

No.115

MAY 2006

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

**TWO
JAW
CHUCK**

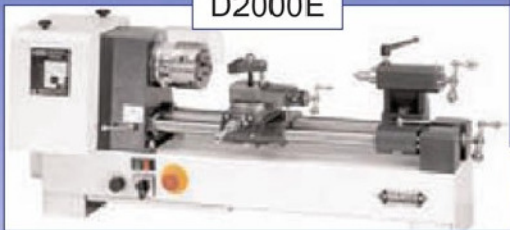


**QUICK
CHANGE
TOOLPOST**

- **CASTING ALUMINIUM**
- **SIMPLE HEAT TREATMENT**

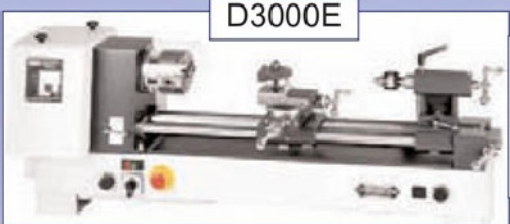
Pro Machine Tools Ltd

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



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

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

**5 YEAR
WARRANTY**
On All Wabeco Machines

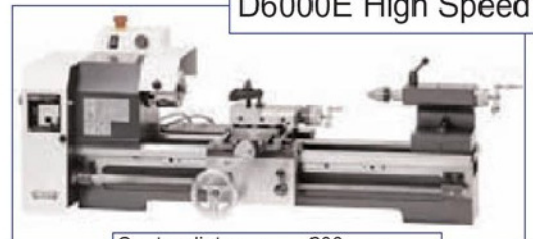
All mills and lathes
can be supplied fully
fitted for CNC
machining or can be
retro fitted at a later
date.

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 quanti-
ty. See our web site for details



D1290E

Longitudinal X-axis 300 mm
Transverse Y-axis 110 mm
Vertical Z-axis 280 mm
Power 1,4 kW, 230 V, 50 Hz
Spindle speed infinitely variable
180 - 3000 r.p.m.



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



EMCO
Hobylmaschinen

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

Published by
ENCANTA MEDIA LTD.
Berwick House, 8-10 Knoll Rise,
Orpington, Kent BR6 0EL
Tel: (+44) 01689 899200
Fax: (+44) 01689 899266

SUBSCRIPTIONS

10 issues UK £37.50, Europe £42.00,
US Airmail \$70.00, RoW Airmail £44.00
Make cheques payable to
Encanta Media Ltd.

UK & EUROPE NEW & RENEWAL

Tel: (+44) 0870 8378600*

Email: modelengworkshop@subscription.co.uk

SUBSCRIPTION QUERIES

Tel: (+44) 0870 8378668*

Email: modelengworkshop@subscription.co.uk

*Calls are charged at the equivalent BT national
residential rate. Lines open weekdays 8am-9.30pm,
Saturdays 8am-4pm

REST OF WORLD NEW, RENEWAL & QUERIES

Tel: (+44) 1858 438798

USA & CANADA

Tel: (760) 603 9768

Email: info@wiseowlmagazines.com

BACK ISSUES, BINDERS, PLANS

Tel: (+44) 01689 899228
Email: customer.services@encanta.co.uk

EDITORIAL:

Editor David Fenner

(Tel/Fax: 01738 583832)

Editorial Administrator

Sarah White (01689 899222)

PRODUCTION: Designer Carol Philpott

SALES & MARKETING:

Group Sales Manager Colin Taylor (01689 899249)

MANAGEMENT: Publisher Jez Walters

Managing Director Owen Davies



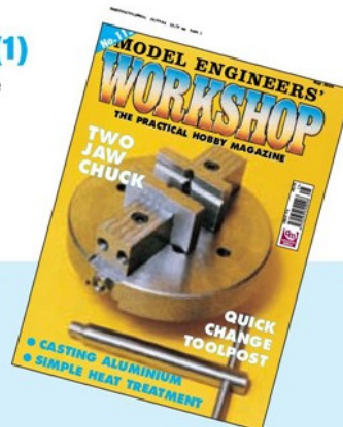
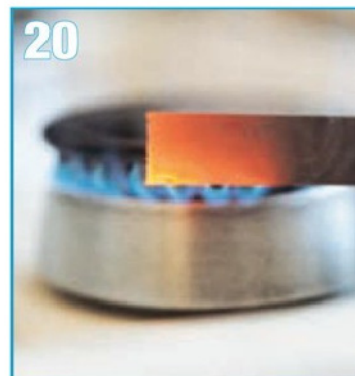
ENCANTA MEDIA

© Encanta Media Ltd. 2006
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.

Contents

- 11 On the Editors's Bench**
Dave Fenner's commentary
- 12 Lathe Only Workshop (8) Five Inch Two Jaw Chuck**
First of two articles covering this Hemingway kit
- 17 Creating a Home Foundry**
- for aluminium casting
- 20 Simple And Sometimes Primitive Heat Treatment**
Hardening, tempering and annealing made easy
- 24 Angle Setter**
A measuring/setting tool to reach the parts others cannot.
- 27 Trade Counter**
New items from suppliers
- 28 Grinding and Making Lathe Tools**
- not as difficult s you might think
- 30 Saddle Stop for the Myford**
An essential accessory for repeatable length control.
- 34 Fitting an Electronic Speed Control to a Warco 6in. Lathe.**
Newton Tesla package for the BH600
- 35 Fireside Reading**
- 36 Quick Change Tool Post**
A straightforward design for home construction
- 42 Ornamental Turning For Model Engineers (5)**
Eccentric cutting frame described
- 48 A Recirculating Cleaner For Airbrushes**
A near zero cost device to conveniently economise on thinners
- 49 RevMaster - A Simple Tachometer (1)**
- to give an accurate indication of spindle speed.
- 54 Scribe a Line**
Reader to reader



On the Cover

Not everyone has a two jaw chuck which may be thought of as something akin to a rotating vice, which may grip some jobs more easily than a faceplate set up. Harold Hall's description of this Hemingway kit begins on page 12.

See page 56 for our special subscription offer!

Please note as from April 1st 2006 we will be closing at 12.00 Noon on Saturdays

Hundreds more items of good quality measuring equipment listed with photos on our website.

