, hoping that it will be of value to someone.

It can be "challenging" when after many hundreds of hours, a prototype finally emerges on to the bench because within minutes another engineer will walk past, look at the job for seconds and say, "that's interesting but it would have been much better if only you had done ..."

So often he is right and the design goes in to the bin and one starts over again. The second iteration emerges and sits on the bench but at this point yet another walks past and says, "I would have put this bit over there". Where was this man when there was a blank sheet of paper on the board and inspiration would not come?

And again and again. It does however yield success in the outside world and is to be welcomed. It's a (painful) oiling of the wheels of progress.

I do not agree with all that Dave Fenner writes but I have and do learn from him. I am grateful for his efforts.

Phillip Bellamy has over the years submitted many letters to MEW and ME and these have always added to the bases of the articles referred to. Certainly I would be the poorer without them.

Can PB be persuaded to write his own articles? His letters are erudite and well illustrated. Could DF add to them in SCRIBE A LINE or could an Ed. get them to cooperate to write the ultimate combination of practical workshop usage and best manufacturing practice? I look forward to Issue 156 but we can do without the vitriol and perhaps Editor, a few of the undiplomatic words might get regularly lost in the printing process. Let's stick to engineering and positive thinking.

Alan Kemp, Winchester.



Ken Willson's finished faceplate.

gandmtools

probably the best website for machines and tooling in the model engineering world!

just a selection from our current stock

Go to the "new arrival" section of our website: www.gandmtools.co.uk for our latest additions to stock.

Check out our ebay shop for many more bargains, go to: www.stores.ebay.co.uk/gandmtoolsales



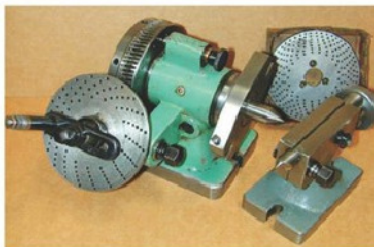
Colchester Bantam 800
Lathe, VGC, Tooled, 3ph,
£1000.00 plus vat.



Harrison M250 Lathe, Tooled,
3ph, VGC,
£2250.00 plus vat.



Tom Senior M1
Vertical/Horizontal
Mill, 3ph,
£700.00 plus vat.



Tom Senior Dividing Head
& Tailstock,
£425.00 plus vat.



Tom Senior D/S/M
Vertical Turret head
Mill, R8, 3ph, VGC,
£2450.00 plus vat.



Harrison M250 Long Bed
Lathe, VGC, Tooled,
£1750.00 plus vat.

- Telephone enquiries welcome on any item of stock. • We hold thousands of items not listed above.
- All items are subject to availability. • All prices are subject to carriage and VAT @ 15%.
- We can deliver to all parts of the UK and deliver worldwide.
- Over 7,000 square feet of tools, machines and workshop equipment.

G and M Tools, The Mill, Mill Lane Ashington, West Sussex RH20 3BX



Opening times: 9am - 1pm & 2pm - 5pm Monday to Friday.



e-mail: sales@gandmtools.co.uk
Telephone: 01903 892510

**Closed Saturdays,
except by appointment.**

web: www.gandmtools.co.uk
fax: 01903 892221

IN OUR NEXT ISSUE

Coming up in issue 157, on sale 30 October 2009



AN ALTERNATIVE TO
THE FOUR JAW CHUCK.

A TAILSTOCK DIE HOLDER
FOR THE MINI-LATHE.



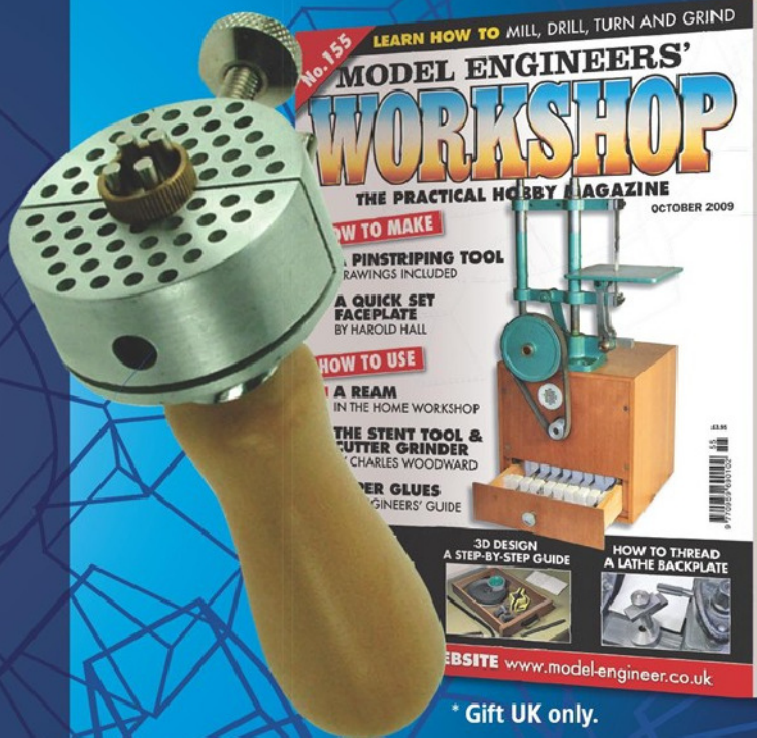
A COMPREHENSIVE
LOOK AT FLYCUTTING.

