

No.142

MILLING • DRILLING • TURNING

MODEL ENGINEERS' WORKSHOP

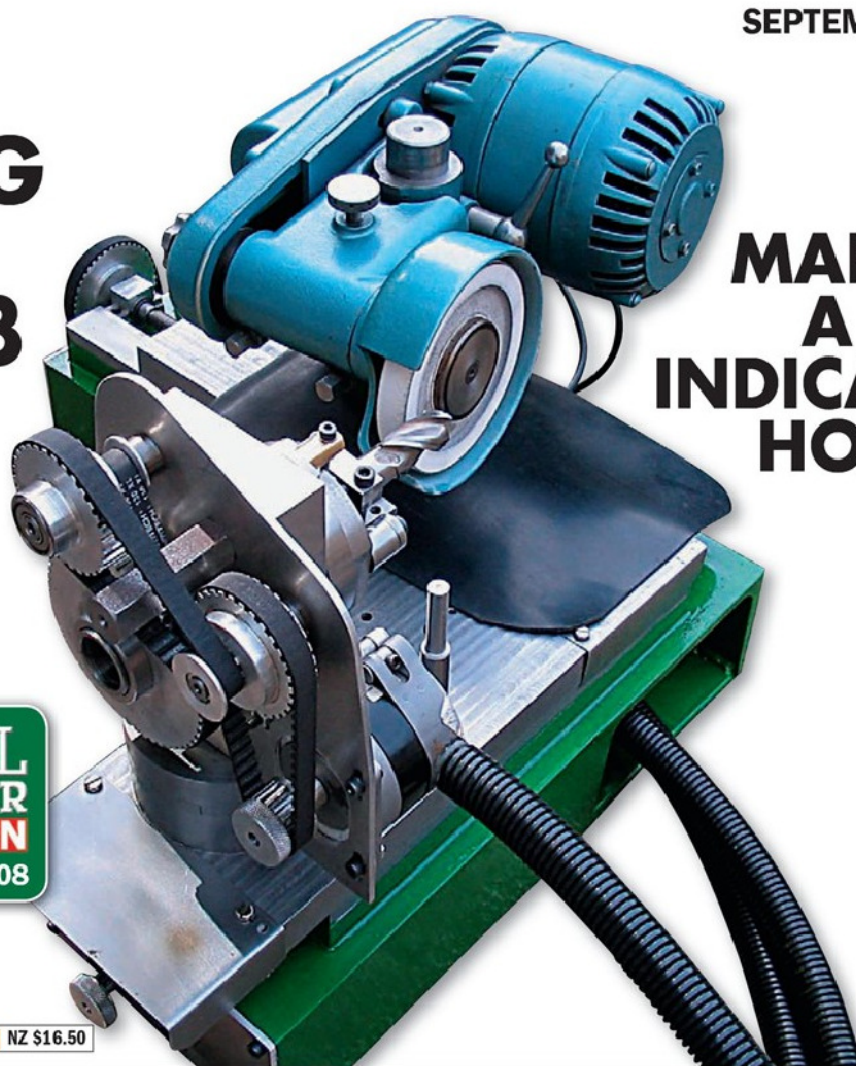
THE PRACTICAL HOBBY MAGAZINE

SEPTEMBER 2008

**CNC
MILLING
WITH
MACH 3**

PART 4
SIMPLE
PROFILING

**MAKING
A DIAL
INDICATOR
HOLDER**



US \$11.25 | CAN \$12.95 | AUS \$12.70 | NZ \$16.50



**MAKING A FOUR FACET
DRILL GRINDING JIG**



**MAKING AN OFFSET
TURNING ADAPTOR**



**CONVERTING A DENFORD
ORAC LATHE TO MACH 3**

Pro Machine Tools Ltd

Precision Machines Made in Germany

"For the discerning engineer."



F1210E



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
MAGICALIA PUBLISHING LTD.

Berwick House, 8-10 Knoll Rise,
Orpington, Kent BR6 0EL
UK Calls: 0844 412 2262
International Calls: +44 (0)1689 899 200
Fax: +44 (0) 1689 899266
Email: customer.services@magicalia.com

SUBSCRIPTIONS

UK SUBSCRIPTIONS
NEW, RENEWALS AND ENQUIRIES
Tel: 08456 777807
Email: modelengworkshop@subscription.co.uk

USA & CANADA SUBSCRIPTIONS
NEW, RENEWALS AND ENQUIRIES
Tel: 001 732-424-7811 Fax: 001 732-424-7814
Email: subs@ewamags.com

REST OF WORLD SUBSCRIPTIONS
NEW, RENEWALS AND ENQUIRIES
Tel: +44 (0) 8456 777807

TO SUBSCRIBE ONLINE, PLEASE TURN TO
THIS ISSUE'S SUBSCRIPTION OFFER

BACK ISSUES & BINDERS

Tel: +44 (0) 1689 899200
Email: customer.services@magicalia.com

EDITORIAL

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

PRODUCTION

Designer: Yvette Masson
Illustrator: Grahame Chambers
Retouching Manager: Michelle Briers
Production Manager: Richard Baldwin
Ad Production: Robin Gray Tel: 01689 899286

SALES AND MARKETING

Sales Director: James Burton Tel: 01689 899237
Assistant Ad Manager: Duncan Armstrong
Tel: 01689 899212

Email: duncan.armstrong@magicalia.com
Marketing & Subscriptions Manager:
Heather Morrison Tel: 01689 899288
Email: heather.morrison@encanta.co.uk

MANAGEMENT

Events Director: Jez Walters
Creative Director: Nikki Parker
Managing Director: Owen Davies
Executive Board: Peter Harkness,
Owen Davies, Adam Laird, Jeremy Tapp



© MAGICALIA PUBLISHING LTD. 2008
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 photocopying,
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.

Model Engineers' Workshop (ISSN 0959-6909) is published
for \$70.00 per year by Magicalia Publishing Ltd c/o EWA
Magazines, 205 US Highway 22, Green Brook, NJ 08812.
Tel: 732-424-7811. Fax: 732-424-7814. Email: subs@
ewamags.com, or visit our website www.ewamags.com.
Periodicals paid at Green Brook, NJ. Postmaster please
send address correction changes to Model Engineers'
Workshop c/o EWA at the address above.



When you have finished with
this magazine please recycle it.

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

Contents

- 10 Subscription offer**
- 11 On The Editor's Bench**
Dave Clark's commentary
- 12 Sharpening Twist Drills Part 2**
Making a four facet grinding jig
- 15 The C3 Mini Lathe Part 10**
Improving the radius turning
attachment and making an offset
taper turning centre
- 20 Retrofitting The Denford
Orac CNC Lathe**
Converting this CNC lathe to Mach3
- 23 A Different Angle On
Headstock Dividing**
Jim Whetren indexes in degrees
- 29 Pattern Making For Beginners**
Dyson Watkins makes
some simple patterns
- 34 Sawing Tee Nuts**
Using a simple jig to speed production
- 36 CNC Milling With Mach 3 Part 4**
Simple circles and profiling
- 39 Converting A Myford ML7 To CNC**
Tony Jeffree looks at configuring Mach3
- 45 Adjustable Dial Indicator Bracket**
Making a useful swivelling
indicator holder
- 48 Simple Aids To Tapping**
Making cheap dedicated tap wrenches
- 50 Next Issue**
- 51 Fireside Reading**
- 52 Trade Counter**
- 56 Scribe a Line**



**Subscribe today and
get a FREE Universal
Work Holder (UK only)**

See page 10



ON THE COVER

This CNC cutter grinder is the subject
of a short series starting in next month's
MEW. Full drawings will be published
with the series.

**SUPPLYING THE
MODEL ENGINEER SINCE 1984
THE ONLY PHASE CONVERTER
MANUFACTURED IN BRITAIN TO ISO9001:2000**
by **POWER CAPACITORS LTD**
30 Redfern Road, Birmingham
B11 2BH

BRITAIN'S FAVOURITE PHASE CONVERTERS

Transwave
CONVERTERS

**See the Market Leaders
Transwave Converters®
and IMO Inverters**
at the London, Harrogate, Bristol, Ascot
and Leamington Spa Model
Engineering Exhibitions

ROTARY CONVERTERS from £440 inc VAT

3-YEAR WARRANTY/MONEY-BACK GUARANTEE



Transwave

240-volt 1-phase input, 415-volt 3-phase output. Single or multi-motor operation via socket/plug or distribution board. Eleven sizes from 1.1kW/1.5hp to 22kW/30hp. Ideal solution for multi-operator environments or where fully automated "hands-free" operation is required irrespective of demand. Output retrofits directly to existing machine wiring loom so no modification to machine necessary. Some sizes suitable for welding applications.

iDRIVE INVERTERS from £103 inc VAT

2-YEAR WARRANTY/MONEY-BACK GUARANTEE



IMO

240-volt 1-phase input, 240-volt 3-phase output (i.e. dual voltage motor required). SOFT START-STOP, SPEED CONTROL, BRAKING, MOTOR PROTECTION and JOG FUNCTIONS. Low-Cost, general purpose simplified torque vector control. Entry level performance suitable for the majority of applications. Integral EMC Filter as standard. Four sizes from 0.75hp/0.55kW to 3hp/2.2kW. IP65 options available.

JAGUAR CUB INVERTERS from £149 inc VAT

5-YEAR WARRANTY/MONEY-BACK GUARANTEE



IMO

240-volt 1-phase input, 240-volt 3-phase output (i.e. dual voltage motor required). SOFT START-STOP, SPEED CONTROL, BRAKING, MOTOR PROTECTION and JOG FUNCTIONS. Simplified torque vector control giving enhanced performance at low RPM. Four sizes from 0.75hp/0.55kW to 3hp/2.2kW.

STATIC CONVERTERS from £235 inc VAT

3-YEAR WARRANTY/MONEY-BACK GUARANTEE

240-volt 1-phase input, 415-volt 3-phase output. Single or multi-motor operation via socket/plug or distribution board. Seven sizes from 1.1kW/1.5hp to 7.5kW/10hp. Ideal solution for "one machine at a time" environments. Output retrofits directly to existing machine wiring loom so no modification to machine necessary. Manual power adjustment via switch using voltmeter as guide.



Transwave

REMOTE CONTROL PENDANT £62 inc VAT

2-YEAR WARRANTY/MONEY-BACK GUARANTEE

Suitable for all IMO inverters, this remote pendant allows you to access the software of the inverter remotely, bypassing the buttons on the inverter itself. START, STOP, POTENTIOMETER SPEED CONTROL, FORWARD, REVERSE. NO-VOLT RELEASE safety feature and two metre length of 7-core flex as standard.



Transwave

JAGUAR VXR INVERTERS from £225 inc VAT

5-YEAR WARRANTY/MONEY-BACK GUARANTEE

240-volt 1-phase input, 240-volt 3-phase output (i.e. dual voltage motor required). SOFT START-STOP, SPEED CONTROL, BRAKING, MOTOR PROTECTION and JOG FUNCTIONS. Advanced vector control giving optimum performance at low RPM. Four sizes from 0.75hp/0.55kW to 3hp/2.2kW.

IMO



NO SURCHARGE FOR DEBIT & CREDIT CARD PAYMENTS



UK LOCAL CALL: 0844 7700 272

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

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



Myford Super 7B Lathe, Cabinet Stand, VGC, Choice of 4, 1ph or 3ph, £3650.00 plus vat.



TEP Bench CNC Engraver, 1ph, £575.00 plus vat.



Aciera F3 High Speed Head, 3ph, £750.00 plus vat.



Aciera F3R Horizontal/Vertical Milling Machine, 3ph, Untested, £1650.00 plus vat.



Boxford 190 VMC CNC Vertical Bench Milling Machine, 1ph, £1250.00 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 @ 17.5%.
- 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

NEW PRODUCTS



**SIEG KX1
Hobby CNC Mill:**
£2,195.00



**SIEG KX3
Hobby CNC Mill:**
£3,195.00

The new SIEG KX1 and KX3 CNC Mills are full 3 axis stepper motor driven milling machines for direct connection to a PC running the popular Windows based Mach3 CNC control software.



- Delivery: £60.00 to most UK mainland destinations.
- Check website or phone for availability.

SEPTEMBER OFFERS

Mini Drill Accessories

No.	Code	Accessory	Shank	Offer Price
22	110-010-02500	Tapered Cartridge Roll	1/8"	£0.75
23	110-010-02600	5 x Tapered Cartridge Rolls	-	£1.50
24	110-010-02700	Sponge Sanding Drum	1/8"	£0.95
25	110-010-02800	5x Sponge Sanding Drums	-	£1.75
26	110-010-02900	10x10mm 120 Grit Flapwheel	1/8"	£0.60
27	110-010-03000	20x10mm 120 Grit Flapwheel	1/8"	£0.85
28	110-010-03100	30x15mm 120 Grit Flapwheel	1/8"	£1.50
29	110-010-03200	40x20mm 120 Grit Flapwheel	1/4"	£1.75
30	110-010-03300	50x20mm 120 Grit Flapwheel	1/4"	£1.95
31	110-010-03400	48pc Sanding Set	1/8"	£4.95



**4 Flute Metric End Mills - HSS TiN Coated
Straight Shank - Centre Cutting**

Code	Size	Shank	Offer Price
060-280-00100	3mm	6mm	£2.00
060-280-00150	3.5mm	6mm	£2.00
060-280-00200	4mm	6mm	£2.00
060-280-00250	4.5mm	6mm	£2.00
060-280-00300	5mm	6mm	£2.00
060-280-00350	5.5mm	6mm	£2.00
060-280-00400	6mm	6mm	£2.00
060-280-00450	6.5mm	10mm	£2.50
060-280-00500	7mm	10mm	£2.50
060-280-00550	7.5mm	10mm	£2.50
060-280-00600	8mm	10mm	£2.50
060-280-00650	8.5mm	10mm	£2.50
060-280-00700	9mm	10mm	£2.50
060-280-00750	9.5mm	10mm	£2.50
060-280-00800	10mm	10mm	£2.50
060-280-00850	10.5mm	12mm	£3.50
060-280-00900	11mm	12mm	£3.50
060-280-00950	11.5mm	12mm	£3.50
060-280-01000	12mm	12mm	£3.50
060-280-01100	10pc set 3mm-12mm in 1mm Increments		£20.00
060-280-01150	19pc set 3mm-12mm in 0.5mm Increments		£39.50



Solid Carbide Internal Boring Tools

Code	Shank Diameter	Overall Length	Min Boring Diameter	Max Boring Depth	Offer Price
060-290-10100	2mm	30mm	2mm	11mm	£4.95
060-290-10200	4mm	50mm	4mm	15mm	£6.95
060-290-10300	6mm	60mm	6mm	27mm	£9.95
060-290-10400	8mm	70mm	8mm	34mm	£12.00
060-290-10500	10mm	70mm	10mm	36mm	£15.00
060-290-10600	12mm	80mm	12mm	41mm	£18.50
060-290-11000	Set of 6 Solid Carbide Internal Boring Tools				£62.50

September Promotion

FREE 6"/150mm Digital Vernier Caliper

When you place any order in September worth £30.00 or more excluding carriage, you will receive this 6"/150mm Digital Vernier Caliper (normal display) worth £6.99, absolutely free.



Offer valid from 1/09/08 to 31/09/08 and subject to availability.

All prices include 17.5% VAT. Carriage is based on order value.
All items & prices are subject to availability.
September Offers end 30/9/08.

E. & O. E.

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

10 Archdale Street
Syston
Leicester, LE7 1NA

Tel: 0116 269 5693 Fax: 0116 260 5805
Email: information@arceurotrade.co.uk
Website: www.arceurotrade.co.uk

Arc Euro Trade

NEW ITEMS!

Chronos

Engineering Supplies

Online Catalogue - www.chronos.ltd.uk

GLANZE THREADING, PARTING & PROFILING LATHE TOOLS SETS

NEW TOP QUALITY INDEXABLE TOOL SETS FROM GLANZE

THIS SET INCLUDES THE FOLLOWING GLANZE INDEXABLE LATHE TOOLS

10/12MM SHANK EXTERNAL THREADING TOOLS HOLDER WITH 2 X 60 DEGREE METRIC CARBIDE INSERTS

10/12MM SHANK INTERNAL THREADING TOOL HOLDER WITH 2 X 60 DEGREE METRIC CARBIDE INSERTS

10/12MM SHANK PROFILING TOOL WITH 2 X 5MM DIAMETER CARBIDE INSERTS

10/12MM SHANK PARTING TOOL WITH 2X2MM CARBIDE PARTING INSERTS

SUPPLIED IN A GOOD QUALITY FITTED CARRY CASE COMPLETE WITH TORX KEY



CODE
777450
777460

SHANK SIZE
10MM SQUARE
2MM SQUARE

PRICE
£115.00
£125.00

INDIVIDUAL GLANZE THREADING TOOLS 60° METRIC

Complete with one three sided carbide insert & Torx Key

CODE	TYPE	SHANK	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

CODE	TYPE	PRICE
1116A60	INT FOR 10 & 12MM TOOLS	£7.25
1116A60S	SET OF 10 ABOVE	£69.50
1616A60	INT FOR 16MM TOOLS	£7.25
1616A60S	SET OF 10 ABOVE	£69.50
1116A60	EXT FOR 10 & 12MM TOOLS	£7.25
1116A60S	SET OF 10 ABOVE	£69.50
1616A60	EXT FOR 16MM TOOLS	£7.25
1616A60S	SET OF 10 ABOVE	£69.50



NEW STYLE 100MM SOBA ROTARY TABLE CODE - 111310

BRAND NEW DESIGN AND
EXCLUSIVE TO CHRONOS!
TABLE DIA - 100MM

CENTRE - 2 MORSE TAPER
OVERALL HEIGHT WHEN HORIZONTAL - 55MM
CENTRE HEIGHT WHEN VERTICAL - 75MM

THIS UNIT COME COMPLETE WITH T NUTS,
STEP CLAMPS AND STUDS TO HOLD WORK TO THE TABLE
THE HAND WHEEL CAN BE DISENGAGED ALSO.

£69.95



BORING HEAD SET !!

BRAND NEW FROM SOBA AND EXCLUSIVE TO CHRONOS!!
THIS SET COMPRISES OF THE FOLLOWING:

40MM MICRO BORING HEAD WITH GRADUATED METRIC DIAL
2 MORSE TAPER SHANK - TAPPED 10MM
3 MORSE TAPER SHANK - TAPPED 12MM
10MM PARALLEL SHANK
3 ASSORTED 8MM DIA HSS BORING BARS
1 TOOL STEEL ADAPTOR TO ACCEPT 5MM HSS TOOL STEEL
1 X 5MM DIA HSS TOOL STEEL
1 X 8MM DIA HSS TOOL STEEL
SUPPLIES IN A NICE WOODEN STORAGE BOX
ALSO AVAILABLE IN IMPERIAL!!

SOBA OPTICAL CENTRE PUNCH

GET IT RIGHT EVERYTIME !!

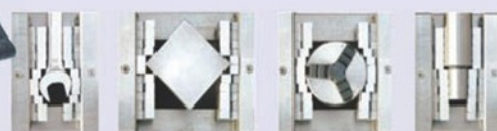
ACHIEVE PRECISE PUNCH LOCATION
IT IS SUPPLIED WITH 2 PERSPEX RODS
WITH EITHER CROSS HAIR OR BULLSEYE
TARGET. THESE ARE PRECISION MADE
SO AS TO MAGNIFY AND ILLUMINATE
THE WORKPIECE TO BE PUNCHED.
THE 48MM INCH DIAMETER BODY IS FITTED
WITH A SLIP RESISTANT BASE
PUNCHES 9.5MM DIAMETER 60° OR 90°

SOBA HSS CENTREDRILL SETS

QUALITY HSS CENTREDRILLS
IN A HANDY STORAGE CASE
ASSORTED QTY'S OF EACH

CODE	TYPE	PRICE
133000	SET 10 IMP BSI-BS6	£24.00
133100	SET 12 MET 1-5mm	£22.00

NEW SOBA MAGIC VICES



Ordering No.	Length		Width		Height		Jaw Width		Jaw Opening		Jaw Depth		PRICE
	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
110035	10.5/8	270	4.3/8	110	2.1/2	63	3	75	3.1/4	82	1.1/2	38	£149.00
110040	14	355	5.1/2	140	3	75	4	100	4	100	1.1/2	38	£172.00

Manufactured from close grained high tensile grade cast Iron, and precision ground body.
The Vice has multiple applications and is useful for clamping polygon work pieces,
circular and round jobs as well as complex pieces. The round parts can be gripped with
superior holding power. This vice has the capability of gripping odd shaped work pieces and
eliminates the use of fixtures and jigs.

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

PROXXON

£344.32
Inc.vat

Milling System

Transformer, Compound Table and Stand included



Engineered in Germany, these smaller size power tools and accessories are unique in design and perfect for hobbyists working in miniature.

www.brimarc.com/proxxon



To view the full range of these quality products, request a FREE copy of the Proxxon catalogue – call 0845 604 0064 or email email@brimarc.com

Machine
- DRO.CO.UK

Open Days
September 3rd - 6th

Ever Considered Installing a Digital Readout System?

Why not come down to one of our open days! Get hands-on experience of the equipment and a demo of the functions and uses. Speak to our engineers for installation advice for your machine or just come along for free tea and biscuits.

"What do I need to bring?" - Measurements of your machine travels, if your not sure please contact our engineers on 01992 450780.

Machines On Display: Myford ML7, Warco VMC, Chester Champion, 9" South Bend, Tapping Arms & Tapping Heads.

Usual Show Discounts Will Apply!

Used & Ex-Demo Units With HUGE Discounts!



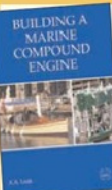
For More Details Please Visit

www.machine-dro.co.uk/opendays

Allendale Electronics Ltd,
43 Hoddesdon Industrial Centre, Pindar Road,
Hoddesdon, Herts, EN11 0FF.
Telephone: 01992 450780
Email: sales@machine-dro.co.uk



Summer Reading from Camden



Building a Marine Compound Engine

Leak • £10.15

The 3" x 5" x 3" compound engine, whose construction is described here, will drive a 25' - 35' hull, and this is an excellent 'primer' for anyone building a marine compound engine of any size, or any larger marine engine. This engine was designed to be capable of sustained hard work, and be built on more-or-less standard model engineers' equipment. How this was achieved is described in this book based on articles which appeared in *Model Engineer* in 1982 and 1983, duly amended in the light of history, with pictures re-scanned and revised layout. The author took a reasonable level of machining ability for granted, so don't expect the absolute nitpicky on machining procedures. This is clearly of use to any builder of this engine, especially in its descriptions of jigs, but its general words of wisdom and guidance mean it will appeal to builders of any marine engine - or to 'armchair' modellers as something different. 42 A4 format pages. Main drawings. 44 B&W photos. Softcover. (Full drawing sets, and castings, available for this engine)



John Fox Jennens Malone The Liquid Stirling Engine

Sier • £16.00

One of the great "What ifs" of British 20th Century invention, the Malone Heat Engine was a form of Stirling engine, but used liquids operating at the critical point, rather than air. Malone's aim was to build a fuel-efficient marine engine which occupied less space than a conventional steam engine or turbine and boiler, increasing cargo capacity. The experimental engines built were largely successful, despite the high temperatures and pressures involved requiring ground-breaking solutions - and then the marine diesel became readily available. But has the Malone engine's day now come? 76 well illustrated pages. Paperback.



Myford Series 7 Manual

Bradley • £ 9.70

This is the 'classic' book on the 'classic' model engineer's lathe - the '7' series from Myford. It covers the features of the various models, installation, and how to use the machine including, for example, milling, gear cutting, taper turning and repetition work, as well as everything to do with turning itself. Covers the ML7, ML7-R and Super 7 models. And, of course, a lot of the information here can be applied to any lathe. 232 pages, full of b&w photos, diagrams, formulae and charts. Paperback.



Advanced Machine Work

1925 • Smith • £ 30.65

Originally "prepared for students in technical, manual training, and trade schools and for the apprentice and the machinist in the shop". The beginner will probably find this book a bit heavy going, until he has done some machining and outgrown first books, but within its 800 pages is an incredible amount of information on machining operations of all sorts - this title comes nearer to "containing it all" than any other book we know! 800 pages, 1000s of illustrations, tables etc. Hardbound.



Fedden • Gunston

£18.10

This is the remarkable story of Roy Fedden whose brilliance, both as a designer and a team leader, meant that Britain, in the shape of the *Bristol Aeroplane Company*, had an extraordinary hold on the supply of aircraft aero engines between the World Wars, when the *Jupiter*, *Mercury*, *Titan*, *Pegasus*, *Perseus*, *Hercules* and *Centaurus* engines, in particular, ruled the air - and were to feature in many Allied WWII aircraft. The author of this highly readable best-seller describes Fedden as "one of the greatest intuitive engineers in history", yet in the middle of WWII, when he had just been knighted, he was effectively sacked by his employers, who had never offered him a place on their Board, despite his huge contribution to the making of the company! Huge amounts of info on the man and his engines. 353 pages full of drawings, photographs and illustrations. Paperback.

Prices shown INCLUDE U.K. Post & Packing
(overseas customers please allow 10% extra for delivery)

Find all the **Very Latest** items on our **WEBSITE** at: www.camdenmin.co.uk which has a complete, regularly updated, listing of all our books and films, engineering or otherwise, and an easy-to-use on-line ordering facility. You can even request a hard copy of our 96 page Booklist, sent **FREE** worldwide, on our website, or write, phone or fax us to receive your copy.

Mail Order (no stamp required in the U.K.) to:
CAMDEN MINIATURE STEAM SERVICES
FREEPOST (BA 1502) Rode Frome Somerset BA11 6UB
Tel: 01373-830151 Fax: 01373-830516





Workshop Accessory kits

Hemingway Kits provide a range of uniquely practical tooling and challenging projects for the small workshop owner.

- Top Designers with proven designs
- Laser print 3D/CAD drawings with illustrated construction notes
- Over 70 full material kits to suit your equipment
- Fast, friendly and knowledgeable service

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

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

INTERBIN
STORAGE & DISPLAY

SHOP ON-LINE!
www.interbin.com

Handi-Panel Kits...

from **ONLY**
£13.10 (+VAT)

Including delivery

www.interbin.com
T. 01279 441221



PPH
MOULDERS

Convert scanned drawings to CAD!



SCAN



CLEAN



CONVERT



EDIT

www.softcover.com



364 Milton Rd, Cambridge CB4 1LW, England. Tel: 01223 424342



Scan 2CAD

G.L.R. METAL FINISHING PRODUCTS

Why pay minimum charges and wait - Do it yourself - Do it well - it makes more sense

NICKEL PLATING KITS

Bright or Black

Electro Plate directly on:

Copper - Brass - Iron - Steel

Welded Brazed or Soldered Joints

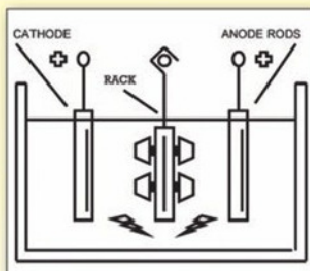
"TEK-NICK" Workshop Kit £62.00 plus Carr £7.50

"TEK-NICK" Mid-Tec Kit £115.00 plus Carr £8.50

"TEK-NICK" Maxi-Tec £180.00 plus Carr £9.50

Instructions with all kits.

Replacement components available.



"TECHRATE"

Steel blackening in salts. Gives an uniform Jet Black finish or on a polished surface gives a Blue/Black finish.

The solution operates at 141C / 285F. Ideal for - tools, small arms, fasteners or fittings. £39.00 plus £6.50 Carriage.

"ZINCFAST XL" Workshop kit £76.50 plus £6.50 Carriage

Produces a bright zinc deposit on **Steel & Iron**. For **Car & Motorcycle** components. Zinc is highly valued as a rustproof finish. Suitable for all types of fasteners. Instructions with all kits. Replacement components available.

"CASE HARDENING POWDER"

This case hardening compound gives an acceptable depth of hardening to steel components.

• 250gms £12.00 plus £2.00 Carr. • 500gms £18.00 plus £4.00 Carr. • 1000gms £30.00 plus £7.50 Carr.

Instructions for safe use of this product included.

DRY ACID SALTS (FOR PICKLING) 500 gms £9.50. **COPPER SULPHATE** 500gms £8.95

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

• Tel: 01327 878988 • Fax: 01327 876396 • 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 - 12.00 noon

WARCO
OUR NEXT EXHIBITION
 Midlands Model
 Engineering Exhibition
 Warwickshire Exhibition Centre,
 Leamington Spa
17th to 21st Oct 2008
 See you there!

WARCO

LOOK NO FURTHER FOR AMAZING DEALS

MINI LATHE



£415.00

- 3 Jaw chuck with inside/outside jaws
- Centre height 3 1/2"
- Distance between centres 12"
- Threading facility

WM-180 VARIABLE SPEED LATHE



£499.00

- Centre height 3 1/2"
- Distance between centres 12"
- Infinitely variable from 0-1,250 and 0-2,500 rpm

WM-240 VARIABLE SPEED LATHE



£699.00

- Centre height 4"
- Distance between centres 18"
- Infinitely variable from 0 - 1,250 and 0 - 2,200 rpm
- Large cross slide with two full length tee slots

Each lathe is supplied with two speed bands to allow maximum torque in the low setting, an accuracy test report, digital rev. counter, hardened bedways, face plate, four way tool post, swarf tray and rear splash back, thread dial indicator and reversible motor.

WM series lathes supplied with metric and imperial threading facility, 3 and 4 jaw chucks, fixed and travelling steadies

WM-250 VARIABLE SPEED LATHE



£999.00

- Centre height 5"
- Distance between centres 22"
- Infinitely variable from 50 to 2,000 rpm
- Reversible leadscrew for left hand threading

WM-280 VARIABLE SPEED LATHE



£1,399.00

- Centre height 5 1/2"
- Distance between centres 27 1/2"
- Infinitely variable from 50 to 2,500 rpm
- Large cross slide with two full length tee slots
- Reversible leadscrew for left hand threading

WM-280V-F VARIABLE SPEED LATHE



£1,500.00

- Centre height 5 1/2"
- Distance between centres 27 1/2"
- Dedicated feed shaft for longitudinal/cross feed
- Separate leadscrew for thread cutting functions
- Large cross slide with two full length tee slots
- Reversible leadscrew for left hand threading

MINI MILL/DRILL

- Variable spindle speeds 50 - 2500rpm
- Powerful 550w motor
- 3 morse taper with draw bar
- Available with either metric or imperial leadscrews
- Fine spindle feed
- Table size: 18 1/8" x 4 3/8"

£455.00



WM-14 VARIABLE SPEED MILL

- Fine feed head elevation with calibrated dial
- Compact, rigid machine
- Table size: 16" x 4 1/2"

£635.00



WM-16 VARIABLE SPEED MILL

- Rack and pinion drill feed plus fine feed for accurate machining
- Table size: 27 1/2" x 7"
- Digital rev. counter
- Large capacity table

£998.00



WM series mills are supplied with digital scale for spindle travel, 2 speed settings to allow high torque in low range. Accuracy test report. Infinitely variable speed range from 50 - 2,250 rpm. Dovetail column ensures positive head location. Precision spindle supported on taper roller bearings. Head tilting 45° 0° 45°. Captive drawbar pushes tooling out of taper. Adjustable gibs to slideways. Locks to head, column and slideways. Available with either metric or imperial leadscrews. Interlock chuck guard. Swarf tray and stand available.

WM-18 VARIABLE SPEED MILL

- Digital rev. counter
- Fine feed to spindle
- Table size: 27 1/2" x 8 1/4"

£1,250.00



SPECIAL OFFER

With each lathe - Live centre, drill chuck, arbor and 5 piece indexable tool set - free of charge.

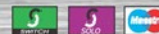
With each milling machine - set collets, metric or imperial, vice, set of end mills - free of charge.

- Avoids necessity to change belts
- Prices unchanged since January 2006
- Enjoy Warco's unequalled, outstanding customer service
- Free tooling package allows for immediate use of your new machine without any additional cost.
- Massive range of additional lathe and milling machine tooling available from stock. Please ask for details.
- Dedicated spares department and long term availability of spares

FREE Delivery UK mainland • All prices include VAT • 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



FREE

MODEL ENGINEERS' WORKSHOP

UNIVERSAL WORK HOLDER

WHEN YOU SUBSCRIBE TODAY!

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. Handle can be removed and the head can then be locked in a bench vice.



SAVE 10% more when you subscribe online



- **SAVE UP TO 30%**
- **FREE UNIVERSAL WORK HOLDER**
- **FREE DELIVERY**
- **NEVER MISS AN ISSUE**

(Gift UK only)

BY PHONE: 08456 777 807 quote ref. E980 **ONLINE:** www.subscription.co.uk/mew/E980

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 Engineer Workshop* for 2 years (24 issues) with a one-off payment of £63.00, **SAVING 30% + FREE GIFT**

☐ I would like to subscribe to *Model Engineer Workshop* for 1 year (12 issues) with a one-off payment of £34.99, **SAVING 22% + FREE GIFT**

OVERSEAS SUBSCRIPTIONS:

☐ I would like to subscribe to *Model Engineer Workshop* for 1 year (12 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.ewamags.com

PAYMENT DETAILS:

☐ **Postal Order/Cheque** ☐ **Visa/Mastercard** ☐ **Maestro**

Please make cheques payable to Magicalia Publishing Ltd and write code E980 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.....

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY):

CODE E980

☐ I would like to subscribe to *Model Engineer Workshop* and **SAVE 22%**, paying £8.75 every 3 months by Direct Debit (UK ONLY) + **FREE GIFT**

Please complete form below

Instructions to your bank or building society to pay by Direct Debit.
Originator's reference 422562

☐ **Pay £8.75 every 3 months by Direct Debit (please tick)**



Name of bank
Address of bank
..... Postcode
Account holder
Signature Date
Sort code Account number

Instructions to your bank or building society: Please pay Magicalia Publishing 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 Magicalia Publishing 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 19th September 2008. Free gift UK only. Subscriptions will begin with the first available issue. Free gift UK only. 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 Engineer subscription. If you are also happy for us to contact you about other products or services available from Model Engineer and Magicalia Publishing Ltd, please indicate here: Contact by: ☐ email ☐ telephone ☐ mobile. If you are happy for us to pass your details on to other carefully selected companies to contact you about their products and services please indicate here: ☐ email ☐ telephone ☐ mobile. If you do NOT wish us to contact you by POST about products or services available from Model Engineer and Magicalia Publishing Ltd, please indicate here ☐ If you do NOT wish us to pass your details on to other carefully selected companies to contact you by POST about their products or services please indicate here ☐

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



David Clark

Model Engineer and Model Engineers' Workshop Special

Plans for the Workshop Special are well advanced and you can pre-order by going to page 55. The Special should also be on sale at The Model Engineer Exhibition. This is sure to be a collector's item because of the Cherry Hill interview. Don't delay, pre-order today, see page 55 for full details. Although a Workshop Special, a few photos of Cherry's models will accompany the main article.

The 2008 Model Engineer Exhibition

I shall be at the ME exhibition again this year, it will be about a 1500 mile round trip. I hope to meet many of you there. The Exhibition promises to be better than ever with the Sinsheim track expected to draw many extra visitors in.

A lot of visitors visit the show on Friday, more so than any other day. They expect to get a bargain, first come, first served, but this is not so. The best bargains are to be had on the Sunday when traders would rather sell a bit cheaper than take unsold merchandise back home.

Visitors seem to think Saturday and Sunday will be overrun with children but this does not happen. Children are few and far between at weekends so don't worry if you can't come on the Friday, come on the Saturday and Sunday instead, it will be just as enjoyable and you will probably avoid the weekday traffic. There is plenty of room at Ascot and although certain stands will be packed, you should be able to get that item you have been waiting for to complete that project. Traders can only take so much of their stock to exhibitions so if you want a specific item, a casting or a complete set of castings, phone the supplier and ask them to take a set to the exhibition with your name on it. It could save you many pounds in postage.

Myford will be at the Exhibition

The Myford stand usually has many spares available at reduced prices, one of the most useful being the zero setting dial for the cross slide, top slide and vertical slide. I purchased them last year and have fitted them to my Myford and very useful they are too. It is so much easier to set the dial to zero before taking a cut.

ON THE EDITOR'S BENCH

Workshop Practice and back issues

I will be manning the Magicalia stand again, selling Workshop Practice books and also back issues of ME and MEW although MEW back issues are in short supply. I increased the quantity of MEW being sent to customer services a couple of issues ago but most of the early issues are not available. Customer services usually sell out within 6 weeks of the issue going off sale. This is one more reason to subscribe.

Talking of subscriptions, anyone buying a subscription at the exhibition can have a free copy of a Workshop Practice book, your choice but if we don't have it on the stand, it will be posted to you. I have asked for a pop up banner this year so visitors can find the Magicalia stand so when you go through the main doors, look out for the sign that says Model Engineer and Model Engineers' Workshop and come and say hello.

Boxford TCL125

I have had a bit of a play with my Boxford CNC. I changed the mains lead as the old one was partially cut through. When I plugged it in, it appeared to be dead, no stepper motor would work and the spindle would not switch on. I checked the fuse in the plug and it had blown. It was a 13 amp fuse but I fitted a 5 amp fuse as I thought a 13 amp might be a bit high and also hoped it would blow quicker if there was a short. I switched back on but still nothing. I looked in the back at the electronic boards, checked all the fuses, they all appeared ok. I switched the power back on with the electronics exposed. The LED indicator on one of the boards came on so power appeared OK. I played around with the emergency stop switch and it clicked out. There was still no movement and the spindle did not come on either.

The Z axis was on the limit switch at the headstock end. I removed the belt cover (after switching the machine off) and turned the motor so the Z slide was away from the stop. Still nothing happened so I switched back on and tried turning the stepper motor. It would not move so obviously the electronics were working.

There must be something else wrong? I switched off and removed the top board to see if any chips needed reseating. Sometimes, with the heating and contraction as the machine is switched on and off, integrated circuits can work their way out of their sockets. There was however, only one integrated circuit on the board that was in a socket and that was seated OK.

I had spent about 2 hours fiddling about and was about to give up and had one last play with some of the other switches and the feed hold popped up. Pressing the X

and Z axis buttons gave movement to the slides, pressing the motor forward button and holding it down, the contactor clicked and the motor burst into life.

Prior to 'having a play' I had put a request for a circuit diagram on a model engineers' website. This turned up by email soon after I started to play with the Boxford. I had also been looking at a web site on the internet about someone else converting a Boxford. The person who sent me the circuit diagram was the same person who runs the web site. It is quite a while since I did any electronics work but looking at the circuit diagram, it seems relatively easy to interface an opto isolating board to the Boxford. The main difference is that the Boxford signals are at 10 volt levels rather than the more usual 5 volts. The chap with the website suggested using a logic shifter to change the voltage levels to 10 volt as this is what he did on his version.

The conversion process will lose the manual controls section but this is no real hardship. I will just remove the old switches and replace with a flat plate to fill the hole. I might stick a numeric keypad (plugged into the PC's USB) on to the plate. I will have to check it works first. This will give jogging controls via Mach 3.

I have purchased an opto isolator breakout board from Ebay for under £20 including postage from Hong Kong. Also purchased were 10 micro switches so I can fit homing switches for a cost of £4.50. I will see what happens and if they arrive safely. Both sellers have plenty of feedback so I don't see any problems arising. I also purchased a big red 'Emergency Stop' switch from a UK seller as the one on the Boxford only has the shell remaining.

I hope to either do the conversion as an article in the future (or get the chap with the web site to do it). Either way, let's try and get some of these old Boxford's back into productive work.

Dates for your diary

Please email david.clark@magicalia.com if you would like your event listed here. Please let me know at least 2 months in advance.

Bradford Model Engineering Society, www.bradfordmes.co.uk are holding their Centenary Exhibition on 4 October until 23rd November inclusive. This is in conjunction with Bradford Industrial Museum www.bradfordmuseums.org Opening times are Tuesday to Saturday 10 till 5, Sunday 12 till 5 and closed on Mondays. A compressor is being arranged so some of the exhibits can be seen working.

SHARPENING TWIST DRILLS ②

Continuing from my discussion on sharpening twist drills published in the previous issue, I will conclude the subject with a design for a four facet drill sharpening jig. This is primarily intended for use with either of the grinding rests that I have had published in MEW but will work with any rest that has means of accurately controlling the amount being ground away. The photograph numbers follow on from those in the previous issue.

The four facet jig (GA and SK. 1 to 9)

The essential requirement of any set up for grinding by the four facet arrangement is accuracy in locating the drill. The axis of the drill must be in exactly the same place for both cutting edges. That is difficult to guarantee unless the drill is held very close to the grinding wheel. I have seen it suggested that the drill can be held in a drill chuck that is rotated on a spindle. Even with a precision drill chuck, it is highly likely that the end of the drill will wander as the chuck is rotated between one edge and the other. The result of this will be that grinding both edges identically will be unlikely. Because of this, laying the drill in a V trough positioned very close to the grinding wheel is in my estimation the only easy option. This assumes that the drill is not bent in any way but that would be the same if the drill was held on its shank for grinding. I do not intend to go into the manufacturing process as the item is quite easy to produce. It does though depend on a controlled feed grinding rest being available such as the two that I have had published in MEW, Ref. 1. Do note how the angled end of the Base (SK. 6) sets the sharpening angle and needs to run against a fence on the grinding rest.

Photo 15. The jig for sharpening drills with the four facet form.



Photo 15 is of the completed jig and shows that it uses the same method of achieving the 180deg. rotation accurately as I suggested for the commercial fixture. It is seen in use in photo 16. Close ups are shown of the primary facets only in photo 17 and fully ground in photo 18.