**Quick Step Mill Milling
Attachment in Case with
Collets,VGC, 240 Volt,
£750.00 plus vat.**

fax 01903 892221



A# MEWAD200615033 5*5*06 10:11 am Page 1

ALLEN DALE	8
BOOK OFFER	58
CAMDEN	9
CHESTER UK	OBC
CHRONOS	7
CLASSIFIED	62-65
DIGITISE	9
ENCANTA MEDIA LTD	59
ENCANTA MEDIA LTD	60-61
FOLKESTONE ENGINEERING	9
G+M TOOLS	4
GLR	6
HEMINGWAY	8
HOME AND WORKSHOP	IBC
JADE PRODUCT	8
MACHINE MART	57
ME SERVICES	8
MEW SUBS	66
PRO MACHINE TOOLS	IFC
PRO MACHINE TOOLS	10
SOFT COVER	8
TRACY TOOLS	56
WARCO	5
WISE OWI	8

WARCO

SEE OUR ALL NEW WEBSITE -
HUNDREDS OF ITEMS OF TOOLING AND
ACCESSORIES - BUY ONLINE AT DISCOUNTED
PRICES -

Just part of a huge range of quality machinery.
Please ring for our new 60 page brochure

Buy Online
www.warco.co.uk

See these machines underpower at:

- Model Steam Rally & Exhibition,
Stoke Park, Guildford, 8th and 9th July 2006
- Bristol Model Engineering Exhibition,
18th to 20th August 2006.

GH-1224

- GH-1224 Lathe. Only £1,850
- Fully enclosed gear headstock
- Centre height 6"
- Distance between centres 24"
- Taper roller bearing spindle
- Hardened & ground bedways
- Removable gap bed - 17" swing in gap
- Supplied with 3 & 4 jaw chucks, fixed & travelling steadies, faceplate.
- Also available 32" between centres **£1,950**

BH-600 LATHE

Special offer
Limited period only
£1,450

- SUPPLIED WITH ACCESSORIES AT NO
EXTRA CHARGE
- 6" 3 JAW CHUCK
 - 8" 4 JAW CHUCK
 - 10" FACE PLATE
 - FIXED & TRAVELLING STEADIES
 - FOUR WAY TOOL POST
 - IMP/MET THREADING
 - STAND, COOLANT TRAY, REAR SPLASH BACK

BV-20 LATHE

- SUPPLIED WITH:
- 4" 3 JAW SELF CENTERING CHUCK
 - 4" 4 JAW INDEPENDENT CHUCK
 - FIXED STEADY
 - TRAVELLING STEADY
 - FACE PLATE
 - FOUR WAY INDEXING TOOL POST
 - 3MT AND 2MT DEAD CENTRES
 - METRIC & IMPERIAL THREAD CUTTING CHANGE GEARS
 - SWarf TRAY
 - REAR CHIP GUARD

ONLY £535

SPECIFICATION:

- CENTRE HEIGHT 4"
- DISTANCE BETWEEN CENTRES 14"
- SWING OVER CROSS SLIDE 5"
- SPINDLE BORE 3/4" CLEARANCE
- SPINDLE SPEEDS (6) 140/1710 RPM • HEADSTOCK TAPER 3MT • TAILSTOCK TAPER 2MT
- RANGE OF IMPERIAL THREADS 8-24 TPI RANGE OF METRIC THREADS 0.4MM - 3MM
- MOTOR 1/2 HP 1 PHASE • DIMENSIONS 38" LONG x 19" WIDE x 15" HIGH • WEIGHT 230 LB



MINI LATHE

- 3 1/2" CENTRE HEIGHT X 12" BETWEEN CENTRES
- SUPPLIED WITH 3 JAW CHUCK
- FACEPLATE
- THREADCUTTING
- COOLANT TRAY AND SPLASH BACK
- VARIABLE SPEED 0-2500RPM WITH BACK GEAR FOR MAXIMUM TORQUE
- HARDENED AND GROUND VEE BED WAYS
- ACCURACY TEST CERTIFICATE WITH EACH LATHE
- RELIABLE USA BUILT PRINTED CIRCUIT BOARD - THE HEART OF THE MACHINE
- OPTIONAL ACCESSORIES STEADIES AND VERTICAL SLIDE.

SPECIAL OFFER
Tailstock drill chuck and TCT indexable
lathe tool set with each machine.

ONLY £375

ALL PRICES INCLUDE
VAT AND DELIVERY

WM-16

- VARIABLE SPEDD MILL
- TABLE SIZE 20" X 7"
- TILTING HEAD
- SPEEDS 0-3,000
- NOW SUPPLIED WITH DIGITAL
REV COUNTER AND DEPTH GAUGE AS STANDRAD

ONLY £998

ZX-15

Table size	654mm x 150mm
Longitudinal travel	455mm
Cross Travel	145mm
Spindle Stroke	90mm
Spindle Taper	3MT
Diameter of Spindle	63.5mm
Diameter of Column	66.65mm
Throat	165mm
Max distance spindle to table	320mm

Please see the website for further info



**ONLY
£550**

WMT 300/1

Combination
Lathe Mill

- 6" CENTRE HEIGHT X 20" BETWEEN CENTRES
- SUPPLIED WITH:
- 5" 3 JAW CHUCK
- TEE SLOTTED FACE PLATE
- FIXED AND TRAVELLING STEADIES
- VICE
- DRILL CHUCK
- FACE CUTTER
- LATHE TOOL SET
- IMP/MET THREADCUTTING

ONLY £799

WMT 300/2

SAME CAPACITY AND
ACCESSORIES AS THE
WMT-300/1 WITH THE ADDED BENEFIT
OF A LARGER MILLING TABLE - 17"
X 6" COMPARED TO 8" X 6".
BACK AND PINION FEED
TO SADDLE AND LEFT HAND
TH-READING FACILITY.

ONLY £1099

WMT 500

SIMILAR TO THE SPECIFICATION
AND ACCESSORIES TO WMT-
300/2. POWER/CROSS FEED TO
MILLING TABLE/CROSS SLIDE.
DEEP THROAT FOR EXTRA
MILLING CAPACITY.

ONLY £1399

NORTHERN SHOWROOM Unit G14 Warrington Business Park Long Lane, WARRINGTON WA2 8TX.



Warco, Fisher Lane, Chiddingfold, Surrey GU8 4TD Fax: 01428 685812 Tel: 01428 682929

warco@warco.co.uk www.warco.co.uk

PRICES INCLUDE V.A.T

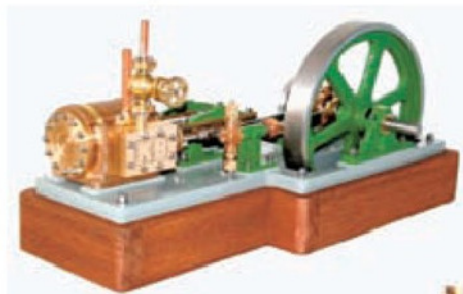


GLR DISTRIBUTERS INTRODUCTORY OFFER FOR THEIR NEW RANGE OF STATIONARY STEAM ENGINES

TINA

1" Bore x 1.1/2" Stroke - Slide Valve
Length of Baseplate 12" - Diameter of Flywheel 6"
Height 6" - Width 6" - Weight 4.1/2 Kilos
Complete with full building Manual, Drawings
and Materials (Hardwood base £15 extra)

Unbeatable value at this price
£145.00 + £07.00 Carriage to mainland UK
All prices include vat



MULTI-TUBULAR BOILER KIT

Runs on Coal - Gas - Spirit
4" dia. x 16swg Copper tube - 8.1/2" high
25 5/16" x 20g Copper tubes
Firebox 3.1/2" dia. 3.1/2" long
Working pressure 80 psi.