(Contents may be subject to change)

DON'T MISS THIS GREAT ISSUE – see page 10 and subscribe today

FREE UNIVERSAL WORK HOLDER when you subscribe to MODEL ENGINEERS' WORKSHOP

- FREE UNIVERSAL WORK HOLDER *
- 13 ISSUES OF MODEL ENGINEERS' WORKSHOP A YEAR
- ACCESS TO SUBSCRIBER ONLY CONTENT
- DELIVERED STRAIGHT TO YOUR DOOR



The Universal Work Holder is ideal for holding small and odd-shaped parts for filing, painting, engraving, sawing, shaping etc. The four steel pins can be placed anywhere around the head and are also useful for bending and forming wire around. The handle can be removed and the head can then be locked in a bench vice.

* Gift UK only.

BY PHONE: 08456 777 807 quote ref. SG34 **ONLINE:** www.model-engineer.co.uk/subscribe
Alternatively, you can complete the form below and return, with payment, to the address provided.

UK ONLY SUBSCRIPTIONS:

I would like to subscribe to *Model Engineers' Workshop* for 1 year (13 issues) with a one-off payment of £44.50, **SAVING 13%**

OVERSEAS SUBSCRIPTIONS:

I would like to subscribe to *Model Engineers' Workshop* for 1 year (13 issues) with a one-off payment: **Europe (incl Eire) £50.40** **ROW Airmail £52.80**

For all Canadian, North and South American subscriptions please call 001 732 424 7811 or go to www.ewmag.com

PAYMENT DETAILS:

☐ Postal Order/Cheque ☐ Visa/Mastercard ☐ Maestro

Please make cheques payable to MyHobbyStore Ltd and write code SG34 on the back

Cardholder's name.....

Card no: (Maestro)

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

Signature Date

YOUR DETAILS:

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

Address

Postcode Country

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

E-mail D.O.B.....

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY):

CODE SG34

I would like to subscribe to *Model Engineers' Workshop* paying £42.00 for 12 months by Direct Debit, **SAVING 18%**

BIGGEST SAVING!

Please complete form below

Instructions to your bank or building society to pay by Direct Debit.

Originator's reference 422562



Name of bank.....

Address of bank

.....

.....

Account holder.....

Signature Date

Sort code Account number

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

Reference Number (Official use only)

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

Terms & Conditions: Offer ends 30th October 2009. Subscriptions will begin with the first available issue. Please continue to buy your magazine until you receive your acknowledgement letter. Refund requests must be in writing to the Publisher and will not be given on accounts with less than £20 credit. A £5 admin charge will apply and will be deducted from any refund. Refunds will only be given at the Publisher's sole discretion. We will use the contact details supplied to communicate with you regarding your Model Engineers Workshop subscription. By supplying your email / address / telephone / mobile number you are happy to receive information and/or products and services via email / telephone / post from or in association with MyHobbyStore Ltd or its agents who may mail, e-mail or phone you with information and/or products and services reflecting your preferences. Tick if you don't want offers from us ☐ and/or third parties ☐

SEND TO: MODEL ENGINEER WORKSHOP SUBSCRIPTIONS, TOWER HOUSE, SOVEREIGN PARK, MARKET HARBOUROUGH, LEICS LE16 9EF

Need a kit? Get the book...

Get the very best from your workshop. Hemingway Kits provide over 70 unique tooling projects:

- 1 Add capabilities to your workshop
- 1 Work to finer limits
- 1 Finish jobs more quickly
- 1 Your production engineering team!