Split point geometry

This form of drill is available commercially and has some similarity to the four facet drill form. Its main difference is that the secondary clearance stops short where the chisel normally would be instead of

Harold Hall makes a four facet sharpening jig

being ground straight across the drill. This provides an edge that cuts much more freely than the chisel on a normal jobber drill and to a lesser extent than the four facet drill making the drill much more free cutting and is the main advantage of the design. It is though very much more difficult to sharpen and quite outside the scope of

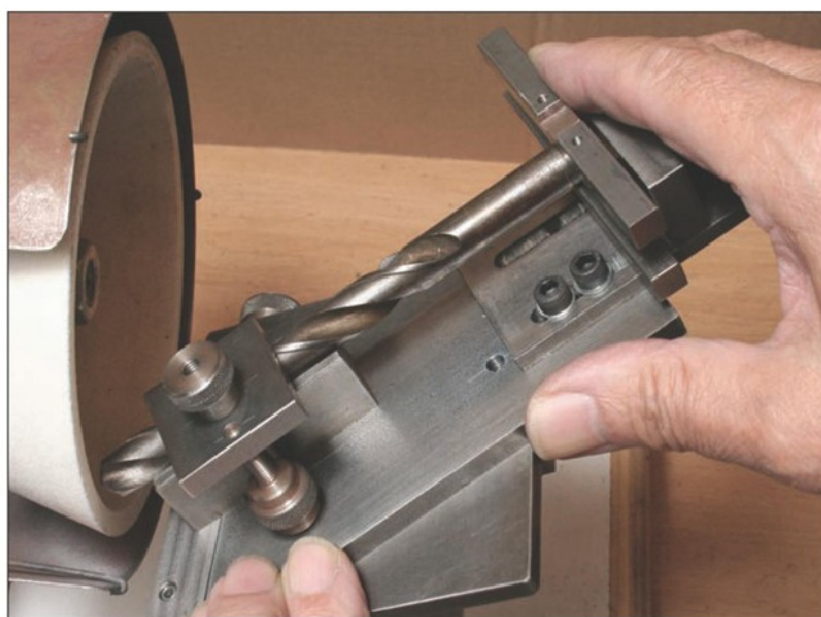


Photo 16. The four facet jig in use.

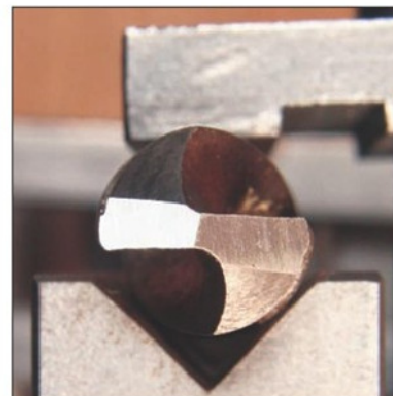


Photo 17. The drill still in the jig having been ground with the first two facets. The drill being converted from one ground conventionally still has some of the original clearance remaining.

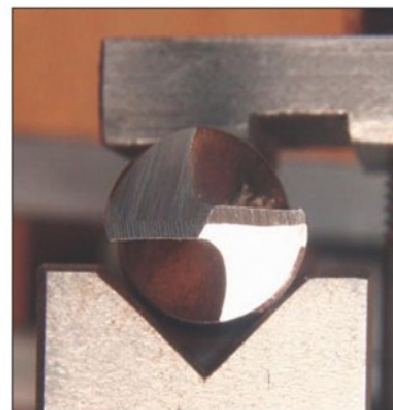
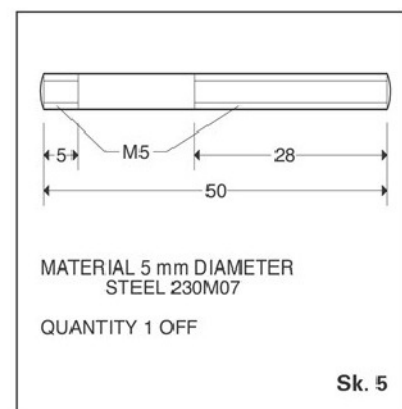
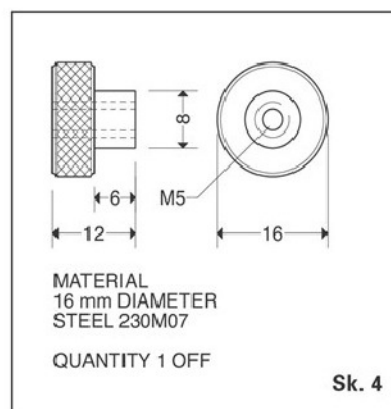
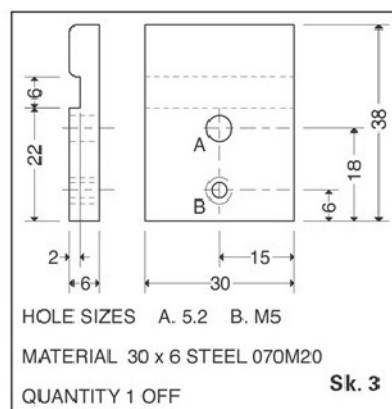
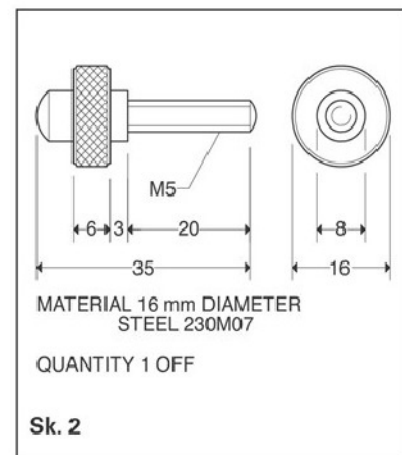
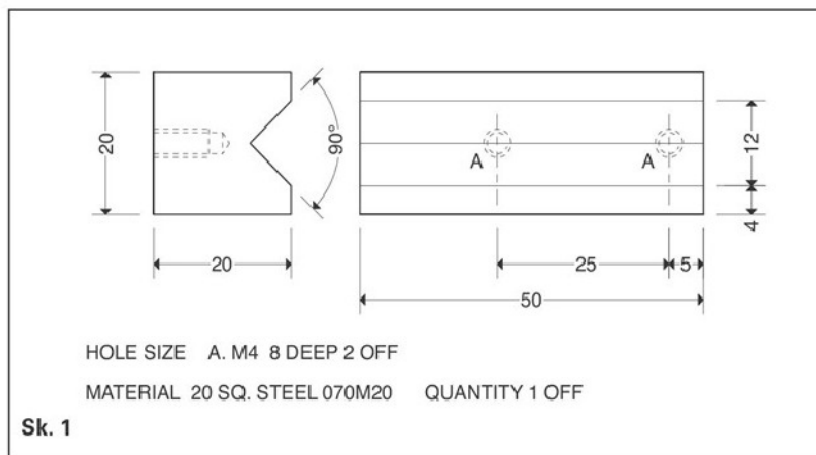
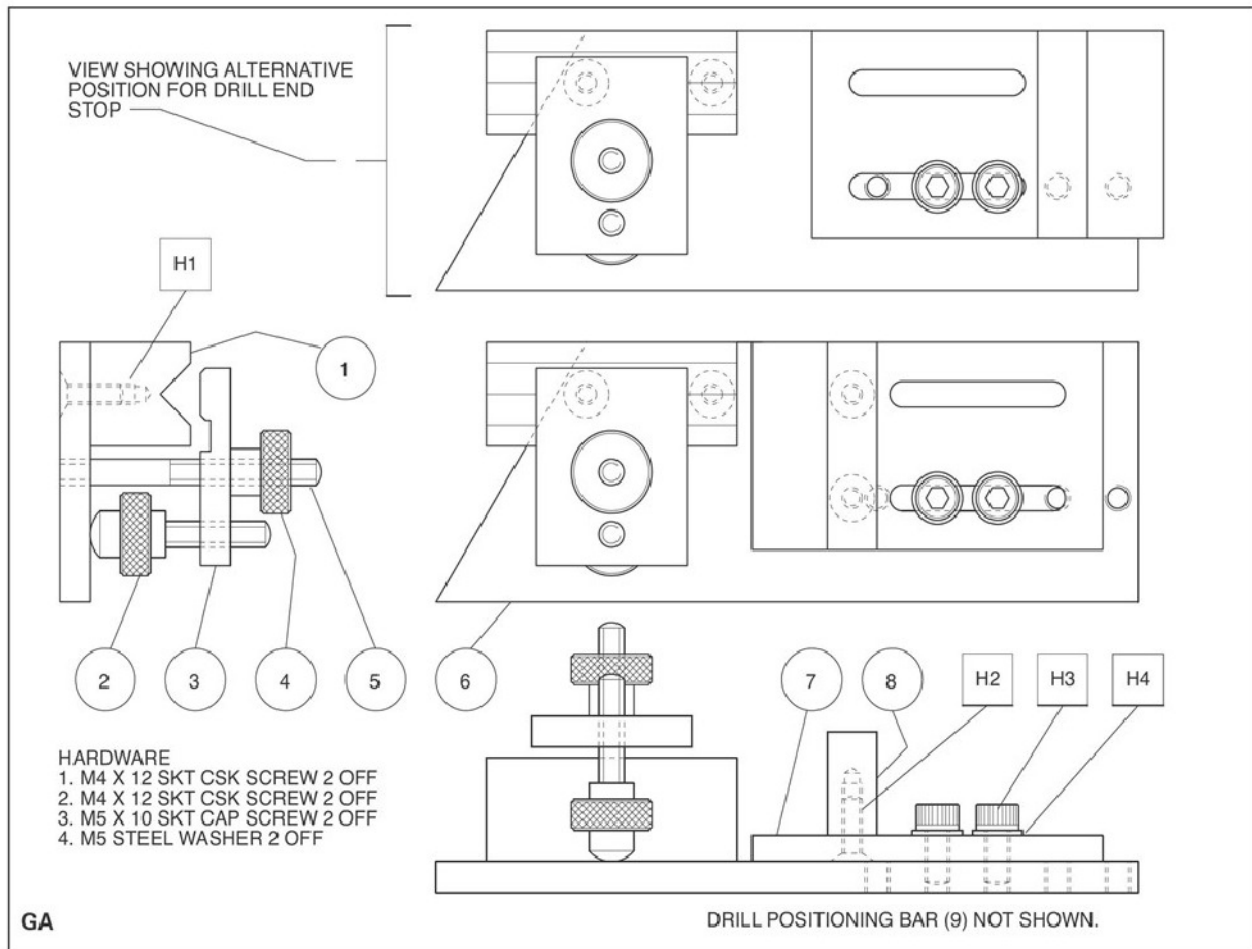


Photo 18. Close up of the finished four facet drill.



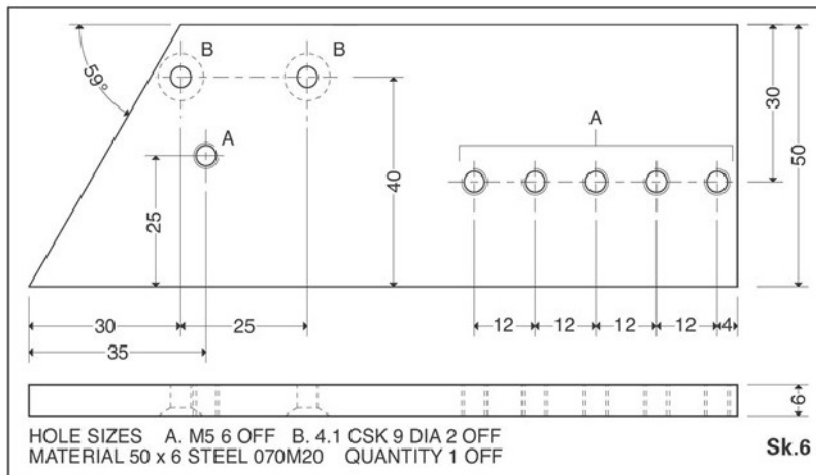
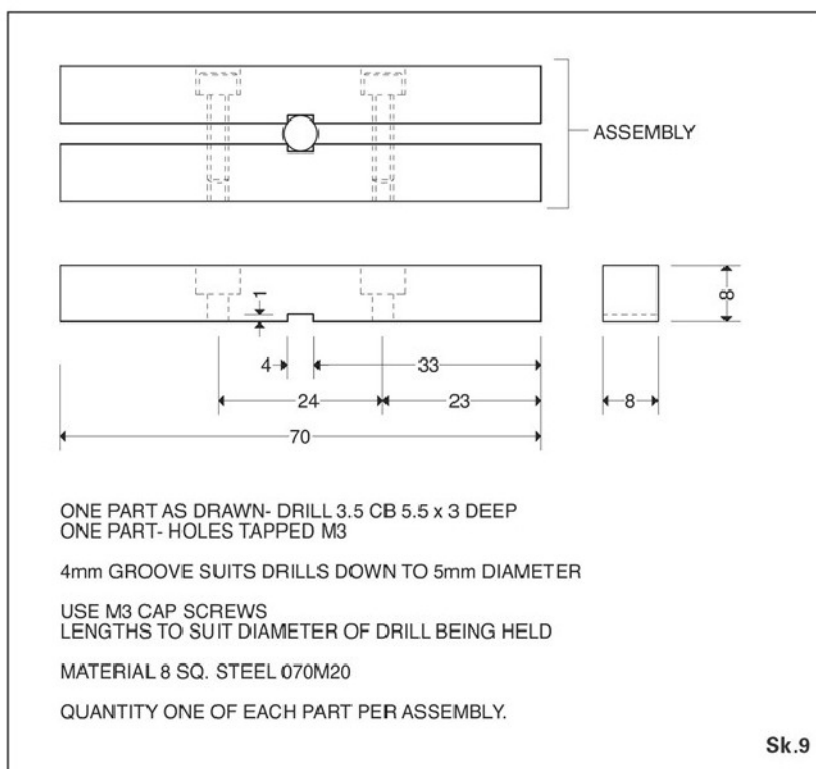
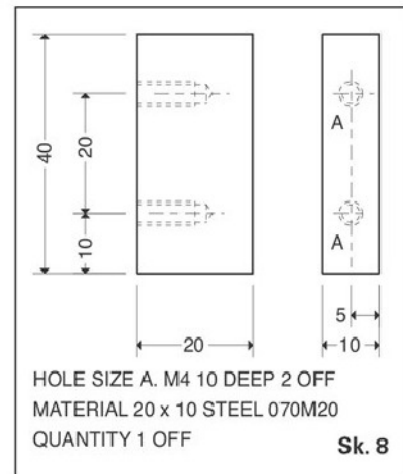
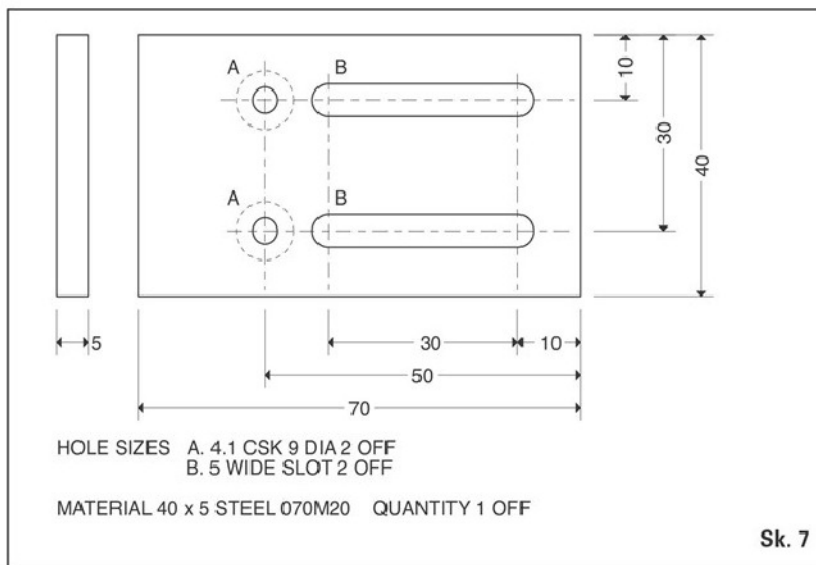


Photo 19. Split point geometry drills are becoming more available but are too complex for sharpening in the average home workshop.



the vast majority of home workshops. Because of this I do not intend to attempt an explanation.

To illustrate the form, I have included photo 19 to help the reader understand their features. The flute form appears very similar, or maybe even identical, to that of the jobber drills. Because of this, should any split point drills come your way they can easily be sharpened conventionally once the drill becomes blunt.

Sharpening tools in the workshop

Sharpening workshop tools is probably one of the least understood workshop tasks. If you have found this article helpful you may also find the book "Tool and Cutter Sharpening" No 38 in the Workshop Practice Series worth reading. See www.myhobbystore.com.

References

Ref. 1. Grinding Rest (advanced) Model Engineers' Workshop issue 89 page 14. Also included in Milling, A Complete Course, Workshop Practice Series number 35.

Ref. 2. Grinding Rest (simple) Model Engineers' Workshop issue 109 page 17. Also included in Tool and Cutter Sharpening, Workshop Practice Series number 38.



THE C3 MINI LATHE 10

Dave Fenner improves the radius turning attachment and makes an offset centre for the tailstock

Radius turning attachment

In an earlier article, I commented briefly on this device and at the time introduced two easy upgrade mods viz. 1) add shims to bring the pivot centres up to lathe centreline height, and 2) a wavy washer to avoid end float of the frame on its bearings. The first of these would ensure that spheres could be produced rather than lemon shaped parts; the second would make it easier to keep the tool point on centreline.

At the time, I also noted that it would be advantageous to improve the location arrangements for the tool bit and to add some form of controlled radial infeed. These two points are now addressed.

On the device as supplied, the cutting tool is clamped in a milled oval slot by two Allen screws. Due to the oval shape, it has several millimetres of sideways latitude.

By inserting a short length of semicircular section steel backing and clamping the tool against it, the bit now benefits from having a fixed location in two planes. This secondary clamping needs only to be a "nip up" and is achieved by means of an

added M6 Allen screw applying thrust via a short piece of silver steel rod.

To add screw adjustment of the radial setting, the existing handle is removed and two stand offs added which carry a bridge piece. This in turn houses an M6 adjuster screw and a new handle made slightly longer than the original. **Photo 1** shows the modified swing frame assembly.

New parts

Before moving forwards and cutting metal, I strongly suggest that prospective up graders start by measuring the swing frame casting. The sizes given for the various components derive from those given for the swing frame casting in **Fig. 1**. Bearing in mind that as the general dimensions are not machined, some variation may be encountered and if so then alter the design as necessary.

Backing

As can be seen in **photo 2**, I placed a fair length of 8mm diameter steel bar in the vice on the mill table with sufficient protruding to make the part. This overhanging section was progressively milled down until it reached half of the original thickness. This piece was then cut off and the ends tidied up by file to match the thickness of the cast frame. The detail is given in **Fig. 2**.

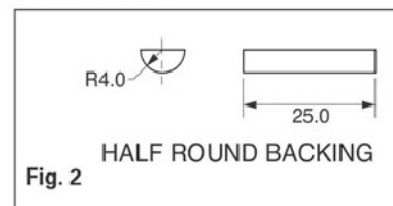
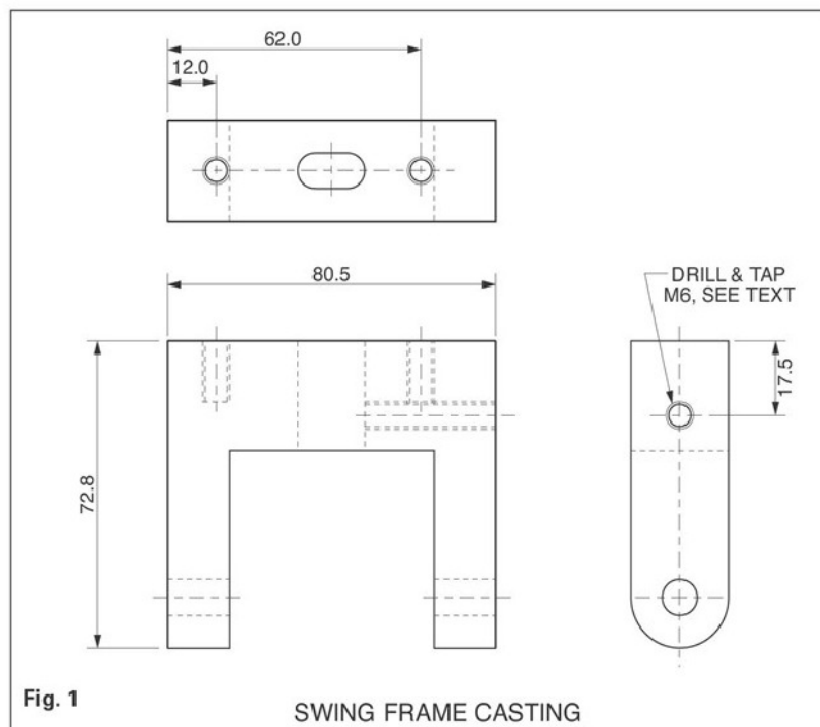


Photo 2. Milling the backing piece.

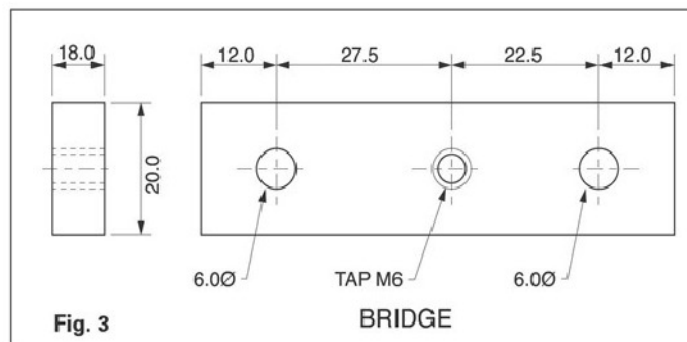




Photo 3. Spotting the hole positions on the bridge.

Bridge

An over length piece of 20 x 8mm bright steel flat was set up in the mill and the three holes spotted, **photo 3**. These were then drilled or tapped as **Fig. 3**. It was then finished to length.

Standoffs (Fig. 4)

Two lengths of 8mm AF bright steel hex were cut then faced to length. 8mm AF was used as some was in stock. Feel free to increase to 10 or perhaps even 12mm AF. Round bar would also be perfectly acceptable, although a feature would

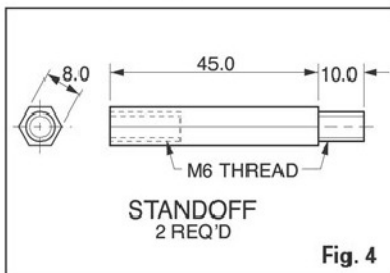


Fig. 4



Photo 4. Turning down the stand offs ready for threading.



Photo 5. Threading using a tailstock guided die holder.

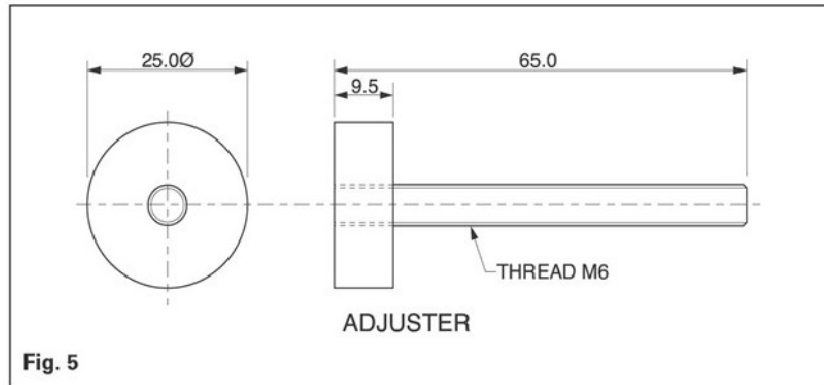


Fig. 5

then be needed for tightening e.g. a cross drilled hole or couple of flats. The required lengths were turned down to 6mm dia, **photo 4** and the M6 threads added using a tailstock guided die holder, **photo 5**. It may be worth pointing out here that typical dies cut differently on their front (usually carrying the size data) and rear faces. The front will usually have a significant taper entry (a sort of inverse situation to a tap), whereas the rear will have less taper. The effect of this may be seen in **photo 6**, which shows one standoff threaded using the die normally (front face leads) while the other has undergone a second operation using the die reversed. This technique can help get the thread a little nearer to a shoulder. The parts were then reversed in the chuck then drilled and tapped M6.

Adjuster (Fig. 5)

For simplicity, this has been constructed from two parts; one is a length of M6 screwed rod and the other a cheese of 25mm diameter free cutting mild steel to make the knob. The length of rod needs no comment and the knob is a straightforward turning and tapping exercise. As the photos show, at this stage I have not taken time to add the divisions; however, this could follow the method described in an earlier article. The pitch of the screw is 1mm or 0.03937in. so one might choose to go for 40 divisions (each approximating to 0.001in.) or 50, (each being exactly 0.02mm).



Photo 7. Drilling hole for second stand off.



Photo 6. Upper component threaded using die normally, lower has second operation with die reversed taking thread closer to shoulder.

To assemble, the rod is screwed into the knob and retained with Loctite. However, before this, it is worth finishing the other end in the lathe to avoid any "swash" effect which could introduce adjustment errors.

Handle and push rod

The push rod is simply cut from $\frac{3}{16}$ in. dia silver steel, the ends being tidied up in the lathe. The handle was cut from $\frac{1}{2}$ in. diameter aluminium, drilled and tapped at one end and then a little aesthetic embellishment was added for fun. A short piece of the ubiquitous M6 steel screwed rod was then Loctited in to give a higher strength male thread.



Photo 8. Hole to take secondary clamp screw and push rod.



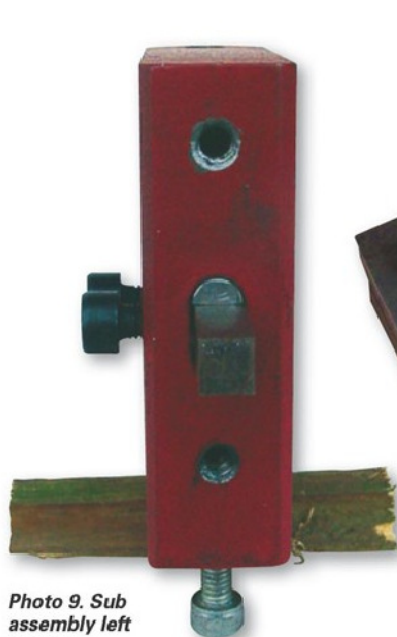


Photo 9. Sub assembly left to cure.

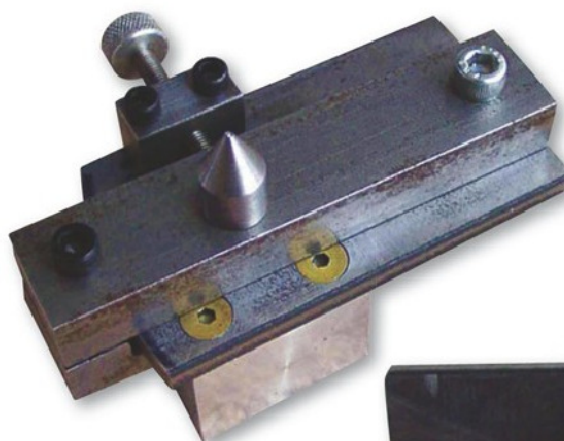


Photo 10. Front view of "offset centre".

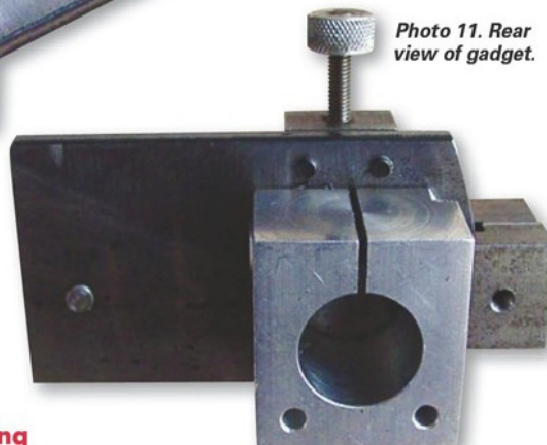


Photo 11. Rear view of gadget.

Modification to casting

Two additional tapped holes are needed, one to take the second standoff, **photo 7** and the other to accommodate the push rod and secondary clamp screw, **photo 8**. Positions for these are shown in **Fig. 1**.

Assembly

The half round surface of the backing was coated with a smear of Loctite and slipped into position. The HSS tool was then replaced and the two original clamping screws partially tightened. The push rod was then inserted and the new clamp screw also partially tightened. The original screws were then fully tightened and the Loctite left to cure, **photo 9**.

The two standoffs were each fitted using a washer to accommodate the thread run out which remained. The bridge was located and held by one new Allen screw and the handle. Finally the adjuster screw was added.

A brief aside on fitting threaded parts to tapped holes

It was pointed out earlier that a second operation with a reversed die would bring the thread closer to a shoulder, but nevertheless, washers were introduced under the standoffs. It may be worth briefly reviewing the general situation and the various design options available.

Clearly if the male thread has a significant run out towards a shoulder, if we try to screw this into a typical tapped hole then it will bind as the thread starts to run out and this will be before the shoulder makes face contact.

Three main options may be considered either in isolation or in combination.

1) The undercut may be turned on the male part, reducing the size close to the shoulder to the minor thread diameter and extending out for a length which removes the run out.

2) The threaded hole in the female part may be drilled out to the major thread diameter for a length which will accommodate the male thread run out.

3) A washer or spacer may be introduced having the same effect, so that only fully formed threads are engaged.

Tailstock "Offset centre" for taper turning

A previous article described a taper turning attachment and noted that another of the accepted set ups for taper turning involves working between centres and moving the tailstock centre away from the lathe centreline. If the tailstock is moved in this manner, there follows the inconvenience of setting it accurately back to datum for normal working.

Devices have been proposed in the past to avoid this hassle (e.g. that by Peter Rawlinson in MEW Issue 108), however, it is hoped that the design offered here will be easily constructed by the relative novice with basic equipment and has been sized to suit the Mini Lathe with minimal projection towards the operator. I would anticipate that the concept might easily be adapted for other machines. Offset centre devices which I have seen in the past, have utilised the Morse taper feature of the tailstock for location, with the attendant possibility of rotational slippage. Location here is therefore by means of a clamp, acting on the outside diameter of the tailstock barrel.

No great precision is needed in making the parts; the only feature which should be precisely positioned is the hole for the centre. As this is machined on the lathe, accurate height is automatically achieved. Front and rear views of the assembled article, off the machine, are shown in **photos 10 & 11**.

MAKING THE PARTS

The clamp (Fig. 6)

Before starting on this in earnest, the tailstock barrel was carefully measured with a micrometer and a test gauge turned up to precisely this diameter from a piece of steel bar. A piece of aluminium flat for the clamp was then cut approximately to length then squared up by turning the faces, the work being held in the four jaw chuck. It was then marked out for the position of the bore and located again in the four jaw chuck to machine this feature, first by drilling and

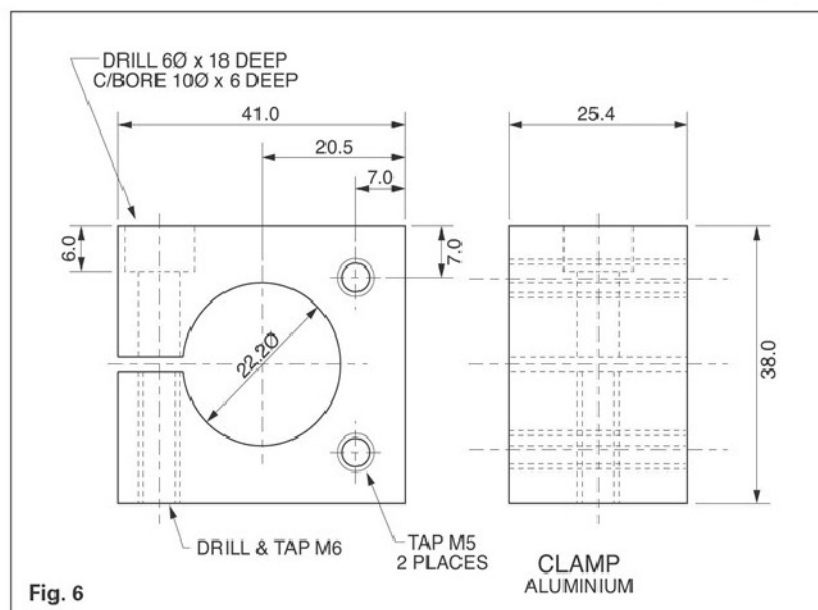


Fig. 6

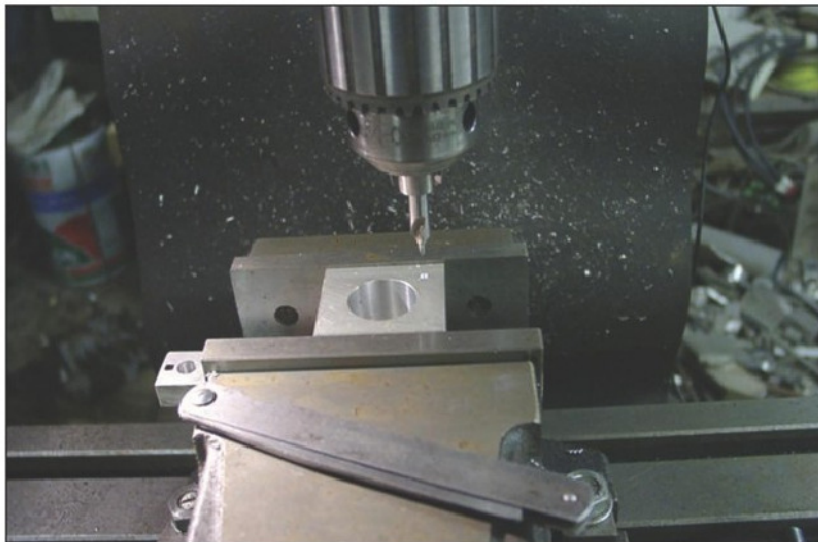


Photo 12. Drilling holes in advance of tapping.

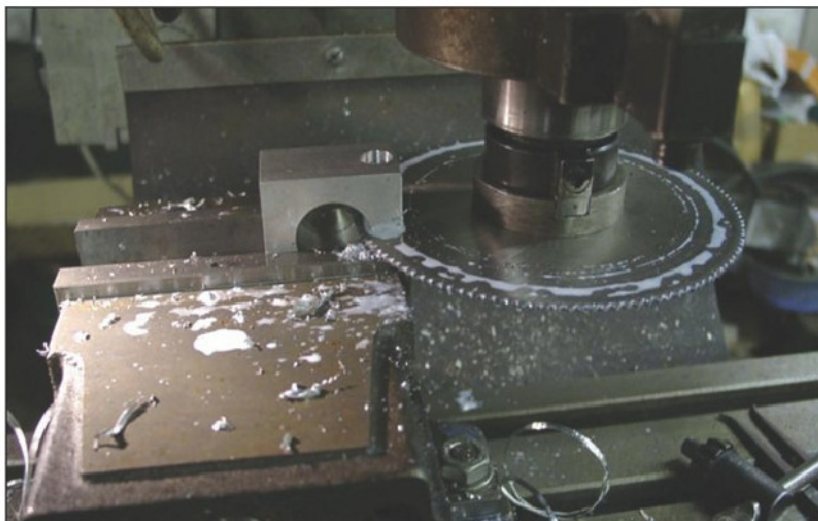


Photo 13. Cutting slot with a slitting saw.

then finally boring to size so that the test gauge would just enter smoothly over the full depth. The two M5 holes were then drilled, **photo 12** and tapped.

I chose to carve the slot by using a $\frac{1}{16}$ in. slitting saw in the mill, **photo 13**. Alternatively, it might be simpler to cut with a hacksaw. A little further work on the clamp will be required later. It is necessary to file a slot to clear the swing clamp, as it

moves around in an arc. The slot is just visible in **photo 11**.

Swing bar and clamp (Fig. 7a & 7b) The material for each of these is $\frac{7}{16}$ in. x $\frac{1}{2}$ in. mild steel flat. For the bar, a length of 103.5mm was sawn off and the ends tidied with a file. The two bolt holes were then drilled, one 5mm dia, the other 6mm. Note that the 8mm dia location for the centre is

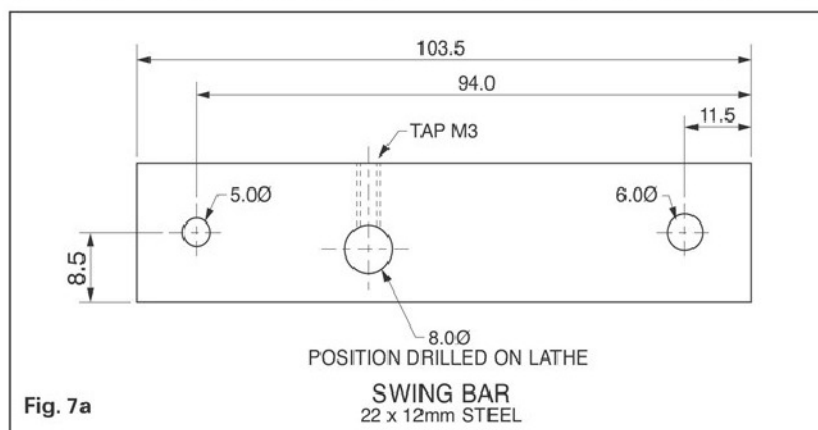


Fig. 7a

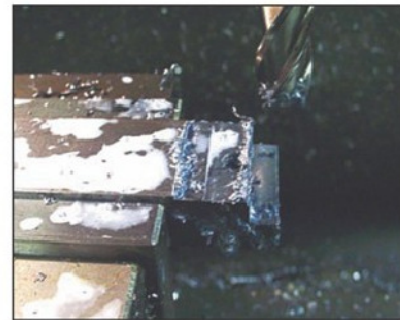


Photo 14. Milling the step.

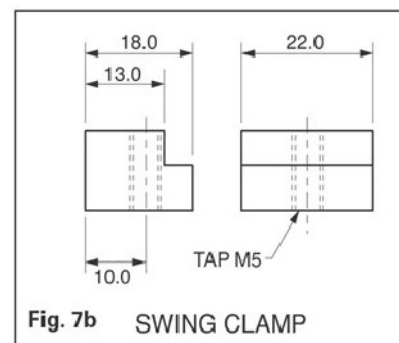


Fig. 7b SWING CLAMP

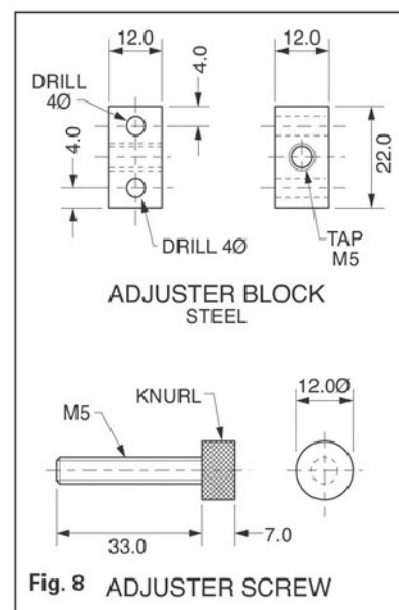


Fig. 8 ADJUSTER SCREW

dealt with later. Moving on to the clamp, here the step was milled out first, **photo 14** and the hole drilled and tapped M5 then the appropriate length was sawn off the bar.

Adjuster block and screw (Fig. 8) The block is again cut from the $\frac{7}{16}$ x $\frac{1}{2}$ in. bar with two holes drilled 4mm diameter and one drilled and tapped M5.

The screw is drawn as a single turned part but for simplicity was made by Loctiting a knurled aluminium head to a piece of M5 screwed rod following the example given earlier for the radius turning attachment.

Backplate (Fig. 9)

The preferred material here would be bright mild steel plate, however, as I had none available, I utilised a piece of black plate taking off the mill scale on the finisher. Drill and tap M6 for the pivot position for the swing bar then transfer the

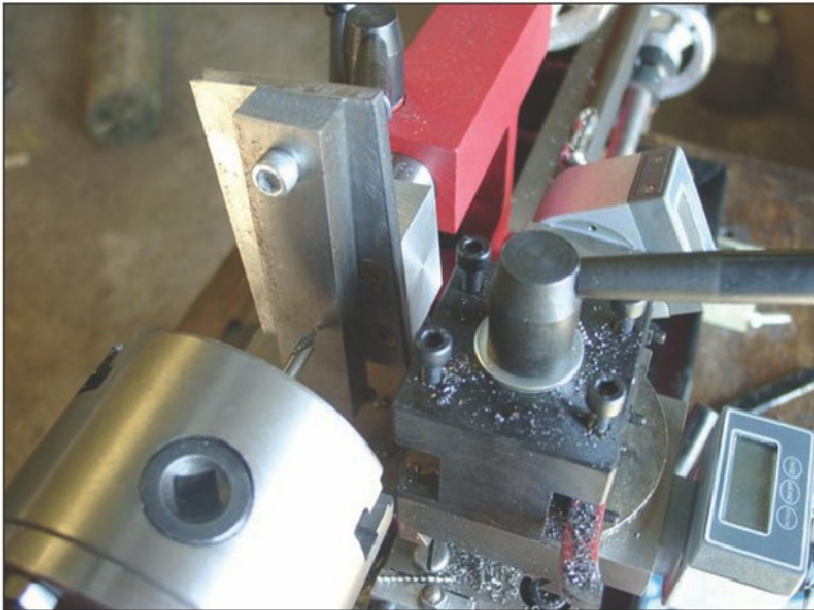
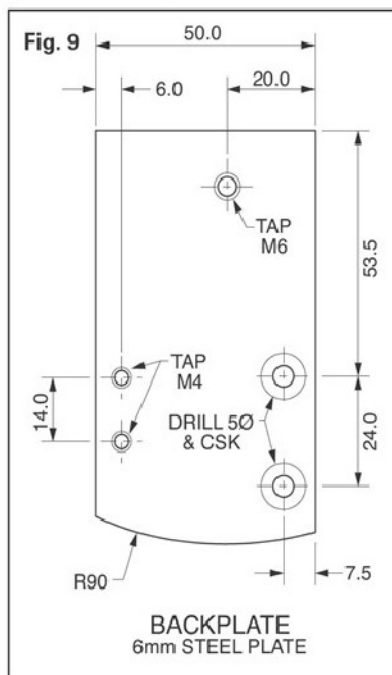


Photo 15. Centre location is positioned on lathe.



hole centres from the clamp, then drill and countersink these two features.

Similarly mark or spot the adjuster block screw holes and drill/tap M4.

Now assemble the various parts with the adjuster screw wound well back and the swing bar biased back against it. Clamp the assembly to the tailstock barrel and fit a centre drill to the lathe chuck. Now use the centre drill to start the location hole for the centre, **photo 15**. Remove the bar, drill out and ream to 8mm. The bar is then drilled and tapped M3 into the 8mm bore, **photo 16** to accommodate a locking screw for the centre.