Suitable for all above engines
£65.00 + Carriage £7.00 to mainland UK
Set of 6 Fittings £85.00
All prices include vat



NEW SUZANNE



SUZANNE

Beautiful Vertical Steam engine used in
Dresden, Germany in the 19th century.
Redrawn by Willie Schneeberger of Switzerland
Top quality Iron and Gunmetal castings
20 professional A4 metric drawings
Cylinder 30mm Bore x 48mm Stroke
Flywheel 180mm. Machined by request.
This fantastic engine can be built for just
£250.00 + £7.00 Carriage to mainland UK
All prices include vat

RACHEL

Unusual wall mounted Steam Engine, based
on drawings by
Otto Lilienthal of Germany in 1882
Cylinder 22mm bore x 40mm stroke
Flywheel 170mm dia. Machined by request.
All drawings are in metric
Top quality Iron and Gunmetal castings
26 professional A4 drawings
Build this beautiful engine for just
£150.00 + £7.00 Carriage to mainland UK
All prices include vat



NEW RACHEL

Pictures are illustrations of models when built by our customers

PLUS OUR USUAL RANGE OF LOCOMOTIVE DRAWINGS - CASTINGS - MATERIALS

7.1/4"G	Tich	0-4-0
7.1/4"G	1366	0-6-0
5"NG	Dholpur	2-8-4
5"G	Butch	0-6-0
5"G	Chub	0-4-0
5"G	Simplex	0-6-0
5"G	Springbok	4-6-0
5"G	King John	4-6-0
5"G	Dean Goods	0-6-0
5"G	2251	0-6-0
5"G	Firefly	2-6-2
5"G	Mogul	2-6-2
5"G	Peggy	0-4-0
5"G	Twin Sisters	0-6-0
5"G	Pansy	0-6-0
5"G	Tich	0-4-0
5"G	Combyne	4-4-2T
5"G	Nine Elms	0-4-2
5"G	Salisbury	4-4-0

Some of our excellent Steam Fittings for all
our Locomotives and Stationary Engines



3.1/2"G	Britannia	4-6-2
3.1/2"G	Molly	0-6-0
3.1/2"G	Cant. Lamb	0-4-0
3.1/2"G	Petrolea	2-4-0
3.1/2"G	Iris	0-6-0
3.1/2"G	Doris	4-6-0
3.1/2"G	Rainhill	0-2-2
3.1/2"G	Heilan Lass.	4-6-2
3.1/2"G	Rob Roy	0-6-0
3.1/2"G	Miss 10 to 8	4-4-0
3.1/2"G	Juliet	0-4-0
3.1/2"G	Virginia	4-4-0
3.1/2"G	Maisie	4-4-2
3.1/2"G	City of Truro	4-4-0
3.1/2"G	P.V. Baker	0-6-0

Radial Tank L.S.W.R. 415
L.S.W.R. A12 Class - Beyer Tender
L.S.W.R. 460 Class

0"G	Princess Coronation	4-6-2
0"G	Morris de Cowley	4-6-2
0"G	Hertford Hall	4-6-0
0"G	Royal Scot	4-6-0
0"G	Josie	4-6-4
0"G	Bat	4-4-0



RAINHILL

2.1/2"G	Southern Maid	0-6-0
2.1/2"G	Austere Ada	2-8-0
2.1/2"G	Olympiade	4-6-0
2.1/2"G	Fayette	4-6-2
2.1/2"G	Purley Grange	4-6-0
2.1/2"G	Dyak	2-6-0

GLR DISTRIBUTORS LTD. UNIT C1, GEDDINGS ROAD. HODDESDON, HERTS. EN11 0NT

Tel. 01992 470098 Fax. 01992 468700 E-Mail peteglr@btopenworld.com

Web site - www.modelmakingsupplies.co.uk

Send six 1st class stamps for Hardback Catalogue

CLARKE CL300M LATHE



CL300MM - £425 OR LATHE
PLUS 2MT LIVE CENTRE 3MT
DEAD CENTRE SET OF 6
TOOLS DRILL CHUCK 4 JAW
CHUCK
£480!!

ACCESSORIES FOR CLARKE 300 & SIMILAR LATHES

QC TOOLPOST



C305 - £39.95

4 JAW CHUCK



7610721 - £65.00

FIXED STEADY



C301 - £19.50

TRAVELLING STEADY



C302 - £19.95

FACEPLATE



C303 - £17.00

FACEPLATE CLAMPS



C304 - £8.50

CLARKE CMD10 MILL/DRILL



£281.95!!

ACCESSORIES FOR CLARKE CMD10 & SIMILAR MILLERS

COLLET SYSTEM



C305 - £62.00

24PC CLAMP SET



C307 - £24.00

12PC CLAMP SET



C308 - £15.00

QUICK VICE



C309 - £24.95

NEW DVD BY SWARFRAT!!



TUNING +
ADJUSTING
YOUR
MILLING
MACHINE!!

SWFS - £19.50

MORE NEW ITEMS

INDEXING 4 WAY TOOLPOST - SUIT ML7



FWP2 - £22.00

160MM BACKPLATE SUITS BOXFORD



BPP160 - £39.95

160MM D14 CAST BACKPLATE



D13CA - £39.95

SET OF EXTRA LONG HSS DRILLS 1/16-1/4"



SCT278 -
£9.95

HIGH QUALITY DIGITAL CALIPERS



DG6 - 6"/150mm - £15.95
DG8 - 8"/150mm - £29.95

WAVY PARALLELS SET



52437050 - £39.95

PAIR OF 123 BLOCKS



6304010 - £16.00

DIAL GAUGE & MAG BASE SET



FANTASTIC VALUE
DIAL GAUGE +
60KG MAG BASE!!!