Send £2 (refundable) for our latest workshop catalogue or visit our website

Hemingway

Hemingway Kits
126 Dunval Road, Bridgnorth
Shropshire WV16 4LZ United Kingdom
Tel/Fax: +44 (0) 1746 767739
Email: info@hemingwaykits.com

www.hemingwaykits.com

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

1,000's

OF BOOKS & MAGAZINES FOR THE MODEL ENGINEER

OUR LBSC COLLECTION:

SHOP, SHEAD & ROAD - THE ORIGINAL BIBLE FOR THE LOCO BUILDER

This famous book first appeared in 1929 and established LBSC in the forefront of miniature steam locomotive design for all time. Features diagrams and plates illustrating most of the locomotives that he built over the years. It is a complete course in locomotive building and this latest reprint, some 80 years after it was first published is, in a way, a tribute to a great and much respected designer. **£15.95 (E)**

'MAISIE' WORDS AND MUSIC

The large boomed 'Atlantics' of the old Great Northern Railway, designed by Mr H. A. Ivatt, were among the most successful engines of their day. They worked all the principal express trains on the GNR and its successor, the LNER, until the advent of the Gresley 'Pacifics'. Even after that they continued to do 'top-link' work with lighter trains. This book covers in detail the building of a 3 1/2" gauge model of this famous prototype and makes enjoyable and informative reading. **£12.95 (E)**

BUILDING 'SPEEDY' A GWR 0-6-0 TANK IN 5" GAUGE

LBSC's 5" gauge GWR 0-6-0T locomotive 'Speedy' was a design produced at the very height of his inventive powers in a period regarded by the experts as the 'vintage' years of LBSC. Literally hundreds of examples of this model have been and continue to be built. In spite of the passing of time and the introduction of rivals in the gauge and style, 'Speedy' remains a very popular model and even if you do not intend to build this particular design, this book is generally informative and worth reading. **£7.95 (C)**

BUY ALL THREE GREAT LBSC BOOKS for just £30.00 POST FREE

Please quote MEW106 when ordering offer closes 12.11.09

Our Aero Engine Collection:

Model Petrol Engines* by Edgar Westbury **£11.95 (C)**

and any three of the following books:

The Atom Minor Mk. III* by Edgar Westbury **£ 5.95 (B)**

Magnetos Simply Explained* by F. N. Hutton **£ 4.95 (B)**

Model Glow Plug Engine* by C. E. Bowden **£ 5.95 (B)**

Model Petrol Engines - Their Design & Construction* by C. F. Caunter **£ 5.95 (B)**

Model Jet Reaction Engines* by C. E. Bowden **£ 5.95 (B)**

ALL FOUR BOOKS - JUST £25.00 POST FREE Please quote MEW107 when ordering offer closes 12.11.09

The Gearcutting Collection:

Gears for Small Mechanisms by W. O. Davis **£19.95 (D)**

and any two of the following books:

Gears and Gearcutting** by Ivan Law **£ 6.95 (C)**

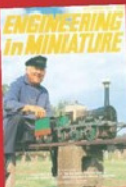
Gears Wheels and Gear Cutting* by A. W. Marshall **£ 5.95 (B)**

Gear Wheels Simply Explained* by A. W. Marshall **£ 5.95 (B)**

Dividing by Harold Hall **£ 6.95 (C)**

ALL THREE BOOKS - JUST £28.00 POST FREE (USUALLY £35.20)

Please quote MEW108 when ordering offer closes 12.11.09



BUILD YOUR OWN REFERENCE LIBRARY

In addition to hundreds of new and out of print Model Engineering books we can also supply individual issues or volumes of *Engineering in Miniature*, *Live Steam*, *Model Engineer*, *Model Engineers Workshop*, *Horological Journal* and over 150 other periodicals from railways to aircraft. Our Magland Section contains over half a million individual issues - we're sure to have the ones you need. Why not telephone or email your wants list.

Tools & Tool Projects Collection:

The Action of Cutting Tools* by Chisholm, Lickey & Brown **£5.95 (B)**

Cutting Tools for Engineers* by A. H. Sandy **£8.95 (C)**

Drills, Taps & Dies* by Tubal Cain **£6.95 (C)**

Grinding, Lapping & Honing* by Edgar Westbury **£5.95 (B)**

Sharpening Small Tools* by Duplex **£6.95 (B)**

Making Small Workshop Tools** by Stan Bray **£6.95 (C)**

Fifty Useful Tools for the Home Workshop* by P. Marshall **£5.95 (B)**

Model Engineers Workshop Projects** by Harold Hall **£6.95 (C)**

Toolmaking Hints & Tips* by R. Hutcheson **£5.95 (B)**

SPECIAL OFFER ANY THREE of these books - Just £15 POST FREE

Or £28 for seven titles POST FREE

Please quote MEW109 when ordering offer closes 12.11.09

POSTAGE CODES (UK): A=85p, B=£1.20, C=£1.60, D=£1.95, E=£2.45, F=£4.90

VISIT www.teepublishing.co.uk or call
01926 614101 for a copy of our latest catalogue.