Centre

Fig. 10 depicts a typical 60 degree centre. The one shown in the photos was made from mild steel, the set up for turning the point being illustrated in **photo 17**. A more

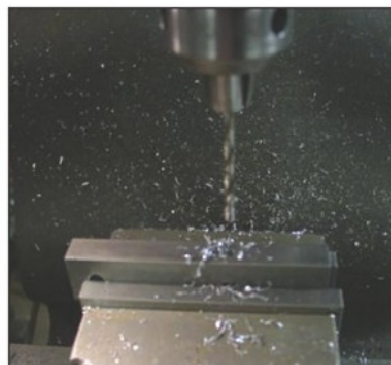
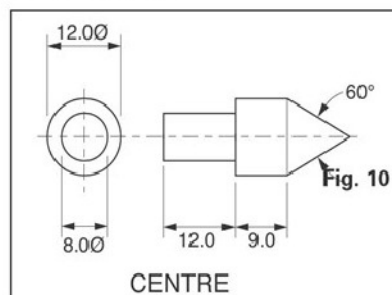


Photo 16. Drilling position for the locking screw.



durable item might be machined from silver steel (then hardened) or perhaps by setting in a carbide point. Note that as the tailstock centre is moved progressively further out of alignment with the headstock, the engagement of the conical centres becomes less than ideal. To counter this, Peter Rawlinson advocated spherical centres, which would, of course, engage correctly for a wide range of work angles. Other variations might include a female centre.

Aesthetics

In this article, I have endeavoured to present a gadget which is both easy and quick to make. The general appearance might be improved by sawing away some of the surplus material on the backplate and spending a little more time cleaning up those surfaces which have suffered long storage and slight rusting.



Photo 17. Set up for turning the 60 degree point.

Conclusion

Purists will correctly point out that because the centre is moved in an arc, it may also move away from the correct centre height. By shifting the angular position of the clamp on the tailstock barrel, this tendency can be eliminated. Should a slight height error remain, the article by Peter McQueen (MEW Issue 81) demonstrated that there will be little effect on the accuracy unless the component geometry combines a large taper angle with small diameter.

Another contributor, (Don Unwin in MEW Issue 99) voiced the philosophy that an attachment must be quick and easy to fit and remove or it will not get used. I like to add the rider that 'unless it is quick and easy to make, it will not get made'. I hope this one qualifies on both counts. **Photo 18** shows the accessory in place on the Mini Lathe. ■

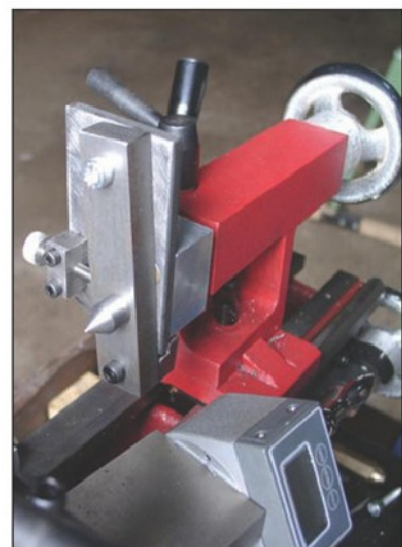


Photo 18. The finished device fitted to the lathe.

RETROFITTING THE DENFORD ORAC CNC LATHE

Dave Fenner finally bites the bullet and upgrades a CNC lathe

Introduction

CNC machining is an area of amateur/model engineering which frequently causes arguments. There will always be those who prefer to twiddle the handles, exercising a great degree of skill, some even maintain that "machining" by numbers has no place in the hobby although many of them will by now have fitted out at least one of their machines with digital readouts, and most will have augmented the traditional micrometer with a digital calliper.

For many years, the cost of computers and the associated hardware ensured that CNC stayed the preserve of well financed industry. Things in this country began to change in the mid 90's driven in part by Richard Bartlett and his low cost Compucut system. Since then, computers have become faster and cheaper and a wide variety of software has become available.

In order for a computer to instruct the machine to perform the required actions automatically, first an overall control program is needed such as Compucut, Desk CNC, Mach 3 etc. In addition, for each component to be made, a set of instructions (Part program) will be required. Several formats are in use, though that which has become predominantly the industry standard is known as G code. It is possible to write the code by typing the lines, but for complex components, this can be time consuming and hence systems have been developed to speed things up. The two main areas are specific DXF to G code converter software, and "wizards" working within a control system such as Mach 3.

For "automated part programming", software may usefully be considered in three sections. CAD or Computer Aided Drafting such as AutoCAD or Turbocad, enables parts to be drawn on the computer screen. Different systems have their own file types, but most will have an option to save in dxf or HPGL format.

A DXF to G code converter can then be used to input a DXF drawing and from it, produce a set of G code instructions although this may need a bit of manual editing to suit the machine being used.

As a final step, the G code is processed by the machine control computer, which then outputs signals to the axis drivers, which then proceed to move the work or tool and perhaps control other functions such as spindle speed and coolant flow.

One of the barriers to using CNC has been the amount of time taken to prepare the G code program; this is particularly true of three axis milling work, where even in some sectors of industry, there are firms which prefer to work in just two axes, controlling the third manually. However this barrier is constantly being eroded with the availability of more low cost dxf to G code converters.

In the early days of CNC, preparing a G code program took a great deal of time



Photo 1. Orac as received but with added "Mezzanine" cross slide.

and skill, which effectively imposed an added set up cost. As a result, CNC tended to be thought of as applicable only to volume production or perhaps complex parts which would be repeated periodically. The software available today makes this process very much faster and hence it can be cost effective to produce even a single part by this means.

Most of what has been written up on CNC, in this and other hobby oriented magazines, has related to milling work and here, nowadays, many enthusiasts are opting for the Mach 3 software, which, in its milling guise, has the facility to control more than four axes, plus additional functions such as spindle, coolant etc.

Mach 3 Turn is the version for lathes and seems to open up new possibilities at very reasonable cost. The Demo versions of Mach3 for both milling and turning can be downloaded free from the internet, however to unlock the full potential the cost is just £85. The software is available in the UK from Rout Out CNC who supply it with a version of Lazy Cam. Buying from Rout Out avoids any potential difficulty of purchasing abroad and also taps into their telephone or email support facility. Much can be accomplished with just the free version. For a start it can be run purely as a desktop simulation exercise (with no CNC machine connected) allowing much self teaching on the system. The free version also includes the various "Wizards" which really do speed up the programming for turning diameters, tapers, faces, radii and threads.

Bearing in mind the advantages of a software upgrade, the decision was taken to get off the pot and proceed with the outstanding project to retrofit my old Denford Orac lathe.

The Orac

I believe these machines were supplied mainly to schools during the early 1980's so the computing power and general electronics are typical of that era. The machine is shown in photo 1 from which it can be seen that it was intended to be totally self contained although a rear RS232 port and TV output were included. All electronics/electronics are housed in the shallow cabinet below the lathe, and an inclined front panel carries all the controls along with a small screen and two tape cassette units. Electrical supply to the machine is by a normal single phase 13 amp plug.

Programming was undertaken by typing in the details line by line – quite a tedious process. It was then intended that the data could be stored using the micro cassette system, but on my example this section was non operational.

Having written a program, this data could also be passed to/ from a separate computer using the RS232. A way was found to utilise this link via the good auspices of John Curtis. (Readers may recall that John devised the system offered via Compucut, for displaying dimensions from Chinese scales as large numerals on a computer monitor.)

Using the RS232 port, John was able to connect to a more modern computer, and produce software which allowed a program written on the Orac to be stored and later retrieved for repeat use. While this avoided the need to rewrite a programme for each session, it did not get away from the laborious method of initial data entry which meant that any parts produced would fall into the relatively simple category.

On the plus side, for repeat working, the little machine proved to be a dream. When

making a quantity of two-part miniature spark plug bodies, the thought of manually screw cutting close to the shoulders caused some disquiet. The original software included a "canned cycle" for threading and using this proved to be fairly easy. Once programmed, fifty odd pairs of parts were rattled out in under a couple of hours.

On the mechanical side, the Orac lends itself well to electronic upgrading. The technical specification notes that the bed is hardened and ground and gives the centre height as four inches, swing over cross slide 2.25in. and distance between centres as 15.75in. The basic machine is well engineered with the spindle (bored 20mm) running in taper roller bearings and the saddle and cross slide movement being driven by sizeable stepper motors via Warner ball screws. It is worth noting that two ball nuts are fitted to each axis to eliminate backlash. Also in place are a variable speed motor control system for the spindle, a low voltage work light, axis limit switches and a spindle speed sensor.

My machine is not equipped with one, but Denford did offer a rotary tool changer which would, if my interpretation of the parts manual is correct, accommodate a total of eight tools. The change mechanism was driven forwards by a small D.C. motor which after passing a trigger, reversed to a mechanical stop giving repeatability and rigidity.

Main electrical parts

The principal elements in the original set up are: the power supply board, the spindle speed controller, the board stack, the front rack, the TV monitor and the two tape units. The board stack is comprised of three PCB's, and the front rack houses several PCB's and the two Parker CD20 stepper drivers. It was only after progressing a fair way with the disassembly exercise that it became obvious that the whole electrical package may be withdrawn to the rear on the chassis plate. Although careful notes were taken concerning what was connected to what, some questions did arise later when examining the component parts. If you plan to re use elements of the system, then a suggestion here would be to take

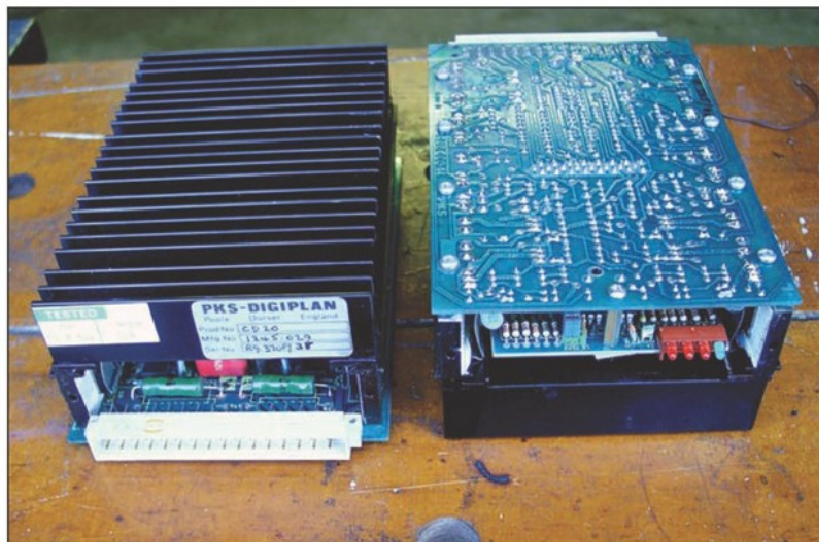


Photo 3. The two original Parker CD20 stepper drives.

copious photographs of the strip down process. Photo 2 shows those elements visible at the rear of the machine.

Safety

As always, if you are not competent when dealing with voltages of mains level and above, then play safe and phone a friend who is. Aside from the expected 240v AC, the original circuitry includes high voltages generated for the mini TV screen and when examining the spindle drive, one board carried a reference to 600v DC. Other surprising voltages were encountered in this area.

What to keep

This will be determined by what is still working and the depth of your pockets. In my case apart from the data recorder, the machine was functioning correctly, so I felt (mistakenly) able to pick and choose. I had earlier decided to remove the original Parker stepper drives and substitute those supplied by Arc Euro Trade. The same type of units had been fitted to the Matchmaker mill and apart from being more modern, and simpler to fit, than

the older Parker drives, photo 3 these offer the benefits of considerably lower cost, simplified wiring and microstepping modes. An alternative would be to use Rout Out drives, but this option would entail a new power supply to match the voltage requirements.

Power supply

This should be considered in conjunction with the regulator board (the middle board of the board stack). The main PSU chassis, photo 4 carries two transformers, a relay, and contactor. The larger toroidal transformer is linked to a pair of bridge rectifiers and smoothing capacitors and was found to deliver a DC output of 65volts for the stepper drives. As this stepper output was comfortably within the specification (80v max.) for the Arc drivers, I was keen to reuse this.



Photo 2. Chassis partly drawn out to rear showing electrical sub assemblies. Left to right, Board stack, Power supply unit, Spindle variable speed drive.

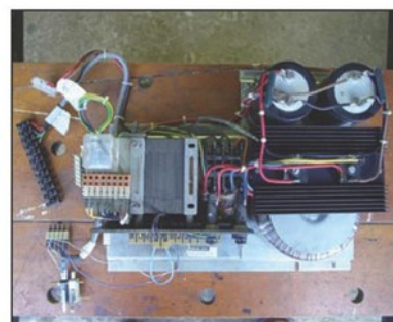


Photo 4. Overview of the Power Supply Unit.



Photo 5. The regulator board.



Photo 6. The original timing disc (sensor board removed).

The smaller transformer gives several outputs and when connected to the regulator board, **photo 5** DC outputs of +12v, -12v, and +24v are available. 12v would be needed so this board was also retained.

Spindle speed sensor

Again my inclination was to try and reuse the existing kit, (perforated disc and sensor board). The original disc, **photo 6** has one row of sixty slots read by one sensor, whilst a second reads a single outer slot generating one pulse on each revolution. The two sensors may be seen in **photo 7**. Accurate speed sensing and control is required for CNC screwcutting. Mach 3 can work with one or a few (typically four) slots triggering a single sensor. Using a four slot arrangement, one slot should be cut about 50 per cent wider, becoming a "master". The mechanical modification therefore consisted of making a new disc having four slots (three about 5mm wide and one about 8mm). The Mach 3 instructions give detailed guidance on slot sizing, which needs to be appropriate to maximum spindle speed. The new disc is shown alongside the old in **photo 8**. In the new arrangement, just one of the original sensors is connected.

Spindle drive

It is believed that the model of variable frequency drive unit was changed by Denford during the life of the product. The motor is wired in delta and the drive is basically an early technology inverter (variable frequency drive). The unit fitted to mine appeared to be made by Brown Pestell. I first tried to get information from the Brown Pestell company, without success. A call to Denford yielded the suggestion that I look at and request information on their website www.denfordata.com. Just two hours after typing in the question, a B-P service manual had been posted, unfortunately for an alternative model. I had by this time realised that the speed controller had been rebadged by Brown Pestell, being originally manufactured by Parametrics (USA). A Google search for "parametrics vfd" brought up a CNC discussion group (www.cnczone.com) where the same question had been covered.

Interestingly (see later) one contributor recommended scrapping these 20 odd

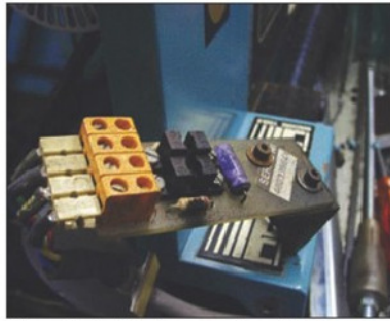


Photo 7. Original sensor board.

year old drives as the capacitors would be past their sell by date.

This site also provided valuable information on the start/stop and speed variation signals and connections, which then allowed the motor and controller to be jury rigged for bench running, **photo 9**.

This raised yet another surprise. It was found that the control terminals on this older generation kit, were actually at a level of around 130 volts, clearly not to be touched by careless fingers, or connected back to the intended controlling computer. An SOS to John Curtis was met with an initial "I don't like the sound of that from a safety point of view" followed up with "well let's take some measurements and see if it can be handled using opto isolation".

When John called in to have a look, the drive had started to malfunction. At initial switch on, it would start, run for a couple of seconds then stop. This would be repeated four or five times before the thing warmed up and behaved normally. His measurements then confirmed my earlier assessment of voltages and he then



Photo 8. New and old discs. The new timing disc has four slots, one being 50% wider.

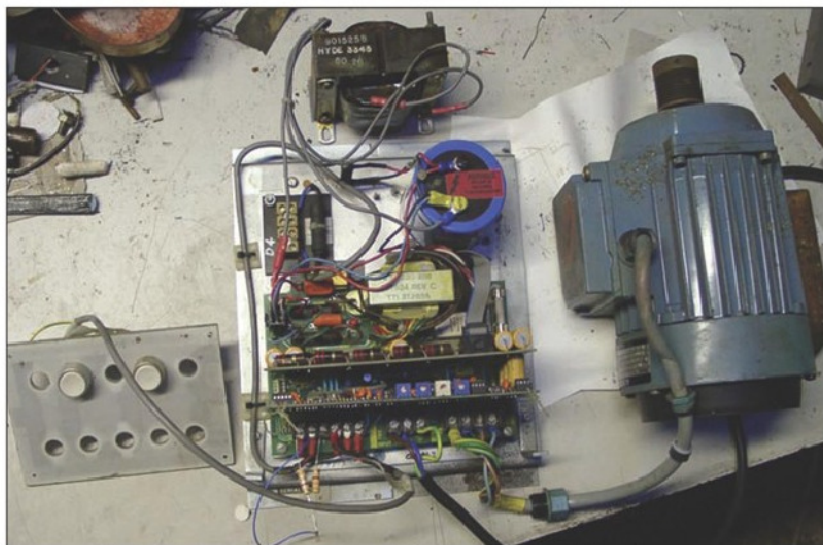


Photo 9. Original spindle drive jury rigged for bench running. Note the block of wood stopping the motor body rotating under torque reaction.

went on to deduce that with a simple mod to the drive, and appropriate isolation, it should be possible to make it work.

Before progressing further, I planned further test running (repeated several times a day) to see if the malfunction would develop or disappear. A couple of days later, I switched on, hit the start button, and was greeted by resounding flash and bang. I believe one of the capacitors had failed spectacularly, so decided to admit defeat and put the assembly aside.

New inverter

Two other machines in the workshop are already fitted with manually controlled inverter drives. The Myford S7 has the package supplied by Newton Tesla, and the Colchester Chipmaster has a Eurotherm unit. Both are excellent. I understand that the successful UK company, Eurotherm, has now been bought over by Parker. This may mean a change in marketing arrangements (working through distributors as do some ball screw manufacturers) and perhaps an increase in effective prices to the private end user.

Both Newton Tesla and Drives Direct would be able to supply a suitable drive, but during a conversation with John Stevenson, I learned that he had been testing an IMO inverter of the correct rating on a small mill and this was now no longer needed. Money changed hands and the decision taken to fit this unit, which duly arrived in the post a couple of days later.

It is supplied with short form instructions; probably just enough to get going, but the full manual (which runs to over a hundred pages) has to be downloaded. Modern inverters have numerous parameters which can be programmed, including features such as max speed, acceleration rate, etc. so a fair bit of time would be taken to go through the options and set up accordingly. At the time of writing, I understand that Arc Euro Trade are considering becoming a distributor for the IMO drives, so anyone requiring one might enquire of them. ■

Next month, we will look at the new interface board, the wiring and the hardware.



A DIFFERENT ANGLE ON HEADSTOCK DIVIDING

Jim Whetren offers a simple solution for indexing in degrees



Photo 1. Feed gear arrangements.

Background

The drive for the leadscrew/ feedscrew of my lathe is provided by a reversible keyed shaft from the headstock driving a train of gears, **photo 1** on a quadrant, **photo 2** with a rotating keyed shaft able to accommodate two gears side by side. I imagine many current lathes have a similar arrangement.

When I have had the need to index work held in the chuck, graduating feedscrew collars for example, I mount the appropriate gear on the headstock shaft and use a spring blade to act as a ratchet with the gear, **photo 3**. This proved to be very positive in operation as a loud click is heard as each tooth is located. Due to the working clearances of the drive mechanism, there is quite a lot of backlash to be taken out.

As there is no need to remove the hand from the chuck to release indexing plungers etc, this type of work can be carried out quickly and accurately with the left hand turning the chuck and the right hand operating a Radford type of graduating tool slide.

I have successfully graduated one degree markings using a 90T wheel keyed to a 25T

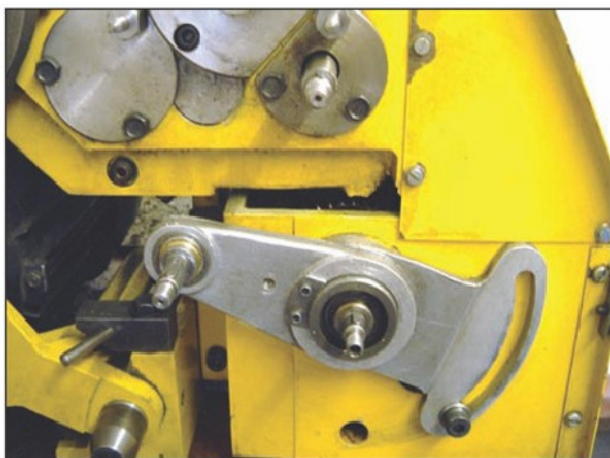


Photo 2. The swinging gear quadrant.

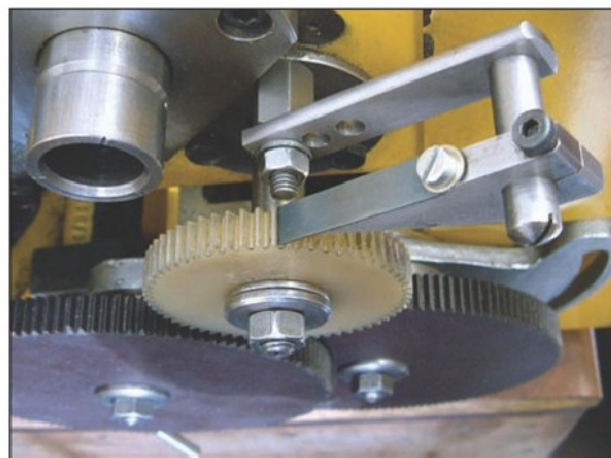


Photo 3. The simple ratchet arrangement.

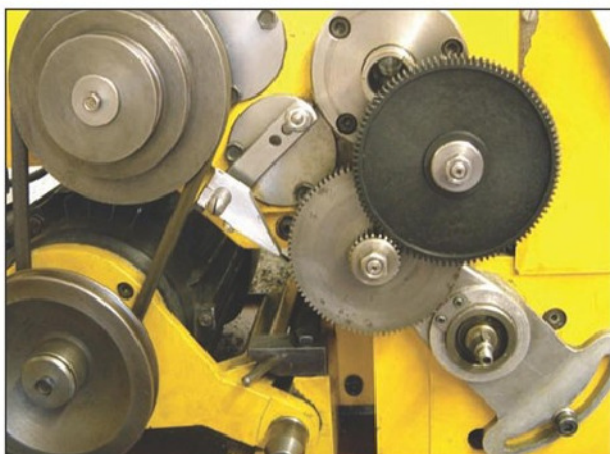


Photo 4. The geared degree setup, the blade is on the end of the triangular piece.



Photo 5. A pillar is used to mount the ratchet assembly.





Photo 6. Indexing components using a spring plunger.



Photo 7. The headstock mandrel adaptor.

wheel used in this case. The ratchet is mounted on threaded pillars, which replaced strategic bolts used to secure the bearing end caps, **photo 5**. Although I do have a normal spring plunger to positively engage and lock the gear, **photo 6** this will not eliminate the backlash, as the mandrel cannot be locked.

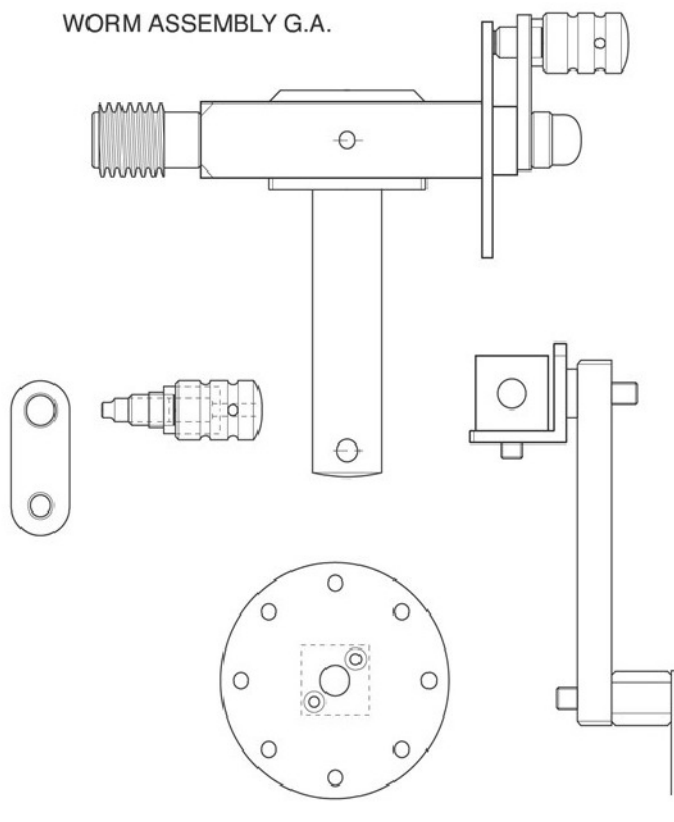
This prompted the production of an expanding adaptor to fit into the mandrel bore to locate the indexing gear, **photo 7**. The ratchet was still used in the same manner as before, **photos 8 & 9**. It will be noted that the end of the mandrel is directly above the train of gears, therefore putting them in the direct firing line for swarf falling on the teeth when boring through holes. Very early on I made an extension sleeve with two slits to spring into the bore, directing the debris outboard of the gears, **photo 10**.

As my main need for headstock dividing is for various graduating operations, I was

stumped with degrees as the quadrant only allows gears to be mounted in one place and the presence of the keyed headstock shaft limits the size of the gear fitted on the mandrel. This prompted the introduction of a worm and index plate arrangement.

Although this provides enormous possibilities of numbers to be indexed, I was only concerned with 360, being the largest number required. Using the worm to drive a 90T wheel and having 4 holes in the plate would achieve this, but 80T was the largest that could be fitted without making lots of extensions and moving everything too far to the left.

WORM ASSEMBLY G.A.



So it was settled that a 45T wheel driven by the worm with 8 holes in the plate would do the trick, **photos 11 & 12**. A 60T wheel can just fit without having to move the feedscrew drive gears, **photo 13** so there are a useful number of divisions which can be obtained by rotating this wheel the required number of turns with the worm and using one hole in the plate. A 50T wheel takes care of feedscrew dials with 25, 50 or 100 divisions. **Photo 14** shows this simple unit ready to be fitted, with only one nut, in place of the ratchet. **Photo 15** shows the acceptable degree of worm drive engagement.



Photo 8. The simple direct indexing setup.

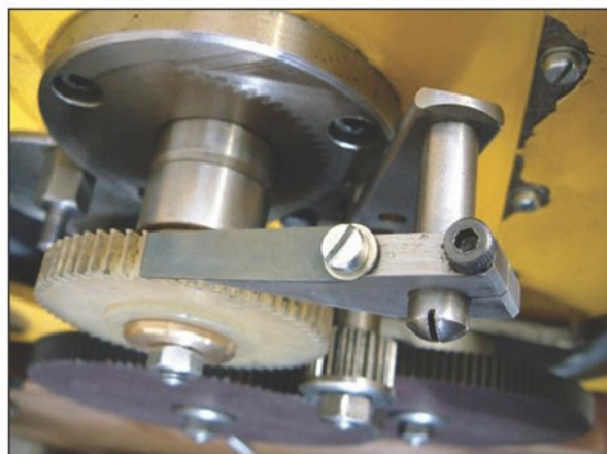


Photo 9. Top view of direct indexing.

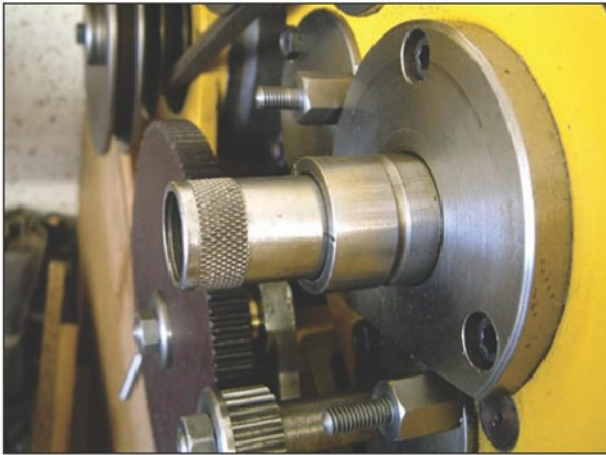


Photo 10. Extension tube in lathe mandrel.

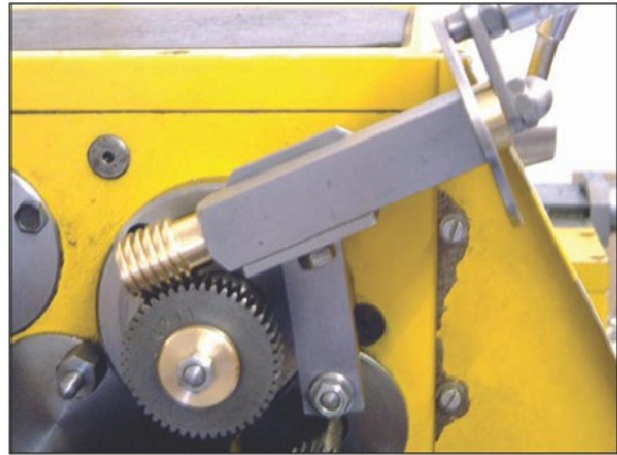


Photo 11. The finished degree setup.

Mandrel Adaptor (Sk. 1)

This is of course made according to the mandrel/gear bores of the particular lathe. The turning of the spigot to fit the bore and the drilling and boring were all done at the same setting. The taper of 10deg. provides easy tightening and releasing. (Leave the top slide set to this angle.) The knurling is also done now with a medium diamond knurl. Reverse the piece and turn the change wheel spigot to a shake free slide fit for the gears. Although a keyway is shown, I haven't made one as the gear is unlikely to slip with my intended use, but should be considered if milling is contemplated.

With regard to the slitting, this could be done in a basic way as I did. Before reversing the piece in the chuck, use a sharp pointed tool to scribe three lines where the slits are to go. The chuck jaws are used for indexing but rather than use a piece of material resting on the bed under the jaw, I have found many set ups can use a small key-ring spirit level removed from its chain. With one of the jaws horizontal facing front, place the level on the jaw and set the bubble to its mark. Run the tool along the work, including the waisted portion. Set the next jaw to the same point on the level and repeat twice.

With the guidance of the scribed lines, the three holes and slits were made, setting the piece in the drill and mill vices by eye.

Tapered plug (Sk. 2)

The drawbar is prepared first to completion. A blank of 3/4in. dia bar is cut and faced to length, centred, drilled and tapped; it is then screwed on to the drawbar. Holding by the drawbar the taper can be turned at the same top slide setting. Both ends of the taper are chamfered and this part is complete. The slots are deburred and the parts assembled with a nut and washer to try the locking action.

Worm shaft assembly

(Figs. 1, 2 & 3)

If the DP of the change wheels is known, it is fairly straightforward to cut the correct pitch of the worm if you are able to use compound gear trains for screw cutting. I can't with my fixed quadrant spindle, and I don't know the DP of my change wheels.

The object is to have the worm threads a close match with the gear teeth for profile and pitch angle. To find the pitch I used a thread gauge, accepting that the angle was wrong, and looked for the best fit in



Photo 12. The eight hole index plate.



Photo 13. Clearance is minimal when using the 60 tooth wheel.

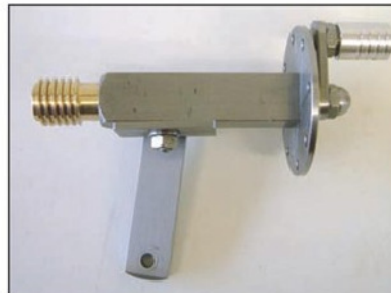
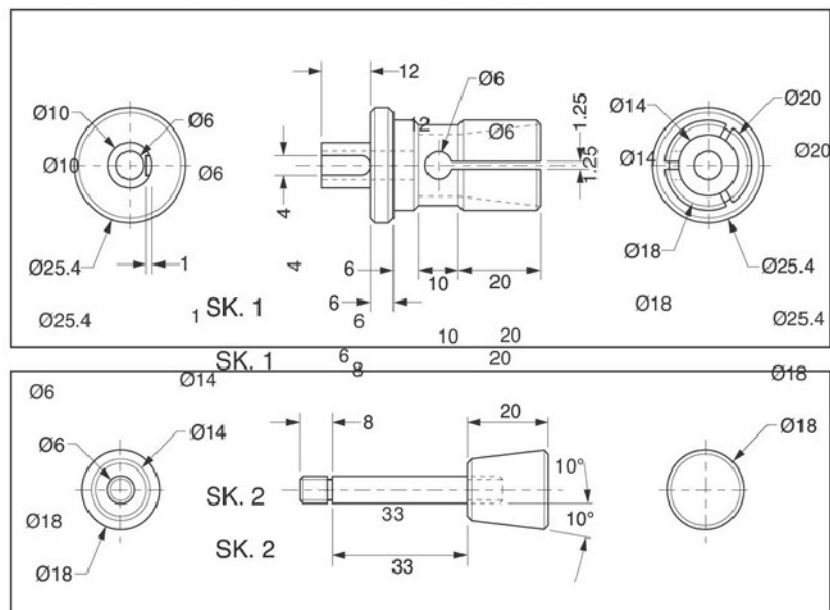
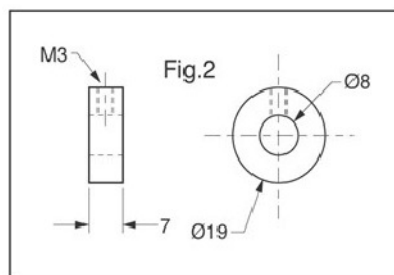
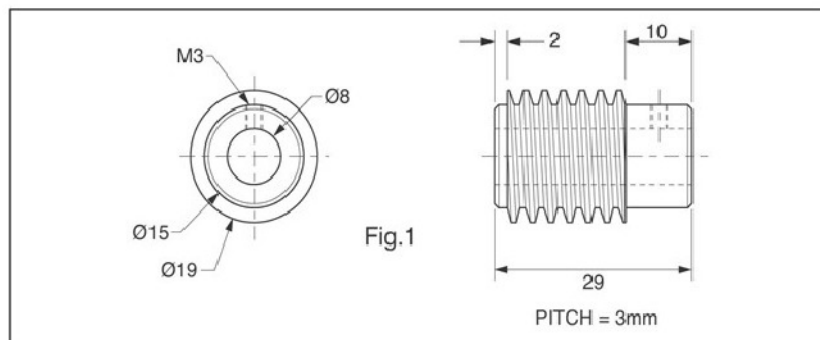


Photo 14. The completed unit removed from the lathe.



Photo 15. Acceptable Worm drive engagement.





the teeth by rocking the gauge around the gear and came up with a 3mm pitch.

The tool required has an included angle of 29deg. and a flat tip of a width of .31 P; so for 3mm Pitch this is 0.93mm. This is hard to measure, so when grinding the tip, check with a glass and a good ruler, aiming to be just inside the graduation lines. The depth will be .6866 P which is 2.06mm.

Worm (Fig. 1)

I made the worm from brass as some of my change wheels are plastic and I wanted something fairly soft. Chuck a piece of 3/4in. dia. material with about 35mm protruding and face and centre the end. Take a light skim off the O/D to clean it up and set the cross slide collar to zero. Take a 1mm cut with a round nose tool for a length of 10mm and repeat followed by a cut of 0.06mm to reach the thread depth. At the end of the final cut, withdraw the tool and move the carriage towards the

chuck 17mm and repeat for a length of 4mm for the runout groove.

With the gear train set up for the 3mm thread pitch and the freshly ground tool correctly set, start to form the thread; preferably using hand power with a mandrel handle. As there is a large area of cut, the in-feed should be about 0.05mm. When the reduced diameter is reached, offer up a gear to test the fit and if necessary take light shavings from the sides of the thread to get the best, even fit between the gear teeth.

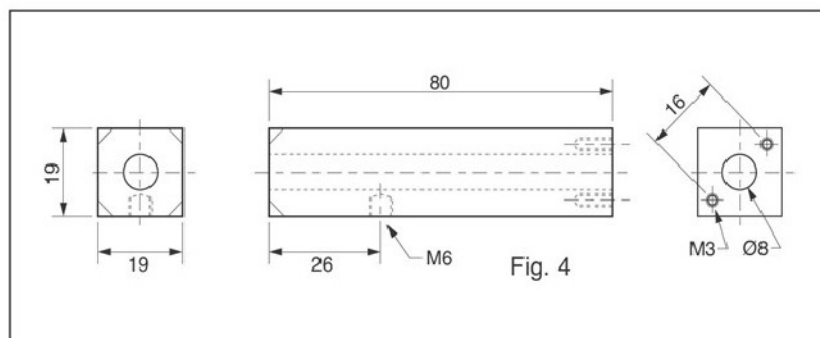
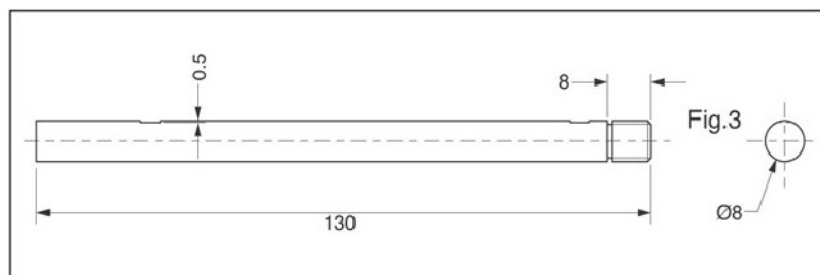
Drill to a depth of 30mm with a 6mm drill, opening up in stages to 8mm or ream if a reamer is available. Part off at 29mm long and drill and tap the M3 thread for the grub screw.

Collar (Fig. 2)

Pull the parent bar out about 12mm and face the end. Take a skim to clean up the O/D and re-centre, or if the hole still runs true, open up to 8mm, 9mm deep. With a 90deg. Vee tool put a small chamfer on the end then move the tool left 7mm and feed in 0.5mm. Continue the cut left for the width of the parting blade and part off. Again drill and tap for the grub screw.

Spindle (Fig. 3)

This is just a length of 8mm dia. MS a good fit in the worm and collar, faced at both ends and chamfered. One end is threaded M8 for 8mm and the thread undercut with a narrow parting tool.



Body (Fig. 4)

This is a straight piece of 3/4in. square MS cut off long enough to face both ends to length. Go over all sides with a file to get clean surfaces and mark one end in the centre, lightly punching. Set running true in the four jaw chuck and centre the end. Drill right through with a long series 6mm drill or carefully centre and drill from both ends. Open up in stages to 8mm or ream to size. The 8mm drill will just pass right through from one end. Chamfer the corners on one end 3mm and put aside for now.

Bracket (Fig. 5)

Cut off a piece of 1in. x 1in. equal angle and file the ends square to a length of 40mm.

From the inside face, find the centre of one side and drill 6mm. From the inside of the other side, centre and then drill and tap M4.

Support arm (Fig. 6)

This is made from 3/4in. x 3/4in. MS. After the ends are squared, mark out and drill the two 6mm holes as per the sketch. The size of this part is to suit my Prazimat DLZ lathe so for others, identify which screw or bolt can be replaced with the threaded pillar or where a tapped hole is required. Fit a 60T gear onto the new mandrel adaptor and fit the worm onto its shaft. Hold the worm engaged with the teeth at the top of the gear, allowing it to assume the helix angle which will have the worm spindle pointing towards the lathe. Secure it in place with a clamp, or in my case, an elastic band. Rotate the mandrel so that the spindle points upwards at an angle of about 30deg. Measure from the centre of the pillar vertically to the centre of the spindle to determine the centre points of the 6mm holes and cut the support to suit.

Division Plate (Fig. 7)

Cut a 62mm square from a piece of 3mm plate and mark and lightly punch the centre. With dividers set to 30mm, scribe a circle and mark off the corners at 45deg. just clear of the circle. Saw these corners off, keeping clear of the marked line, and then with a file, remove the remaining projections, again clear of the circle line, removing all sharp edges.

With the piece firmly clamped to the drill table or in a suitable vice, bring a centre drill into the punch mark and drill to the point of break through. Drill and tap M6 and remove the burrs from both sides with a countersink bit.

Mount a short end of 1in. dia. bar in the chuck, face, centre and tap M6 about 10mm deep. Insert a short length of studding into the fixture and tightly screw on the plate.

Taking light cuts, bring the piece circular and to the 60mm diameter. Lightly chamfer both sides. I was able to spot all the holes at this stage by using the flexible drive from a mini drill, having made a grinding attachment for my Cowells lathe, photo 16 as per Ralph Sparrow's similar setup for a Unimat 3 described in MEW issue 117. I used the holder bolted to a cross slide T slot, with the hand piece set horizontal and at centre height.

With a No1 centre drill (1/16in. dia.), put a centre in the piece of studding and then fit the centre drill in the collet of the flexible drive. Bring the drill into the centre in the stud with the cross slide and lock the slide.

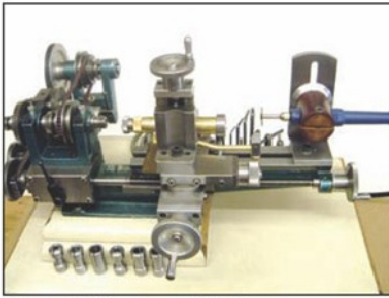


Photo 16. The Cowells lathe in use as a tool grinder.

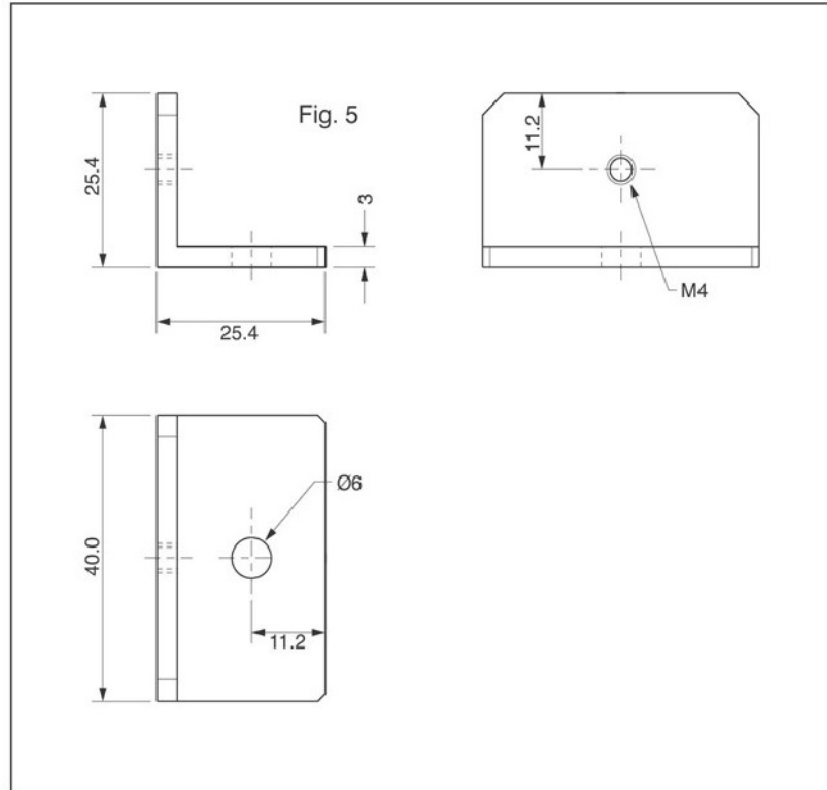
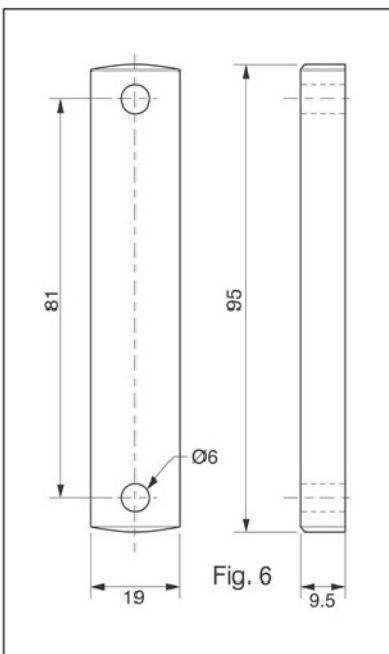
Feed outwards to remove any backlash and zero the dial. Unlock the slide and move out 8mm rellocking the slide. I used a 40T wheel to index the mandrel. Drill into the plate to form a good centre, index 20 'clicks' and drill another.