SMT247IMP - 0-1" - £18.00
SMT247MET - 0-10MM - £18.00

DTI & HOLDER SET



SMT089I IMP - £25.00
SMT089M MET - £25.00

6" - 150MM TELESCOPIC BORE GAUGE SET



STGI - £10.50

PRECISION PARALLEL SET 10 PAIRS UP TO 15 X 31 X 200 MM



PSSI - £89.95

VA6 MILLING VICE



VA6 - £89.95

**SPECIAL
OFFER!!!**
VERY HEAVY!!!
PLEASE ENSURE
SUITABILITY

QUALITY KEYLESS DRILL CHUCK 13MM CAP WITH A MT 2 OR 3



SKEY2 - 2MT - £20.00
SKEY3 - 3MT - £20.00

VERTEX PRECISION SURFACE PLATE - 200 X 200 X 50



VS01 - £52.95

SMALL COOLANT SYSTEM WITH 5 X 12 X 8" TANK



CG115 - £85.00

PIPE BENDER FOR 1/4 - 5/16 - 3/8



CTBS - £9.95

DRILL GRINDING JIG 1/8 - 3/4 CAPACITY



DJSO - £12.95

POSILOCK MILLING CHUCK SET WITH 8 COLLETS



PC28EB - 2MT - £85.00
PC28EB - RB - £85.00

TAP CHUCK M4-M12 WITH A 2MT ARBOR



TC01 - £34.95

K4 MILLING VICE



CG6 - £69.95

MODEL ENGINEERS HANDBOOK



MX118 - £9.95

SET OF 12 HSS CENTRE DRILLS



MX36 - £11.00

ALL PRICES INCLUDE VAT & CARRIAGE (UK MAINLAND)

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

TEL (01582) 471900 FAX (01582) 471920

WWW.CHRONOS.LTD.UK

EMAIL SALES@CHRONOS.LTD.UK

VISIT US AT OUR 6500 SQ FT PREMISES!!



The Hallmark of Distinction



Order with confidence from the leading supplier of Workshop Accessory Kits. Trusted by the world's most demanding constructors and tool makers

- The Name to Trust since 1976
- More designs than ever
- Industry quality instruction sets
- Hugely satisfying to build and use

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

Hemingway

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

A#_MODEAD2006710 www.hemingwaykits.com

Convert scanned drawings to CAD!



SCAN



CLEAN



CONVERT



EDIT

www.softcover.com



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

ATTENTION ALL NORTH AMERICAN READERS!

Did you know that you can order an annual subscription to this magazine direct from our official U.S. subscription representative?

For more information and rates contact:

Wise Owl Worldwide Publications,

5674 El Camino Real Suite D

Carlsbad, Ca 92008-7130 USA

Tel: 760-603-9768 Fax: 760-603-9769

E-mail: info@wiseowlmagazines.com

Jade Products 65 Ilmer Close Rugby Works. CV21 1TY

< Tel 01788 573056 >

[Auto Darkening Welding Helmets](http://AutoDarkeningWeldingHelmets)

2 Models Battery & Solar Powered
Vari Shade Range 9 - 13 CE Approved
External rotary shade control
12 month Warranty Spare Parts
Prices incl VAT UK delivery £3.95

Battery
£54.95

Solar
£67.95



Also from us digital measuring eqpt.
Moore & Wright 150mm digital caliper £25.95
Moore & Wright Digi Micrometer £68.95
Lathe & Mill Machine DRO Systems

www.autodarkhelmet.co.uk
www.digital-caliper.co.uk



Machine - DRO.CO.UK

Suppliers of Digital Readouts for Engineering Machinery

Mill Function DRO Display Console;

- 2-axis & 3-axis console available.
- Functions include PCD, 200 zero store, Arc contouring.
- Mounting arm included.



Lathe Function Display Console;

- Functions include Radius/Diameter, Taper measure, Metric/imperial.
- Mounting arm included.

GS series of Glass Linear Scales;

- GS300 Standard - General use scales.
- GS500 Slim - Slim scales ideal for smaller machines.
- GS600 Long Length - Available in lengths between 1 and 3 meters.



Please Contact us for a Catalogue or download a copy from our website www.Machine-dro.co.uk

TEL: 01992 450780 WEB: www.machine-dro.co.uk

FAX: 01992 450781 E: sales@machine-dro.co.uk

ALLEDALE ELECTRONICS LTD.

43 Hoddesdon Ind. Centre, Pindar Rd, Hoddesdon, Herts. EN11 0FF

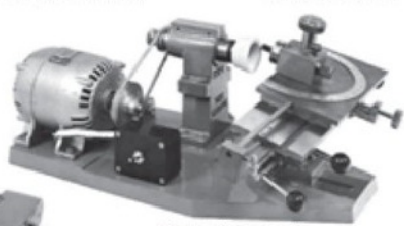
KITS FOR TWO TOOL AND CUTTER GRINDERS

THE SOPHISTICATED

THE SIMPLE



THE QUORN



THE KENNET

FOR INFORMATION ON THESE AND OTHER KITS S.A.E. TO

MODEL ENGINEERING SERVICES

PIPWORTH FARM, PIPWORTH LANE, ECKINGTON, SHEFFIELD S21 4EY

PHONE 01246 433218

www.lawm.freemove.co.uk

3D CAD

WITHOUT SPENDING £1,000'S

Bring your ideas to life using professional 3D CAD. Use Alibre to produce 3D models, 2D drawings and photo-realistic images.

Alibre
Special Offer
"Home & Hobby"
Edition
£550+VAT

Alibre Design is an easy to use fully parametric computer aided design system at a fraction of the cost of packages with similar functionality.

www.digitise.ltd.uk

0870 0119394
info@digitise.ltd.uk

FREE
FULLY FUNCTIONAL
30 DAY TRIAL

Digitise
Authorised reseller of Alibre Design

WOULD YOU LIKE YOUR DESIGNS MANUFACTURED? ... PLEASE CALL

Folkestone Engineering Supplies

Offers a fast friendly service, competitive prices, no minimum order value, no VAT, competitive delivery fee's and large stocks.

Free catalogue

or visit our web site www.metal2models.btinternet.co.uk

Fasteners (metric & imperial), ferrous and non-ferrous metals (round, hex, square, flat, etc), also off-cuts (subject to availability). Goods supplied mail order or callers (by appointment) welcome.

A small sample of our stock and prices are shown below. Metal priced per 300mm/11.8" length, larger sizes are priced by the 150mm, 75mm and 25mm.