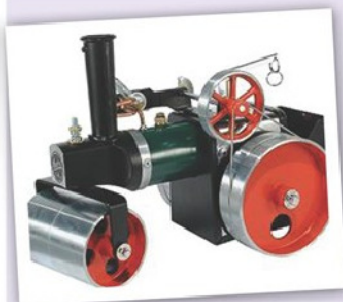
ORDER NOW ON OUR SECURE WEBSITE

OR CALL our 24 hour orderline on **01926 614101**

or write to TEE PUBLISHING, The Fosse, Fosseway,
Nr. Leamington Spa, Warks. CV31 1XN.

Prices quoted UK only and subject to availability. Overseas customers please enquire for postage costs.

Presenting these fantastic working model steam engines!



1312 Steam Roller SR1a

Our Price: £124.99

RRP: £138.50

A superbly realistic model of an early road roller.
Pack: 285 x 150 x 185mm Gr.Wt. 1940g.



1313 Traction Engine TE1a (Green)

Our Price: £129.99

RRP: £145.50

Attractive working model of a traditional English traction engine. Available with green or brass coloured boiler.
Pack: 285 x 150 x 185mm Gr. Wt. 2000g.



1313 Traction Engine TE1a (Brass)

Our Price: £129.99

RRP: £145.50

Attractive working model of a traditional English traction engine. Available with green or brass coloured boiler.
Pack: 285 x 150 x 185mm Gr. Wt. 2000g.



1313C Mamod CENTURION Traction Engine

Our Price: £184.99

RRP: £206.00

Another delightful NEW release from the ever popular MAMOD works. A traditional Traction Engine with an all NEW double acting piston slide valve which makes the action smoother as well as giving increased power.
Pack: 285 x 150 x 185mm Gr.Wt. 2200g.

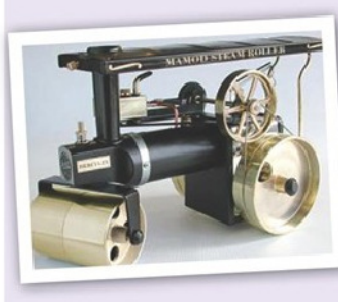


1411 Le Mans Racer LM1

Our Price: £254.99

RRP: £285.00

A superbly realistic model of an early road roller.
Pack: 285 x 150 x 185mm Gr.Wt. 1940g.

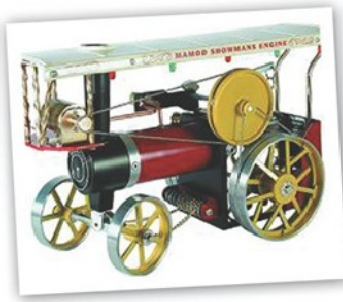


Hercules Steam Roller

Our Price: £184.99

RRP: £206.00

Attractive working model of a traditional English traction engine. Available with green or brass coloured boiler.
Pack: 285 x 150 x 185mm Gr. Wt. 2000g.



1380 Showmans Engine

Our Price: £239.99

RRP: £266.75

With Generator and LED Bulbs.
Pack: 360 x 190mm. Gr. Wt. 2500g.
(Forward running only).

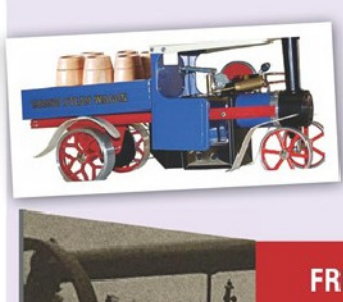


1380SP SHOWMANS Engine with D/A Piston

Our Price: £289.99

RRP: £300.00

Another delightful NEW release from the ever popular MAMOD works. A traditional Traction Engine with an all NEW double acting piston slide valve which makes the action smoother as well as giving increased power.
Pack: 285 x 150 x 185mm Gr.Wt. 2200g.



1318 Steam Wagon SW1 (Blue)

Our Price: £189.99

RRP: £212.00

A robust model of a steam wagon.
Pack: 450 x 180 x 210mm Gr.Wt 3070g.



1319BT Brooklands Tourer

Our Price: £174.99

RRP: £194.00

A magnificent working model of a steam car which captures the elegance of a bygone age.
Pack: 450 x 150 x 210mm Gr.Wt 2450g.

FREE BOOK WHEN YOU ORDER ANY MAMOD PRODUCT BEFORE 30th OCTOBER!

NB prices are in pounds sterling VAT and are exclusive of P&P

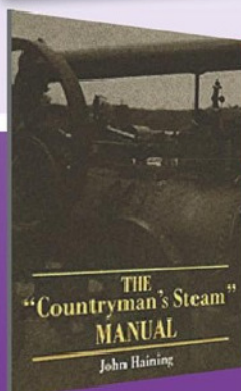


0844 848 8822 Hotlines open 10.00am - 4.00pm Monday to Friday



Order online at www.myhobbystore.com

We have everything the military modeller needs, to find what your looking for please go to www.myhobbystore.com to see our full range of products



ON SALE NOW!