Unlock the slide and wind out a further 17mm rellocking the slide. Form a centre and then indexing 5 'clicks', at a time, form a further 7 centres.

Remove the plate and open up the tapped hole to 8mm. With a piece of 8mm dia. bar held vertically in the drilling vice, place the plate on the bar and with the centre drill in the drill chuck, align one of the two fixing centres under the drill and between the vice jaws. Drill M3 tapping size, repeating for the other hole. With the centre drill again, align one of the indexing holes and drill through 4mm. It is simply a matter of rotating the piece to allow the drill to self centre and holding down firmly by hand. At this size and with gentle down-feed, there is no risk of the drill grabbing. If this does not suit, use 8mm studding with a nut and washer nipped up after the drill has located. When the index holes are drilled, countersink both sides 0.5mm deep using the depth stop and rotating around the pin.

Body & plate fitting

Take the body and scribe a line between diagonal corners on the non chamfered end, emphasising with a marker pen.



Mount vertically in the drill vice and mount the plate on the body located with the piece of bar and sighting down one of the tapping holes align it central over the marked diagonal. Spot through into the body and remove the plate. Continue drilling to a depth of 10mm and tap the hole.

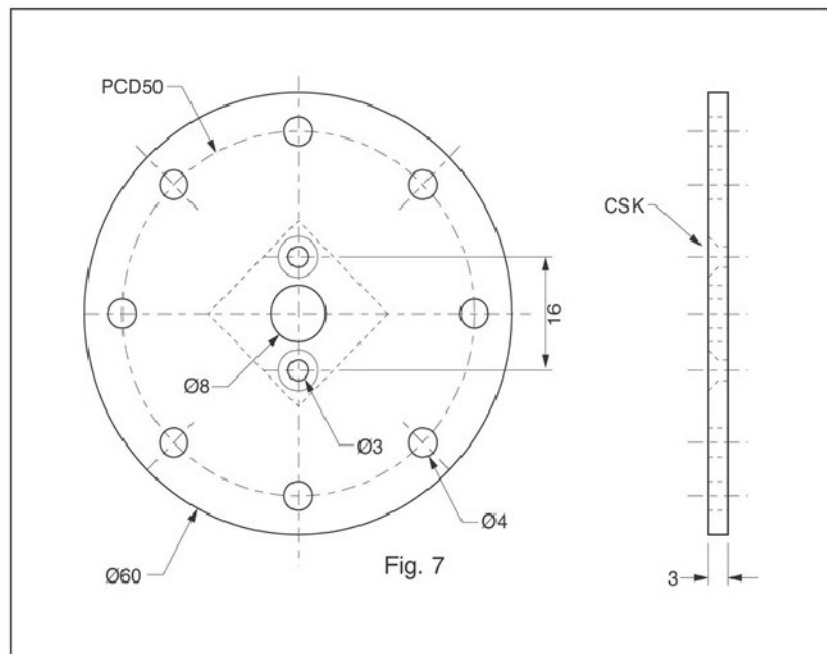
Open one hole in the plate to 3mm and secure it to the body with an Allen screw, checking that the piece of bar rotates freely before finally tightening. Drill and tap the other hole and open the plate to 3mm. Countersink to allow a countersunk screw to lie below the surface and set the depth stop. Secure this side with a csk

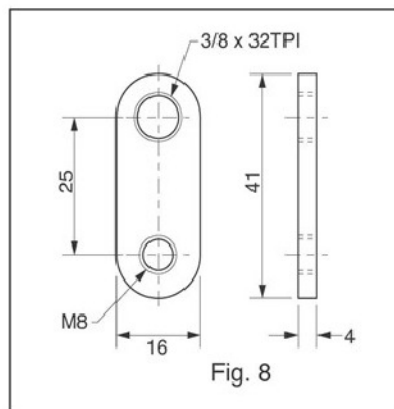
screw. Remove the Allen screw and countersink to the stop and fit another csk screw.

(As an aside, I have an ancient Startrite Drill with an epicyclic gearbox on the spindle which is brilliant for these operations. 1: Drill in high gear. 2: Countersink in low gear. 3: Tap in neutral. Job done at one setting, with no belt changes and no tapping attachment.)

Index arm (Fig. 8)

Square the ends of a piece of 16mm x 4mm flat bar to 41mm long and punch mark two centres at 25mm as per the sketch. Drill and tap one hole M8 and the





other $\frac{3}{8}$ in. x 32 tpi. With material of this thickness it is possible to round the ends with a file in less time than setting up any form of machining method. Plus you gain the satisfaction of completing accurate hand work and keeping these skills alive. Draw file both sides to remove any burrs and obtain a flat, even surface.

Index pin (Fig. 9)

This is a simple piece of turning as per the sketch from 6mm dia silver steel or mild steel requiring little comment save to say that the 4mm dia pin should be a close fit in the index plate holes and the pin should be turned to length with a broad round nosed tool, ensuring a shake free fit in the plate holes.

Pin housing (Fig. 10)

Made from $\frac{1}{2}$ in. dia MS the main concern here is concentricity. Chuck the material with 30mm protruding and face and centre the end. Drill and ream the 6mm hole 24mm deep to a good sliding fit with the pin. If only a hand reamer is available, it doesn't matter as the pin doesn't go right in. Should it bind right at the end of its travel, this can be relieved without detriment to its action. Use a centre drill to start the 3.5mm drill at the bottom of the hole and drill 4mm deep.

Turn down the end to 9.5mm dia for 10mm and further reduce the diameter to 8.5mm for 6mm. Using a tailstock die holder with the die fully expanded, cut the thread. Try the arm for fit and take another cut if necessary to give a firm fit by hand tightening.

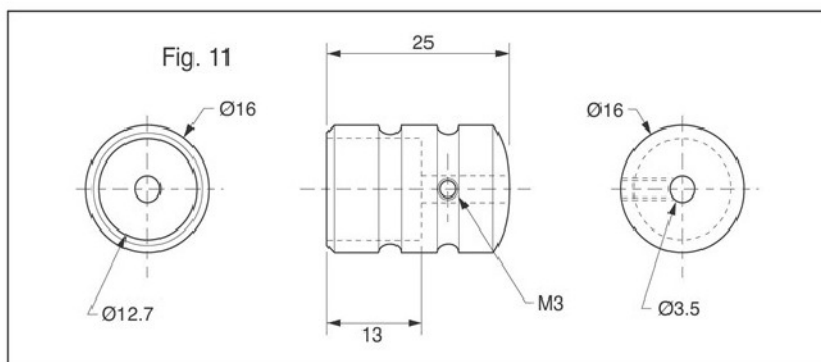
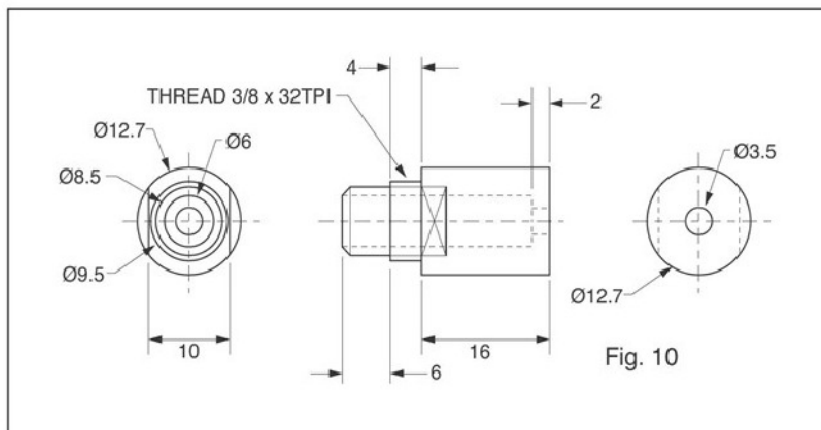
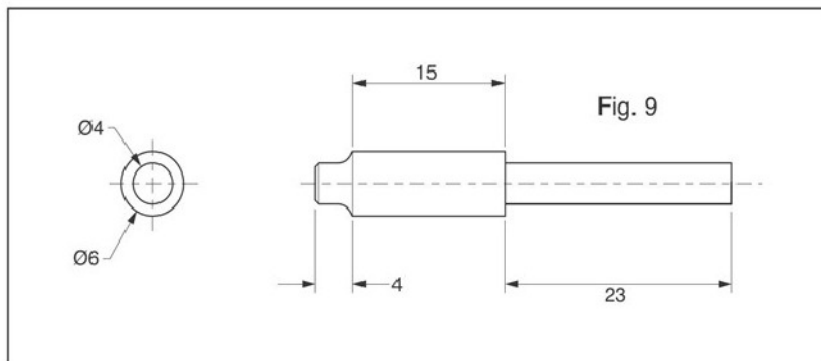
Undercut the thread, chamfer the end and part off at 26mm. The two flats shown are to take a 10mm o/e spanner for tightening. I had some free cutting 13mm hexagon bar and used that. More turning to do but no indexing and milling.

Knob (Fig. 11)

Make it from $\frac{3}{4}$ in. dia aluminium as this does not rust with constant handling. The bar was chucked with 30mm protruding and all the drilling and turning completed, the procedure being the same as for the housing. The piece was parted off 25mm long and reversed in the chuck to dome the end by your preferred method, form tool, radius tool or graver. Drill and tap for a 6BA grub screw.

Assembly and setup

Prepare two pieces of M6 studding, 20mm long. Take one, face and chamfer one end and dome the other. The other is turned down to 4mm for 3.5 mm long and the



end faced and chamfered then threaded M4. Dome the end after threading.

As there is little room to undercut, countersink the bracket thread. Reverse and dome the other end.

Screw this stud into the bracket and loosely attach it to the support arm with a nut & washer. Fit a piece of studding into the hole where the screw was removed for the pillar or the new tapped hole. Run a nut onto the stud and attach the arm assy. with another nut & washer.

Adjust these nuts to bring the 6mm hole at the bottom of the bracket central with the gear teeth and tighten. Fit the worm shaft into the body and secure the worm and gear as before. Adjust the position of the bracket to enable the body to sit at the bottom and clamp in place. This assembly should now be in the working position. Use a marker pen in the hole in the bracket to mark the bottom of the body. Remove the body and using a square, mark a line across the body through the centre of the drawn circle, which is unlikely to be central. Scribe a line at the true centre and centre punch the intersection. Drill 5mm without breaking through and tap this hole

M6, insert the chamfered end of the first stud and tighten.

Reassemble the parts making sure the worm and gear are correctly meshed; adjust the nuts on the support stud to bring the support to the correct position. This will now determine the length required for the pillar. I used a spacer behind the bracket as the pillar was already in place.

Fit the collar onto the worm spindle and adjust for free turning with no end play. Remove the worm and collar to file flats on the spindle where the grub screws left witnesses and reassemble. Fit the index arm onto the spindle, running it up to the collar then backing off slightly. Secure it with a locknut; preferably an acorn type.

Assemble the plunger parts with a light spring and check for free movement. Screw this onto the arm, ensuring there is clearance between the pin housing and the plate as the arm is rotated.

The attachment has been in use for some time and has performed very well. I hope you have the same success with it that I did. ■

PATTERNMAKING FOR BEGINNERS

Dyson Watkins
describes a few examples

For this article I shall set out to make some castings in aluminium, with the intention of using them for upgrading the tool and cutter grinder featured in MEW issue 132. The intention is to provide an up and down precision movement of the wheel head which will give an added facility of simple surface grinding.

The process of making any casting involves the making of a depression or hollow in some kind of media. The shape of the depression will determine the shape of the casting, and it is the accurate method of forming this depression that is the most involved part of the whole process. This article does not pretend to be more than a guide to the making of a suitable pattern for a particular casting but it will hopefully give some help to anyone wishing to make a start in producing their own castings.

Casting media

The media used for casting metals is generally fine silica sand to which some Bentonite clay has been added. The clay has the property of binding the sand to make it less friable particularly because the water content is kept low. Too much water causes the generation of steam when the molten metal is run into the mould causing porosity in the casting. If the water content is really excessive it can cause large volumes of steam to be released. A common rule of thumb for determining the correct consistency is to squeeze some of the mixed sand in the hand. When released it should retain its shape without the hand feeling wet. If it is then dropped on to the floor it should break up. This type of media is called 'greensand' and is the commonest type of media used for making moulds.

A type of media also in common use is oil tempered sand such as 'Petrobond'. This is considerably more expensive than Greensand. It is however capable of producing a better surface finish on the casting and can be used in combination with greensand by using only enough petrobond to surround the pattern, the remainder being greensand. One reason for this, apart from the improved finish, is that the petrobond being oil bound tends to burn into a hard and charred consistency, much of it then being consigned to the rubbish bin. Greensand can be used repeatedly provided it is sieved after any lumps are broken up. The action of the Bentonite clay does reduce with repeated usage, but its binding action on the sand can be regenerated by the addition of a little more of the clay. It is imperative that no free water (or ice) be introduced into the mould because this will cause the sudden generation of steam possibly with explosive results.

Patterns

Patterns can be made for one off castings, or may be made more durable to face up to the more arduous situation of



Photo 1. A simple sacrificial styrofoam pattern.

producing a quantity of castings from the same pattern. It is worthy of consideration that the work expended in producing a pattern for a one off casting is time well spent, because it is easier to produce a good finish on the pattern than it is to clean up the flaws from the casting itself.

One off patterns can be made by using a polystyrene former. This will vaporise on contact with the inflowing molten metal. The use of a sprue is still necessary to allow entry of the metal into the mould and a riser to indicate whether or not the mould cavity has been filled as well as providing an escape route for gases.

This type of pattern, although being sacrificial, is particularly useful because it can be used to produce complex shapes and the reason for this is that it does not have to be removed prior to pouring, making re-entrant shapes possible. This means that such a pattern, if made in one piece – say from wood, would be difficult, or even impossible to remove from the sand. The surface finish can however be an issue as the casting will take on the surface finish of the polystyrene. If a better finish is required than that possible using the usual packaging type of foam, then the use of Styrofoam will improve matters somewhat, because of its finer surface finish.

The foam can be cut quite easily using a hot wire cutter. This imparts a better finish than that attainable using a saw which does tend to drag on polystyrene and tear little bits away resulting in a poor surface. Styrofoam has a closer structure however, and can be sawn with reasonable results. It is also harder and light sanding results in an improved finish.

Fig. 1 is a top support block intended to be clamped on the upper end of a column of 1in. square section. It will be sawn into

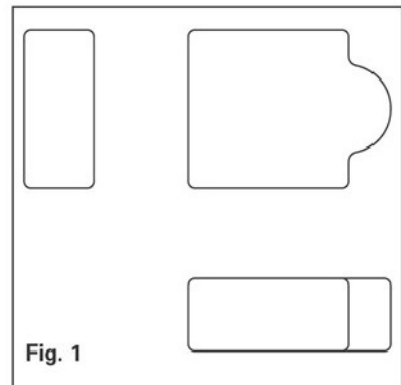


Fig. 1

two parts after casting and the recess for the column milled out and the two parts bolted together. The pattern can be made easily from either Styrofoam or wood. I shall use Styrofoam; the pattern is as shown in photo 1.

This is about as simple as it is possible to achieve in pattern making other than simply making a depression in the sand, but it is worth taking time in making the pattern square with parallel faces because apart from aesthetic considerations, the casting will have to be gripped in a vice for milling and it saves preparation time in getting the part fettled. Because the pattern will not be removed from the sand, there is no requirement for the application of draft angles on the sides. The sides can therefore be left square.

Split patterns

The pattern for the sliding jockey bracket shown in Fig. 2 & photo 2 is a bit more challenging. It could be feasible to cut and carve it from a single piece of wood

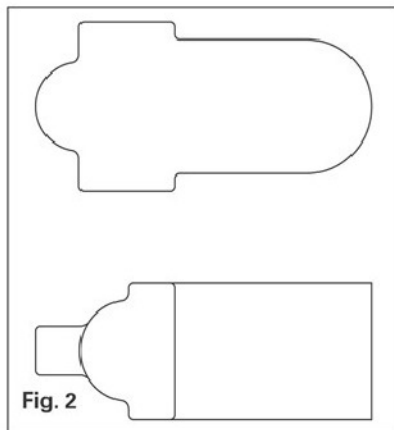


Fig. 2

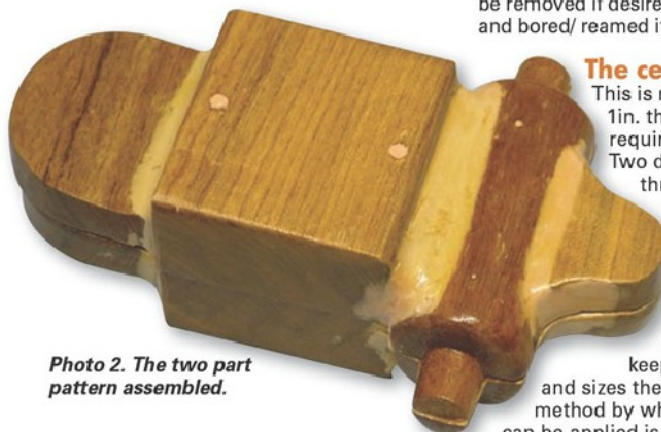


Photo 2. The two part pattern assembled.

but this approach would be much more difficult than making it up from a number of smaller pieces fixed together. Taking the cylindrical part first, **Fig. 3 & photo 3** the best method is to prepare a length of close grained timber to a section of $1\frac{1}{4}$ in. x $\frac{5}{8}$ in. by about 18in. long. Cut to make two lengths of 9in. This will provide some waste which will keep the portion to be worked on a safer distance from the lathe chuck if it is decided to do the turning with a turning chisel.

Measure and mark out the positions for the two dowels, and for the two woodscrews. Drill pilot holes for the screws then screw the two pieces together to make an overall section of $1\frac{1}{4}$ in. square. Drill a trial hole/holes in some scrap wood to arrive at a suitable hole diameter in

which the dowels will be a snug fit because they must on no account fly out whilst turning and because they will need to be removed later, they cannot be glued into the holes yet. Tap the two dowels into their respective holes.

Clean off a small amount from each end of the assembly, and mark the positions of the centres. A no. 1 centre drill can be used to provide a positive location for the lathe centres. A four jaw chuck could be used at the headstock end if preferred, the other end supported by the tailstock. When the turning has been finished, **photo 4** sand in the lathe to a smooth finish. It will be an advantage not to remove the square ends just yet, they will be useful for holding the work in the vice or for clamping to the bench when working. The core prints can be removed if desired, and the boss drilled and bored/reamed if preferred.

The centre boss

This is made up from timber 1in. thick. Two pieces are required of the same size. Two dowel holes are drilled through the two blocks so that they can be located accurately to each other. This will allow work to be carried out on both halves simultaneously while keeping their shapes and sizes the same. The easiest method by which the draft angles can be applied is to use a linisher, tilting the fence to the required angle. An angle of 1 to 2 degrees will be sufficient.



Photo 3. The cylindrical part of the pattern prior to assembly.

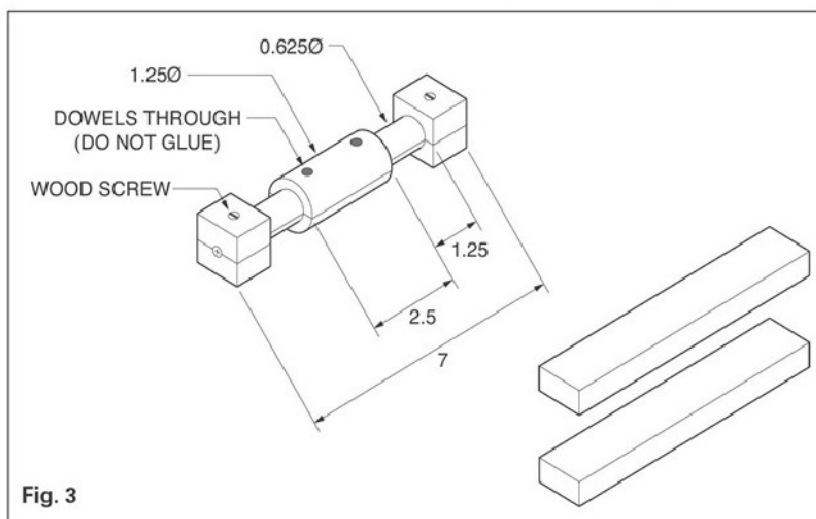


Fig. 3



Photo 4. Turning the wooden pattern with dowels fitted.

When satisfied with the work on the body, the cylindrical part can be attached, as shown in **photo 2**. I find hot-melt glue convenient and fast setting. A couple of small spots will hold the parts together for subsequent work on the fillets and allow time for quick positioning before the adhesive is fully set. Take great care to attach the individual parts exactly on centre. The second half is glued up after locating the parts using dowel pins. For the filling up of the spaces in between, and including fillets, car body filler is fine, as well as being fast setting.

The profiles can be cleaned up by filing or preferably using a piece of dowelling of suitable diameter wrapped around with glass paper. This way, the hassle of cleaning out file teeth is avoided. Avoid using car body filler impregnated with glass fibre. The smooth filler gives a better finish. The lugs are made for the front and rear of the assembly and attached in a similar manner; filleting is carried out with filler as before. Check the draw angles prior to finishing with sanding sealer. Several coats will be needed with a light rub down in between with wire wool or fine glass paper. A good finish is necessary to ensure that no problems occur during removal from the sand.

To complete the two part pattern for the sliding jockey bracket, all that remains is to furnish one half with dowels that locate in matching holes drilled in the other half. These are best turned up from brass and need to be a tight fit in the one half, but a clearance in the other. It must be easy to remove the one half of the pattern from the other, so do not make them too long. Three to four mm projection should be sufficient. The finished pattern halves are shown in **photo 5**.

The mould is rammed up in the usual way and to save on propane, both patterns, i.e. the Styrofoam pattern in **photo 1** and the jockey bracket in **photo 2**



Photo 5. The pattern assembly glued together.



Photo 6. Castings straight from the mould.

can be cast together in the same flask. The casting is as shown in **photo 6**; the runner, riser and gating can be clearly seen. In the foregoing example, no mention has been made of shrinkage allowance.

The castings in the example are quite small and a precision result was not aimed for. Where the finished casting is fairly big, the shrinkage will be proportionally greater and in order to arrive at a more precise dimension, an allowance needs to be added to the corresponding dimension of the pattern. The amount of the allowance is different for different metals, and a table of shrinkage allowances is given below.

Metal	Percent	Per foot
Aluminium	1.6	$\frac{3}{16}$ "
Brass	1.6	$\frac{3}{16}$ "
Bronze	1.3	$\frac{5}{32}$ "
Gun Metal	1.3	$\frac{5}{32}$ "
Cast Iron	0.5	$\frac{1}{16}$ "

An example of the application of shrinkage allowance is illustrated in the drawings of the large fixed steady for the Myford. For convenience, simplified drawings are given here in **Figs. 4 & 5**. The two parts of the pattern are shown in

photo 7, and the assembled two part pattern is shown in **photo 8**. These two parts are not symmetrical, and could not be used as a turn over pattern. The casting is shown in **photo 9**.

It is worth looking at the chain of thought leading to the final pattern design. Some of the procedures affecting the final design may not apply to everyone due to the differing manufacturing processes available to the individual. As I had no milling machine available to me at the time of making the Myford steady, I had to carefully decide how I was going to carry out the various machining operations. I had no option but to machine the slots after cutting the casting into two parts, so that it would fit on the Myford vertical slide.

The design had to be arranged so that the base could be machined where it fitted the lathe bed. If I had a mill, then the easy option would have been to mount the casting on a rotary table and mill the three slots after the base had been machined. The easiest way to determine the centre point of the casting is to tape a piece of dampened paper on one side of the casting and allow it to dry. The paper will shrink tight. Stand the steady in position on the lathe and with a



Photo 7. A two part pattern separated.

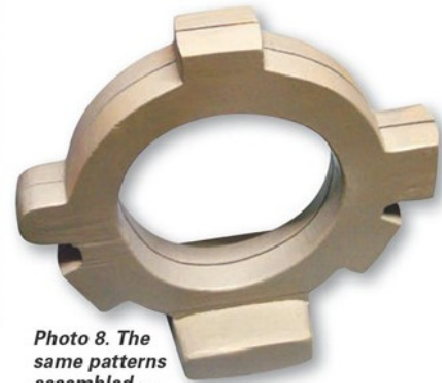


Photo 8. The same patterns assembled....



Photo 9.and the resulting casting.

sharp needle point in the chuck slide the casting up to the needle and allow it to penetrate the paper. Transfer the casting to the rotary table and locate the centre. Clamp up and machine the slots. I would have chosen this method had I possessed a mill at that time.

The hinging of the two parts needed to be considered. Two castings could have been made, avoiding the requirement for a steel insert together with a slot to

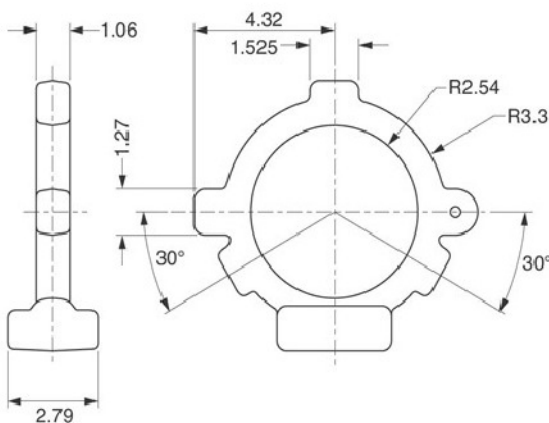


Fig. 4

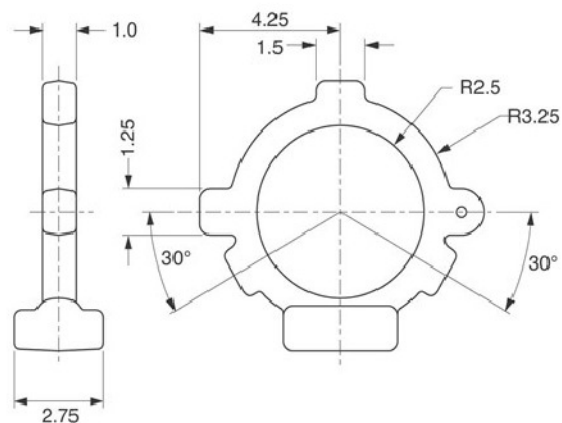


Fig. 5



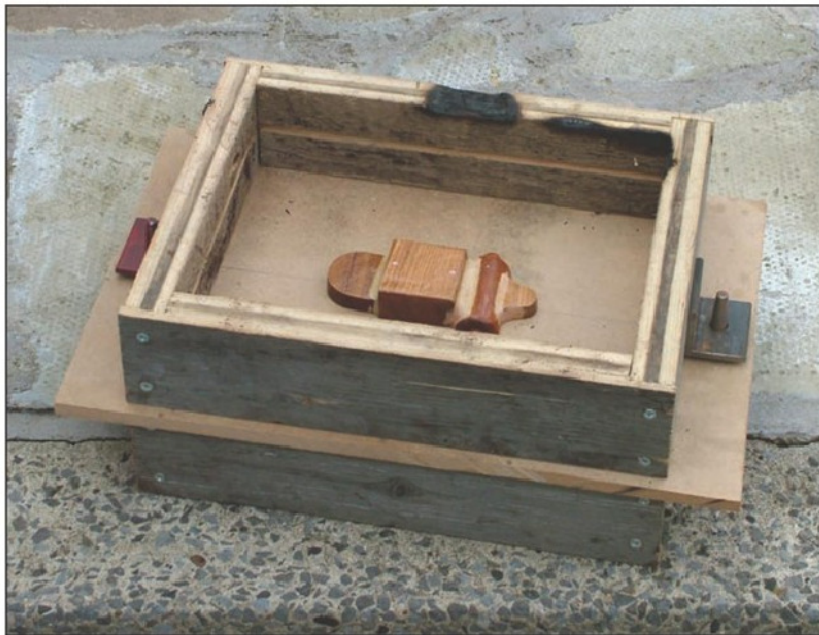


Photo 10. A turnover pattern in the mould box.

house one end. The two sets of holes machined in each slot allows for further adjustment of the fingers, increasing the range of movement.

So, having decided on the parameters affecting the final design, we need to consider the design of the pattern. For my purposes and facilities the casting would be made of aluminium. My casting facilities do not extend to the moulding of cast iron, which would be the natural choice. The pattern therefore needs to be modified in accordance with the shrinkage allowances relating to aluminium.

Reference to the table gives the shrinkage for aluminium as 1.6%. All dimensions used in making the pattern therefore need to be increased by this factor so that the casting in cooling down will shrink to the required sizes. The maximum amount of shrinkage is about 0.135", and will be across the extreme outer dimensions. This, in a critical design could be crucial and is worth remembering for such situations.

Turn over pattern

It is possible to produce a casting of this type by using just half of the pattern. This is feasible as long as both upper and lower halves are symmetrical. This method is known as a 'turn over pattern'. Cut a piece of plywood large enough to cover the flask and extend beyond the pins fitted to the cope. Mark out the centre positions corresponding to the pin centres on the ply, and draw a centre line accurately between them. The half pattern is now placed exactly on the centre line and fixed in position making certain that it is placed far enough down the centre line so as to allow space for positioning the pouring gate and sprue, photo 10.

Provided that the pattern is symmetrical along the centre line then, after ramming up the first half with sand, it can be turned over and the other half can be rammed up. The two half impressions will then form the whole cavity. If making a turn over pattern it is worth making a loose pattern for the in-gate which is used on one half

only. The runner and riser have to be set in position prior to ramming up the upper half. The sequence of events is as follows.

- 1) The cope is placed with pins facing up.
- 2) Place the pattern over the pins, and locate the drag on top.
- 3) Dust with parting powder, and ram up the drag.
- 4) Scrape off the excess to leave a flat surface.
- 5) Lift off, and invert the drag together with the pattern.
- 6) Tap the edges of the ply in order to loosen the pattern from the sand.
- 7) Lift the pattern away from the drag and inspect the cavity for any possible damage.
- 8) If all is well, turn the pattern over, and replace on the pins of the cope.
- 9) The cope together with the pattern is now lowered on to the drag taking care to maintain the orientation of the pattern.
- 10) Position the runner and riser (and the in-gate pattern if used).
- 11) Dust with parting powder, and ram up the cope.
- 12) Ventilate the sand above the pattern. Use a piece of welding rod of about $\frac{1}{16}$ " diameter. Push it carefully down to touch the pattern, withdraw it a little way and move it up and down a few times. This will scrape a little sand from the sides of the hole, forming a short plug. This will allow gasses to escape and prevent voids from being formed in the 'roof' of the cavity. Repeat in several places particularly in areas likely to trap air.
- 13) Tap the ply all round as previously. Likewise the pins and withdraw. Firm up the edges to prevent bits of loose sand from being carried into the mould by the molten metal.
- 14) Separate the drag from the cope and carefully lift away the pattern.
- 15) Inspect the mould.
- 16) If no in-gate pattern was used then one has to be cut to allow access for the metal. I use an old teaspoon for this job.
- 17) Any roughness or slight damage can now be remedied. The use of a fine soft 'art' brush can be used moistened with water for firming up any crumbly or dry spots on the edges of the cavity.
- 18) Replace the drag carefully into position.

The mould is now ready for pouring. It is a wise precaution to place the mould to be poured onto a layer of sand so that if any spillage occurs the molten metal will be contained and prevented from causing any damage. Contact with damp concrete can cause bits of the concrete to fly up due to the sudden generation of steam within the concrete. I usually use a sheet metal tray 4ft x 3ft with a 1in. lip all round which contains the sand. The tray was reclaimed from a large pet cage and used to form its removable base.

There are occasions when shortcuts can be taken. Recently, one of my sons accidentally broke the moulded plastic handwheel on his mortising machine. The mating parts duly arrived in the 'post', and I decided to cast a replacement in aluminium. Time was not available to make

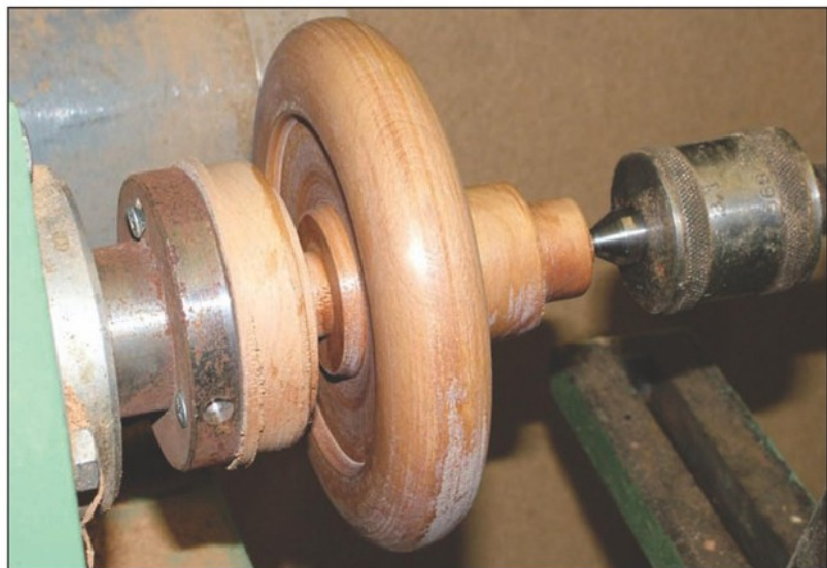


Photo 11. The wooden handle pattern being turned.

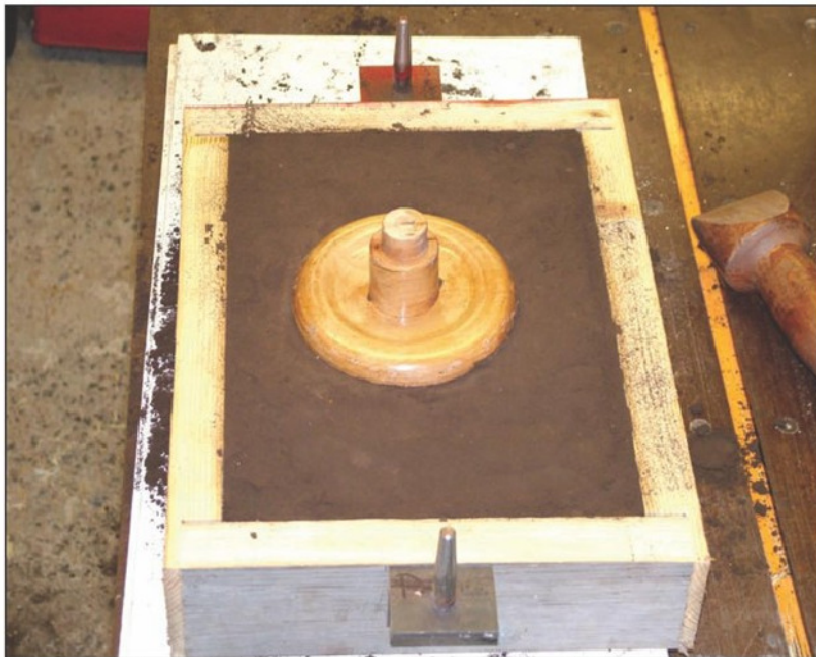


Photo 12. The bottom half of the pattern is inserted halfway into the sand.



Photo 13. The casting showing the casting sprue.

up a split pattern so the pattern was made in one piece as shown in **photo 11**.

The approach was to turn the pattern allowing the 'spindle' portion to remain over length so that the sprue would stand on top and pouring would take place into the centre of the wheel. The pattern is pressed into the sand, which has not been rammed too firmly. The sand is carefully scraped away allowing just the portion of the pattern above the centre line to remain above the sand, **photo 12**. The other half of the flask is lowered into position and the sprue pin located above the centre of the pattern. The surface is dusted over with parting powder and the flask rammed up. Adequate venting was provided around the highest parts of the cavity, the box opened and the pattern removed. The casting is shown in **photo 13**. The finished handwheel is shown in **photo 14**.

Core boxes

It is sometimes desirable, if not essential to make castings with holes moulded in. In order to form the hole, molten metal has to be displaced leaving the desired shape of cavity. A core has then to be made that has the same shape. A core box is made in which the core has to be moulded. Where the walls of the cavity require machining to arrive at a final size, a machining allowance needs to be decided

upon which means that the core will be smaller than the hole by the amount of the allowance. So that the core can be located accurately in the mould, recesses have to be moulded into the sand where the core sits. These are the core prints. On each end of a core, location spigots are moulded which fit the prints. Where the core is mounted vertically in a mould, the prints are usually conical in shape, making location during the closure of the flask much easier.

The finished jockey bracket, described earlier in this article, has two holes for which cores could be made. The $\frac{3}{4}$ in. diameter hole through the boss runs horizontally, and would normally have cylindrical core prints. The vertical square sectioned hole would benefit from having conical core prints for the aforementioned reasons.

A typical core box drawing is shown in **Fig. 6**. The box is dowelled for ease of assembly and dismantling. The box can be made in the lathe where the bores can be drilled or bored as desired.

To impart enough strength to the core, a small quantity of sodium silicate is mixed into the sand, (the quantity being just enough to impart the same consistency as for green sand) and while it is still in the core box, carbon dioxide gas is passed through it via a hole through the centre

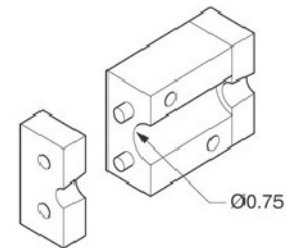


Fig. 6

big enough to accept a hollow needle. A sparklets CO2 dispenser fitted with a hypodermic needle of the sort supplied with computer ink jet refills can be used. CO2 is also supplied for beer kegs and is perfectly suitable. The sand can also be rigidised by adding Fordath 444 cream, **Ref. 1**, and then baking in the oven when the wife is away! Be warned, the stench is oily and hangs around for some time. A more suitable alternative would be an old caravan oven, or a small tabletop oven. I haven't tried a microwave so I have no idea whether it would work.

There are occasions where a core is quite delicate and in such instances it can be reinforced by adding one or more lengths of iron wire such as that used by florists for making floral displays. Cores can be any shape other than cylindrical and it is up to the mould makers ingenuity to devise a core box to provide the desired shape. The important things to remember are that it must be possible to get sand into the core box in the first place, and afterwards get it out again without breaking it in the process.

Equipment required for pattern making can be very basic. The most important are marking out tools including a rule, compasses, marking gauge and an adjustable square. A plane is desirable as is a bandsaw and a collection of clamps of various sizes. A tool I find most useful is a hot melt glue gun. A sander or finisher is useful but not absolutely essential. A selection of small files is also handy. For cleaning up radii and awkward corners, I use bits of wood dowelling of varying diameters and using the hot melt glue gun, glue a length of glasspaper around one end. It avoids having to try cleaning file teeth after clogging them up.

This article is intended to cover some of the basic aspects of patternmaking, but the following step is to cast metal. A few words would probably not be amiss at this stage in respect to personal safety and possibly safety of property. Clothing needs to be suitable for the job and the most important of these items are as follows: a good pair of goggles, or preferably a face visor, a long leather apron and leather gauntlets of the welder's variety. Strong leather boots but leave the laces out in case you need to take them off in a hurry and finally, a suitable fire extinguisher.

If using propane, make certain to keep the bottle well away from the furnace and run the gas hose away from where you have to walk. Finally, have fun but work safely. ■

Ref. 1. Fordath Ltd. Brandon Way, West Bromwich, B70 8JL

SAWING TEE NUTS – AN AFTERNOON IN THE WORKSHOP

Marcus Bowman uses a simple jig to quicken manufacture

Tee nuts are the perfect way of securing clamps to the table of a drilling or milling machine, **photo 1 & Fig. 1**. The nut fits the slot; it won't turn as you screw in a stud and the shouldered flanges spread the clamping load effectively. The depth of the nut also gives a secure thread for the stud.

Making Tee nuts can be time consuming though and the usual method of making the flanges by nibbling away at the sides with an end mill is a good candidate for the definition of frustration.

Here's a way of sawing the shoulders from a rectangular block to make the nuts more quickly.

Make a jig

Because I wanted to make a number of nuts in a range of sizes, I made a simple jig to hold square or rectangular BMS bar, **photos 2, 3 & 4**. There's nothing fancy about this and mine was made from convenient pieces from the scrap bin. The jig consists of a base, a backstop and a clamp, with a little bit of material to spread the load under the end of the clamp jacking screw.