	BMS	Brass	Aluminium	Stainless-Steel	Other items in stock
1/4" Rnd	£0.28	£0.54	£0.39	£0.98	Aluminium, Brass, Copper, Steel and Stainless Steel tube.
1/2" Rnd	£0.78	£1.65	£1.18	£2.90	
3/4" Rnd	£1.44	£3.79	£1.97	£5.49	
1.0" Rnd	£2.26	£6.35	£3.35	£8.40	
1/4" Hex	£0.34	£0.66	£1.00	£1.65	Black Mild Steel.
1/2" Hex	£0.78	£1.94	£2.10	£3.78	Nickel Silver Round.
3/4" Hex	£2.14	£4.50	£3.60	£8.80	
1.0" Hex	£3.39	£7.38	£4.55	£12.50	Phosphor Bronze,
1/4" Sqre	£0.42	£0.97	£0.50	£1.70	Silver Steel and Ground Flat Stock.
1/2" Sqre	£0.98	£3.15	£1.47	£4.14	
3/4" Sqre	£1.94	£5.42	£2.65	£5.98	Spring steel.
1.0" Sqre	£3.54	£10.84	£4.95	£8.98	

BMS available in EN1A F/C, EN8, EN16T and EN24T
Aluminium in HE30 and 2011 f/c

Fasteners

Socket Screws metric and imperial, BA machine screws 0BA to 16BA.

62 Canterbury Road, Hawkinge, Kent CT18 7BP

Telephone 01303 894611

Email: metal2models@btopenworld.com

Open weekdays (0900-1600)

Saturday mornings (0900-1200)



Rudy Kouhoup - High Quality Tuition; NOW on DVD!

All Rudy Kouhoup's wonderful instructional films are now available on DVD. Whilst the picture may not always be Hollywood quality, the quality of instruction is exceptional; with these films your instructor is there with you. Details of all Rudy's films are in our FREE Booklist, or on our website, but here is a selection of his most popular films:

Fundamentals of Machine Lathe Operation 95 mins • DVD £ 29.95

Revised and extended version of THE video for the beginner to the lathe - there really is no better way to start learning how to run a lathe. However, it is basic, so if you have some experience in lathe operation, don't buy this video, buy the one following.

Advanced Aspects of Machine Lathe Operation 120 mins • DVD £ 29.95

In this video Rudy continues the tuition process, demonstrating rather more advanced details than contained in the video above specifically how to achieve a very high degree of accuracy while boring, turning, facing, threading, milling or grinding on your lathe.

Grinding Lathe Tools 125 mins • DVD £ 29.95

Here Rudy looks at all aspects of grinding lathe tools to perfection. Really very good, and also includes plans for building a simple, but effective, grinding table. In the main covers tools used in European type (IE horizontal) tool holders.

Fundamentals of Milling Machine Operation (previously titled Rudy Kouhoup on Milling on video) 120 mins • DVD £ 29.95

Covers virtually all aspects of using a vertical, bench type, milling machine in detail - great if you have just bought a mill! Includes drawings and instructions for making a fly-cutter.

Advanced Aspects of Milling Machine Operation 120 mins • DVD £ 29.95

Shows you the methods by which your mill can be highly accurate in every function. He also describes techniques that will expand the usefulness of your mill and dramatically improve your skill levels.

Operating a Horizontal Milling Machine 150 mins • DVD £ 29.95

Using an old Atlas horizontal milling machine he had acquired and reconditioned, Rudy shows the many cuts this remarkable machine can make. Plus he provides an outline and plans for two tools you can use with your own horizontal milling machine.

Using Layout Tools 100 mins • DVD £ 29.95

Covered here are the use of all the layout tools you are likely to encounter, with the function of each demonstrated. Plus Rudy gives you a detailed look at mechanical drawings and how to interpret them.

Pinstriping Made Simple 69 mins • DVD £ 29.95

Excellent film showing how to line models neatly, and give your models that extra touch of class. Includes a full set of plans for building a tram for drawing large arcs and fine lines.

Figure It Out - Common Sense and a Calculator 140 mins • DVD £ 29.95

Covers Proportions - Scaling UP and Down, Properties of Triangles, Angular functions of Right Triangles, Getting rid of chart dependency and Rotary Tables and Dividing Heads. Our Star describes and illustrates his real world approach to problem solving, and demonstrates some of the practical aspects of figuring things out whilst working in his workshop and at the drawing board.

N.B. These DVDs are not regionalised, so will play worldwide. However, readers in the U.S.A. should contact Bay-Corn Enterprises, PO Box 351, Interlochen, MI 49643. Tel. (Toll Free) (888) 452-6947.

Prices shown INCLUDE VAT and U.K. delivery

(Prices shown also include delivery overseas OUTSIDE the EU - customers within the EU please allow £1.00 extra for delivery)

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

On-line ordering: www.camdenmin.co.uk



Pro Machine Tools Ltd

Precision Machines Made in Germany
"For the discerning engineer."



F1100



Hi Speed



CNC



CNC

5 YEAR
WARRANTY



F1210E

Longitudinal X-axis	500 mm
Vertical Z-axis	280 mm
Transverse Y-axis	150 mm
Optional	180 mm
Power	1,4 kW, 230 V, 50 Hz
Spindle speed r.p.m.	180 - 3000
Swivel range both sides	90°
Tool holder	MT 2Optional MT3 or SK 30
Drilling stroke	40 mm
Work bench	700 x 180 mm

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

GOL®matic

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



ON THE EDITOR'S BENCH

In the Workshop

By the time this issue is published, May will be part way through, and hopefully summer will be imminent. At the time of writing, (late March) yet another snowfall has just melted, and as the thermometer has crept above freezing, a couple of jobs have been undertaken. Interestingly they lie considerably apart in terms of size and precision. During an earlier visit to our club track a discussion about the fence railings required, prompted me to consider that this would be something more easily tackled in house rather than get involved in much on site welding. Tubular uprights had already been cut and merely required the top and bottom plates to be welded on. Top plates were cut roughly to size by band saw, tacked in place, ground down to OD with a 9in. angle grinder, then welded round using TIG. This minimised the added filler and hence subsequent fettling.

The gaps between the posts were to be filled with several panels each 54inches long. My chosen method here was first to lay down a baseboard of heavy ply, then mark this out with the positions of the thirteen uprights (12mm dia. bars). Nails were then tapped in to the board, offset 6mm from the marked lines to act as stops. The horizontals were then clamped in place, the uprights added, and the whole thing tacked up. The panel was then removed from the jig and propped up on the "Workmate" to give better access for welding the joints.

The second job is really the start, or perhaps more accurately the resurgence, of a "Mini project" and was sparked off by an article in "RCM&E" describing a model aircraft powered by two Italian pulsejet engines. Now back in the school days around fifty years ago, when we flew control line models, a pulsejet was something to dream about. A little later, (still nearly fifty ago) I did make up a TIG welded stainless tailpipe for the Brauner design whilst at Rolls-Royce. Unfortunately this became lost in a later house move.



Railing panel on jig.