SPECIAL EDITION ONLY £4.99

THE BEST OF MODEL ENGINEER

Featuring some of the best engine designs from the last 100 years

Dear Readers

I get a lot of pleasure putting together the Model Engineer Specials. I select good quality interesting articles for your enjoyment.



Pre order your copy now, and it will be sent to you hot off the press.

I am sure you will find plenty inside to interest you.

David Clark

David Clark, Editor

INSIDE VOLUME 1

- Plans for a hot air engine and 2 steam engines designed by Stan Bray
- A locomotive design from Martin Evans
- I/C and steam engines from Edgar Westbury
- Workshop articles from the pages of Model Engineer
- Key articles looking at workshop tools and techniques

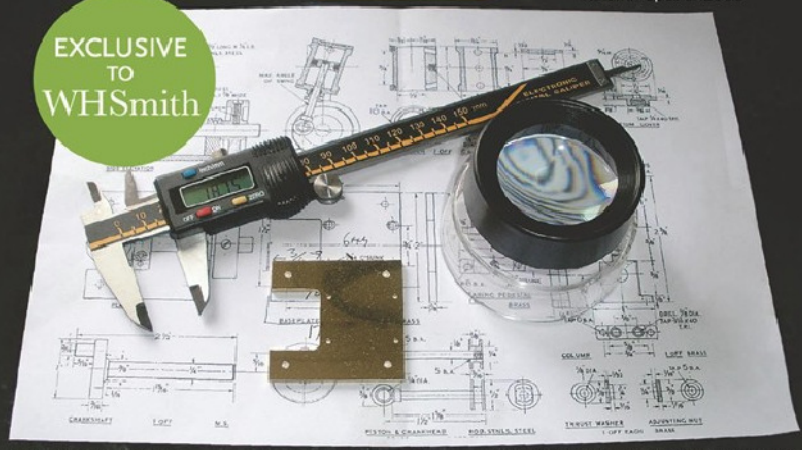
THE BEST OF MODEL ENGINEER

EST.1898

VOLUME 1

www.model-engineer.co.uk
Autumn Special 2009

EXCLUSIVE TO WHSmith



HOT AIR AND STEAM ENGINES FROM STAN BRAY

A LOCOMOTIVE DESIGN FROM MARTIN EVANS

I/C AND STEAM ENGINES FROM EDGAR WESTBURY



WORKSHOP ARTICLES FROM THE PAGES OF MODEL ENGINEER



PRE-ORDER YOUR COPY TODAY!

buy online at **myhobbystore.com** or call **0844 848 8822**

Phone lines open Mon-Friday, 10am - 2pm

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

VISIT OUR WEBSITE FOR FULL PRODUCT RANGE

- Huge range of accessories & tooling
- Please call for our latest colour catalogue

www.toolco.co.uk



Unit 4, Ebley Industrial Park,
Westward Road, Stroud, Glos GL5 4SP
(Just 4 miles from Junct 13 M5 Motorway)

Tel: 01452 770550

Email: sales@toolco.co.uk

View our full range of machines and equipment at our **Stroud Showroom**

Phone for opening times before travelling

For more than 25 years I have been serving model engineers, offering services including the supply of top quality 'used' machines and accessories, valuations, pre purchase inspection of third party machines plus general advice and information.

For an online stocklist plus details of services available please go to my website or contact David Anchell direct.

www.quillstar.co.uk

Telephone: 0115 9206123 • Mobile: 07779432060

THE TOOL BOX

Quality used hand & light machine tools for all crafts.

We provide a comprehensive back-issue service for MODEL ENGINEER, Engineering in Miniature and MODEL ENGINEER'S WORKSHOP.

We don't publish lists, but if there's something you need, get in touch or visit our web site. We are always keen to purchase good equipment and craft-related books.

www.thetoolbox.org.uk info@thetoolbox.org.uk

Open 9-1, 2-5 Mon-Fri, 9-5 Saturdays throughout the year
Colyton, East Devon EX24 6LU Tel/fax 01297 552868

Folkestone Engineering Supplies

An outstanding range of materials, fasteners & quality small tools for the model engineer.