The backstop is to prevent the nut blank being pushed back under the cutting force from the saw and to locate the nut at right

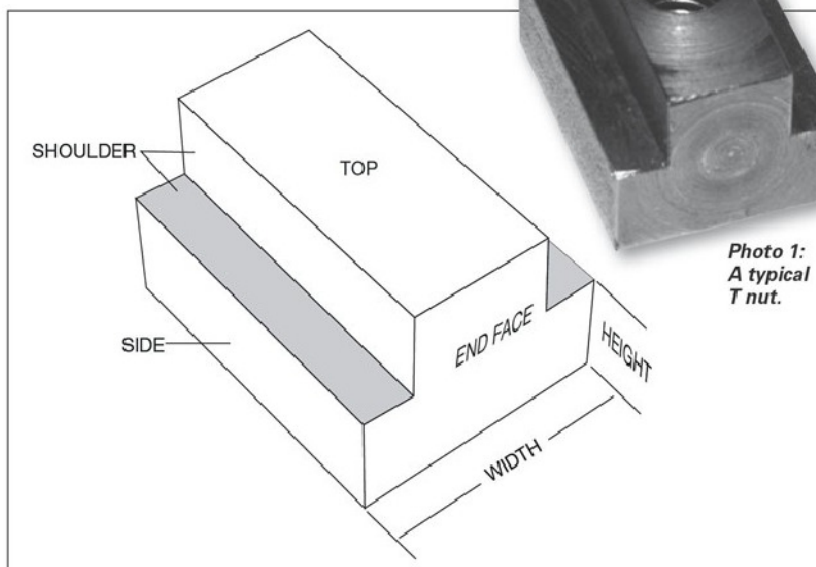


Fig 1. T nut features.

angles to the edge of the jig. The slot in the backstop is to allow some adjustment, although with hindsight, this is unnecessary. If the backstop is set to accommodate the widest nut you will ever need, it can be used to cut narrower nuts without further adjustment, provided you use a saw with a large enough diameter to be able to reach the smaller nuts.

I used the jig to make tee nuts for the mill, the drilling machine, the lathe cross-slide, a small rotary table, a large rotary table and an X-Y co-ordinate table. Being able to lay my hands on a tee nut quickly means I am much more likely to clamp my work securely and that's a step forwards.

Prepare the blanks

Cut the nut blanks to length and then clean up the ends in the lathe. I have an old reciprocating power hacksaw so I set the length stop then sat with my feet up and enjoyed tea and biscuits...

If the width or height of the nut blanks is not the same as for the finished nuts, now is the time to trim wherever is necessary. You can do this in the mill or the lathe; the lathe being the quicker of the two.

Don't plan to make the nuts a really close fit in the T slots; allow some clearance for swarf and for pimples sticking up from the as-cast base of some slots. The machining marks on my nuts reveal that I turned the excess off in the lathe, holding the nut blanks in a four jaw chuck.

Saw the waste

Clamp the jig in the milling vice, then clamp a nut blank in the jig. The basic method is to cut horizontally into the side of the blank then turn the blank on its side and cut horizontally to release the shoulder, **Fig. 2**. The joy is that this can be done without marking out and once the jig is set up, you can turn out tee nuts at a fair rate of knots.

With the blank in the jig, set the underside of the slitting saw blade level with the underside of the nut by lowering the saw blade until it just touches the top surface of the jig, **Fig. 3**. Now raise the saw blade by the finished thickness of the nut flange.

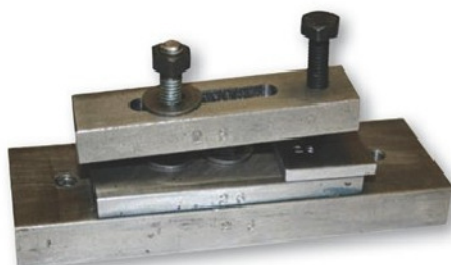


Photo 2. The sawing jig.

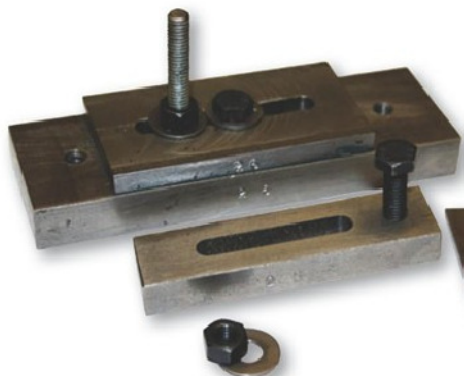


Photo 3. The jig partially disassembled.



Photo 4. Component parts of the jig.

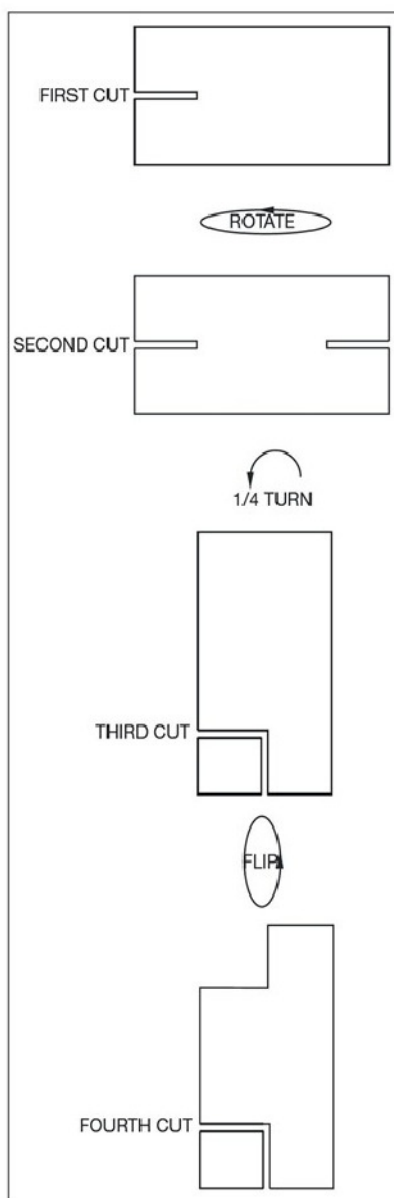


Fig 2. Sawing sequence.

Move the blade horizontally to the right until it just touches the side of the blank. Move it away from you, beyond the end of the nut. Now move it to the right to the width you want to make the shoulder.

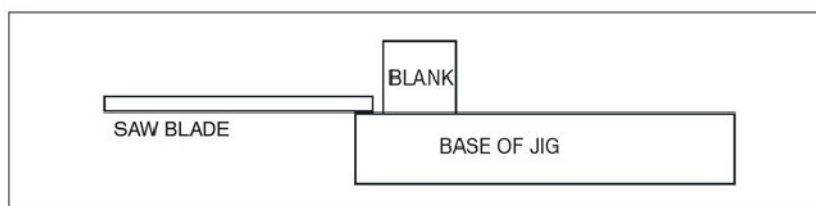


Fig 3. Aligning the saw with the top of the base.

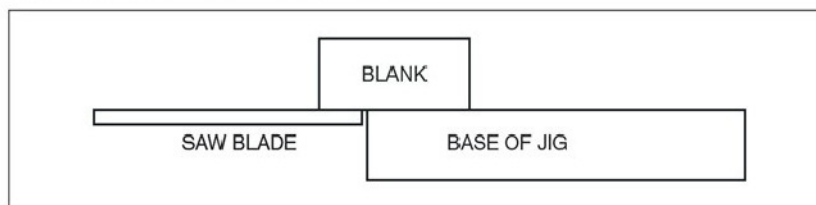


Fig 4. Aligning the saw with the underside of the nut blank.

Switch the spindle on and cut towards you, through the blank. My saw blade is 80mm diameter; have neat cutting oil at the ready and apply copious lubrication by your favourite method please. Once that's done, rotate the blank in the jig keeping the bottom of the blank on the base of the jig and cut the other shoulder in the same way without changing the height or the depth of cut, **photo 5**. That way, the shoulders will end up level.

Cut and repeat

Repeat these cuts on as many of the blanks as you need for your batch of nuts of this size. Turn the blank onto its side. Reset the height of the blade so that the top of the blade is level with the underside of the nut. The easiest way to do this is to temporarily clamp the nut blank onto the jig with a small overhang then bring the saw blade up from underneath to touch the underside of the blank, **Fig 4**. A visual check is usually good enough for this kind of job but use a strong light behind the nut to help you see when the blade just touches the underside of the nut. Alternatively, you can stick a piece of cigarette paper on the protruding part of the underside of the nut and rotate the saw blade gently as you bring it up to the nut. Stop when the paper catches then put the nut back in the correct position on the jig. Raise the saw blade by the amount you need to cut from the blank to form the shoulder (subtract the thickness of the Tee from the width of the blank, and

halve the answer). Set the depth of cut in the same way as before by touching the side of the blank, (which will be the top surface of the finished nut), then winding the blade beyond the blank and moving it horizontally by the depth of cut. Cut towards you to release the shoulder of the nut. Flip the blank over then cut to release the other shoulder. Repeat for the rest of the blanks in your batch. All this takes longer to explain than to do.

A tip

Just one tip; the clamp should press onto the blank where it will not overhang a cut so that there is no tendency for the cut to be pushed closed, nipping the saw as it cuts.

Now see if you can find a way to drill and tap the blanks using a repetition setup for locating the blanks under the drill. I centre popped the first blank then used a simple length stop so that each blank would be held in the same position in the vice. Drill through each blank with the appropriate tapping size drill and then just touch the top of the hole with a clearance size drill to avoid the tap raising the edge of the first thread above the nut.

The little sawing jig may take an hour or so to make but it can cope with a large range of sizes of nut. The nuts themselves can be knocked out in fairly short order, so an afternoon in the workshop can make you feel very productive. Now all you need are some studs and some clamps and you'll be very securely equipped. ■

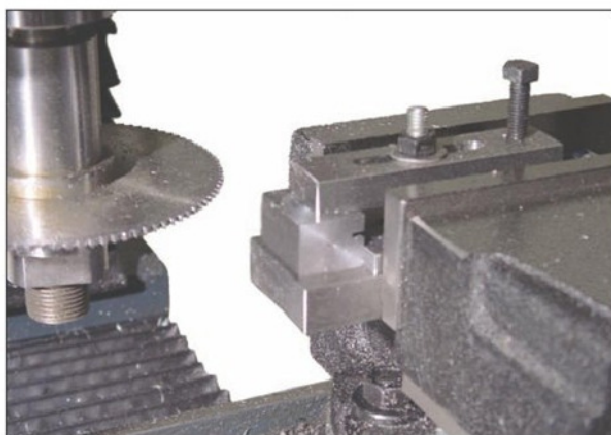


Photo 5. Ready for the second cut.

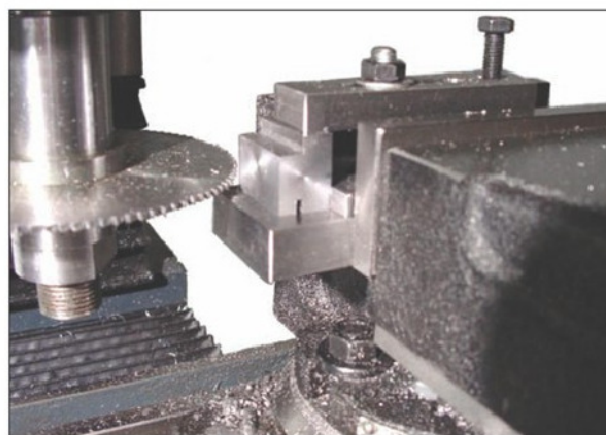


Photo 6. Ready for the last cut.

CNC MILLING WITH MACH3 4

Simple profiling

This month, we move onto simple profiling starting with the G12 and G13 circle cutting cycle and continue with straight cuts using the G41 offset left command. This is quite a long program as it cuts five holes and then cuts the profile. In future articles, unless very short, I will limit the program to the relevant bits and leave the beginning and end off. Program 1, lines N1 to N5 (with dimensions altered as necessary) will set up the start of your program and lines N55 to N57 will end the program. If you put these lines into a text document, leaving a gap to insert the different codes, you can use this as a basis for all your future programs. Note, you do not need the line numbers. They are optional. I have only put them in for your benefit.

It has been suggested that I explain the reason for the set up and also the cancel G codes in line one. They are there in case you stop a program in the middle. This could leave certain codes still active, which could be dangerous or the program may not work. As we learn the G codes to set an operation, we will also learn the G code that cancels that operation.

Program 1

- N1 G0 G15 G17 G21 G40 G49 G50 G69 G80 G90
- N2 G91 G28 Z0. X0. Y0.
- N3 M6 T1 S4000
- N4 G54 G90 G0 X-16.5 Y0. Z100.
- N5 G0 G43 H1 Z50.0 M3
- N6 G99 G91 G81 X0. Y0. R1.5 Z-0.2 F30.
- N7 G90
- N8 G80
- N9 G1 Z-0.2 F100
- N10 G13 I0.5 F10
- N11 G0 Z2.5
- N12 X-9.
- N13 G99 G91 G81 X0. Y0. R1.6 Z-0.2 F30.

- N14 G90
- N15 G80
- N17 G1 Z-0.2 F100
- N18 G13 I0.65 F10
- N19 G0 Z2.5
- N20 X0.
- N21 G99 G91 G81 X0. Y0. R1.5 Z-0.2 F30.
- N22 G90
- N23 G80
- N24 G1 Z-0.2 F100
- N25 G13 I0.5 F10
- N26 G0 Z2.5
- N27 X9.
- N28 G99 G91 G81 X0. Y0. R1.5 Z-0.4 F30.

- N29 G90
- N30 G80
- N31 G1 Z-0.2 F100
- N32 G13 I0.65 F10
- N33 G0 Z2.5
- N34 X16.5
- N35 G99 G91 G81 X0. Y0. R1.6 Z-0.4 F30.
- N36 G90
- N37 G80
- N38 G1 Z-0.2 F100
- N39 G13 I0.5 D1 F10
- N40 G0 Z2.5
- N41 G0 G49 Z50.
- N42 G91 G28 X0. Y0. Z0. M5
- N43 M0
- N44 G90 G0 X-30. Y15.
- N45 G00 G43 H1 Z50.0 M3
- N46 G0 Z3.
- N47 G1 Z-0.5 F50
- N48 G1 G41 Y12. F80
- N49 X26.
- N50 Y-12.
- N51 X-26.
- N52 Y14.
- N53 G0 Z10
- N54 G40
- N55 G0 G49 Z50.
- N56 G91 G28 X0. Y0. Z0. M5
- N57 M30

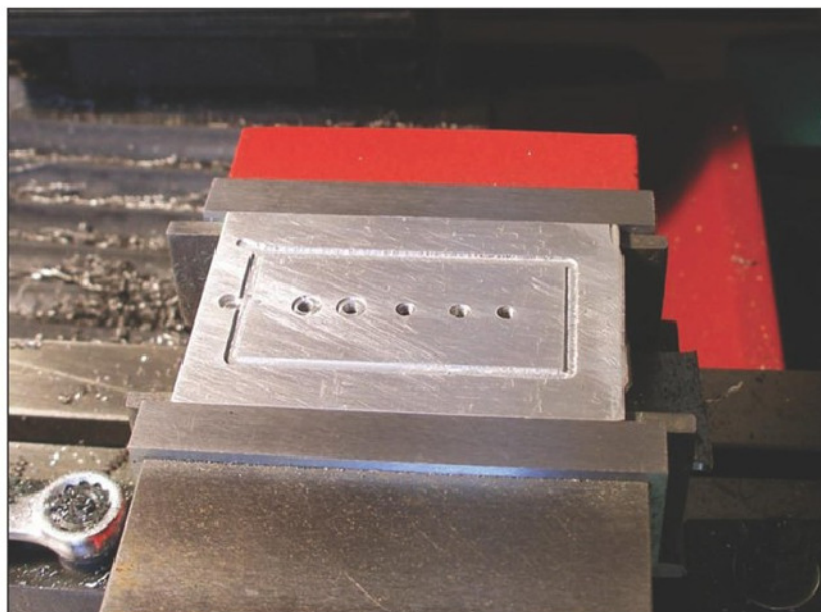


Photo 2. The fixture showing the milled profile.

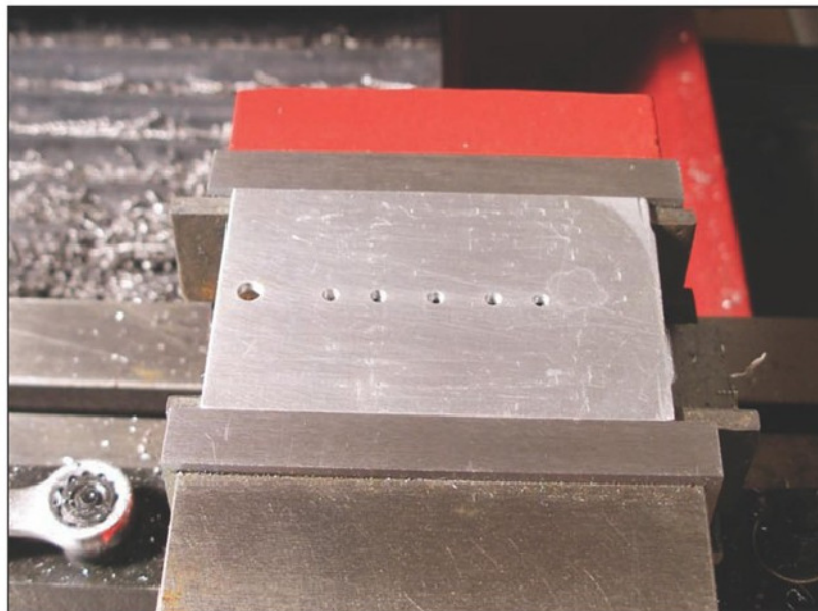
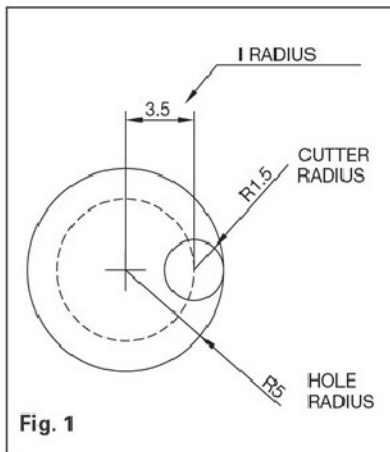


Photo 1. A simple fixture.

G12 & G13 circle cutting cycle

G12 cuts a circle in the clockwise direction and G13 cuts the circle in a counter clockwise direction. On Mach3, both G12 and G13 ignore radius compensation. This means you have to program the radius of the circle less half the cutter dia. If the circle is too large or too small, you will have to alter the radius of the cycle dimension to get it right.

Say you want to cut a 10mm diameter circle with a 3mm cutter. The radius of the circle is 5mm and the radius of the cutter is



1.5mm. This means that you have to take the cutter radius (1.5mm) from the circle radius (5mm) making 3.5mm. This is the dimension you would program the G12 or G13 with. The radius is programmed using the letter 'I' and you also need to add the feed using the F parameter so the code for a counter clockwise circle of 10mm diameter with a 3mm cutter using a feed of 10mm per minute would be as follows – G13 I3.5 F10. An example of this (with a different hole size and cutter diameter) is given in line ten in program 1. **Fig. 1** shows how to work the 'I' dimension out. The dotted line is the cutter path.

G13 will climb mill, counter clockwise. G12 will conventional mill clockwise. The diameter of the finished hole will be the same (subject to the cutter pushing off) whether you mill clockwise or counter clockwise. Note that the cycle will only cut a circle. If you need to cut a circular pocket, you will have to program two or more G13 (or G12) cycles with overlapping paths.

Unlike some programming systems, you have to program the cutter down to the depth that you require the cycle to cut. Please remember to raise the cutter up in the Z direction so it is clear before moving the cutter to another X Y position. There is not a code to cancel the G12, G13 command. I think that covers all you need to know about the G12 and G13 cycles, It wasn't too bad was it?

Cutter compensation G41 and G42

Now we move on to lines N44 to N54. This uses cutter compensation command G41 to run round the outside of the profile of a component. I have used a simple rectangle as an example. Radiused profiles will be discussed next time.

G41 is cutter radius compensation left, **Fig. 2**. This means that the cutter is offset to the left of the job in direction of travel and is climb or down cut milling. The chip removed by the cutter starts large and tapers to nothing. Climb milling is usually ok on machines with ball screws but not with normal leadscrews. This is because the cutter will pull the job (and the machine table) into the cutter unless restrained by a ball screw with minimal backlash.

G42 is cutter compensation right, **Fig. 3**. This means that the cutter is offset to the right in the direction of travel and is conventional or up cut milling. This pushes the job away from the cutter. The chip starts small and gets larger as the tooth digs into the work.

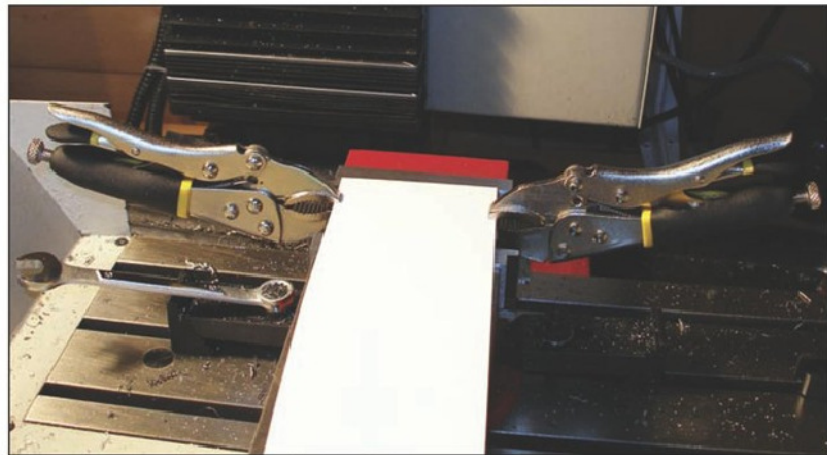


Photo 3. The material clamped to the fixture.

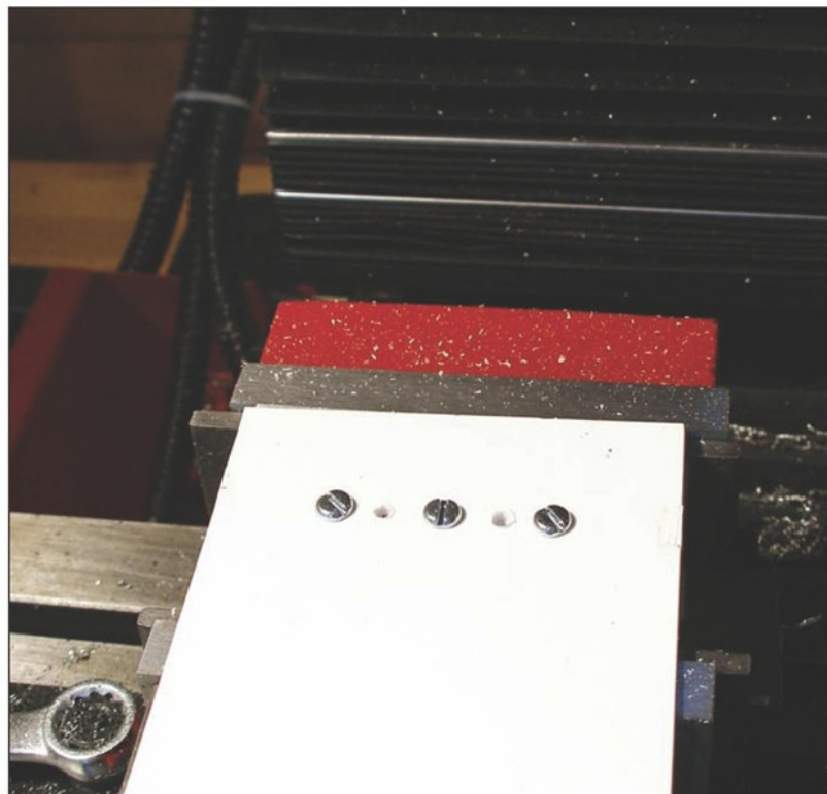


Photo 4. The material drilled and screwed to the fixture.

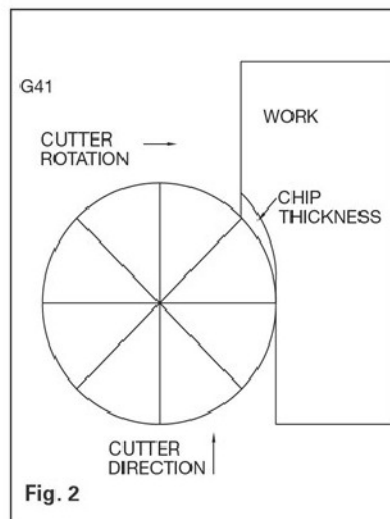


Fig. 2

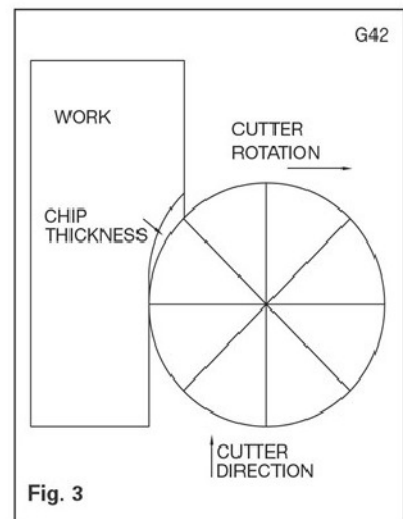


Fig. 3



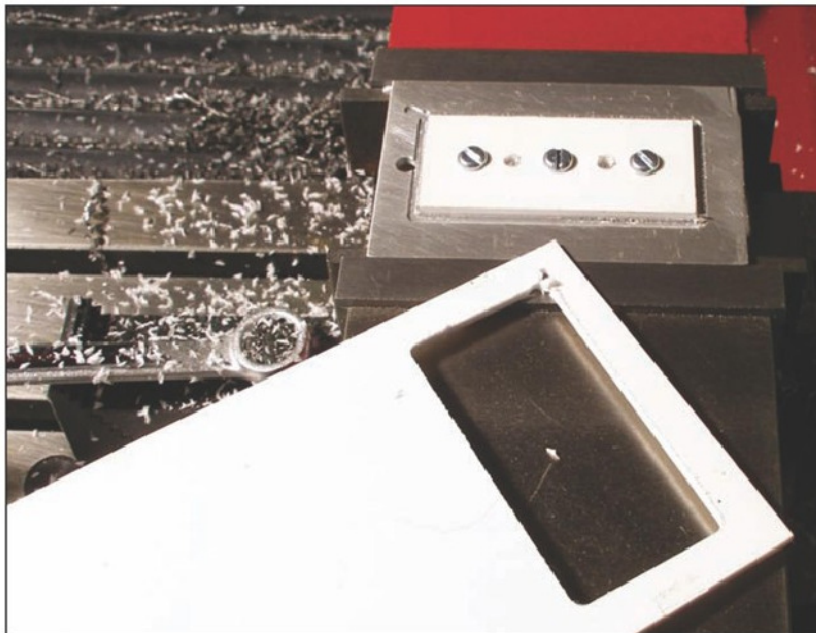


Photo 5. The finished profile milled around the outside.

Cancelling compensation, G40

Cutter compensation is cancelled by G40. You need to be careful how you remove compensation as results can sometimes be unpredictable. If possible, I prefer to raise the cutter at the end of the cut prior to taking compensation off.

N44 G90 G0 X-30. Y15.

Line N44 sets absolute (G90) and moves to the start position for the profile. This is outside the profile and far enough away so that the cutter does not encroach on the profile. The X dimension is 4mm to the left of the start of the profile. In practice, it is not a critical dimension, I picked it at random to avoid the profile.

N45 G00 G43 H1 Z50.0 M3

Line N45 sets cutter height and compensation as mentioned last time.

N46 G0 Z3.

Line N46 stops the cutter above the material. (It is not advisable to plunge straight into the work even if there is no material in the way.)

N47 G1 Z-0.5 F50

Line N47 lowers the cutter to depth at a controlled feed rate.

N48 G1 G41 Y12. F80

Line N48 moves the cutter in a Y direction to the edge of the job but leaves it offset by the cutter diameter. Note, you must put the correct tool diameter in the tool offset

Table 2 :
The main M-codes used in Mach3

M code	Used for
M0	Program stop.
M1	Optional program stop.
M2	Program end.
M3	Rotate spindle clockwise.
M4	Rotate spindle counter clockwise.
M5	Stop spindle rotation.
M6	Tool change.
M30	Program end, rewind to start.
M98	Call subroutine.
M99	Return from subroutine.

table before running the program. The tool used in this program was 2mm diameter. (You can lie to the program about the tool diameter offset but the reasons for that will be the subject of a later article.)

N49 X26.

Line N49 moves the cutter to X 26 + tool radius = 26mm + 1mm making 27mm.

N50 Y-12.

Line N50 moves the cutter in the Y direction to -12mm + the radius (1mm) making - 13mm.

N51 X-26.

Line N51 moves the cutter to X-26 + the cutter radius making -27mm.

N52 Y14.

Line N52 moves the cutter in the Y direction to Y 14 + the cutter radius making Y 15mm. Again this finishing point is not critical as long as it goes past the edge of the profile.

N53 G0 Z10

Line N53 raises the cutter 10mm above the work.

N54 G40

Line N54 uses G40 to cancel the compensation.

That's it, your first profile. The machining sequence of the component used as an example is shown in **photos 1 through 5**. It is a small component made from modellers' plastic card. I started with a simple drilling program (not shown as we covered basic drilling last time) to put 5 holes into a piece of aluminium plate to use as a fixture. The end holes (ignore the large one as that was already in the material) and the centre one were tapped M3 to hold the plastic down.

The plastic card was clamped on to the fixture with two small mole wrenches and the five holes pocketed. The machine then went to the home position and stopped so I could put the 3 screws in and remove the mole grips. The machine then ran round the profile finishing the part off. In a simple fixture job like this, the centre hole is position X0, Y0. After you have drilled the holes when making the fixture, don't alter your G54 position. When you program the pockets and the profile using the same X0 Y0, they will be automatically correct. ■

Next time we will look at a profile using radii and at the G2 and G3 arc commands.

Table 1: The main G-codes used in Mach3

G code	Used for	G code	Used for
G0	Rapid movement.	G43	Apply tool length offset (plus).
G1	Linear interpolation.	G49	Cancel tool length offset.
G2	Clockwise circular and or helical interpolation.	G54	Use fixture offset 1.
G3	Counter clockwise circular and or helical interpolation.	G55	Use fixture offset 2.
G4	Dwell.	G56	Use fixture offset 3.
G12	Clockwise circular pocket.	G57	Use fixture offset 4.
G13	Counter clockwise circular pocket.	G58	Use fixture offset 5.
G15	Cancel polar coordinates.	G59	Use fixture offset 6 / use general fixture number.
G16	Start polar Coordinate moves in G0 and G1.	G68	Rotate program coordinate system.
G17	XY Plane select.	G69	Cancel rotation.
G18	XZ plane select.	G70	Inch units.
G19	YZ plane select.	G71	Millimetre units.
G20	Inch units.	G73	Canned cycle - peck drilling.
G21	Millimetre units.	G80	Cancel canned cycles.
G28	Return home.	G81	Canned cycle - drilling.
G28.1	Reference axes.	G82	Canned cycle - drilling with dwell.
G30	Return home.	G83	Canned cycle - peck drilling.
G40	Cancel cutter radius compensation.	G90	Absolute distance mode.
G41	Start cutter radius compensation left.	G91	Incremental distance mode.
G42	Start cutter radius compensation right.	G98	Initial level return after canned cycles.
		G99	R-point level return after canned cycles.

CONVERTING A MYFORD ML7 TO CNC 4

Tony Jeffree Looks at
configuring Mach 3

Introduction

In parts 1, 2, and 3 of this series of articles, published in MEW issues 138, 139, and 141, I described modifications to the ML7 leadscrew and cross slide feed screw thrust bearings, the installation of stepper motors to drive the leadscrew and cross-slide and building the stepper motor drive electronics. In this fourth article, I will describe some of the final pieces of the jigsaw - configuring a PC to drive the control hardware and using Mach 3 software under Windows XP.

Choosing a PC

With the mechanical conversion and the drive circuitry all in place, all that remains before the system is functional is to configure Mach 3 on a suitable PC. I'm not planning to attempt to write a tutorial on using Mach 3 as part of this article; apart from anything else, as this is my first venture into using Mach 3, I am very far from being a Mach 3 expert, so I will leave that to others for the time being.

Mach 3 runs under Microsoft Windows; either Windows 2000 or Windows XP, so the first problem is to find a suitable PC, with a parallel port, that runs 2000 or XP, and that is reasonably powerful (a 2 GHz or better processor is advisable). It is also advisable to avoid PCs that have integrated "shared memory" graphics functions, as these can be problematic with Mach 3, although as PC processor performance improves, this is getting to be less of an issue. The PC I bought for this exercise was a 3GHz MaxData desktop machine that came from Ebuyer and was already loaded with Windows XP. If you can't find a PC with a parallel port, then it is still possible to add one if there is a spare slot on the PC's mother board. Some laptop computers will run Mach 3 successfully; however, particularly as laptops with parallel ports are becoming as rare as hens' teeth, I believe that you stand a better chance of getting a working system if you start with a desktop machine rather than a laptop.

It is preferable to start with a "pristine" machine when loading Mach 3; either a new machine or one that has had its operating system freshly reloaded. That way, you can be much more certain of getting a clean installation and avoid any problems that may have been left around in the system by other software that had been loaded into the machine.

Also, it is preferable to keep to the absolute minimum of other software on the machine you are using to run Mach 3; the last thing you want is for unforeseen interactions between Mach 3 and your other software to mess up the operation of the machine. In other words, regard the Mach 3 machine as a dedicated CNC system and nothing more; don't expect to



Photo 1. The keyboard with built in joystick.

be able to surf the web while you are cutting parts any more than you would expect to be able to do that on a dedicated CNC machining centre from one of the big name manufacturers. In fact, it is advisable to disable any networking capability that the machine has and rely on the use of disks or "memory stick" drives to transfer data between the Mach 3 system and any other PC that you may use for making CAD drawings, generating G-code, or downloading the latest version of Mach 3.

As mentioned in Part 3, I bought a flat screen LCD monitor from Ebuyer with the computer system; the monitor doesn't need to be particularly high spec - I simply went for the cheapest LCD monitor I could find on Ebuyer at the time. It is possible (and very desirable too) to use a touch screen with Mach 3; however, these tend to be considerably more expensive than normal LCD's. You will also need a keyboard and mouse of some description; I decided to try a compact wireless keyboard that has a built-in "joystick"-style pointing device, as shown in **photo 1**. This is a slightly odd beast to use, but can be used with the keyboard held in the hands, although the keyboard is just a shade too big to type with the thumbs; however, the "mouse" buttons can be operated by the left thumb, while the joystick is operated by the right thumb. This joystick function also has other potential advantages, as I will describe later on.

I haven't bothered to list part numbers for these PC components, as the availability and specification of these devices seems to change too rapidly for that to be useful; best to see what is available on the market at the time. It is also worth bearing in mind that a PC that has been outgrown by the needs of the bloated and power-hungry software packages that we seem to get foisted on us these days may still be useful as a Mach 3 machine, especially after giving it an operating system re-load.

Installing Mach 3

I would strongly recommend that you read the Mach 3 documentation before you attempt to install or configure Mach 3 on your PC. There is a lot of useful information to be found on the Mach 3 website, including a discussion forum where you can post questions and get answers from Mach 3 experts and several "videos" that talk you through the use of Mach 3's facilities; however, the best starting point is a document called "Using Mach 3 turn" which can be found at http://www.machsupport.com/docs/Mach3Turn_1.84.pdf. In particular, this article contains sections on installation and configuration of the software; don't try to install the software before reading it, preferably more than once, so you are clear about what is required. As this document describes the installation process in detail, I won't repeat that description here, so the rest of the article will assume that you have successfully installed Mach 3 on your machine.

The latest versions of the Mach 3 software and the various "plug ins" and other software accessories can be found in the "Downloads" section of the Mach Support website. At the time of writing, the current "lockdown" version of Mach 3 is R2.63 and the current "development" version is R3.041.

Mach 3 is undergoing pretty much continuous development as new features are added and bugs are fixed; the "lockdown" version is one that is supposedly stable, however, in practice, it has known bugs that have been fixed in the development version. Hence, the development version was the one that I downloaded and used.

Mach 3 does have a license fee associated with it; you can use it freely without paying the fee, but some of the more advanced features are not available unless you pay the license, and the size of the G-code program that you can run

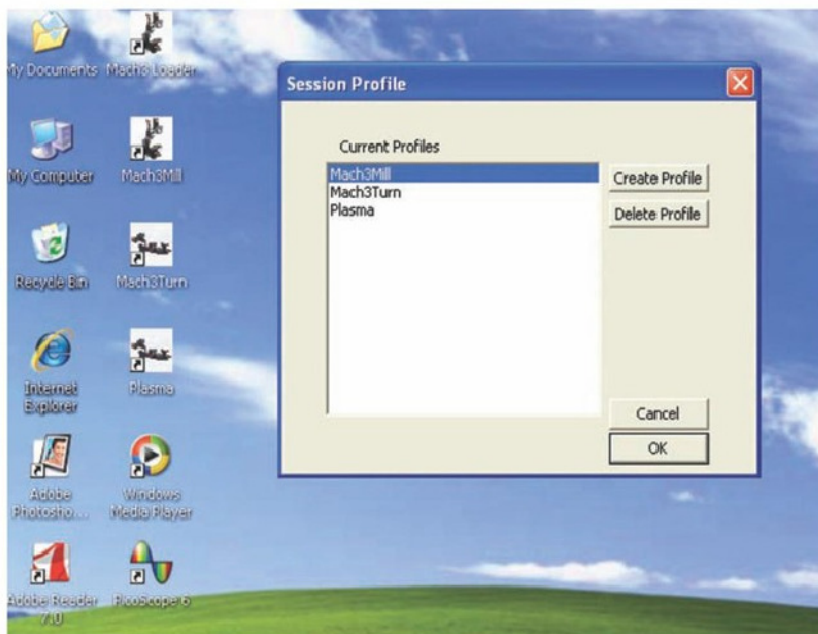


Photo 2. The initial Mach 3 loader screen.

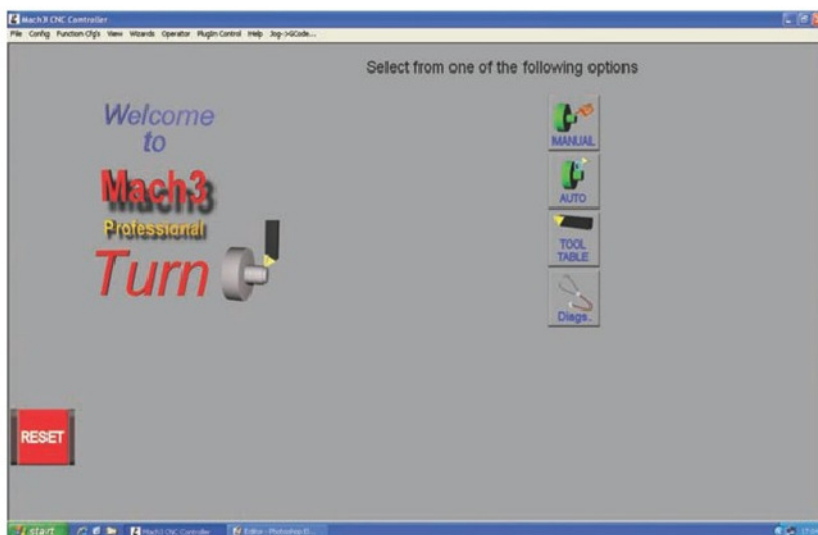


Photo 3. The Mach 3 turn screen.

is limited. As the license fees fund the ongoing development of the software, I would encourage you to buy a license if you plan to use this software on a regular basis.

Configuring Mach 3

Mach 3 is a complex and powerful software system and one that has considerable flexibility in the way it can be configured. On the one hand, that is a good thing, as it means that it should be possible to configure it to do pretty much whatever you need; on the other hand, it means that the process of configuring it to do exactly what you want takes time and understanding of how the system works. What I plan to do here is to describe the process of configuration that I went through to reach the point where I have a working system able to drive the hardware I have built; I don't plan to describe the full spectrum of what is possible with the Mach system, as that would take some considerable time.



Photo 4. The configuration drop down menu.

Once Mach 3 is installed on your computer, you will find that a number of Mach 3 related icons will have been added to your PC's desktop, as can be seen in photo 2. One of these is labelled

"Mach3Turn". Double-clicking this icon starts the Mach 3 system, using the configuration contained in the file "Mach3Turn.xml". One of the handy features of Mach 3 is that an entire set of machine configuration parameters is documented in an XML file, so you can quickly switch between configurations by the simple expedient of re-starting Mach 3 with the appropriate XML file. A second icon on the desktop, labelled "Mach3 Loader", allows you to start Mach 3 with any of the available configurations. Double clicking the Mach3 Loader icon brings up the "session profile" window shown in photo 2, in which you can see the available XML files on my system at present. This window also allows you to "clone" an existing configuration by copying it and assigning a different name to the copy. So, you might, for example, choose to keep a master copy of your configuration's XML file and clone a copy for experimentation with other settings, allowing you to restore the old settings if you need to.

The Mach 3 installation is contained in a subdirectory of the main "C" drive, called (unsurprisingly), C:/Mach3. This is the subdirectory where the XML configuration files are stored, so if you take up my offer of a copy of my XML file, you will need to copy it into this directory, where it will overwrite any file with the name "Mach3Turn.xml", and therefore become the configuration that will be loaded when you double-click the Mach3Turn icon. If you don't want this to happen, then rename the file to something else ("TonysMach3Turn.xml" for example) before copying it into the Mach3 directory; you will then need to use the Mach3 Loader icon instead and select the configuration to use from the list it offers you.

Whichever route you take, using the Mach3Turn icon, or Mach3 Loader and then selecting a Turn XML file, the Mach3 software will load and will present you with a screen rather like the one shown in photo 3, with a large red Reset button flashing in the bottom left corner, a list of buttons to select different screens on the right and a line of menu tabs along the top. For the moment, your interest is on the second menu button from the left, labelled "Config". If you click that tab, you get a drop down menu offering a list of options, as shown in photo 4.

The first four menu options form a natural succession; the first is "Select Native Units", which allows you to specify the units that you will use to define the motor performance parameters, the second is "Ports and Pins", which allows you to specify how many axes are operational, and which pins on which parallel port (there can be multiple ports) relate to which function, the third is Motor Tuning, which allows you to define the way the motors operate, how fast they can accelerate and what their maximum speed can be and the fourth is General Config which, as its name implies, allows a number of general configuration parameters to be set.

Starting with Native Units, photo 5 shows the window that opens when you select that tab; the options are to click MM's or Inches to select the appropriate units. As we are dealing with an ML7 that has Imperial leadscrews, Inches is the most convenient choice here; if you were setting up a metric machine, you would choose MM's.



Photo 5. Setup screen for units, imperial or metric.

Ports and Pins

The Ports and Pins menu item opens a window that in turn contains seven tabbed sections, dealing with different aspects of configuring the interface between Mach 3 and the outside world, via the parallel port(s). Dealing with these tabs in succession, the first is Port Setup and Axis Selection, shown in **photo 6**. If you need to use more than one parallel port, this is where you would configure the address of the port and enable it; as this project requires only a single parallel port and it is likely to be located at the default address, it is unlikely that you will need to change its settings from the ones shown in the photo; a tick in the Port Enabled box for port 1 and the address set to 0x378. This screen also allows the "kernel speed" of the Mach 3 software to be set; again, it is unlikely for this project that you will need to change this from the setting shown of 25000Hz.