Industrial Practice

As an update on the article "Lathe or Machining Centre" in issue 112, the company concerned, Bonspiel Engineering, have since purchased a second machine, initially to produce one design of component. The part is illustrated in the accompanying photo and is produced from 7/8 in. dia. stainless bar using ten milling cutters in the rear turret and four on the front, which reduce the round bar to the generally rectangular section shown, and mill the two internal threads. Cycle time is under ten minutes. During the machining process, the lathe spindle revolves more as an indexing than turning facility, and for some operations, both turrets are simultaneously active, the rear on the main spindle, the front on the secondary. The bar feed system allows unmanned machining to proceed for as long as tool life permits. Machined parts are taken by conveyor to a small bin. These are then finished in a vibratory deburrer prior to gold plating.

Mitre board saw guide



Fast forward to the mid eighties, when it was thought about once more, and another tailpipe made up using ERW exhaust pipe glued together with the then recently acquired MIG welding set. It was not a work of art. This (mark 2) has now been cut up to retrieve the main length of pipe, which will be later mated with a new conical transfer section and 64mm diameter combustion chamber. Welding will be by TIG and hopefully mark 3 will be an improvement over mark 2.

More nonsense from Euroland

The letter from Tony Jeffree in Scribe a Line issue 112 drew attention to the effect "green" legislation is having on small business. A recent article in "Industrial Technology" magazine was headlined "Environmental laws will define global competitiveness". Within Europe we are constantly bombarded with new regulations, many supposedly to control or reduce pollution. The further difficulty is that for those of us in the UK, our government seems forever to take the steam hammer approach. In Scotland things have moved yet further where we are blessed with SEPA (Scottish Environment Protection Agency), which, amongst other things, now prohibits farmers from moving stones brought up by ploughing, out of the field where they were raised. Their real recent Christmas cracker though, related to so called "waste oil heaters". Over the past few years, many garages and workshops installed these as a low cost method of heating; efficiently and cleanly burning used engine oil. In addition local DIY mechanics would also bring in their oil for burning. So what

do SEPA do? They outlaw the burning of used oil in these heaters unless you pay for a licence (I am told it's about £9000) and install continuous exhaust gas monitoring equipment. In other words they (unlike DEFRA in England and Wales) have taken the Euro directive and interpreted it to lump these small heaters in the same category as a multi-gigawatt power station. So what, you may ask, will the DIY mechanic now do? Well, human nature being what it is, my guess is that he will bury his used oil in the garden or simply pour it down a drain - just great for the environment. So is there any test data to say these little heaters produced any more of an environmental problem than a kerosene oil fired boiler? If there is I haven't found it. Another question which I feel has not been sufficiently addressed is "Exactly what is waste?" For many processes, one man's waste is another's valuable raw material. One surmises that SEPA will want to increase its revenue and therefore seek to classify many by-products as waste, thereby forcing anyone who stores, handles, transports etc to spend hard earned cash on the appropriate licence. I now prefer to think of our worthy bureaucrats as the Senseless Edict Promotion Asylum.

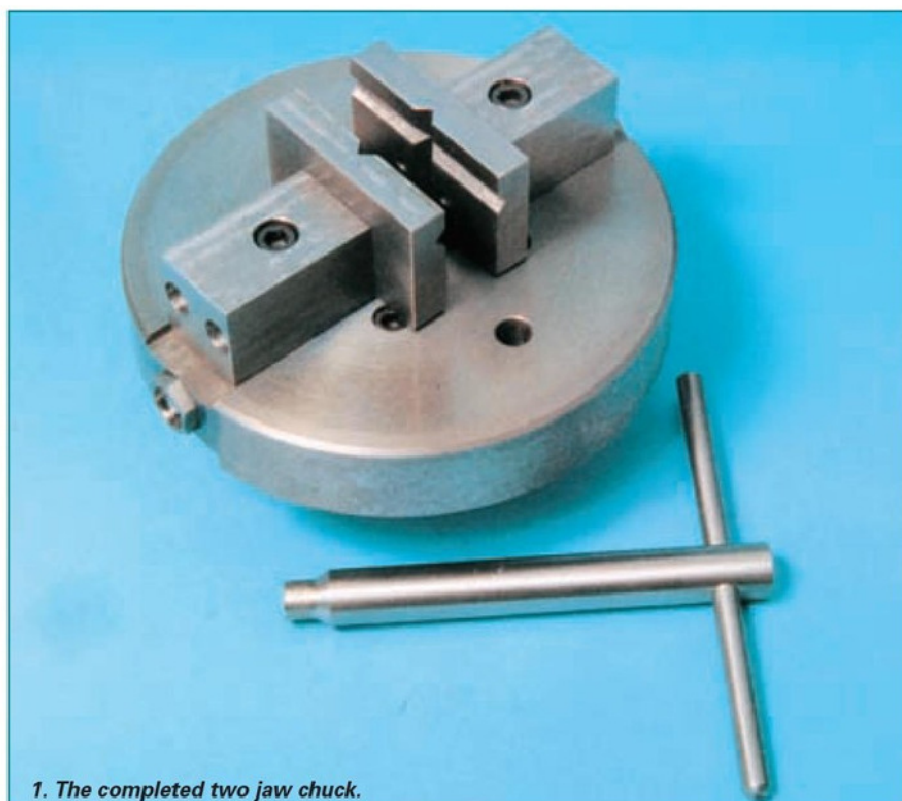
Dates for the Diary

August 18th, 19th, 20th, Bristol Model Engineering Exhibition, Thornbury Leisure Centre.

October 13th to 18th, Midlands Model Engineering Exhibition, Warwickshire Exhibition Centre, Nr. Leamington Spa.

THE LATHE ONLY WORKSHOP ③

Five Inch Two Jaw Chuck



1. The completed two jaw chuck.

Two jaw chuck may be likened to a "rotating vice", and just as a conventional vice offers versatile clamping for either bench or milling work, so this form of chuck opens up fresh avenues for workholding in the lathe. **Photo 1**, shows the subject for this article and it is physically the largest of the items in this series. It is though, still easily within the capacity of the average 3½in. centre lathe fitted with a vertical slide. There is therefore little reason for changing the design to cope with the manufacturing limitations. However, I am proposing a few minor changes for



2. Surfacing the first end of a jaw.

reasons that I will explain through the article. The kit for this is supplied by Hemingway Kits (ref 1) and includes drawings, materials, hardware and some suggestions as to the method of construction. The drawings shown with the article are in the main those given by Hemingway, but reduced in size for to accommodate within the magazine. The originals are in A3 format and are very well presented. I did feel though, that some comments would be useful concerning the accuracy of some of the parts to be made. I will also add that as this article assumes it is being made with a lathe only, the processes differ quite markedly from those proposed by Hemingway Kits and by the designer Mark Figs in his article (ref. 2). It is of course also an excellent project for the more fully equipped workshop where much of the methodology described in this article would still be appropriate.