Fast friendly service

www.metal2models.britinternet.co.uk

Tel: 01303 894611 Fax: 08707 625556

Routout CNC Router

Compact Footprint:
680mm X 800mm
Work Area: 600mm X 720mm
Cutting Area:
X=460mm
Y=390mm
Z=90mm
Rapid Speed 5000 mm / Min
Compatible with Mach 3
Low Maintenance

From Only £1420.00 inc VAT

Tel (01269) 841230 or
Order Online
www.routoutcnc.com

Routout CNC 3 Axis CNC Kit

Whether you are building your own CNC Machine/ converting an existing machine or you have simply bought a kit, we can help! The Routout CNC software and Stepper Motor Drivers will enable you to control your new addition to the workshop from your PC with ease.

- ★ Three 2.5 Amp Microstepping Stepper Motor Drive Boards
- ★ Easy LPT Breakout Board
- ★ Free Routout - Linux EMC CD (Or add mach 3 CNC for £111.55)

Only £91 inc VAT

Tel (01269) 841230
Order Online www.routoutcnc.com

NEIL GRIFFIN

- St. Albans, Hertfordshire

Engineering Services

Machining for Model Engineers

From drawing, sketch, pattern etc.

Friendly personal service.

Telephone / Fax: 01727 752865

Mobile: 07966 195910

www.powercapacitors.co.uk

Transwave CONVERTERS THE ONE-STOP CONVERTER SHOP



OPERATE THREE PHASE MACHINERY FROM YOUR SINGLE PHASE SUPPLY

- ROTARY CONVERTERS
- STATIC CONVERTERS
- IWO FREQUENCY CONVERTERS offering electronic motor control and a 2-year or 5-year warranty

PRICES from £89.00 + VAT

See the Market Leader at the London, Harrogate, Bristol, Ascot and Leamington Spa Model Engineering Exhibitions.

Local Call: 0844 7700 272
transwave@powercapacitors.co.uk

Advertising works, you are reading this...

...call Katie on 0844 848 5239

M-MACHINE

Unit 6 Forge Way, Cleveland Trading Estate
Darlington, Co. Durham. DL1 2PJ

Metals for Model Makers

Contact us for Copper, Brass, Aluminium, Steel, Phosphor Bronze, etc.

PHONE & FAX 01325 381300

e-mail: sales@m-machine.co.uk
www.m-machine-metals.co.uk

BOOST PHASE CONVERTERS



The UK's most advanced phase converters with a unique 3 year guarantee. Never beaten on price.

Tel: 01344 303 311

Fax: 01344 303 312

Mob. 07952 717960

www.boost-energy.com
info@boost-energy.com

BOOST HAS BEEN MANUFACTURING HIGH QUALITY PHASE CONVERTERS IN THE UK SINCE 1957

Cowells Small Machine Tool Ltd.

Cowells Small Machine Tools Ltd.
Tending Road, Little Bentley, Colchester CO7 8SH Essex, England
Tel/Fax +44 (0)1206 251 792 e-mail: sales@cowells.com

www.cowells.com

Manufactures of high precision screwcutting lathes, 8mm horological collet lathes and milling machines, plus comprehensive accessory range. Talk directly to the manufacturer



THINKING OF SELLING YOUR LATHE MILL OR COMPLETE WORKSHOP?

and want it handled in a quick, professional no fuss manner? Contact David Anchell, Quillstar (Nottingham).

Tel: 0115 9206123 Mob: 07779432060



**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 range 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 CLASSIFIED

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

MODEL ENGINEERS'
WORKSHOP

MODEL
ENGINEER

EVENSON ENGINEERING

*Quality Machines
and Tooling*

New Machines & Tooling

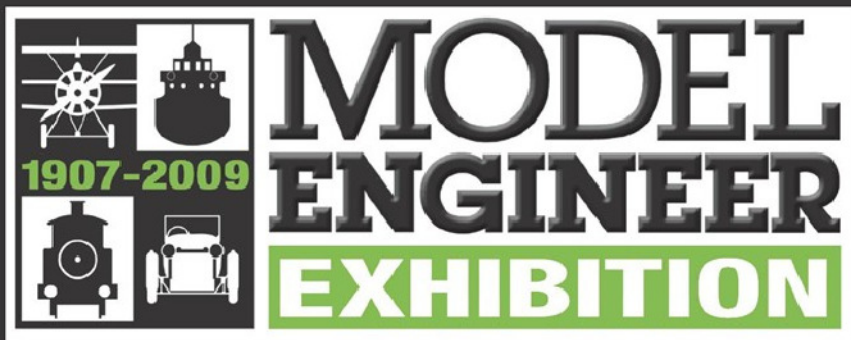
- | | | | |
|---|-------|--|--------------|
| • Union Graduate Wood Lathe, 42" bed, 1 phase, as new | £1050 | • 24" x 24" Surface Table (English) with lid | £125 |
| • Union Graduate Wood Lathe, 32" bed, excellent condition | £850 | • Burnard D14 Collet Chuck, lever operated | £225 |
| • Union Graduate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