The next tab, Motor Outputs, **photo 7** is where the step and direction signals for the various axes are assigned to specific output pins of the parallel ports. For this project, we are interested only in the X and Z axes, which correspond to the cross-slide and the leadscrew respectively. So in the Enabled column, there should be an "X" next to all of the axes except for the X and Z axes. Clicking in the box toggles between a "Tick" and an "X". In the second and third columns, Step Pin# and Dir Pin#, there should be 3 and 2 for the X axis, and 7 and 6 for the Z axis; all the others should be set to zero. The column marked "Dir LowActive" defines which way the motor will spin when the software wants it to go in a particular direction. This will probably need to be set to "X" for all axes; however, if you find that the X axis moves away from the work (X axis position increasing) when executing a move that should take it towards the work (X axis position decreasing), then this setting needs to be changed to a "Tick" for the X axis. Similarly, if you find that the Z axis moves away from the headstock (Z axis position increasing) when executing a move that should take it towards the headstock (Z axis position decreasing), then this setting needs to be changed to a "Tick" for the Z axis.

The Step LowActive column needs to be all X's for the particular stepper drives that I used; for other stepper drives (notably the Gecko drives), this may need to be changed to active low. The Step and Dir port columns should be set to 1 for X and Z, and to zero for all other axes.

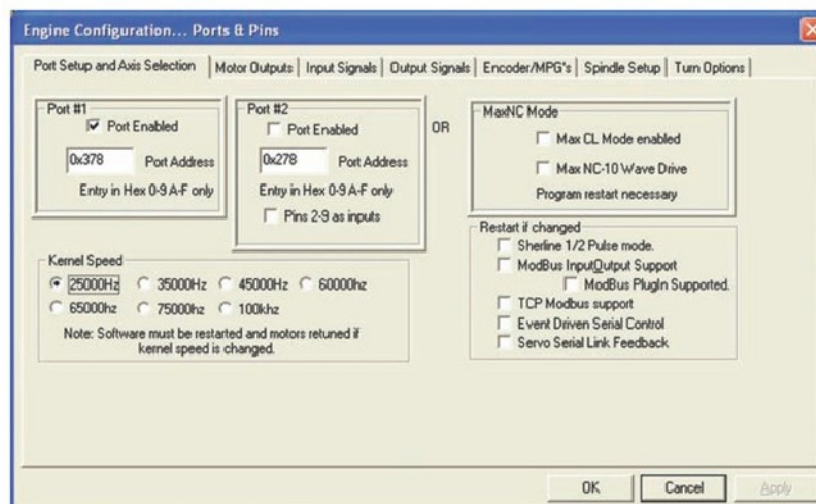


Photo 6. The port setup screen.

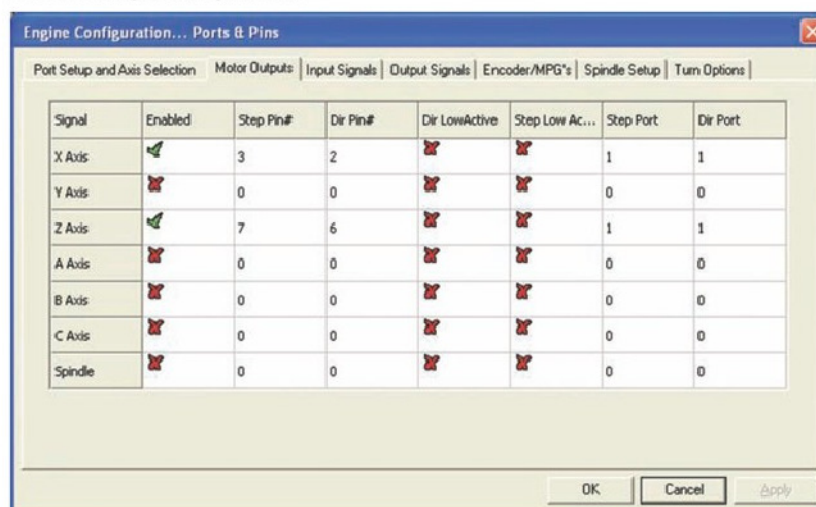


Photo 7. The axis selection screen.

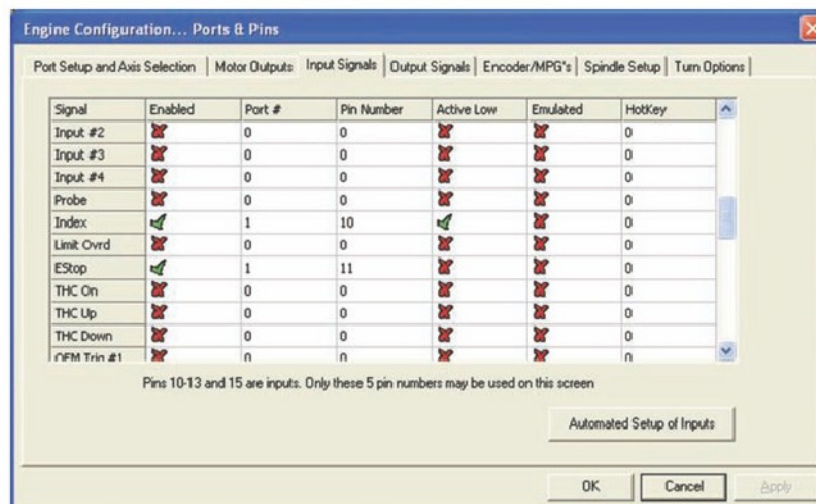


Photo 8. Setting up the input signals.

The next tab, Input Signals, **photo 8** is where the ports and pins are defined for the two external inputs to Mach that we are using, namely, the Index (which is the name Mach 3 uses for the spindle sensor input) and the E-Stop. There are a good number of possible inputs, all of which should be disabled (a "X" in the Enabled column) except for Index and EStop; the

scroll bar at the far right of the window allows you to look at the whole of the list. For the Index row, the Port and Pin columns should be set to 1 and 10 respectively, as the "In1" signal on the Optoport board is connected to Pin 10 of the parallel port. Similarly, the EStop row should contain 1 and 11 in the Port and Pin columns. The "Index" input should be set

to Active Low (a "Tick" in the Active Low column); the E-Stop is set to Active High. The Emulated column should be all X's. In passing, the Emulated and Hotkey columns allow inputs to be simulated from the keyboard instead of the parallel port inputs, which could be useful for some purposes.

Next tab is for the Output Settings, **photo 9**. For present purposes, the only output that is relevant is the Charge Pump; the Optoport board requires this to be fed to Pin 1, so the Enabled column is ticked for the Charge Pump row, and the Port and Pin are both set to 1. In **photo 1** you will notice that I have also enabled Output #1 and Output #2; these I have set to pins 17 and 16, which are the pins on the Optoport board that control the two relays. In reality, if these relays are not being used (which they aren't in my system), then it doesn't much matter whether they are enabled or not.

The next tab, Encoder/MPG's, would be of interest if we were using encoder or MPG (Manual Pulse Generator) inputs, for example, to implement an electronic handwheel; as we are not, this tab can be ignored. The next tab of interest is Spindle Setup, **photo 10**. Here, the bit that is important to us is the Special Functions box in the top right-hand corner; these define how the Index signal from the spindle sensor will be used. The three check boxes, Use Spindle Feedback in Sync Modes, Closed Loop Spindle Control, and Spindle Speed Averaging, should all be checked and the P, I, and D parameters set to 0.62, 0.22, and 0.15 respectively; however, I suspect that some/all of these parameters are only relevant if you are using Mach 3 to control the spindle speed.

The final tab in this set is Turn Options, **photo 11**. Here, the Diameter box should

be checked; this means that X dimensions are shown in terms of the diameter of the work, rather than the radius, which makes life simpler when thinking about finished dimensions, and when setting the work origin. The Reversed Arcs in Front Toolpost box should also be checked.

Having entered all the Ports & Pins information, the "Apply" button is clicked, and the "OK" button clicked to close the window.

Motor settings

Selecting the Motor Tuning menu item brings up a window that allows the various axis motors to be configured.

Photo 12 shows this window; at the right hand side, a column of buttons shows which axes are configurable - logically, you can only configure those axes that you enabled in the Ports & Pins configuration windows, so only the X and Z buttons are functional in this case. **Photo 12** shows the X axis parameters. The X axis feed screw is 10 turns per inch, the stepper motor drive is set to 8 microsteps per full step, the motor does 200 full steps per rev and the toothed pulleys give a 2:1 reduction. Multiplying these numbers all together, the conclusion is that the X axis needs 32000 steps per inch; as we are working in inch units, **photo 5**, 32000 goes in the "Steps Per" box. I chose to set the Velocity and Acceleration to 30 inches per minute and 30 inches per second squared; it is certainly possible to squeeze more performance out of the X axis, but there isn't much point in doing so. Settings of 5uS for the step and dir pulse durations seemed to work OK. Click the "save axis settings" button before clicking the Z Axis button to do the same for the Z axis; this time, as the leadscrew pitch is 8 TPI, the "Steps per" figure is 25600, and the other parameters are the same as for the X axis.

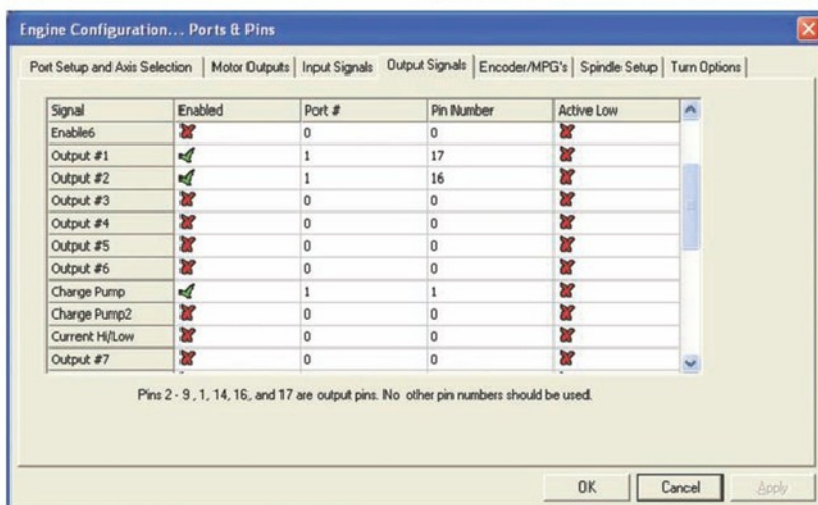


Photo 9. Setting the output signals.

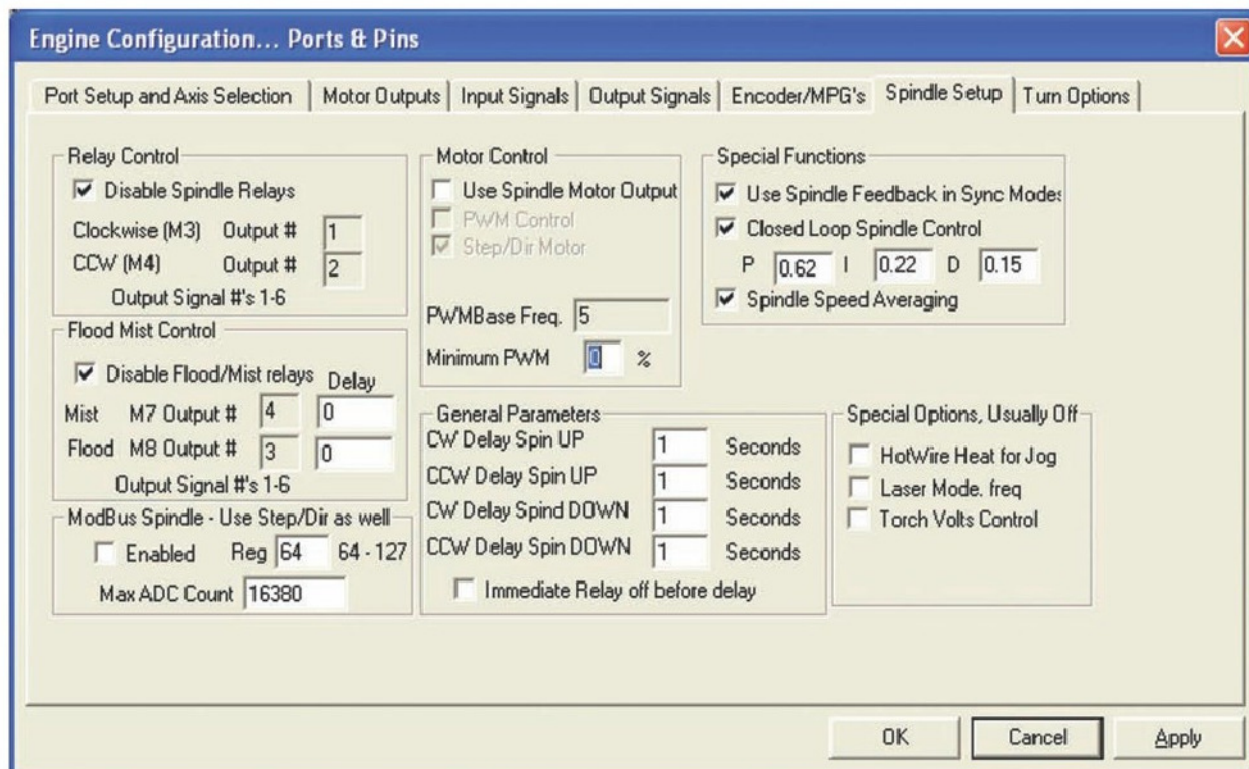


Photo 10. Spindle speed and coolant setup.

Again, click "Save Axis Settings" before clicking OK to exit the window.

The final bit of configuration, at least for the moment, is General Config, **photo 14**. In this screen, there are two parameters that affect the way that the spindle index pulse is handled by Mach 3; these are in the box at the top right of the window, marked Input Signal Debouncing/Noise rejection. The Debounce interval should be set to 0, and the Index Debounce set to 200.

Having completed the configuration, it is important to make sure that the parameters are saved in the XML file; to do this, select the last option in the Config drop down menu - Save Settings.

Checking things out

At this point, the main functions of Mach 3 should be properly configured. If you select the Manual button on the main Mach 3 screen, the display changes to something like **photo 15**. The big red "RESET" button in the bottom left corner will be flashing; you won't be able to do anything with the system until you click on the reset button. If this fails to stop the button flashing, then your E-Stop input is preventing the reset; there could be a number of reasons why this is happening, including:

- 1) Power supply problems (check that there is around 38V on the power supply capacitor, and check that there is 5V being generated at the Optoport board's 5V terminal);
- 2) Charge pump not operating correctly (the orange "CP" LED on the Optoport board should be lit). This could be due to incorrect configuration of the outputs;
- 3) The inputs are not properly configured in Mach 3;
- 4) The E-Stop contacts are not closed;
- 5) The E-Stop wiring between the contacts and the Optoport board is incorrect;
- 6) You haven't powered the drive system on, so no signal is reaching the PC from the Optoport board;
- 7) The USB and D25 cables between the PC and the Optoport board are not connected.

Once you manage to clear the flashing RESET button, it should be possible to "jog" the X and Z axes using the cursor keys on the PC keyboard; the up arrow key should move the cross-slide in towards the work (away from the operator), and the X Axis Position DRO (digital read-out) on the screen should decrease as the axis moves. The down arrow key should give the reverse X movements. The right and left arrow keys should work in a similar manner for the Z axis; right arrow moves the saddle to the right and the Z Axis Position DRO on the screen should increase. If either axis moves in the opposite direction to the description above, then the "Dir Low Active" setting in Motor Outputs is wrong for that axis, as mentioned earlier and this should be changed before proceeding.

If a motor fails to move at all, then there could be a number of possible reasons:

- 1) Power supply and Charge Pump problems (see above);
- 2) Incorrect configuration in the Motor Outputs screen;
- 3) Incorrect wiring between the Optoport board and the stepper drives;

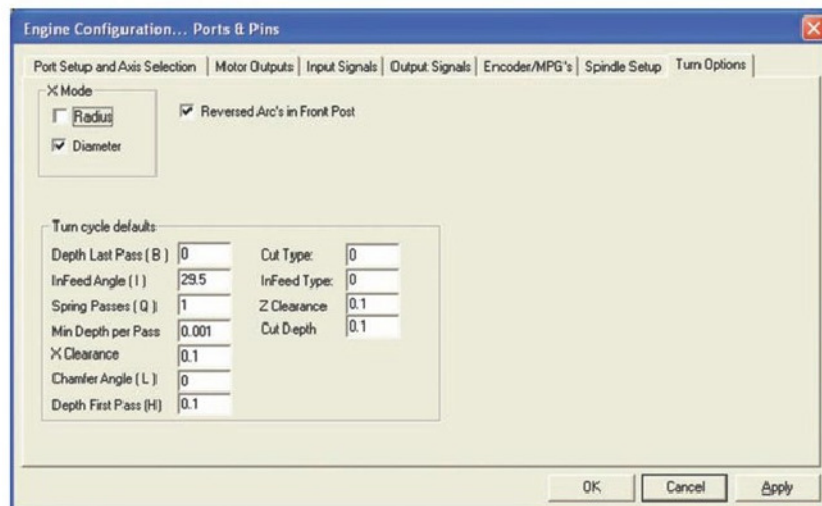


Photo 11. Turning cycle defaults.

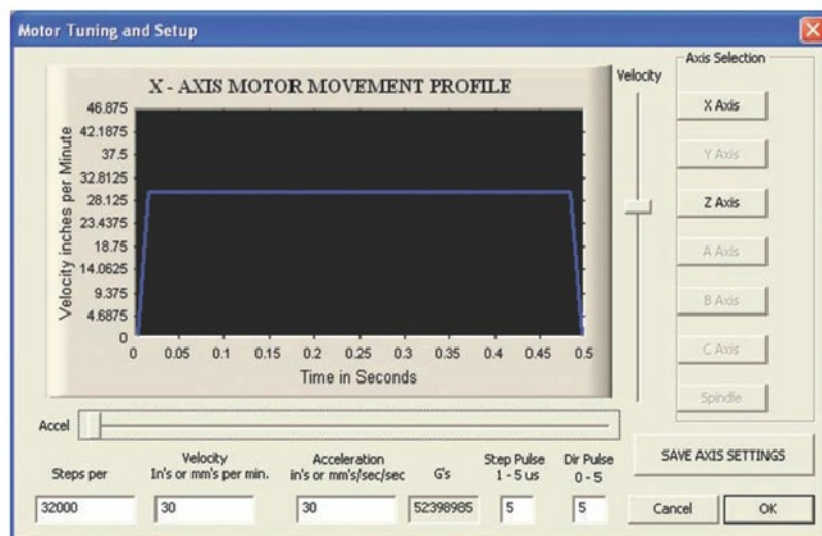


Photo 12. Setting the X axis motor parameters.

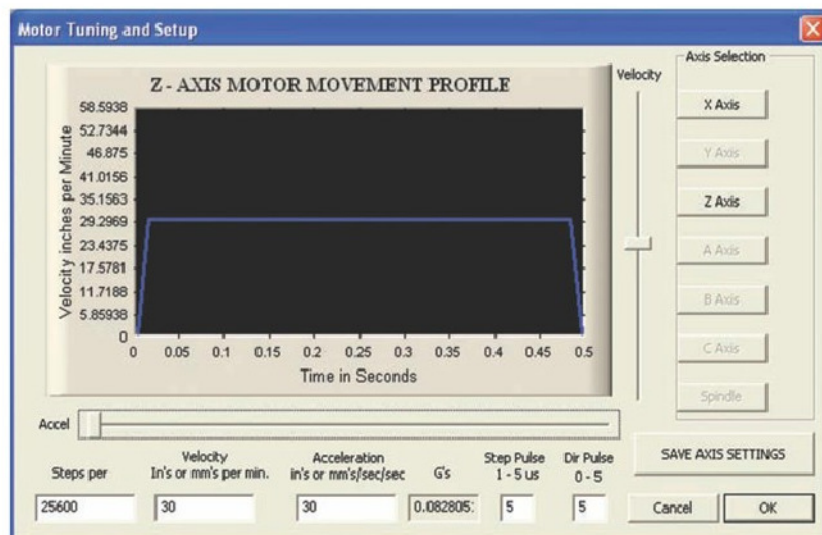


Photo 13. Setting the Z axis motor parameters.

- 4) Incorrect setting of the switches on the stepper drives;
- 5) Incorrect wiring between the stepper drives and the power supply;
- 6) Incorrect wiring between the stepper

drives and the stepper motors. If the latter is the problem, then there is also the possibility that the faulty wiring has blown the output of the stepper drive, and that you will need to replace it.

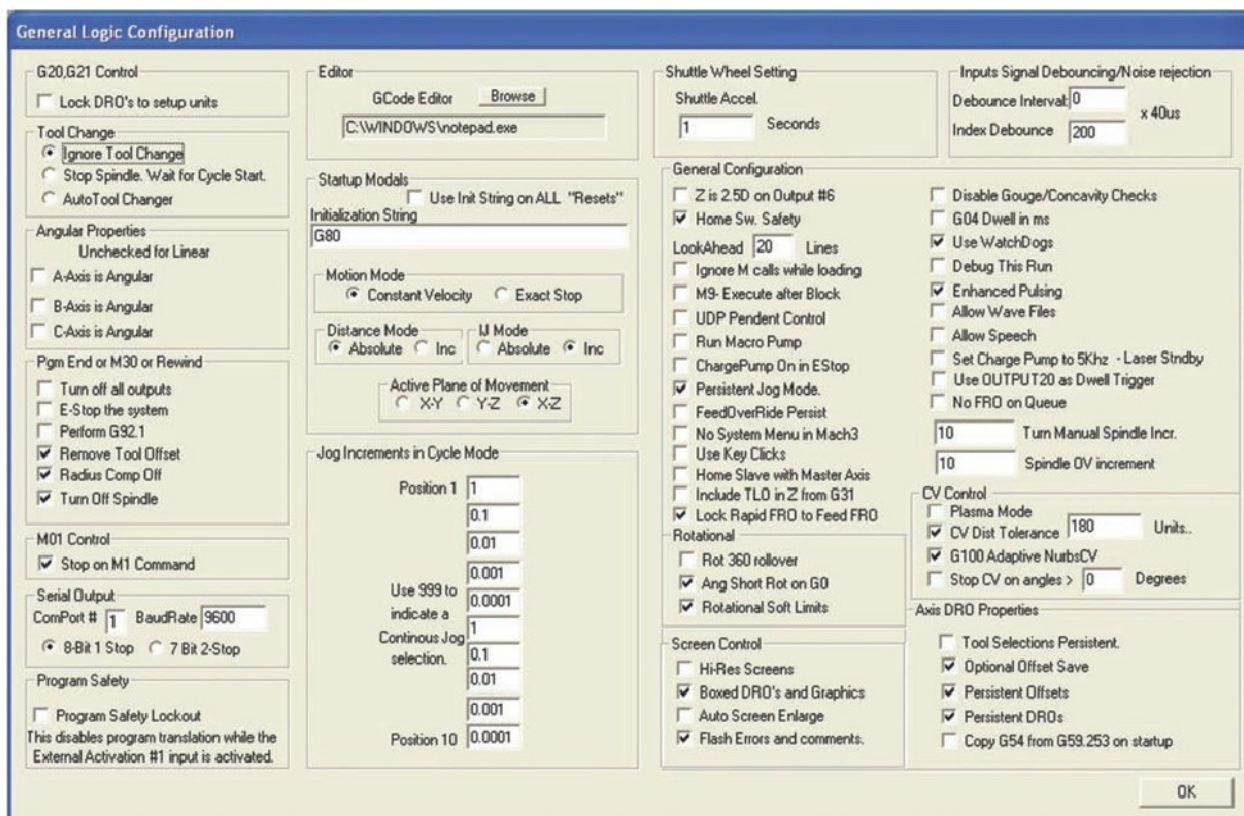


Photo 14. The general configuration screen.

The other thing that is worth checking is that the spindle "index" sensor signal is being correctly interpreted by Mach 3. Start the lathe and look at the "STrue" DRO on the screen; if the sensor is operating correctly, then the DRO should stabilize to the true RPM of the spindle. If the value doesn't change from zero, then there could be a number of problems:

- 1) Power supply and Charge Pump problems (see above);
- 2) The sensor isn't operating correctly. There should be 5V on pin 1, and pin 2 should alternate between 0V and 5V as the magnet rotates past it. If this isn't happening then it could be that the sensor is incorrectly wired, or the magnet is the wrong way around (S facing the sensor);
- 3) The sensor is wired into the wrong input on the Optoport board;
- 4) The "Index" settings in Input Signals are incorrect;
- 5) The "Debounce" settings in General Config are incorrect.

Hopefully, all is well at this point, you can happily "jog" the axes back and forth with the cursor keys, and the spindle RPM is displayed correctly; if not, take the necessary remedial action and try again.

Next month we look at adding a control wheel (shuttle) to the system. ■

Correction

In MEW issue 141, page 48, Fig. 3 was incorrect. The correct information is as shown in the version printed here.

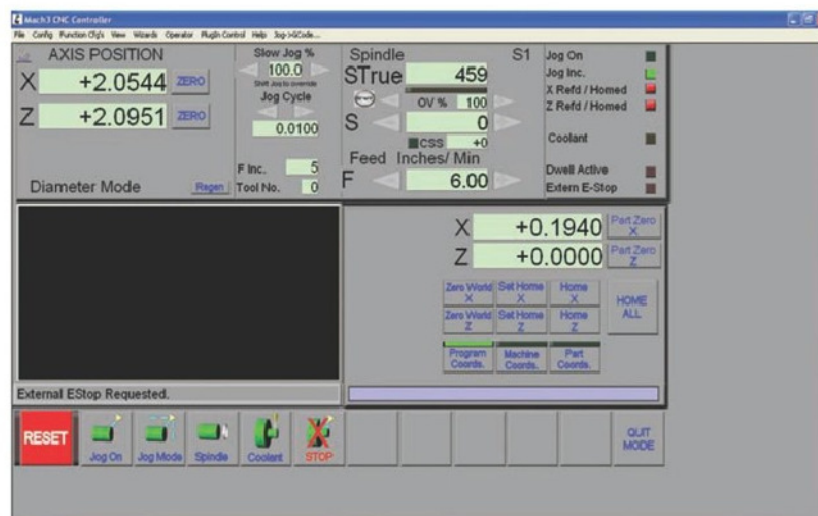


Photo 15. The main Mach 3 turning screen.

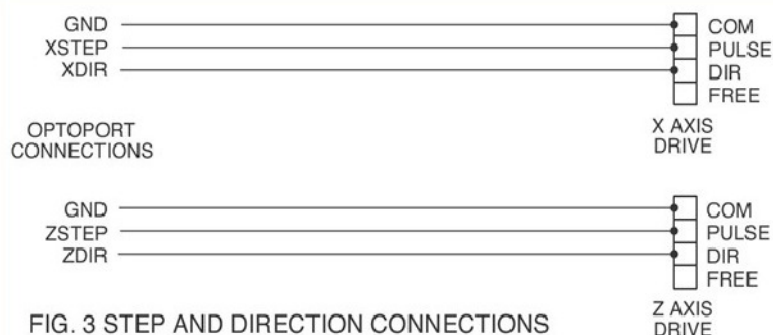


FIG. 3 STEP AND DIRECTION CONNECTIONS

ADJUSTABLE DIAL INDICATOR BRACKET

Dyson Watkins uses his new mill

During the time I have spent in industry, I have on numerous occasions found it necessary to true up a job either on the lathe or mill. The usual recourse was to bend a piece of $\frac{1}{4}$ in. diameter rod or a piece of bent wire into an 'L' shape, stick one end into the machine chuck and the indicator was fixed on the other end which stuck out, **photo 1**. The method was mostly satisfactory, particularly on larger radii, but came unstuck on setting up small bores and flanges. This was usually due to the difficulty of getting the indicator close enough to the centre due to the bend in the rod.

One of the other difficulties was down to the habit of using the bent rod to make something else, and another length of rod had to be found, usually on some other workbench. I learned quite a few new Anglo Saxon words and phrases due to this practice. Now in retirement, I purchased a Naerok RDM350 milling machine back in April of this year and spent some time rummaging for a piece of suitable rod to use for the aforementioned purpose and found only short lengths. I therefore decided there and then, as some Anglo Saxon words flooded back into my mind that something just had to be done to bury this problem once and for all because I was not getting any younger and this was likely to affect my blood pressure.

The design

A few desirable properties were set down on paper, the more important of which were that one piece of equipment should cover most eventualities. The 'small hole' problem was one and the other was that the device should cover any likely range of diameters. An additional requirement was that the item should not be so much like a piece of rubbish that it would end up treated as such. It is easy to make, and it does simplify the setting up of a dial indicator quickly and accurately.

Using the bracket

The procedure for the initial set up is to drill and ream a small hole simply to set the centre line of the spindle on centre with the hole. Then you can set the bracket to clock this hole. Once this has been carried out, further adjustment of the part shown in **Fig. 5** should not require to be carried out on a regular basis. Adjustment will normally be carried out by moving the indicator hinge through the required arc and locking it. The hinge grub screw could be replaced with a small thumb screw or a cap head screw.

Clocking a small hole is usually the most awkward, due to the small sweep of the indicator and the hassle of getting the stylus somewhere close to the position required for setting up, **photo 2**.



Photo 1. The usual temporary arrangement.



Photo 2. Clocking a small hole.



Photo 3. Clocking the outside of a larger component.

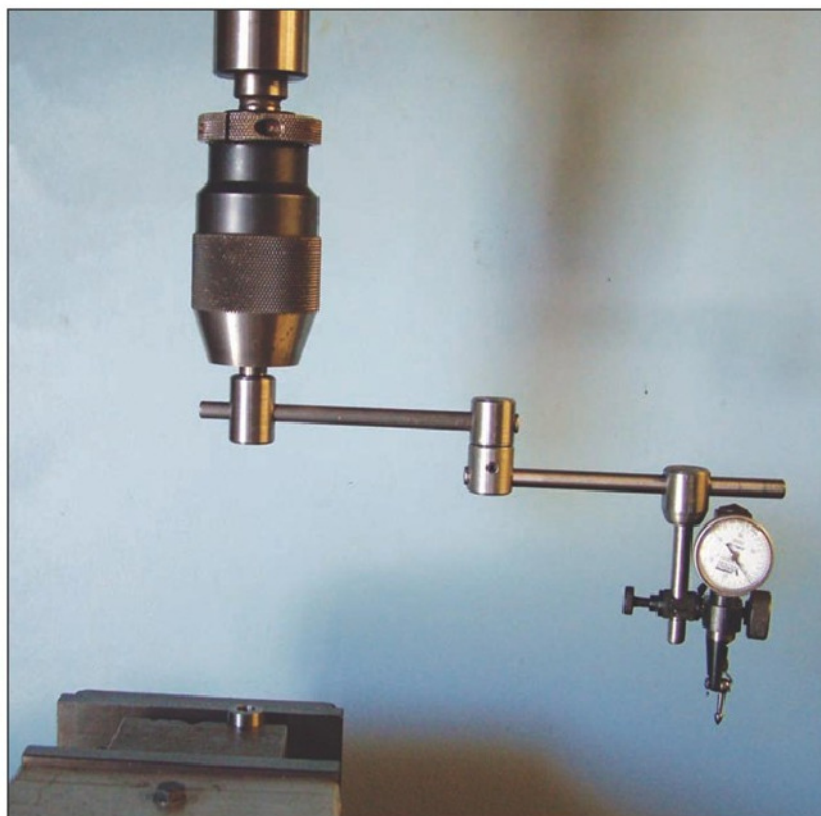


Photo 4. Fully extended, the bracket is suitable for clocking the head on the mill true.

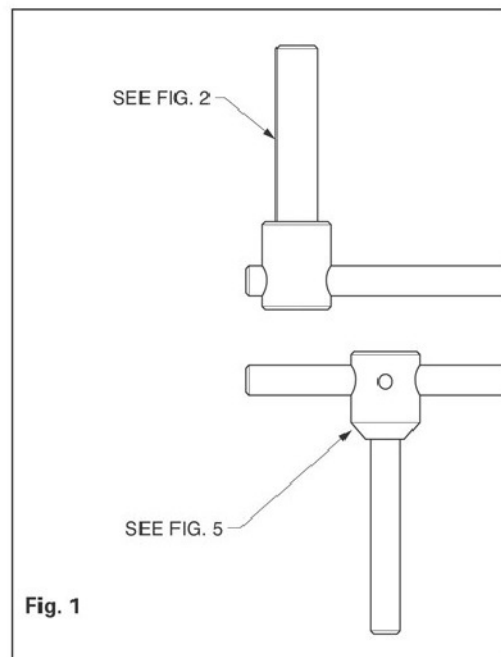


Fig. 1

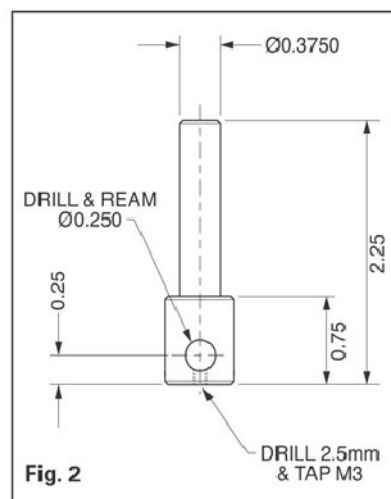


Fig. 2

When clocking a larger item, the item is set up as near as possible by eye and the indicator is hinged out and locked to a convenient radius and setting up is carried out with the minimum of fuss, **photo 3**.

The maximum radius that it is possible to sweep is about 8in. with rods of the existing lengths. This is sufficient to clock a large radius, like squaring the head of a milling machine with its table, **photo 4**. Should a larger radius be required, then longer rods can be substituted. I should have made one of these gadgets years ago. It works well on the lathe too.

Construction

The assembly drawing, **Fig. 1** shows the parts assembled with grub screws. The screw in the main spindle, **Fig. 2** locks the main rod in place. The second screw locks the hinge top, **Fig. 3** in place. The top screw in **Fig. 4** locks the swivelling action of the hinge. The bottom screw in **Fig. 4** locks the lower rod into place. The top screw in **Fig. 5** is used to vary the radius and sets the indicator stylus in the centre of the smallest practicable radius to be clocked and the lower screw locks the rod that holds the clock.

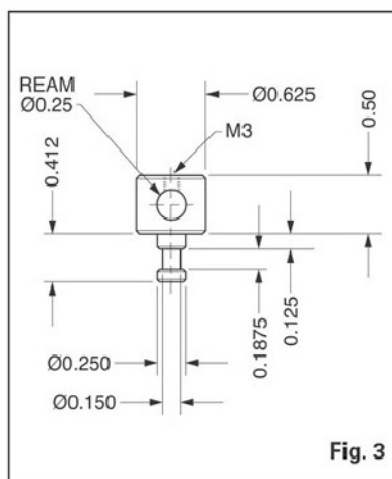
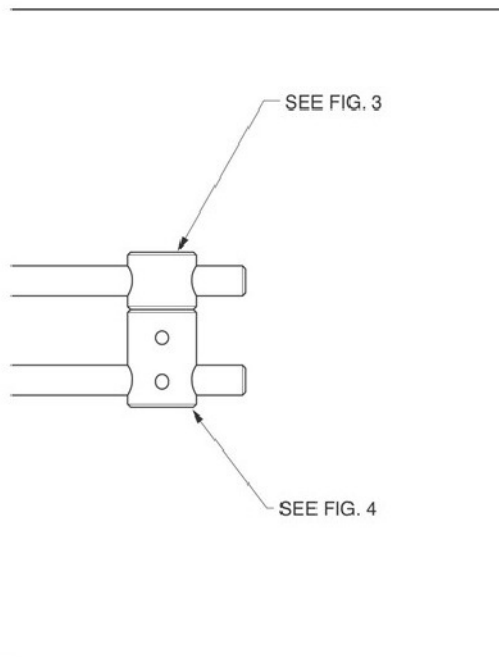


Fig. 3

Spindle (Fig. 2)

This part and the other bosses are turned from $\frac{1}{8}$ in. bright steel bar. They are turned in the three jaw chuck and either parted off, or sawn off slightly over length and faced to size. The cross holes are drilled and reamed in the vice on the milling machine. To do this, lightly tap the work down onto a parallel and tighten the vice firmly followed by sliding out the parallel to avoid drilling into it.

Set up a wobbler in the milling machine chuck and set up the spindle on centre. Adjust over the point where the hole is to be drilled and centre drill the position. Next, drill and ream to match the rod diameter, **photo 5**. Return to the lathe, and centre drill the head end, followed by a 2.5mm drill through into the cross hole. To finish, tap the hole through M3,

Upper hinge (Fig. 3)

This item is possibly the most fussy from the aspect that there are lots of little machining procedures involved with it. It is possibly better to make this item before its mating part, **Fig. 4**. Carrying out the drilling work on a milling machine does make the job of drilling holes on a centre line much easier.



Photo 5. Cross drilling holes is a lot easier now I have a mill.

Lower hinge (Fig. 4)

This part is quite straight forward. The most important aspects are the relative squareness of the two reamed holes. Make certain also that the retaining screw hole is positioned in the centre of the undercut in the upper hinge. The idea of the undercut is that should any burrs be thrown up by the screw end, they will not interfere with the smooth rotation of the two parts. The other feature is that the parts will not fall apart when the screw is slackened off for adjustment purposes with the possibility of wrecking the indicator.

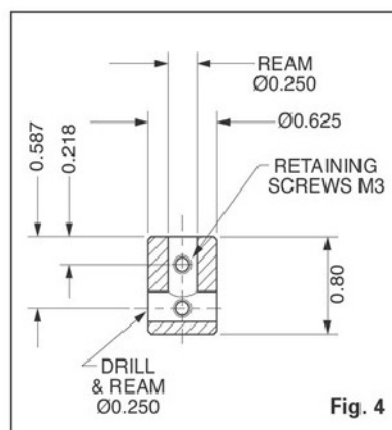


Fig. 4

Indicator rod holder (Fig. 5)

This is the one part which might require modification depending on the type of indicator adaptor shank arrangement one might have. Check your indicator before making the bracket and alter the vertical reamed hole to suit the shank fitted.

The rods

No drawings are given for the rods. The cross rods are just two lengths of $\frac{1}{8}$ in. silver steel about 95mm long and the indicator rod is about 45mm long but can be varied to suit your indicator.

This indicator bracket has performed successfully and the time spent making it was considered well worthwhile. ■

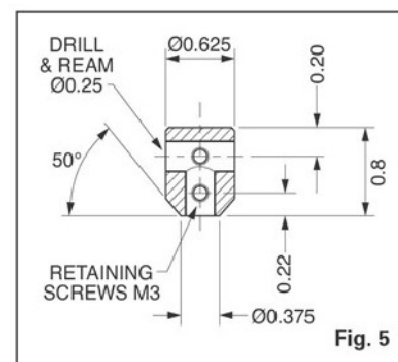


Fig. 5



SIMPLE AIDS TO TAPPING

Chris Smith makes
some tap wrenches

Over the years, I found myself continually using the same range of taps on a regular basis, either tapping new holes or cleaning out existing tapped holes. Each time this occurred it meant getting the box of taps out and finding the right tap and tap wrench. While this may not seem a very large task it was just another delay to the job in hand.

One day I finally decided to do something about it and this is what followed. The idea, which had been maturing in my mind, was to make a tap holder, which I could produce on a repetition scale to a set pattern, with only slight modifications being made to fit different size taps. This meant that each tap would have its own tap wrench and would only have to be removed in the event of breakage or if worn out.

The diameter of the steel chosen to make most of these tap wrenches was $\frac{5}{16}$ in. because I had a quantity of this size material in stock. This steel, which had been in a friend's garage for a number of years, was in rusty condition and while the loose rust was easily removed, the



Photo 1. The 3 drill jigs used to make the holders.

Fig. 1

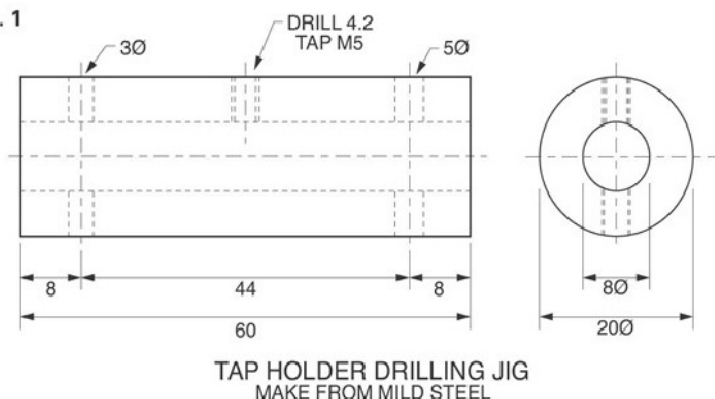
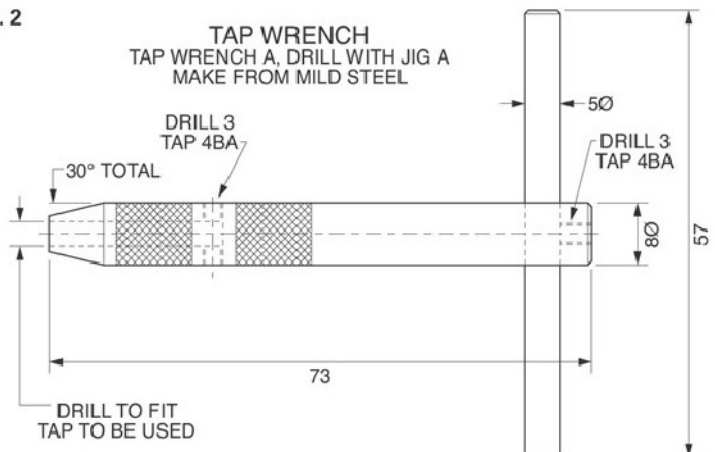


Fig. 2



pits-marks still remain but this has not prevented them from doing the job they have been made for.

Photo 1 (right) shows the original jig, which differs from the one shown in Fig. 1 in that the Allen grub screw for securing the work into the jig, is in line with the jig holes, this allows the work to be removed from the jig, without having to remove the jig from the drill vice. The jig is customised to suit the individual's material, which may be in a metric or an imperial size. Following Fig. 2, the material is cut to length and faced at both ends and a 30deg. total taper is turned on one end. The knurling, the hole for the tap and the tommy bar retaining screw, are all done after the cross-holes have been drilled using the jig.