Jaws (3)

First, machine one end of the blank as shown in **Photo 2**, initially doing this by stepping across the width of the jaw, then taking one final very shallow cut to provide

Harold Hall describes construction of this useful accessory

the finished end. Taking a cut one inch wide would, though, appear to be rather drastic for such light weight machinery but the helix of the cutter will mean that the resulting cut at any one time is far less than one inch.

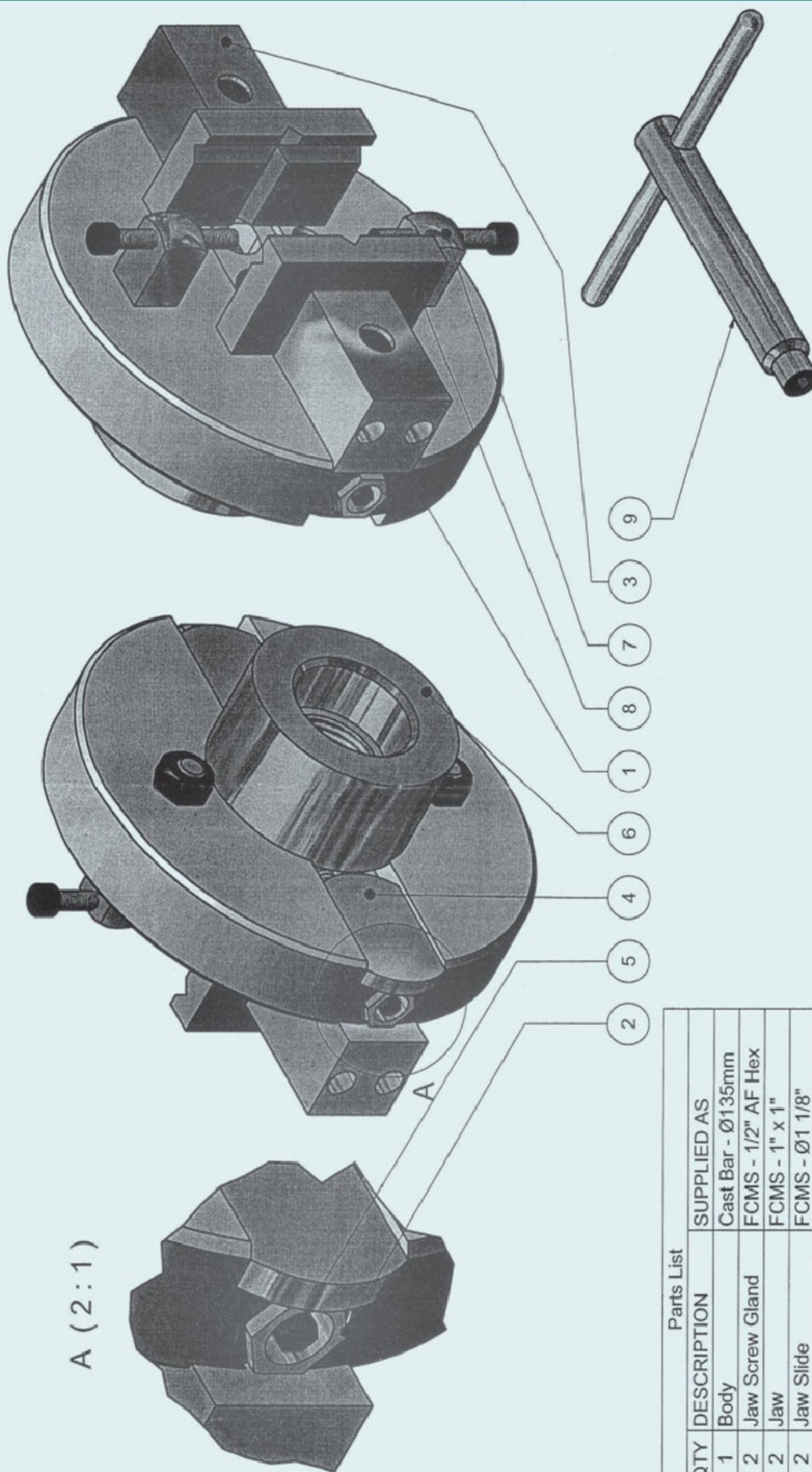
Reverse the blank in the vice and generally repeat the above process to create the step and finish to the 1½in. length, **Photo 3**. Note how the method of mounting the vice gives considerable scope for positioning the workpiece relative to the cutter. This is far more than is possible if clamping the part to the slide face using the three tee slots available.

Just seen at the rear of the vice is a small piece of steel that has been clamped to the vice to position the jaw length wise. This permits the second jaw to be made an identical length to the first using the cross slide's micrometer dial without recourse to measurement. However, it is also necessary for the thickness of the step to be the same for both. If you took my advice in the introductory article and made a saddle stop then this will be the easy. Otherwise, it will be a case of using and remembering the saddle traverse



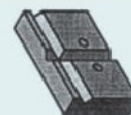
3. Machining the second end with its step for locating the jaw plate.