HEADLINE SPONSORS:

**MODEL
ENGINEER**
MODEL ENGINEERS'
WORKSHOP

11-13 December 2009 • Sandown Park Racecourse

102 years

**FREE CAR PARKING & BUS SERVICE
FROM ESHER TRAIN STATION**

By popular demand this year's Model Engineer Exhibition will be returning to Sandown Park Exhibition Centre. The event promises to be the premier event in the model engineer's diary for 2009, with hundreds of world class models on display and entered in the world famous Model Engineer Competition. We also offer you the chance to come along and visit the UK's leading specialist suppliers, plus the opportunity to meet the clubs and societies who help and support those wishing to take up this fascinating hobby.

COME AND ENJOY:

- The world class Model Engineer Competition
- The SMEE Lectures
- The wide range of Club and Society model displays and working demonstrations
- The UK's leading trade specialist suppliers
- The workshop tools and equipment made by model engineers
- The railway, traction engine and stationary steam models
- The Stirling, IC and gas turbine engine models
- Aircraft and marine models



FOR ADVANCED TICKETS:

01689 899 210

TICKET HOTLINES OPEN MON-FRI, 9.00 - 17.30

www.myhobbystore.com

EXHIBITION OPENING HOURS: 10.00 - 17.00 FRI & SAT / 10.00 - 16.00 SUN.

LAST ADMISSION: 1 HOUR BEFORE SHOW CLOSES EACH DAY.

Please note all attractions are correct at time of going to press but may be altered or withdrawn without notice due to unforeseen circumstances.

HOME AND WORKSHOP MACHINERY

Genuine Used Machines & Tooling

144 Maidstone Road, Fooks 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



£745

Eagle SW (wet) surface grinder



£675

RJH 4" vertical belt finisher (240 volts)



£1250 each

Bridgeport heads also fit A&S 2E mills



£245 (plain £145)

Emir 48" x 48" + 4 vices



£125

NEW (old stock) drilling machines, better quality!



£2450

Excel 1440E lathe + chucks, steadies (1997)



£2950

Harrison M250 5" x 30 lathe



Beautiful selection



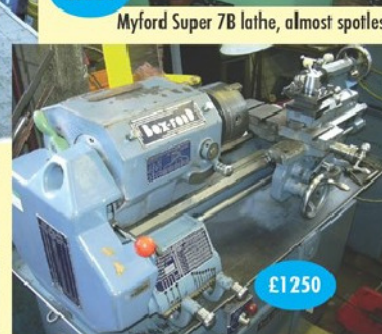
£1950

Myford Super 7 lathe



£3650

Myford Super 7B lathe, almost spotless!



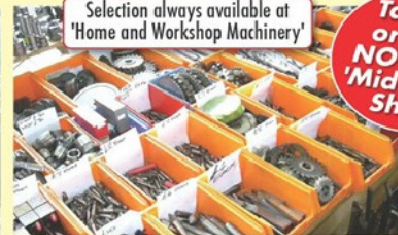
£1250

Boxford AUD 4 1/2" gearbox, power cross feed



£1250

Prazimat lathe



Selection always available at 'Home and Workshop Machinery'



£950

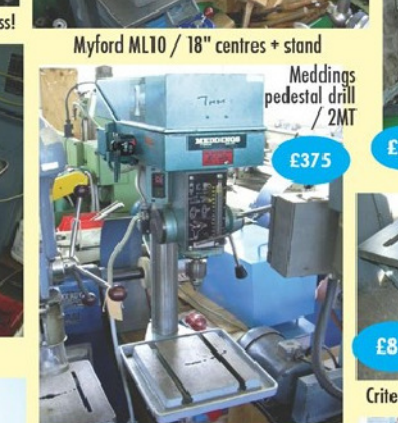
Colchester Chipmaster lathe

- Adcock & Shipley 2E vertical heads, slotting heads £625 / £495 / £625
- J & S grinding wheel balancer + balance £395
- J & S balance + bottom base only £80
- Colchester Triumph 2000 lathe £4250
- Elliot Sturdimill (coming in) £2250
- Colchester Mascot (single) back toolpost £245
- Elliot 10" shaper £375
- Startrite 352 bandsaw £975
- Beech benches **NOW IN!**
- Startrite TA1250 sawbench £2250
- Marico keyway broaches just in!
- Harrison L5/L5A/140/L6 T/steadies
- Harrison D14 faceplates
- Eclipse De-magnetiser £80
- Hofmann dividing head + gears £625
- Clarkson Autolock chucks Selection
- Colchester Triumph 2000 fixed steady £245
- Harrison M3000 Aijest attachment £345



£1125

Myford ML10 / 18" centres + stand



£375

Meddings pedestal drill / 2MT

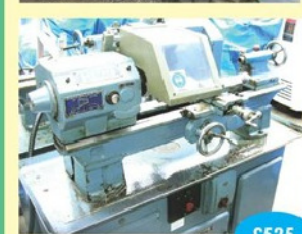


£1525

Boxford ME10 + power cross feed (240 volts)



EACH £150



£525

Boxford TUD (240 volts)



£1150

Colchester Bantam lathe



£1750



NEW £125



£1250



£1250

loads of k...