Clamp the jig into the machine vice and secure the vice to the drilling machine table. Make sure that a 5mm drill in the chuck will pass through both the top and the bottom hole of the jig without binding.



Photo 2. An alternative setup for drilling the cross holes.

Drill all the pieces with the 5mm and 3mm holes. Return to the lathe and drill the hole for the tap and the tommy bar retaining screw hole. Finally put the knurling on and tap any remaining untapped holes. All the Allen grub screws used are cup point. The grub screws holding the tap into the holder grip onto the square end of the tap.

If you have not yet acquired a drilling machine, or have a drilling machine and no machine vice the following are two ways of drilling the cross-holes. Secure the tap holder in the jig and grip the jig in the Mole grips. With the drill in the lathe chuck enter it into one side of the jig. Bring the tailstock up to the jig and with the centre resting in the opposite jig hole lock up the tailstock. Apply the pressure using the tailstock to drill the hole, at the same time taking care not to drill into the lathe centre. To prevent drilling the lathe centre you can always drill from both sides. The same procedure can be carried out on the drilling machine with the aid of the simple device shown in **photo 2**.

The tap wrenches described up to now are all right when using taps up to M4 or 4 B.A. but when getting to M5 or 2 B.A. the wrench requires a bit more leverage, which also means an increase in body thickness and the tommy bar also needs the thickness and length increased as in **Fig. 3**.

Photo 1 (centre) shows the jig that I used. No drawing of the jig is given as all the appropriate information to make the jig can be taken from **Fig. 3**. The only comment is to put the jig clamping screw or screws inline with the holes to be drilled. **Photo 3** shows the finished set of tap wrenches, all engraved with the size and type and in easy reach.

Lathe and drilling machine tap wrenches

The following tap wrenches all started with the need to tap a piece of work squarely, while it is still in the lathe. Most taps in the past came with a centre hole in the end, which could be held in line by the lathe centre, while tapping a hole. Now more and more taps I seem to use do not have this centre hole. The tap wrenches

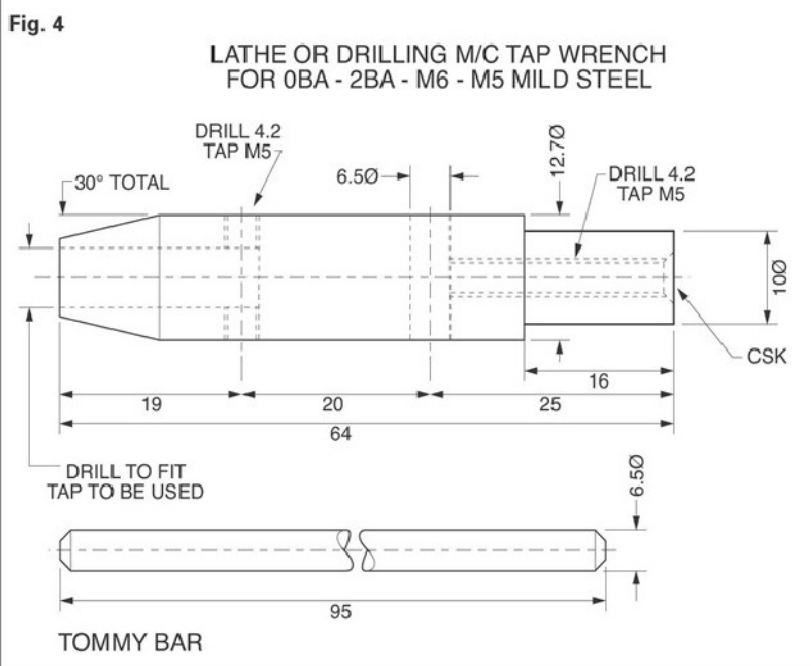
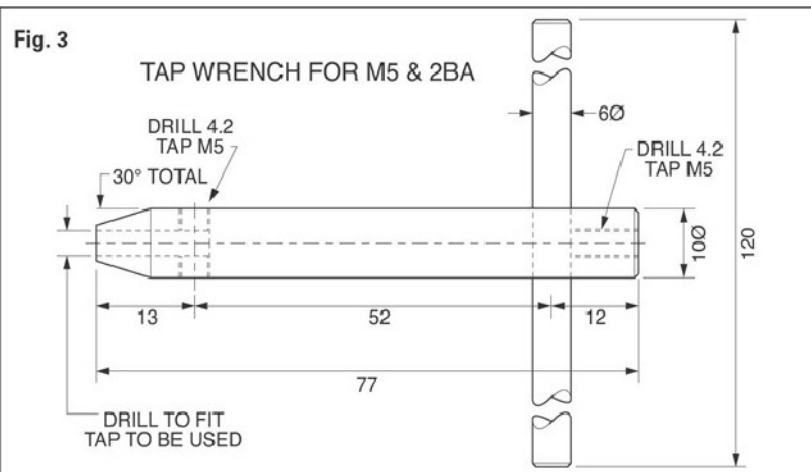


Photo 3. The finished tap wrenches all engraved ready for use.



Photo 4. The Tommy bars are easily removed for storage if required.



Fig. 5

LATHE OR DRILLING M/C TAP WRENCH FOR TAPS FROM M6 TO M10

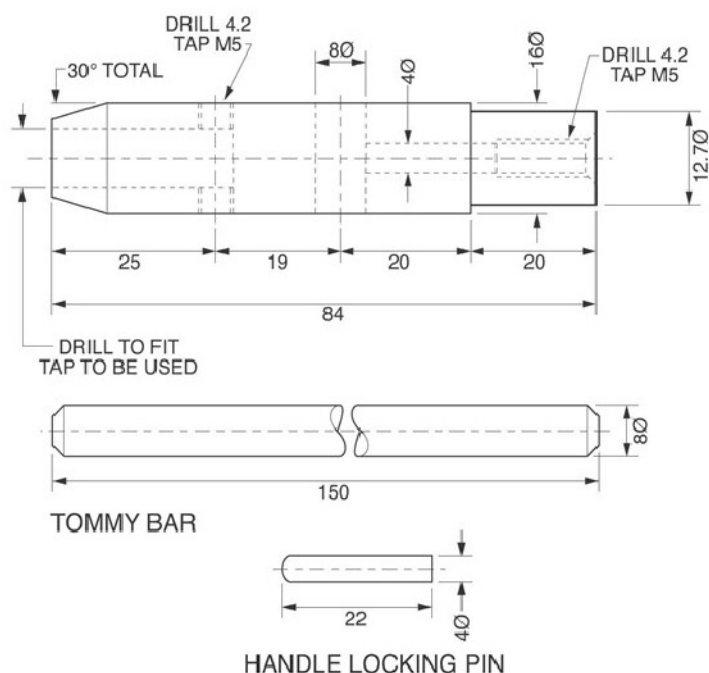


Photo 5. Using a wrench in the lathe.



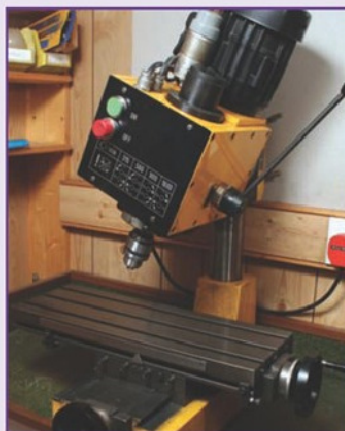
Photo 6. Using one of the wrenches in the drilling machine.

to be described can be used in the lathe and in the drilling machine, although not while they are running. The tap wrenches made, are only to cover my immediate requirements. **Photo 1** (left) is one of the jigs used, but both are styled on the previous jigs. The larger wrenches need to have a handle locking pin, because the normal M5 taps will not thread the hole right to the bottom; the pin is made from a piece of hard steel. All the tommy bars are easily removed for storing. The finished wrenches are shown in **photo 4**, while **photos 5 & 6** show them in use. ■

IN OUR NEXT ISSUE

Coming up in issue 143, on sale 19th September 2008

BUILD THIS CNC CUTTER GRINDER
Part 1 of this construction article.



KNOW YOUR MILLING MACHINE
with Harold Hall.

AN AFTERNOON IN THE WORKSHOP
A simple chain drilling jig.



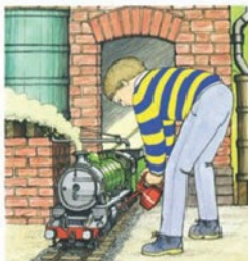
(Contents may be subject to change)

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



FIRESIDE READING

Peter's Railway



the story of a new railway
some stories from the old railways
and how-it-works

Christopher Vine

Peter's Railway

by Christopher Vine

A lot of readers may well have read Thomas The Tank Engine books when they were small, I know I did. They probably started a lifelong interest in railways. Thomas books appear to be aimed at the under six year old's but there has been nothing for the 6 to 10 year old group until now. Christopher Vine has rectified this with the introduction of "Peter's Railway", the story of building a half mile long railway across grandpa's farm to Peter's house.

Written by Chris Vine (author of "How Not To Paint A Locomotive") and with a

foreword written by Pete Waterman, it certainly has good credentials. The illustrations are very good and the book itself is very well laid out. It follows through from the initial idea of a railway through a visit to a railway exhibition to get an idea of the size to go for right through to surveying the layout, levelling the site and laying the track.

The track making and laying, including the use of ballast and track and a permanent way train (pushed by hand) are all discussed in detail. Embankments and cuttings are covered in language the child can understand. Raising

steam and locomotive lubrication are explained in detail and a diagram of the locomotive controls, clearly labelled, is included. There are a couple of (tall?) stories about real railways included that may get the child to ask questions.

There are sketches of special wagons and carriages including two circus wagons, one for the family cat and one for the dog. I won't mention the extra special vehicle that appears at the end as it might ruin the story for you. (You are going to read it before you pass it on to your grand child?)

The railway travels from Yewston station (think about it) via Bluebell wood then alongside the river to Gerald's Cross station where Eight Elms engine shed is based. There are small station buildings at each end and scenic views along the entire route. The book ends with a Grand Opening Day and tea and

cakes when the train returned to the farm. A good day out was had by all. There is a short glossary of railway related words at the end of the book for readers who would like to understand a bit more.

This is a thoroughly enjoyable book for the younger reader and grandpa might enjoy it too. Chris Vine is to be congratulated on producing a book of this calibre; I look forward to the next in the series.

Peter's Railway is available from www.myhobbystore.com and will also be on sale at The Model Engineer Exhibition. It is also available direct from Mr Chris Vine, (MEW), PO Box 9246, Bridge of Weir, PA11 3WD or www.petersrailway.com. The price is £11.99 plus £1.50 p&p, a total of £13.49.

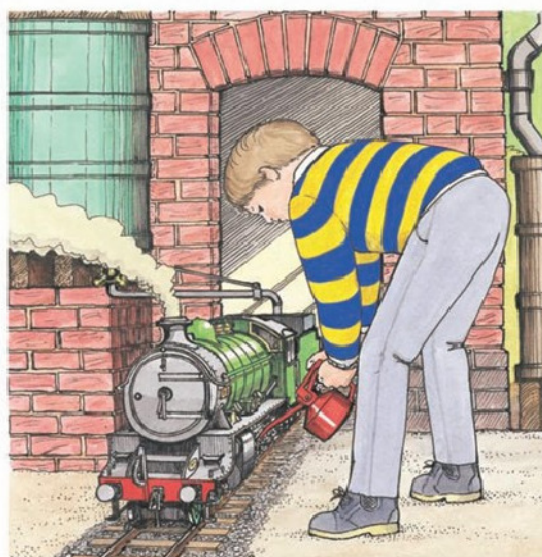
Constructing the Railway

The next weekend Peter and Grandpa were ready to start laying the track for the railway.

The first thing to do was to spread some of the ballast onto the track bed and rake it smooth and level. They did this for some distance and then it was time to lay the track panels onto the ballast. When they had set ten panels end to end they bolted them together with nuts, bolts and fishplates.



Page 40



Peter's Railway

by
Christopher Vine

The first book in a new series for kids who love trains.
The story of a new 7 1/4" gauge steam railway
some stories from the old railways
and how-it-works pages.

Hardback, 96 pages with 30 watercolour illustrations and 7 double pages of simple technical diagrams and explanations. Aimed at approximately 6 to 10 years.

To Order: Please send cheque or postal order for £11.99 + £1.50 p&p (£13.49 total) to C Vine (ME), PO Box 9246, Bridge of Weir, PA11 3WD (UK) or visit www.petersrailway.com to buy on-line or visit a local preserved or miniature railway. Many of their shops now stock it.
How (not) to paint a locomotive still available at same address and website. £21.50p inc p&p

TRADE COUNTER

TurboCAD Pro Version 15

MSI DESIGN have released version 15 of their TurboCAD Professional package; **photo 1** shows the screen with some of the tools and the main drawing area. One of the main reasons I use TurboCAD is because it will open almost any CAD file that I throw at it. It seems to be more AutoCAD compatible than the various versions of AutoCAD itself. It does need quite a high spec computer with plenty of memory but most programs nowadays need this.

Minimum System Requirements

- Pentium IV Processor.
- Microsoft (r) Windows XP 512 Mb RAM, Microsoft (r), Vista 2 Gb RAM
- 300 MB of free hard disk space depending on accessory applications installed, 64+ MB of swap space.
- Super VGA (1024 x768) display.
- High Color (16 bit) graphics card.
- 4X CD-ROM drive with 32 bit drivers.

The following items are

recommended but not required:

- 2+ GHz Processor, 2 Gb RAM
- 3D Graphics accelerator card
- Wheel mouse
- Internet connection
- Microsoft® Internet Explorer™ required for Internet registration
- Macromedia® Flash™ plug-in required for on-line tutorials.

The main difference between TurboCAD and AutoCAD is the price. TurboCAD is a fraction of the price of AutoCAD and in my opinion will do the job just as well, if not better from the home users' point of view.

Installation is easy and registration via the Internet was quick and painless. When you open TurboCAD it gives you the option to open a recently used drawing or to select a template or new drawing from scratch. It defaulted to Imperial but it was easy to change to Metric by going to the options menu, selecting general and changing the template to default Metric.

Having been bought up on AutoCAD Lite, I found the initial changeover to TurboCAD a little slow but after a few hours use, it starts to become easier. There is a thick 600 page reference manual included with the Professional version and help is also available on line. Also included in the box was a small Getting Started Guide, which I found very useful.

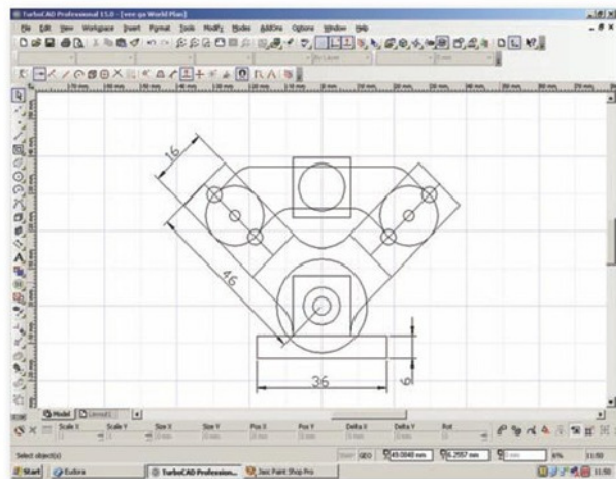


Photo 2

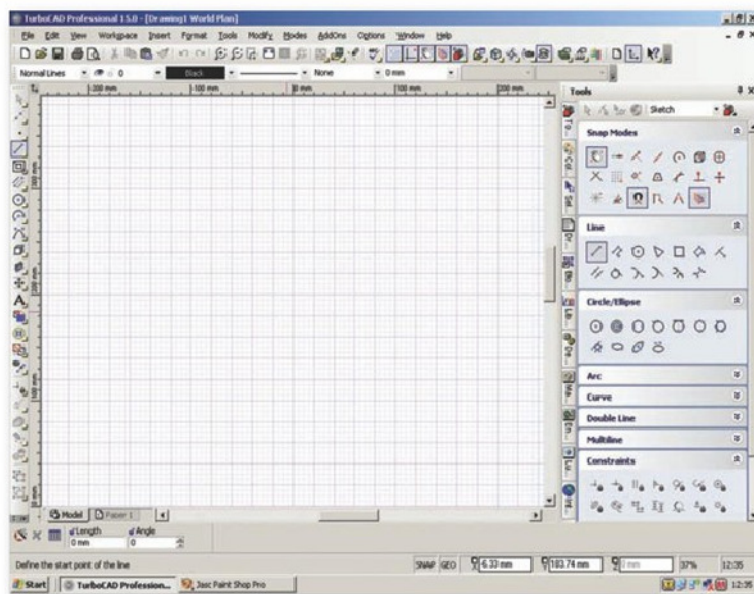


Photo 1

Using the Shift and Tab keys together puts you into the coordinate boxes at the bottom of the screen and you can enter coordinates and tab to the next. It is almost as quick as the AutoCAD command line. If you are drawing a circle, keep tabbing until you reach the radius or diameter field, whichever you want. To create a tangent from one arc to another, you have to select the line command to draw a line from tangent to tangent. I tried snapping to each tangent in turn but it seemed to put the tangent to the previous snap point used wherever that was. This is easy enough to do but if you are used to AutoCAD you might find it a bit strange at first.

I used TurboCAD to do a quick drawing for a Vee twin oscillating engine and had no major problems, **photo 2**. If you have used any sort of CAD package in the past, you will find it quick to learn TurboCAD. If you have not used a CAD package before, you will be pleasantly surprised with the ease that you can learn it.

There are many functions and a comprehensive range of 3D commands are included. Some of the sample drawings on the front and back cover of the box are superb. I just wonder how long it will take me to learn how to use the entire package properly. Fortunately, all I need is the basic drawing facilities although I do eventually intend to learn the full capabilities of the package. I suppose there is nothing for it but to sit down for an hour a day and learn it.

One of the useful functions is parallel line where you can draw a line offset to another line. Basic 3D functions seem quite easy;

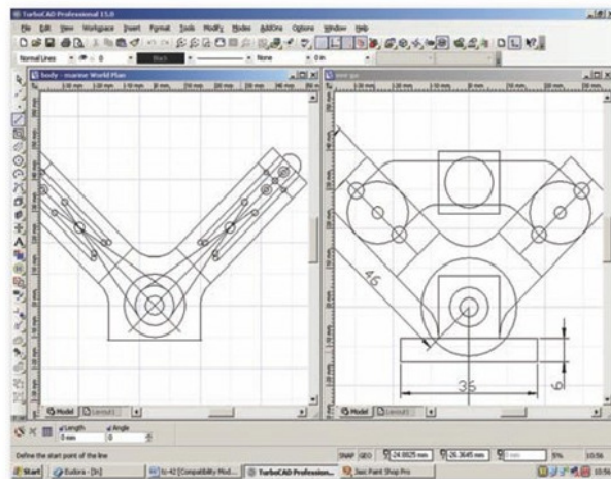


Photo 3

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

drawing a box in 3D takes only seconds. All the toolbars can be docked at the edges of the screen or float in the drawing window. The whole user interface can be customised to suit your way of working with the most often used commands on screen and readily available.

TurboCAD uses a multiple document interface (MDI). This means TurboCAD can have several drawings open at the same time and you can copy and paste objects between them, **photo 3**. You can also have multiple windows of the same file open, which is ideal when working in 3D.

Most object properties can be changed from the properties window. There are several properties common to all objects and some objects also have their own unique properties.

There is a facility to copy an object in a linear copy, an array copy or a radial copy where the objects can be copied around a circle. There is also a mirror copy, a vector copy and an offset copy, all useful functions that you will find a use for as you progress with learning TurboCAD.

There is a library function where you can draw an item, combine it into a block and save it so that you can insert the block into another drawing. A simple use of a block is to draw a door and then you can save as a block and insert into as many places on the drawing or drawings as required. This means you have to draw the door only once but can use it many hundreds of times in the future. Blocks can also be edited at a later date if necessary.

I have not used the 3D capabilities of TurboCAD but looking through the manual, a typical example is of a bent up bracket. You draw the bracket in its bent state and then you can unbend the bracket and get the dimension required before bending, ideal in a sheet metalwork environment.

I have only touched on the TurboCAD program, there is so much too it and so many commands that you really do need the 600 page manual (or the online help) to learn it.



Photo 4

TurboCAD Pro v15 Mechanical is £350. If you would like to try out TurboCAD before buying the latest version, TurboCAD Deluxe v14 is still available while stocks last for £30.

If you visit <http://www.turbocad.co.uk/tutorials.php> and scroll to the bottom of the page, **photo 4** there is a link to all sorts of 3D drawings in TurboCAD. If you look at these, you will get a much better idea of what TurboCAD can do.

Tel: Paul Tracey 01962 835 081 or email ptracey@avanquest.co.uk

TurboCAD Summer Offers

TurboCAD Pro v15 Mechanical	£350
TurboCAD Delux v15	£40
v15 2D Training Guide	£20
v15 3D Training Guide	£20
TurboCAD Pro v14 Mechanical	£120
TurboCAD Deluxe v14	£30
v14 2D Training Guide	£20
v14 3D Training Guide	£20

New Stock:

CAD Symbols	£43
Over 30 million 2D & 3D symbols. Machine parts, steel construction, screws, flanges, bolts, nuts etc.	
Animation Lab	£77
Works with Pro 14 & 15 +Deluxe 15. Create animated CAD designs - you can even add sound.	



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

SAVE MONEY, SUBSCRIBE TODAY (see page 10 for details).

Allendale Electronics Ltd

Special MEW reader offers

The items below are available to MEW readers at a special discount price. You must order by phone to get the discount and mention Model Engineers' Workshop. This discount will not be applied on the website. All items are + P&P.

Due to the excellent response last month, Allendale are offering more measuring equipment at a reduced price.

Next there is a 50mm Digital thickness gauge order no ME-CAL-TH-50 for £20.95 or ME-CAL-TH-50 75 for 75mm for £26.95. This is useful for all sorts of measuring in the home workshop. Although marketed as a thickness gauge, the deep jaws will enable many awkwardly shaped objects to be measured. The gauge is also spring loaded for one handed use.



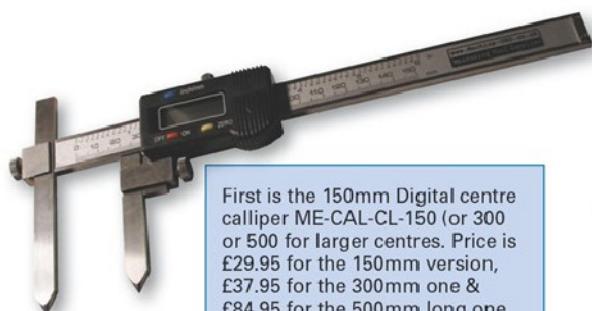
Another item, the digital gear calliper is up next, order ME-CAL-GEAR-25 for £59.95.



Finally for this month we have a 35 -50mm bore gauge and a 50 -150mm bore gauge, order 'Dial bore gauge 35-50' for £24.95 or 'Dial bore gauge 50 -160' for £29.95 Set the basic size using a micrometer or vernier, and read out the bore size direct from the clock. The pair are available together for only £44.95



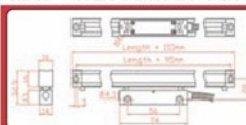
First is the 150mm Digital centre calliper ME-CAL-CL-150 (or 300 or 500 for larger centres. Price is £29.95 for the 150mm version, £37.95 for the 300mm one & £84.95 for the 500mm long one. All are easily set by removing the end anvil and zeroing the display, refit the anvil and away you go.



Machine
-DRO.CO.UK

Open Days
September 3rd - 6th

NEW - GS200 MICRO GLASS LINEAR SCALE...



Prices From £142.95 inc VAT
See Website For Details...

Centre Pitched Calipers...



- Measure between two hole centres and edge to hole centre.
- Adjustable ground points.
- Metric/imperial conversion.
- Wooden storage case.

Part no	Range	WAS	SALE
ME-CAL-CP-150	10-150mm/6"	£29.95	£29.95
ME-CAL-CP-300	10-300mm/12"	£44.95	£37.95
ME-CAL-CP-500	10-500mm/20"	£99.95	£84.95

Thickness Caliper...



- Spring jaw action to provide correct measuring force.
- Single handed operation.
- 10mm diameter measuring rimmed contacts.
- Wooden storage case.

Part no	Range	WAS	SALE
ME-CAL-TH-50	0-50mm/2"	£24.95	£20.95

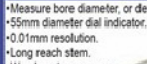
Gear Tooth Caliper...



- Measure the thickness of gear teeth.
- Horizontal and Vertical readout.
- Metric/inch conversion.
- Storage case.

Part no	Range	WAS	SALE
ME-CAL-GEAR-25	0-25mm/1"	£59.95	£59.95

Dial Bore Gauges...



- Measure bore diameter, or detect a taper or ovality.
- 55mm diameter dial indicator.
- 0.01mm resolution.
- Long reach stem.
- Wooden storage case.

Part no	Range	Reach	WAS	SALE
ME-BG-35-50	35-50mm	150mm	£24.95	£24.95
ME-BG-50-150	50-150mm	150mm	£34.95	£29.95

For More Details Please Visit
www.machine-dro.co.uk

Allendale Electronics Ltd,
43 Hoddesdon Industrial Centre, Pindar Road,
Hoddesdon, Herts, EN11 0FF.
Telephone: 01992 450780
Email: sales@machine-dro.co.uk



GS200 Micro Series Glass Linear Scales

Allendale have recently introduced the GS200 Micro Series Glass Linear Scales to their range of digital readout systems. The GS200 Micro Linear Scales offer the same level of precision and reliability as the GS300 standard linear scales, but they have a much smaller profile, making GS200 the ideal scale series for confined installations. They will fit neatly on the compound or cross slide on a lathe or a quill feed on a drilling or milling machine. Allendale are stocking reading lengths for the GS200 from 70mm to 320mm with a 5um Resolution as standard with a tolerance of $\pm 10\mu\text{m}$. The scale body has a cross sectional size of 16x16mm and the reading head is 13 x 14mm, with an overall profile size of 32.5mm x 16mm.

The versatility of the "GS" range of linear scales allows any combination of length and scale series to be used together. It is possible to fit a GS200 Micro scale to the compound slide, a GS500 Slim scale to the cross slide and a GS300 Standard scale to the bed of the lathe in a single install. Allendale's full range of scales and readouts provide a flexible solution to your readout requirements at an affordable price. Please mention Model Engineers' Workshop when phoning.



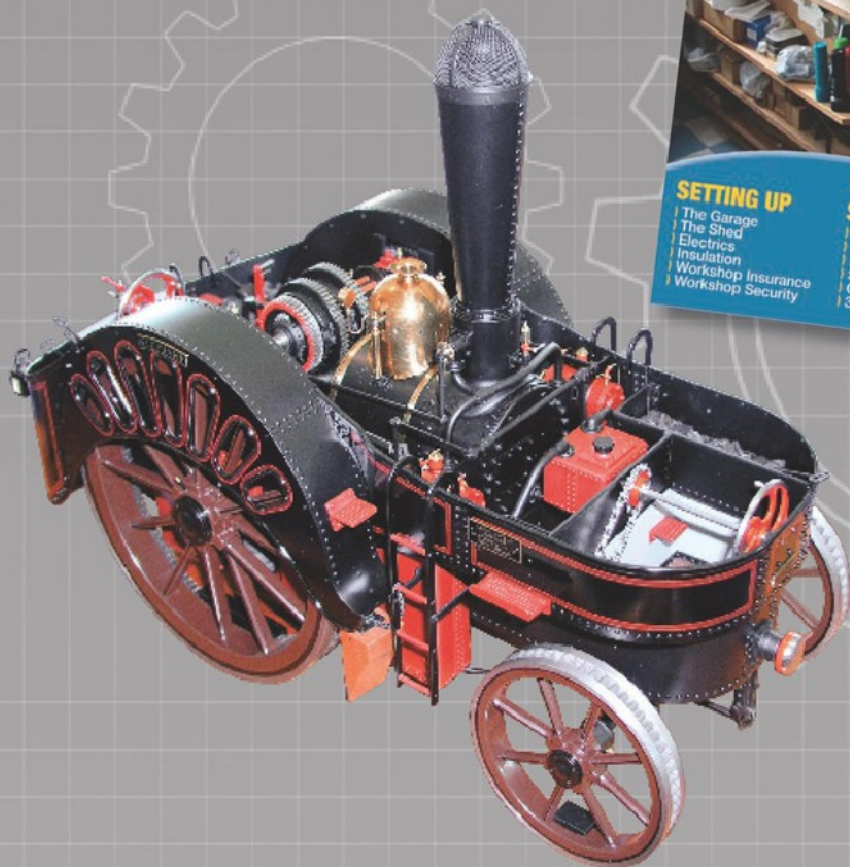
Allendale Electronics Ltd, 43 Hoddesdon Industrial Centre,
Pindar Road, Hoddesdon, Herts, EN11 0FF
Tel: 01992 450780 Fax: 01992 450781
Web: www.Machine-DRO.co.uk
E-mail: Sales@machine-dro.co.uk

SPECIAL EDITION MAGAZINE

COMING SOON

SETTING UP A WORKSHOP

Setting up a Workshop is the 'all you need to know' guide for beginners through to advanced metal workers. It teaches you the ins and outs of selecting the workshop, setting up security and selecting machines.



MODEL ENGINEERS'
WORKSHOP

**MODEL
ENGINEER**

ON SALE FROM 18th September 2008 at WHSmith
or BUY ONLINE at www.myhobbystore.com

SCRIBE A LINE

Titivation of Chinese Machinery

I've recently become thoroughly fed up with the ordinary hacksaw. The onset of a little bit of arthritis hasn't helped much either. So I thought I would stretch the budget and invest in a powered one.

I chose a hacksaw over a bandsaw because I preferred to change a simple blade occasionally rather than a band often. It is so easy to lose the edge from a bandsaw whilst a good hacksaw blade can go on for ever (well almost).

I bought the powered saw from a very well known and reputable tool supplier. The low price guaranteed that it was Chinese. It arrived looking reassuringly robust and well finished with a nicely ground vice bed.

It worked well and I revelled in the prospect of the saw chuntering on whilst I got on with something more exciting. I was however expecting a quiet machine, which it wasn't. Then I remembered the various advertisements offering lathes etc "straight off the ship or for another £100 stripped down and rebuilt".

Whilst I am a firm believer in the maxim "if it ain't bust don't fix it", here was a valid opportunity to have a look at the inside.

The traditional powered hacksaw is driven via a connecting rod from a motor driven eccentric pin. This one however has three robust cast iron plates where the centre one, combining the saw bow, slides back and forwards between the two outers. The motor attached to one of the outer plates still drives an eccentric pin but in this case it is equipped with a ball race. This moves up and down in a vertical slot in the centre plate. In turning of course, it then drives the centre plate back and forwards in the appropriate manner, ingeniously simple. Why the traditional connecting rod system has lasted so long beats me!

However, to the point at issue; the sliding surfaces should have been ground, which they weren't. They were perhaps coarsely machined and had to be contributing to the high noise level. I don't have access to a surface grinder and I didn't fancy spending hours with scrapers (as I have done in years past). I used instead an ordinary palm sander equipped with emery paper (it was in fact "wet and dry" which I happened to have available). I smoothly went over each face for about half an hour. Whilst the

machine marks didn't entirely disappear, the surfaces were improved considerably and the signs were that the change, in each case, was even over the whole surface (I would never recommend a circular disk sander for such a job as they tend to dig in).

With one exception the rest of the Machine was nicely made. The exception is meat for a future modification. The bolts holding the three plates together but still allowing the centre one to slide depends for adjustment on lock nuts. It's begging for the addition of correctly sized spacers and shims. Apart from the fiddling required on the lock nut adjustment mentioned above, the reassembly was smooth and I made sure all running surfaces were liberally greased. In operation the saw is now reassuringly quieter.

No doubt it begs the question "would I follow this route again?" The simple answer is YES. It's impossible to beat the low prices available even when considering the extra effort put in. It's a nice machine. I'm very pleased with it.

Jim Perry by email

The Stent tool and cutter grinder

I was interested in the article by Mr. Woodward about his modifications to his Stent grinder. I too was unhappy about its centre of gravity being too high. His article lead me to buy (for a whole £10.00) from B&Q a bench grinder slightly smaller than generally used. Although using 6in. wheels, the motor was small and looked very much like Mr. Woodward's. I was waving it about in various positions around the machine when I thought that if I mounted a plate on the vertical slide and turned the grinder onto its front I could get the right hand wheel in the 90deg configuration just about where the original wheel had been. I tried this out and the right hand wheel was forward but still in a position where it would grind cutters on the end and probably on the side. I was thinking originally of mounting the vertical slide on a plate to take the grinder back a bit but this seemed unnecessary.

When positioned, the grinder worked well except for a tendency to 'wobble' the motor on its plastic base. This was overcome by taking support brackets from the base and base plate to support

the motor on each end where the diameter was reduced at the motor bearings. The support brackets were made out of 5in. x 4in. x 18mm ply, split across the motor bearing hole. The whole was supported by four 6mm rods threaded each end to bolt the lot to the baseplate. This has become absolutely solid now and runs well. As a bonus, the second (left hand) wheel, when swung into line with the work slide, operates as a surface grinder for small components and could possibly use a cup wheel.

This has turned the Stent into a much more compact, stable machine and gets rid of the belts and pulleys.

Dave Robinson by email

The Editor replies: Mr Woodward's Stent and also his clock wheel cutting machine (the subject of a future article) will be on display at the Model Engineer Exhibition in September. They will be in the competition section.

Drill sharpening 1

I read with interest the two articles about drill sharpening jigs in the August issue as two days previously I had reluctantly replaced my old Picador version of the type of jig featured with a new "copy". (The Picador one I have is of UK manufacture, probably to the original design and is more substantial but has suffered "metal fatigue".) Before using the new one I was determine to make a fine feed base as the rough and ready adjustment provided was a major cause of failure and frustration for me when using the jig and so was delighted to see Jim Whetren's article.

When comparing the old and new jigs there are some remarkable similarities but the geometry is different between my old Picador and the new copy I have. On the new one, the pillar is held at an angle in the base but in the Picador it is vertical as shown in Jim's drawing. Anyone making the fine adjustment base may therefore need to modify the design to suit their particular version of the jig.

Moving on to the article by Harold Hall, it again addressed a problem I had encountered when using the jig and that is the use of the "rotational stop". I will certainly look at a modification along those lines shown but I am a little concerned about the effect of not getting the two bars parallel. With the lack of space available though, I suspect there will have to be some compromise and hence I will probably follow the solution Harold has arrived at. (When he suggests using the end stop as a fine feed, I suspect this is with his suggested 180 deg. modification in use, otherwise if the original rotational stop is in place the drill will turn as it is advanced and spoil the setting.)

Thanks to both contributors for excellent articles and for including them in the same issue, it is always good to see different approaches to the same subject.

John Shepherd by email

Screwcutting help wanted

I have a problem with my screwcutting on my Boxford Model A. After setting up the cross slides and zeroing the dials, plus setting the tool with the gauge against the work, I find that the threads assume what can only be described as buttress form, I.E. removing more metal from the right hand side than the left.

Where am I going wrong? After many frustrating attempts to turn a left hand feed screw for my lathe tailstock, every time the thread takes on the same form. I

am a novice in terms of turning as the only other experience I have was as a boy at school in the 50's. Any help your readers can offer will be very much appreciated.

T.E.Clarkson Pontefract.

The Editor replies: I have sent Mr Clarkson Martin Cleeve's *Workshop Practice book no 3, Screwcutting In The Lathe*. If any readers can help, please get in touch by email or the Berwick house address.

Star Letter



The clingfilm in use

Keyboards in the workshop

Using a computer in the workshop is a very common practice these days, so there is always a keyboard too. But such a keyboard can be the Achilles heel of the system because little metal chips can easily get into the spaces between the keys and... Well, the consequences are quite predictable but never very pleasant. Of course there are keyboards that are waterproof, or dustproof or whatever proof but at a price. Because I had to put the computer and its peripherals quite close to the CNC-machine, I was confronted with

the problem of dust, grime and chips sneaking in the keyboard. As I didn't feel like reaching deep into my pockets, I thought of a cheap solution. As you can see from the attached picture, I covered the keyboard in kitchen film. The stuff that clings to itself and to whatever it comes in contact with. That way the keyboard is isolated from intruders yet it stays completely functional and you can still see the keys. And if the film gets soiled or torn just replace it with another sheet. Simple, cheap and effective.

Michel Christiaens by email

The Editor replies: I have checked my Picador and it is upright like Jim's but the Warco is at an angle. The mounting pillar on the fine feed jig will need to be mounted on an angle. This can easily be done by mounting the base in a vice at the required angle and machining to suit the pillar.

Drill sharpening 2

I refer to both Harold Hall's article in Issue 141 and Jim Whetren's article in the same issue. I have owned one of the jigs as shown in Harold Hall's photo 5 and Jim Whetren's photo 1 for a long time, perhaps 30 years or so. Mine was made by Hollands & Blair of Gillingham and was sold as the Spiralux Drill Grinding Attachment. Looking on the internet, it seems that attachments to the same design are marketed by all and sundry under different names. Perhaps they are all made in the same factory?

My instructions give the following uses for the differing angles: 59deg. General Purpose Drilling; 88deg. To prevent snatching on thin materials; 68deg. Recommended high production angle for small drills; 49deg. For soft materials (copper, lead, some light alloys, etc); 41deg. Countersinking angle. Interestingly, Harold quotes the exact double of these figures.

Harold also quotes the present day standard of 90deg. for modern

countersink screws. I am no expert, but I do wonder if using 82deg. would always ensure that the CSK screw would only contact the material on its outer edge thus forming a perfect contact all round. Using a 90deg. countersink would mean that any possible mismatch between the CSK screw and the drilled countersink could mean that an ugly gap may appear between the screw and hole. As I say, I am no expert but do seem to recall reading about this somewhere.

Harold also mentions the angle of the rotating pin. Mine is set at 83deg., ie 7deg. off vertical. Jim's photo does not show this and he does not mention it in the text. Also, there is nothing in my instructions about it, nor can I find anything on the internet. Perhaps someone more knowledgeable could comment on this.

Harold comments that his instructions leave a lot to be desired. My instructions state that one should set the bit to project by approximately 1/16 in. then to advance the Lip Stop (the finger in photo 9) to just engage the flute. The bit is then rotated such that its cutting edge rests against the Lip Stop and is then clamped in position. Then, "providing the instructions are followed, the drill should appear as shown in Fig. 3 (effectively what Harold is saying). Due to differences in twist drill design it may be necessary to extend the drill point more or less than 1/16 in." Quite!

Peter G. Shaw by email Cockermonth.

The Editor replies: Having had a quick look in Machinery's Handbook, 82deg. is the angle for standard American flat head machine screws. Interestingly, the angle is given as 78deg. - 82deg. If the screw was made to 78deg. and fitted to an 82deg. countersink, the head would indeed be floating in the wind. The only time I can remember using 82deg. was on aircraft components.

Simple can be best

Here is an object lesson. I bought a Kerry drill press from Myford a couple of years ago and spent some time restoring it to a very presentable condition. Life being what it is, I had never sorted out the drill table, which was difficult to rotate whilst attempting to align the drill and workpiece. As a result, I tend to use my mill instead of the drill press. A few days ago, with the mill carefully set up to do something else, I needed to do some accurate drilling and had quite a battle setting up the drill press. As a result I was determined to sort the table out and started to think about how I could do it with my workshop tools. The problem is that the table is too big to put in my Super 7 and turn down the spigot. My first thought was I could use the mill and a boring head. I carefully marked out the centre of the spigot and with a wiggler got the centre aligned with the mill vertical axis and fitted the boring head. Then I discovered none of my boring bars was suitable for turning down the outside of a spigot - the cutting edge faced the wrong way!

I got out my GHT workshop manual and found a suitable tool illustrated, located some bar stock and thought 'I'll do that tomorrow.' Then I measured the relative internal and external diameters of the spigot and hole in the horizontal arm and discovered that there wasn't much difference - maybe a couple of thou needed removing. And then the penny dropped! Why spend all that time making a tool to remove perhaps a couple of thou of interference fit? Why not use my wide bladed diamond file and carefully rub down the spigot? Twenty minutes and two very dirty hands later resulted in a perfectly fitting table that is easy to rotate and lock in position.

The moral of the story is that given a little thought there is often a simple solution to most problems and wearing gloves saves a lot of soap and rusty stains in the kitchen sink!

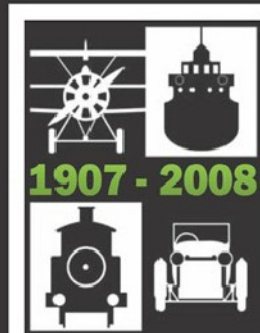
Brian Corfield by email

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, Magicalia Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL. Alternatively email: david.clark@magicalia.com

THE STAR LETTER OF THE MONTH WINS A WORKSHOP PRACTICE BOOK



MODEL ENGINEER EXHIBITION

101 years

19-21 September 2008 • Ascot Racecourse

SINSHEIM COMES TO ASCOT

WE ARE DELIGHTED TO ANNOUNCE THAT WE HAVE REACHED AGREEMENT WITH OUR FRIENDS IN SINSHEIM FOR 2.5KM OF THEIR WORLD FAMOUS TRACK TO BE BROUGHT OVER TO ASCOT.

THIS HIGHLIGHT OF THE 101ST MODEL ENGINEER EXHIBITION, WILL BE POSSIBLY THE LONGEST GROUND LEVEL 5IN. GAUGE RAILWAY IN THE COUNTRY.



- EXPRESS RUNNING IN 5IN. GAUGE
- NUMEROUS LOCOS AND ROLLING STOCK
- WORLD FAMOUS MODEL ENGINEER COMPETITION
- CLUBS, DISPLAYS AND DEMONSTRATIONS
- SMEE LECTURES
- TOP TRADE STANDS

**NEW
FOR
2008**

Newmarket Special Events* are proud to offer the following package:

- EXCLUSIVE EVENING TOUR of the KEMPTON GREAT ENGINE.
- 1 Nights Hotel Accommodation including a full English breakfast.
- Day pass for the Model Engineer Exhibition 101st year.
- Coach transfers and return between hotel and Kempton & Hotel and Ascot.
- All inclusive prices starting from £89!

For 2 day tour details including Kempton great Engine call: 0844 3912125



ADVANCED TICKETS.

BOOK YOUR ADVANCED TICKETS NOW AT

www.model-engineer.co.uk

(you can still book by phone if you do not have internet access on 0844 848 3227)

Please note all EXHIBITION OPENING HOURS: 10.00 - 5pm Friday and Saturday 10.00 - 4pm Sunday in circumstance.