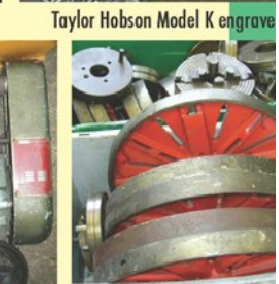


loads of k...



£725

Bridgeport slotting head



£345 + larger model £395

Duplex D29 toolpost grinder



£85

Criterion 12" x 9" swivel table



£3950

Colchester Triumph lathe



£164.50

Crompton/Tyco NEW motor for ML7/Super 7



JUST IN!

Larger chucks and vices

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!



SEE US
AT THE
MIDLANDS
ME SHOW
16TH-20TH OCTOBER



SAWS



LATHES



MILLS



DRILLS

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

Chester Machine Tools

DB8VS LATHE



FEATURES

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

~~£969.65~~
£775.00

Centre Distance 400mm
Swing 210mm
Speeds Variable 50-2000rpm
Motor 750w
Weight 110kgs

HV128 BANDSAW



~~£239.00~~
£219.00

Capacity Round 5"/128mm
Capacity Rectangle 4" x 6"/100 x 150mm
Speed Range 65/95/165rpm
Motor 1/3hp
Net weight 62kgs

CENTURY MILL



~~£1049.00~~
£899.00

FEATURES

- Variable Speed Spindle
- Digital Depth Readout
- Fine Feed Quill
- Heavy Duty Cast Iron Construction

Max Drilling Capacity 20mm
Max End Mill Capacity 22mm
Max Face Mill Capacity 70mm
Table Size 600x180mm
Cross Travel 200mm
Long Travel 350mm
Taper MT3
Speeds 50-3000rpm
Size 720x565x1020mm
Weight 135kgs

CHAMPION 16VS



~~£699.00~~
£629.00

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

DB11VS



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

~~£1469.00~~
£1199.00

FEATURES

- Digital Speed Readout
- Variable Spindle Speed
- Metric & Imperial Thread Cutting

STANDARD ACCESSORIES

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



100mm
3-Jaw
Chuck

~~£69.00~~
£60.00



Mag
Base and
Dial
Gauge

~~£35.00~~
£30.00



100mm
4-Jaw
Independent
Chuck

~~£64.00~~
£55.00



6" x 5" x
4 1/2" Open
Angle Plate

~~£28.09~~
£25.00



Quick
Action
Vice
Low
Working
Height

£39.00



T1 Quick
Change
Toolpost
and 5
Holders

~~£128.00~~
£115.00



Machine
Angle
Level

~~£69.00~~
£60.00



5" Bench Hand
Shears

~~£44.95~~ **£40.00**



V Blocks
and
Clamps
1" Capacity

~~£12.00~~
£10.00



Digital Quill
Suitable for Bridgeport style
turret mills.

~~£175.95~~ **£155.00**



Magnifier
Lamp

£40.00



Centre
Punch
Set

£4.50



Hoist
250kgs

~~£69.00~~
£60.00



DT8300D Multi Meter

~~£8.89~~ **£7.00**



MY64L Multi Meter

~~£35.54~~ **£15.00**



Disc Size 6"
Belt Size 4" x 36"
Table Size 216 x 146mm
Motor 370w
Net Weight 25kgs

4" x 6" Belt and Disc Sander

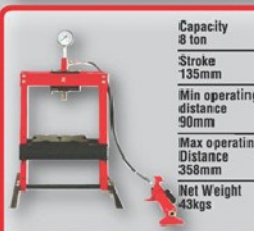
~~£74.99~~ **£69.00**



Working Speed 0-14000rpm
Power 1/10hp
Drive Flexible Shaft
Drill Chuck 0.3-4mm
Net Weight 2.3kgs

Flexi Drive

~~£109.00~~ **£89.99**



8 ton Press

~~£134.95~~ **£119.00**



1 ton Crane

~~£177.00~~ **£139.00**

All prices include VAT. Delivery Free to UK mainland – excluding certain Scottish postcodes. (Unless otherwise stated) Prices valid for duration of this issue only.



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