FREE

Private Adverts

MODEL ENGINEER

MODEL ENGINEERS' WORKSHOP

Subscribers, see these adverts five days early!

**SUBSCRIBE
TODAY
AND SAVE
£££'S**

Machines for sale

■ Myford lathe - 31in. long bed on cabinet. Excellent condition, new motor, screw cutting g/box, 3&4 jaw chucks, taper turning, quick-change toolpost plus lots more. £2,500. **Tel: 01268 523590 from 8am to 6pm or 07795 285649 Evenings, East Sussex.**

■ Capco Surface Grinder - fitted with Optidress, Magchuck, and No1 and No2 Coventry die grinding Fixtures in fitted boxes, £1200 **Tel: 01443 819965 or 07970 886 345 Cardiff.**

■ Complete workshop including ML7, Polly two locomotive with driving trolley and ground level track, sell complete only, £5,500. **Tel: 01248 410562 North Wales.**

■ Elliot QO Omni-Mill, 3 phase, 3 Morse taper, Horizontal & Vertical with some tooling in good condition, £1700. **Tel: 01298 79216 Buxton.**

■ Marico two speed broaching press, VGC. £230. **Tel: 01226 781484 Barnsley.**

■ Colchester Triumph round head lathe, metric, single phase reversing motor, 3 & 4 jaw chucks & Norton gearbox. Weighs

15CWT, buyer removes, £1200. Tom Senior horizontal mill with vertical head, single phase. On pallet ready for collection, £1200. **Tel: 01663 746080 Derbyshire.**

■ Myford VMC with Ortec 2 axis readout, vertical readout, single phase, R8 spindle taper with some tooling. Offers? **Tel: 01293 547487 Crawley.**

■ Myford metric conversion, boxed set, £150. Myford saw table with metal and wood blades, boxed, £200. Myford dividing attachment with two plates, £250. **Tel 01482 656626 East Yorks.**

■ Hemmingway/Myford back stop kit, new, cost £30, accept £20+P&P. Genuine Myford fixed steady £50 + P&P. **Tel 01226 759204 South Yorkshire.**

■ Chester 626 mill & equipment as new, £750. Warco horizontal & vertical bandsaw, 3 speed as new, £75. **Tel: 01922 683770 Walsall.**

■ Conquest lathe, 3 & 4 jaw chuck, face plate, fixed steady, drill chuck & gear set. Needs some TLC, £100. **Tel: 0161 6522404 Oldham.**

■ Boxford lathe with gearbox, 5in., single phase, 3 & 4 jaw chuck & collets, £350. Alpine mill/drill, table 28½in. x 8½in. 1½in. capacity 3 phase with convertor, 3400. **Tel: 01706 843207 Oldham.**

Miscellaneous offered

■ Lawes Mihalik 'Spot on' optical centre punch in storage pot with full instructions, £47. **Tel: 01895 236203 Uxbridge.**

Miscellaneous wanted

■ Ohlson & Rice Compact III petrol engine. Also instruction book and spares. **Tel: 01493 858071 Great Yarmouth.**

Magazines for sale

■ Model Engineers' Workshop no 1 to latest, mint condition, some bound, buyer to collect or pay postage. Offers? **Tel: 0121 4223466 West Midlands.**

■ Model Engineers' Workshop, back issues from No 13 (Oct 1992) to present. Good clean condition. £5.70 per issue inc. p&p (in UK). **Tel: 0115 9376333 Nottinghamshire.**

■ Model Engineers' Workshop no's 15 to 46 (missing 17, 31 & 32) and no's 64 to 140, offers? **Tel: 01246 297443 Chesterfield.**

Magazines wanted

■ Newly retired chap 'yipee' wants back copies of Model Engineers' Workshop 2007 backwards. Also wanted, books and magazines on model steam boat engines. **Tel: 01905 345274 Worcester.**

Books for sale

■ Building The Allchin by Hughes £20+P&P. **Tel 01226 759204 South Yorkshire.**

■ Clock and Watch Escapements, £10 + P&P. Watch making and repairing, £10 + P&P. Both by Gazeley. **Tel: 01993 841778 Oxfordshire.**

Material wanted

■ Hardened and blue tempered spring steel, minimum 2in. wide, 0.006 Thou thick. Few square feet required. **Tel: 01359 231940 Suffolk.**

Books wanted

■ Rewinding and Repair of Electric Motors", by Karl Wilkinson, published by SPON around 1940/50. **Tel: 01723 362537 Scarborough.**

FOR SALE Wanted **MACHINES** Tools **MODELS** Miscellaneous **BOOKS** Magazines **MATERIALS** Information

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

Phone:			Town:		
No Mobile phone numbers except by prior arrangement			Please use nearest well known town		

Please insert advert into: (Tick one box only)

☐ Model Engineer ☐ Model Engineers' Workshop

Name

Address

.....

Postcode

Please post to:

ME/MEW FREE ADS, Magicalia Publishing Ltd,
Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL

Photocopies of this form are acceptable.

Adverts will be placed as soon as space is available.

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

Pro Machine Tools Ltd

Precision Machines Made in Germany
"For the discerning engineer"



D2000E

Centre distance 350 mm
Centre height 110 mm
Power 1,4 kW, 230 V, 50 Hz
Spindle speed infinitely variable
45 - 2300 r.p.m.
Feed 0,085 and 0,16 mm



D6000E

Longitudinal X-axis 600 mm
Transverse Y-axis 140 mm
Vertical Z-axis 280 mm
Power 1,4 kW, 230 V, 50 Hz
Spindle speed infinitely variable
180 - 3000 r.p.m.



D3000E

Centre distance 500 mm
Centre height 110 mm
Power 1,4 kW, 230 V, 50 Hz
Spindle speed infinitely variable
45 - 2300 r.p.m.
Feed infinitely variable 0 - 250 mm/min



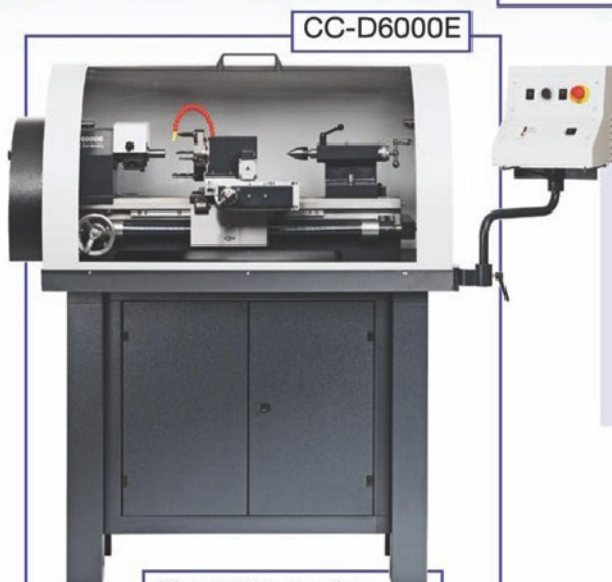
D4000E

Centre distance 350 mm
Centre height 100 mm
Power 1,4 kW, 230 V, 50 Hz
Spindle speed infinitely variable
45 - 2300 r.p.m.
Feed 0,085 and 0,16 mm



D6000E High Speed

Centre distance 600 mm
Centre height 135 mm
Power 2,0 kW, 230 V, 50 Hz
Spindle speed infinitely variable
100 - 5000 r.p.m.
Feed 0,085 and 0,16 mm



CC-D6000E

CC-D6000 E with safety machine cabin and integrated coolant unit, ball screws, automatic 8-station tool changer and base cabinet

5 YEAR WARRANTY
On ALL Wabeco Machines

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

" These lathes are incredibly quiet
and the speed adjustment is excel-
lent; no pulleys or belts to worry
about. "

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 eastern quantity.
See our web site for details



emco
Hobbiemaschinen

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

NEWTON TESLA

**SMOOTH, QUIET, HIGH PERFORMANCE
VARIABLE SPEED CONTROL FOR YOUR LATHE OR MILL.**



CL RANGE KEY FEATURES

- Comprehensive package with controller and matched motor. **All pre-wired ready to go!**
- Power Range: 1/2hp, 1hp, 2hp and 3hp.
- **AMAZING 10 YEAR WARRANTY!!!!**
- Smooth control across entire speed range, giving chatter free machining and excellent finish.
- Quiet, vibration free operation.
- High torque down to lowest speed.
- Powered from domestic single phase mains.
- Complete electronic motor protection.
- Simplifies screw-cutting, tapping blind holes from the tailstock, parting/facing off large diameter bars, drilling operations from the tailstock, reaming operations and setup/centering of 4 jaw chucks.



Some of the machines suitable for Newton Tesla Variable Speed Controllers.

- Myford ML7, Super 7, Super 7 Plus, and VMC.
- Raglan Mk5 and 'Little John' lathes
- **Boxford**
- Colchester Bantam, Student.
- Tom Senior
- Bridgeport / Adcock-Shipley
- **WARCO** BV-20, 918, WMT300, BH600
- Drummond
- Viceroy
- **Chester UK** Multi-purpose lathes and milling machines.
- Union 'Graduate' woodturning lathes

www.newton-tesla.com

Prices of the CL range of systems start from £390 inc VAT. UK mainland delivery is £18.
We also supply Inverter drives offering single-to-3PH speed control from only £113 + VAT.
Other Products and Services: Control System Design, AC & DC Drives, Electric Motors, Factory Automation.

1987—2007

Supplying to Model Engineers and Industry for 20 Years.

Newton Tesla (Electric Drives) Ltd,
Units G15 & G18, Warrington Business Park, Long Lane, Warrington,
Cheshire WA2 8TX, UK.
Tel: 01925 444773 Fax: 01925 241477
E-mail: info@newton-tesla.com Web: www.newton-tesla.com

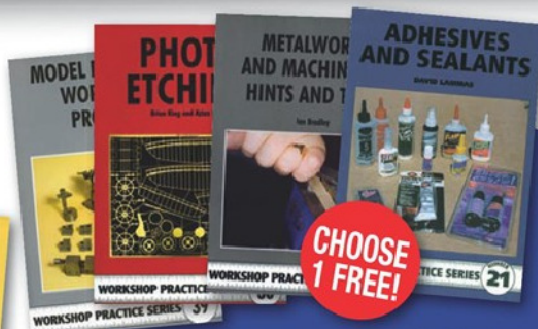
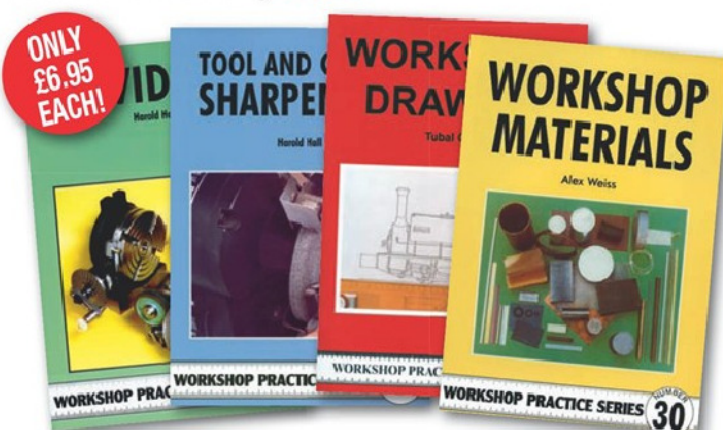


MyHobbystore.com

putting modellers first

BUY TWO BOOKS FROM THE WORKSHOP PRACTICE SERIES AND GET ONE FREE!

Buy any two books from the 42 titles available in the **Workshop Practice Series** and receive another absolutely **FREE!**



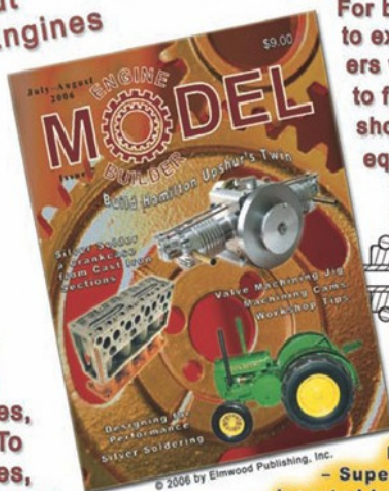
Choose any FREE book from 42 titles!

Visit www.myhobbystore.com to view the full range of titles in the Workshop Practice Series. Buy any two books and choose one FREE! Please quote **FREE WORKSHOP PRACTICE BOOK** when ordering online or by phone 01689 899200.

ORDER YOUR BACK ISSUES OF MODEL ENGINEERS' WORKSHOP MAGAZINE ONLINE!

Model Engine Builder

About IC Engines



For beginning to expert builders with small to full-sized shops and equipment



Build Articles, How-To Articles, Centerfold Articles, Large Drawings
279mm X 432mm
(11" X 17")

– Brilliant Illustrations
– Superb Drawings inserted but not bound in so you can take them into your shop

Subscribe now for 2007/2008
All Back Issues are available.
Subscribe directly on our Web site or print the Subscription Form found there and send it today to:



Morton M5
Issue 2
Build Article

Elmwood Publishing, Inc.
737 Elmwood Ave.
Vallejo, CA 94591-8641 U.S.A.
www.modelenginebuilder.com
Toll-free, U.S. & Canada 1-866-996-8999
Elsewhere 00-1-707-643-1970
Fax 00-1-707-642-5783

Jade Products, 43 Long Hassocks, Rugby Works, CV23 0JS.
Telephone 01788 573056 Telefax 01788 573057



ONYX Lathe & Mill DRO Systems

2 Axis Lathe Full System **£349.95** incl. VAT
2 Axis Mill Full System **£349.95** incl. VAT
3 Axis Mill Full System **£399.95** incl. VAT

Full systems at fixed prices - add only £5.95 UK postcode delivery charge. Choose your linear scales from our measuring range of 50 - 1,020mm. Included are display console, 2/3 linear scales, scale covers and all necessary mechanical & electrical fitment accessories for a professional install to your machine.

B Series
£47.95



Auto Darkening Welding Helmets

2 Solar Powered Models
Easy use external rotary shade control #9 - 13
12 month warranty - spare parts - prices incl. VAT
UK Delivery £5.95
www.onyx-dro.co.uk
www.autodarkhelmet.co.uk



SX Series
£74.95



Recycle your magazine and seven days later it could come back as your newspaper.



www.recyclenow.com

The possibilities are endless.

NOW OPEN IN LINCOLN & BURTON UPON TRENT

METAL LATHE - CL300M
 • 300mm between centres
 • LH/RH thread screw cutting
 • Electronic variable speed
 • Self centring 3 jaw chuck & guard
 • Power feed

SLASHED ONLY
£329.99
£387.99
 (was £422.99 inc VAT)

Full range of accessories available

Machine Mart

53 SUPERSTORES NATIONWIDE

Where **Quality** Costs Less

FREE CATALOGUE

GET YOUR COPY NOW
IN-STORE
ONLINE
 machineart.co.uk
PHONE
 0845 450 1855



Clarke MICRO MILLING & DRILLING MACHINE

- 150w/230v motor
- Variable speed 100-2000rpm
- MT2 Spindle Taper
- Face mill capacity 20mm, end mill 10mm
- Table cross travel 90mm, longitudinal travel 180mm

CMD10

SLASHED ONLY
£219.99
£257.99
 (was £270.99 inc VAT)

Clarke VARIABLE SPEED LATHE

- 150w motor
- Ultra compact precision lathe
- Variable speed control 100-2000rpm

CL250M

ONLY
£249.99
£293.99
 (was £319.99 inc VAT)

Clarke 12 SPD MILL/DRILL

Precision engineered with cast iron head, base & column

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

CMD1225C

ONLY
£599.99
£703.99
 (was £749.99 inc VAT)

Clarke ARC/TIG INVERTERS

- Used for ARC & TIG welding
- Low amp operation - ideal for auto bodywork & thin mild/stainless steel
- Inc. Arc welding kit
- Lightweight only 3.5kg

FROM ONLY
£129.99
£152.99
 (was £169.99 inc VAT)

MODEL	AMPS	ELECTRODE	EX VAT	INC VAT
85	25/80	2mm	£129.99	£152.73
110	30/105	2.5mm	£159.99	£187.98
155	22/140	3.25mm	£269.99	£317.23

Clarke HYDRAULIC PRESSES

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

FROM ONLY
£159.99
£187.99
 (was £209.99 inc VAT)

MODEL	EX VAT	INC VAT
10 ton bench	£159.99	£187.98
10 ton floor	£179.99	£211.48
15 ton floor	£399.00	£468.83
25 ton floor	£649.00	£762.58
50 ton floor	£1198.00	£1407.65

Clarke ANGLE GRINDERS

FROM ONLY
£15.99
£18.79
 (was £20.99 inc VAT)

Inc. disc & handle

MODEL	DISC (MM)	MOTOR	EX VAT	INC VAT
CAG122	115	900w	£15.99	£18.79
B&D CD115	115	700w	£21.99	£25.84
CON115	115	1010w	£24.99	£29.36
CAG232 (9")	230	2000w	£26.99	£31.71
Ryobi EAG-8011	115	800w	£25.99	£30.54

Clarke MAGNIFYING LAMPS

- Powerful 3 diode 80mm precision lens
- Adjustable spring balanced arm for exact positioning
- Quick tuning universal clamp base

FROM ONLY
£14.99
£17.99
 (was £19.99 inc VAT)

CS4-9C

ONLY
£59.99
£69.99
 (was £74.99 inc VAT)

Clarke BELT AND DISC SANDER

Also Available 6" belt 9" sander also available

REDUCED
£134.99
£164.48
 (was £179.23 inc VAT)

230v motor
 4"x36" belt - tilts & locks at any angle 0 to 90°
 6" diameter disc - 6" dust extraction port
 Supplied with removable sanding table

Clarke ELECTRIC WINCHES

FROM ONLY
£109.99
£129.99
 (was £149.99 inc VAT)

- Powerful and compact general purpose winches
- Quick and easy to install for all types of pulling & lifting work
- Cable doubles to increase load capacity

MODEL	POWER	X1 CABLE	X2 CABLE	EX VAT	INC VAT
CHP250	530w	125kg	250kg	£109.99	£129.23
CHP400	880w	200kg	400kg	£139.99	£164.48

Clarke WORKSHOP CRANES

FROM ONLY
£129.99
£152.99
 (was £169.99 inc VAT)

MODEL	DESC.	EX VAT	INC VAT
CFC500F	1/2 ton folding	£129.99	£152.73
CFC1000	1 ton folding	£129.99	£152.73
CFC1000L	1 ton long reach	£149.99	£176.23
CFC1000	1 ton large folding	£159.99	£187.98
HDC100	1 ton pro	£319.99	£375.98
HDC200	2 ton pro	£669.00	£786.08

Fully tested to proof load

Clarke CHESTS & CABINETS

FROM ONLY
£56.99
£66.99
 (was £74.99 inc VAT)

HEAVY DUTY

MAX. LOADING 500kg

MODEL	DESC.	DR. LOAD	EX VAT	INC VAT
CB8203	3 Dr step up	38kg	£56.99	£66.99
T CB8209	9 Dr chest	38kg	£99.99	£117.48
CB8210	10 Dr chest	30kg	£129.99	£152.73
2 CB8213	3 Dr chest	43kg	£159.99	£187.98
CB8215	5 Dr cab	43kg	£169.99	£199.73
CB8217	7 Dr cab	43kg	£199.99	£234.98

Clarke SOLDERING KIT

ONLY
£12.99
£15.99
 (was £17.99 inc VAT)

- 100w, 230v trigger operated instant heat soldering gun
- Hands free magnifier & 30-watt suction tool to remove excess from joints
- Scrapers/probe tool
- Spare gun tip

Clarke MEASURING EQUIPMENT

FROM ONLY
£8.99
£10.99
 (was £12.99 inc VAT)

MODEL	DESCRIPTION	EX VAT	INC VAT
CN100	150mm/6" Vernier Caliper	£9.99	£10.56
CN180	0-25mm Micrometer	£9.99	£11.73
CN145	150mm/6" Digital Vernier	£17.99	£21.14
CN265	300mm/12" Digital Vernier	£29.99	£35.23

Clarke ROTARY TOOL KIT

ONLY
£24.99
£29.99
 (was £34.99 inc VAT)

Kit includes:

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

Clarke ENGINEERS STEEL WORKBENCHES

FROM ONLY
£119.99
£140.99
 (was £159.99 inc VAT)

HEAVY DUTY

- Sturdy lower shelf
- Durable powder coated finish
- Includes SINGLE LOCKABLE DRAWER

MODEL	SIZE (LxWxH)	EX VAT	INC VAT
CWB1000B	1000x500x880	£119.99	£140.98
CWB1500B	1500x500x880	£159.99	£187.98
CWB2000B	2000x500x880	£189.99	£223.23

Clarke QUALITY TOOL KITS

- Assorted AF and metric sets
- Huge selection of the most popular tools

FROM ONLY
£59.99
£70.99
 (was £79.99 inc VAT)

MODEL	PIECES	WEIGHT	EX VAT	INC VAT
CH1497	242	19kg	£59.99	£70.48
CH1548	300	24kg	£84.99	£99.86

Clarke BOLTLESS SHELVING/BENCHES

- Weight loading per shelf up to 150KGs
- Strong 9mm fibreboard shelves
- Quick assembly unit

FROM ONLY
£25.99
£30.99
 (was £34.99 inc VAT)

CS5150

Available in red, dark grey & blue from only £29.98 EX VAT £35.23 INC VAT

Clarke TAP & DIE SETS

FROM ONLY
£12.99
£15.99
 (was £17.99 inc VAT)

- High quality tungsten steel
- Supplied in metal storage case, except 1 piece

TYPE	EX VAT	INC VAT
16pc Metric	£12.99	£15.26
19pc UNF	£14.99	£17.61
24pc UNC/UNF/NPT	£19.99	£23.48
28pc Metric	£19.99	£23.48
33pc Metric/UNF/BSP	£29.99	£35.23
32pc Metric	£34.99	£41.11

Clarke BENCH GRINDER STAND

- Complete with bolt mountings and feet anchor holes

ONLY
£24.99
£29.99
 (was £34.99 inc VAT)

Stand Only

Clarke BENCH GRINDERS

FROM ONLY
£14.99
£17.99
 (was £19.99 inc VAT)

6" & 8" available with light

Clarke BENCH GRINDERS

MODEL	DUTY	WHEEL DIA.	EX VAT	INC VAT
CBG6RP	DIY	150mm	£14.99	£17.61
CBG6RZ	PRO	150mm	£19.99	£23.48
CBG6RSC	HD	150mm	£26.99	£31.71
CBG6S8P	PRO	150mm	£25.99	£30.54
CBG6RWC*	HD	150mm	£29.99	£35.23
CBG6RSC	HD	200mm	£39.99	£46.46
CBG6RW (wet)	HD	150/200mm	£34.99	£41.11

Clarke MIG WELDERS

Includes:

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

FROM ONLY
£99.99
£117.99
 (was £129.99 inc VAT)

Pro90-151TE includes CO₂ gas bottle

MODEL	MIN-MAX AMPS	EX VAT	INC VAT
85EN8 (No gas)	27-85	£109.99	£129.23
90EN (No gas/gas)	24-90	£119.99	£140.98
Pro 90	24-90	£129.99	£152.73
110E	30-100	£169.99	£187.98
135TE	30-130	£179.99	£211.48
151TE	30-150	£199.99	£234.98
165TE Turbo	30-155	£269.99	£317.23
175TE Turbo	30-170	£329.99	£387.73
205TE Turbo	30-185	£359.99	£422.98

Clarke TURBO AIR COMPRESSORS

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

FROM ONLY
£73.99
£86.99
 (was £99.99 inc VAT)

BIG 2Hp 7.8cfm

- Bigger Outputs
- Higher Specifications

Clarke DRILL PRESSES

- Tables tilt 0-45° left and right
- Depth gauge
- Chuck guards
- B=Bench mounted
- F=Floor standing

MODEL	WATTS/EX VAT	INC VAT
CPD500	250/5	£33.99
CPD1018	245/5	£49.98
CPD1518	300/5	£79.98
CPD108	370/12	£89.98
CPD2018	370/12	£99.98
CPD15F	370/12	£109.98
CPD3018	510/12	£139.98
CPD351F	510/12	£149.98
CPD4018	510/12	£159.98
CPD451F	510/12	£189.98
CPD501F	980/12	£379.98

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

ONLY
£649.99
£763.99
 (was £849.99 inc VAT)

Full range of accessories available

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

ONLY
£649.99
£763.99
 (was £849.99 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 £152.73 INC VAT

ALSO AVAILABLE:

CL430 - As above but without the Mill/Drill head
£539.98 EX VAT £634.48 INC VAT

BUY IN-STORE

MAIL ORDER

0845 450 1800 Mon-Sat 8:30-6pm

ORDER ONLINE

www.machineart.co.uk

Over 6500 products, see the full range

NEW STORES

Sunday Opening at Burton Upon Trent Lincoln & Warrington

VISIT YOUR LOCAL SUPERSTORE OPEN MON-FRI 8.30-6.00, SAT 8.30-5.30

BARNLEY Pontefract Road, Barnsley	01296 732 297	GATESHEAD 50 Lloyds Hill Road	0191 490 2520	NOTTINGHAM 211 Lower Parliament Street	0115 956 1811
BIRMINGHAM GREAT BARR 4 Birmingham Road	0121 358 7779	GLASGOW 280 Gt Western Rd	0141 332 9231	PETERBOROUGH 417 Lincoln Road, Milfield	01753 311770
B'HAM HAY MILLS 1152 Coventry Road, Hay Mills	0121 771 3433	GLOUCESTER 221A Barton Street	01452 417 940	PLYMOUTH 68-64 Embankment Road	01752 264660
BOLTON 1 Thynne Street	01204 365799	GRIMSBY Ellis Way	01472 354435	POOLE 137-139 Bournemouth Road, Parkstone	01202 771913
BRADFORD 105-107 Manningham Lane	01274 399892	HILL 8-10 Holderness Road	01482 223611	PORTSMOUTH 277-283 Copnor Road, Copnor	023 9265 4777
BRIGHTON 1-3 Church Road, Lawrence Hill	0117 905 1090	ILFORD 746-748 Eastern Ave	0208 518 4286	PRESTON 53 Blackpool Road	01772 203663
BURTON UPON TRENT 12a Lichfield Street	01283 584 708	LEEDS 227-229 Kirkstall Road	0113 231 0400	SHEFFIELD 453 London Road, Heeley	0114 258 8831
BRADFORD 44-46 City Road	0204 542424	LEICESTER 69 Melton Road	0153 261 0688	SOUTHAMPTON 516-518 Portswood Road	023 9055 7788
CLAREVILLE 85 London Road	01228 591666	LINCOLN Unit 5, Polson Centre, Canwick Rd	01522 543 036	SOUTHERN 1139-1141 London Rd, Leigh on Sea	01702 483 742
CHESTER 43-45 St. James Street	01244 311258	LIVERPOOL 60-68 London Road	0151 709 4484	STOKE-ON-TRENT 382-386 Waterloo Road, Hanley	01782 287321
CHESTER 4 North Station Road	01206 762823	LONDON 6-10 Holderness Road	020 8803 0861	SUNDERLAND 13-15 Ryhope Road, Grangeburn	0191 510 8772
COVENTRY Bishop St	024 7622 4221	LONDON 503-507 Lea Bridge Road, Leyton	01202 8556 8284	SWANSEA 7 Sarni et Road, Llanerhaeron	01792 292669
CROYDON 423-427 Brighton Road, South Croydon	020 8763 0640	MAIDSTONE 57 Upper Stone Street	01622 768 572	SWINDON 21 Victoria Road	01793 491171
DARLINGTON 214 Northgate	01325 388841	MANCHESTER 71 Manchester Road, Atrincham	0161 941 2666	TWICKENHAM 83-85 Heath Road	020 8892 9171
DEAL (Kent) 182-186 High Street	01304 373 404	MANCHESTER 169 Churchfield Road South	01623 622160	WARRINGTON Unit 3, Hawley's Trade Pk, Hawley's Ln	01925 630 937
DEBENT (Derwent Street)	01302 290931	MIDDLESBROUGH Mandale Triangle, Thornaby	01642 677881	WOLVERHAMPTON Parkfield Road, Bilston	01902 494188
DUNDEE 24-26 Trades Lane	01382 225 140	NORWICH 282a Highgate Street	01603 766402	WORCESTER 48a Upper Tything	01905 223451
EDINBURGH 163-171 Piersfield Terrace	0131 659 5915				

Maximum call charges from a BT line are 3.4p/min to 0845 numbers, and 6.7p/min to 0870 numbers. 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.

All advertisements will be inserted in the first available issue. There are no reimbursements 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

www.arceurotrade.co.uk

Unbeatable Value Engineering Products by Mail Order

Shop on-line or call us on 0116 269 5693 for our **New Catalogue No.5**

NEWTON TESLA

SMOOTH, QUIET, HIGH PERFORMANCE
VARIABLE SPEED CONTROL FOR YOUR LATHE OR MILL.



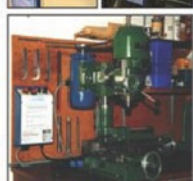
CL RANGE KEY FEATURES

- Comprehensive package with controller and matched motor. All pre-wired ready to go!
- Power Range: 1/2hp, 1hp, 2hp and 3hp.
- AMAZING 10 YEAR WARRANTY!!!!**

- Smooth control across entire speed range, giving chatter free machining and excellent finish.
- Quiet, vibration free operation.
- High torque down to lowest speed.



- Powered from domestic single phase mains.
- Complete electronic motor protection.
- Simplifies screw-cutting, tapping blind holes from the tailstock, parting/facing off large diameter bars, drilling operations from the tailstock, reaming operations and setup/centering of 4 jaw chucks.



Some of the machines available for Newton Tesla Variable Speed Controllers:

- Myford RL7, Super 7, Super 7 Plus, and VHC.
- Knight M45 and Little John lathes
- Bedford
- Colchester Bantam, Student.
- Tom Senior
- Endeavour / Adcock-Shepley
- WARCO BV-25, 918, WHIT300, BH500
- Drummond
- Wessex
- Chester UK Multi-purpose lathes and milling machines.
- Union 'Graduator' woodturning lathes.

www.newton-tesla.com

Prices of the CL range of systems start from £390 inc VAT. UK mainland delivery is £18. We also supply Inverter drives offering single-to-3PH speed control from only £113 + VAT. Other Products and Services: Control System Design, AC & DC Drives, Electric Motors, Factory Automation.

1987-2007

Supplying to Model Engineers and Industry for 20 Years.

Newton Tesla (Electric Drives) Ltd,
Units G12 & G13, Warrington Business Park, Long Lane, Warrington,
Cheshire WA2 8TX, UK.
Tel: 01925 444773 Fax: 01925 241477
E-mail: info@newton-tesla.com Web: www.newton-tesla.com



Carr's Solders
Cadbury Camp Lane,
Clapton in Gordano, Bristol. BS20 7SD
Tel: 01275 852 027 Fax: 01275 810 555
Email: sales@finescale.org.uk
www.finescale.org.uk

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 £85.00)

Only £79.99
Tel: (01269) 841230
Order Online www.routoutcnc.com

We can also provide higher power Stepper Motor Drivers for larger machines such as Bridgeport's from as little as £57.00

CLOCK CONSTRUCTION & REPAIR
Books by John Wilding and others
Free Catalogue
01420 487 747
www.ritetimepublishing.com

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

For the best in used hand & light machine tools for all crafts

We also purchase good equipment and sell related books, as well as providing a world-wide back-issue service for Model Engineer and Engineering in miniature, we don't publish lists, but if there's something you need, get in touch.

Open Monday - Saturday throughout the year

Colyton, East Devon EX24 6LU Tel/fax: 01297 552868

E-mail: info@the toolbox.org.uk www.thetoolbox.org.uk

Fieldsend
miniature engineering
Patterns and casting's made to your individual needs
Contact: **Peter Fieldsend**
Website: www.miniature-engineering.com
E-mail: info@miniature-engineering.com
Telephone: 07521212792

Machine Shop Services

for all types of machining to samples or drawings fast, friendly service.

Est. over 20 years

Contact: **Mike King**

Tel/Fax: **0116 2333740** (Leics)
Mobile: **07890 155259**

MAXITRAK
Passenger Carrying Garden Railways
• Steam • Diesel • Kits • Second Hand
• Accessories • Track etc
Tel: 01580 893030
WWW.MAXITRAK.CO.UK

Catalogue £3.50

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**

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

Myford
Enjoy a day with us at the
MYFORD OPEN HOUSE
Thursday 2nd October
to
Saturday 4th October 2008
To find out more contact Malcolm
0115 925 4222
Website: **www.myford.com**
Email: **sales@myford.com**

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

920 Lathe Fully equipped plus stand
SPECIAL OFFER £770



Prices include VAT and delivery to UK mainland. Excludes certain Scottish postcodes (subject to terms and conditions). Prices subject to change without notice.

VM20 £782



BG1224 Lathe Fully equipped
£1557



Please contact us for details of our product range

VM26 £1405



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
Important: Phone for opening times before travelling

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

Routout 3 Axis Z90 CNC Router

CNC



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

Only £1300.00 Inc. 1/2 Days Training
Tel (01269) 841230 or
Order Online www.routoutcnc.com

Cowells Small Machine Tool Ltd.

Cowells Small Machine Tools Ltd.
Banking Road, Little Baulby, 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





Folkestone Engineering Supplies

An outstanding range of materials, fasteners & quality small tools for the model engineer.
Fast friendly service
www.metal2models.btinternet.co.uk
Tel: 01303 894611 Fax: 08707 625556

TAPS & DIES for Model Engineers

LARGEST manufacturer/supplier 27 years - EXCELLENT Quality
British quality HQS taps & dies (better than HSS) cuts stainless
AWARD winning ALL types/sizes: BSW,BSF, UNC,UNF
BSP,BSPT,NPT, BSC,Cycle,WF,BSB,BA, Model Eng



Over 1000 Wooden-boxes
British-made (designed by us) in ALL above types on the shelf
3 boxes = **MES (30pc) + ME4 (27pc)**
+ **BA3 (35pc)** covers EVERY type & size of Model Eng taps & dies

MES = 1/8,5/32,3/16,7/32,1/4,9/32,5/16,3/8,7/16,1/2 (all 40tpi)
ME4 = 5/32,3/16,7/32,1/4,9/32,5/16,3/8,7/16,1/2 (all 32tpi)
BA3 = 0,1,2,3,4,5,6,7,8,9,10 (ask for prices or see website)

Metal-boxes (designed by us) with T or S or B or dies:-
ME1 = 1/8+3/16+1/4+5/16+3/8+7/16+1/2 (all 40tpi)
ME2 = 5/32+3/16+1/4+5/16+3/8+7/16+1/2 (all 32tpi)
TAPS: 1 box=£30.80, 9 box=£23.10, 36 box=£19.40
DIES: 1 box=£49.00, 5 box=£36.75, 15 box=£30.87
World-delivery, Bankcards, SAME DAY post/VAT

1000's of all other types/sizes
Also: Drills, Reamers, Endmills, Slotdrills
Slitting Saws etc - No Minimum order

www.tapdie.com
THE TAP & DIE CO
445 West Green Road, London N15 3PL - UK
Tel: +44 (0)20 88881865 Fax: +44 (0)20 88884613

To advertise here call...

...01689 899 212

EVENSON ENGINEERING

Quality Machines and Tooling

Machine Sales

D.16 12" face plate (Triumph 2000)£90 Boxford V.S.L. Lathe, lots of tooling and full collet set.....£1600 In excellent condition, 1 1/4" spindle bore 6" dividing head no tailstock.....£120 Colchester master, roundhead, in excellent condition.....£1400 4 Foot treadle guillotine, modern machine cut 1/5mm, good condition..£450 Union graduate bowl only wood turning lathe 1 phase.....£400 Bridgeport milling machine excellent condition.....£2200 8" cap ajax power hacksaw.....£275 Denford Viceroy lathe with gear box.....£850 Kasto 8" power hacksaw modern machine.....£375 Wadkin horizontal surface grinder.....£500 Harrison vertical mill as new.....£800 2 off Tom Senior m1 milling machines 1 single phase.....Each £1200 1-3 phase good condition Viceroy AEW milling machine 30int good condition.....£1200	Compound x-y table, English made in excellent condition.....£325 suit large drill Marco Broach set - boxed as new small set.....£150 Eagle Hand Op' surface grinder excellent condition.....£750 Eagle Hand Op' surface grinder with Opti dress and mag.....£845 chuck - superb Elliott 'oo' Omni Mill 3mt Quill vertical and horizontal mill.....£1450 Tom Senior Milling Machines with head - various to choose from.....£700 Reglan Lathe - vari speed (2 x plastic change wheel broken).....£850 90° Head for Bridgeport (M head).....£325 Colchester student Tailstock Turret R/H.....£300 2MT Clarkson Avto Lock Milling Chuck like new.....£110 Colchester student R/H - 3PT Steady.....£110 Genuine Dixon Toolpost + 3 holders for student Lathe.....£160 - Excellent Condition
---	--

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

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



Cowells miniature milling machine



Elliot '00' Omnimill, one of the best ones yet!! vertical and horizontal



JUST IN! Fobco, Startrite, Ajax & Meddings 240 volt bench drills



Denbigh No.6 flypress + stand



Boxford drilling (pedestal) machines



Deckel GK12, 1-1 precision engraver



Myford ML7R 3 1/2" x 19", gearbox, cabinet stand



Transwave 5.5hp rotary converter as new used in the film industry!



Myford Super 7 lathe + stand



Gobro 24" box and pan folder + Accs.



Crompton/Tyco NEW motor for ML7/Super 7



Colchester Bantam 1600 two speed lathe



SIP 39" high, 16 speed, 2MT 5/8", rack table NEW



JUST IN!
Harrison M250 5" x 30 lathe

Myford/Boxford Accessories

- Myford dividing head £395
- Boxford dividing head £895
- Myford vertical slide £100 - £245
- Boxford vertical slide £345 - £425
- Myford 6" 4 jaw chuck £90 - £140
- Boxford 6" 4 jaw chuck £85 - £125
- Myford collets boxed £275
- Boxford collets + draw bar £175
- Myford fixed steady £90
- Myford travelling steady £40
- Myford 9" faceplate £45

+++ loads more **NEW** stock rolling in daily!



Harrison pedestal grinder



Myford IAS vertical milling machine / R8 taper



Union Rishton 1 phase grinder (ex. MOD)



Waltons 50" 16g guillotine + stops



Boxford 1130 5 1/2" x 30" + stand



Kerry 1124, 5 1/2" x 24" late square head lathe



Bridgeport slotting head



Colchester Master 2500 lathe + DRO



Milling/Drilling ground X-Y table



Harrison 11" + gearbox + gap bed



Myford ML10 lathe + stand and Dewhurst reverse switch



Boxford CUD 5" lathe + inverter



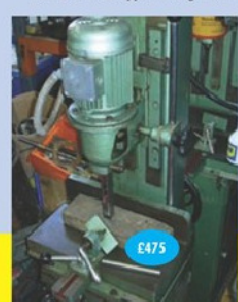
Eagle surface grinder just in 'as is'



RJH bench grinder / buffer - 240 volts



Tom Senior 'E' Type milling machine



Multico mortiser

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!



£1950

Boxford STS 1020 lathe



£425

Hulton Universal 12 / 12" throat press



£50 each

'LO' Colchester drive/catch plates



£1425

Lurem Universal woodworking machine No.C260N



£70

'LOO' face plate + we have loads more from Myford to Colchester Mascot



£85

NSK 0 - 6" micrometer set (boxed)



£425

Smart and Brown (second operation) lathe + collets



£20 each

Myford MA99E collet chuck collets



£245

CEJ (Sweden) gauge blocks / slips



£1500

Warco lathe



£12 each

Gear involute cutters 'More just in'



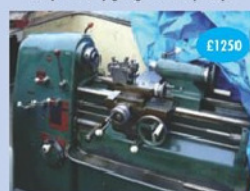
from £25

More broaches metric and imperial



Just in
£345

Q and S 6" power hacksaw + coolant



£1250

Colchester Chipmaster lathe



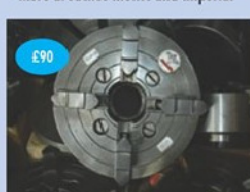
£345

Boxford 'Little Giant' toolpost grinder



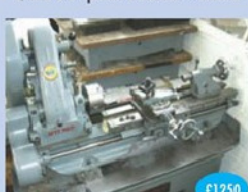
£120

Clarkson 40INT collet chuck + collets
(we have 2MT-5MT and 30INT to 50INT in stock!!)



£90

Burnerd Boxford 4jaw chuck
(more variations available)



£1250

Myford ML7 lathe



£475

EMG tool grinder



£650

Mastroy C210T lathe



£525

Viceroy 5" x 24" lathe



£950

Colchester Student 1500 6" x 24" lathe



£1200

Harrison L5 lathe



£2250

Startrite TA1250 12" full sliding table
saw bench (240 volts)



£950

Harrison Graduate wood lathe
complete



£1400

Colchester Student 1200 + dual dials



£120

Metal working bench (heavy duty)



£120

Woodworking bench (heavy duty)
+ 4 vices



£120

Woodworking bench (heavy duty)
+ 2 vices



£40

Harrison L5 travelling steady
(LSA, L6, Student, Master also)



£425

Jones and Shipman broaching press



£425

Clarke Vacuum former 917 (up-graded)
+ stand



From
£20

Eclipse angle plates



£40 each

Dickson toolposts to suit Colchester
Mascot (others available)



£145

Engineers Flat



£245

Denford Viceroy buffer's



£345

Tom Senior slotting head



£225

Burnerd 'LO', D13 & D14 collet chucks



£1650

Van Norman 944 boring bar + tools



£625

RJH vertical finisher + built
in extractor

Chester Machine Tools

Southern Showroom Open Event at:

TPH Machine Tools, Unit 4/5 Blackwater Close, Fairview Industrial Park,
Marsh Way, Rainham, Essex, RM13 8UA.

Tel 01708 523916 or Email machines@tphmachinetools.co.uk

Friday

29th August 9am-5pm

Saturday

30th August 9am-4pm



- Discounted tooling
- Special offers
- Refreshments
- Families and Children welcome
- FREE Prize draw to win a Toolbox



Chester Machine Tools - Head Office Clwyd Close, Hawarden Industrial Park CHESTER CH5 3PZ
T: + 44 (0)1244 531631 F: + 44 (0) 1244 531331 email: sales@chestermachinetools.com www.chestermachinetools.com

Chester Machine Tools
Midlands Showroom, Unit 4 Plant Lane Business Park, Burntwood, Staffs WS7 3JQ
T: +44 (0)1543 448940 F: +44 (0)1543 448938 www.chestermachinetools.com