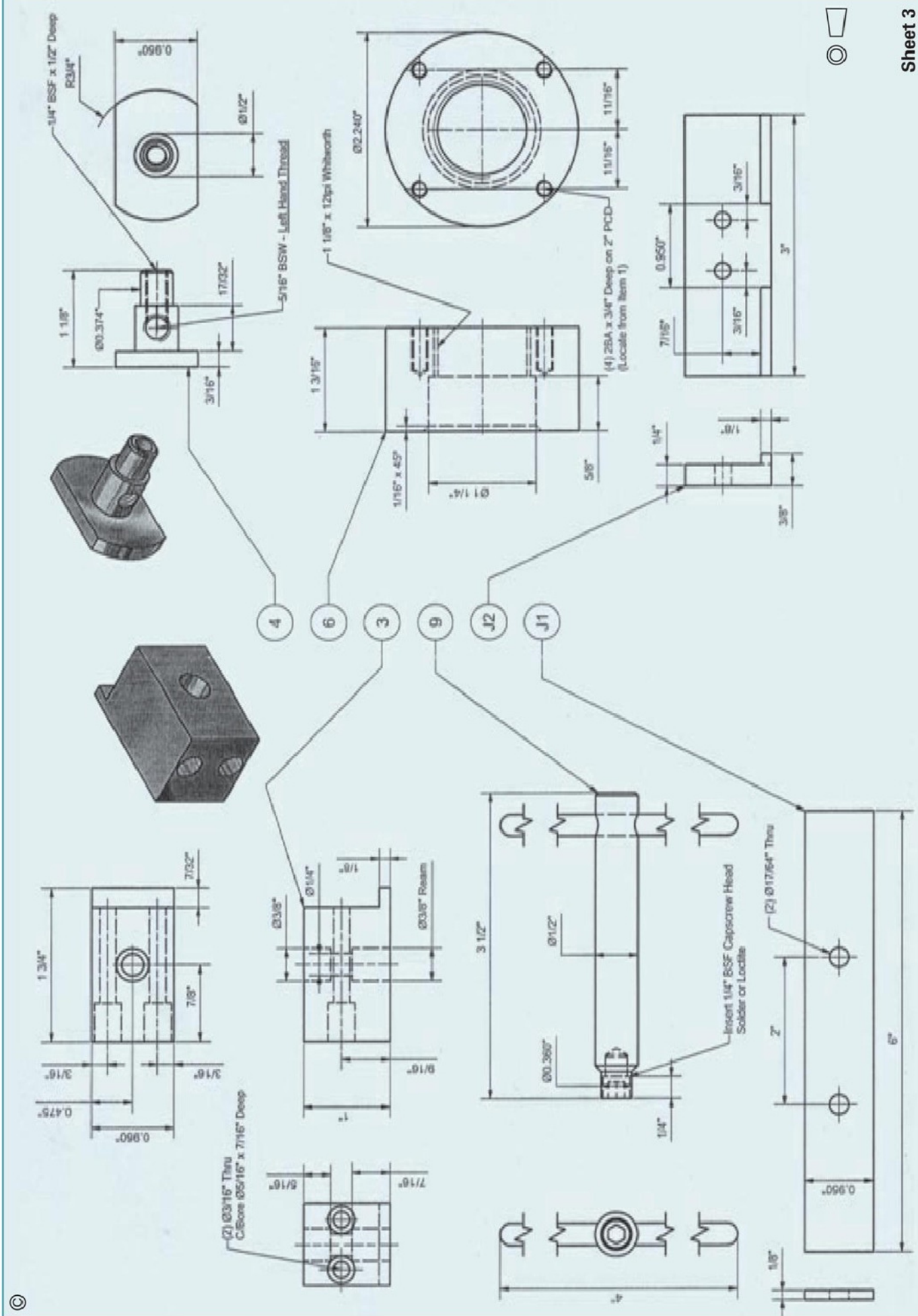
A (2:1)



Parts List			
ITEM	QTY	DESCRIPTION	SUPPLIED AS
1	1	Body	Cast Bar - Ø135mm
2	2	Jaw Screw Gland	FCMS - 1/2" AF Hex
3	2	Jaw	FCMS - 1" x 1"
4	2	Jaw Slide	FCMS - Ø1 1/8"
5	2	Jaw Screw	FCMS - Ø1 1/2"
6	1	Adaptor (Myford)	FCMS - Ø2"
7	2	Stop	FCMS - 1" Square
8	2	Jaw Plate	FCMS - 1 1/4" x 3/8"
9	1	Chuck Key Assy.	FCMS - Ø1 1/2" & Ø1 1/4"
J1	1	Slot Jig	FCMS - 1" x 1/8"
J2	1	Jaw Plate Jig	FCMS - 1" x 3/8"









4. The vertical slide is set at 45 degrees to machine the vee in the jaw plate.

micrometer dial reading if available. If not, make the first a little on the thick side, make the second to dimension, then without moving the saddle return the first jaw and skim the step at that setting.

Turn the jaw in the chuck so as to make the first side available for machining, it is probable that you will need to insert parallels to bring the surface above the vice's jaws. As it is essential that the sides of the finished jaws are accurately parallel the slide must be set up with its face parallel to the cross slide movement, test this with a DTI prior to mounting the vice. The working surface of the vice must also be parallel to the vice's base.

Lightly skim the first side to remove blemishes then turn over and machine the other side to say 0.960in. Repeat for the second jaw. With the second jaw still in the vice bring this to 0.950in. wide making sure the saddle is clamped at this setting. Remove and fit the first jaw and machine this without moving the saddle, thereby making both the same width. Should you end up with a slightly different dimension, say 0.948in., this is not that important. However, where later I refer to 0.950in. you should obviously work to 0.948in. Having machined the first side, do remove the burr produced by this before placing the work back in the vice for machining the second side. If this is not done you may end up with one jaw slightly different in width to the other depending on the effect the burr causes in each case.

Finally at this stage, lightly machine the top face, purely for appearance purposes. With this in mind, do machine the three faces of the jaw using a sharp end mill and step across the face by equal increments as should be visible in **Photo 1**. Typically, if using a $\frac{1}{16}$ in. end mill, step across by 0.2in., that is two turns of the leadscrew if 10 TPI, no need to read the dials. Drilling the holes will be described later.

Jaw plates (8)

Skim ends ensuring both parts are the same length, generally as detailed for the jaws.

Make the horizontal vee as shown in **Photo 4**. The position for this is not given on the drawings and is not that important except that both jaws must be identical so that they align accurately when fitted. This is achieved by the use of a locating fence as seen in the photograph. Set and lock the cross slide to position the top of the vee so that both jaws will be the same. Using the saddle stop will determine the width of the vee for both jaws. This will not work though for the vertical vee as any off centre error will be doubled when one is reversed and they are placed face to face.

Measure the width of the vee just made and take this value away from the length of the jaw, dividing this value by two. Using a height gauge scribe a line at this dimension from each end of the jaw after having marked this with marking blue for ease of visibility. Make an initial cut with the end mill, say $\frac{1}{16}$ in. deep, approximately central to the two lines. Now, using the cross slide, adjust the depth of cut in stages until one edge just coincides with one of the marked lines. Follow this by adjusting the saddle until the other line is reached. Repeat for the second jaw.

Whilst marking out for the width of the vee also mark one jaw with the position of the two holes. Again do this from each end of the jaw to ensure the pair of holes are central. Clamp the two jaws together and drill a tapping size hole through both, do not tap at this stage. Now mark the back with marking blue and mark with the width of the jaws, again ensure that these are central. Mark the mating surfaces, jaw and jaw plate, one pair with one centre punch mark and the other pair with two. From this point keep them in matched pairs just in case there are minor differences.

Jaws (3)

Clamp the jaw plates to the part made jaws, aligning the marks on the rear of the plate with the width of the jaw. Drill through the plate into the jaws, again with a tapping size drill. Remove the jaw plate and open up holes. Reverse and drill the clearance hole for the screw heads and use a counter bore to flatten the bottom of the hole.

The next task is to drill the hole for mating the jaw to the jaw slide, this needs to be accurately central across the width. If using a surface gauge, rather than a vernier height gauge it is best marked from both sides, any error in the setting of the surface gauge will result in two very close parallel lines. Estimating the centre from these when centre punching will be relatively easy. The hole is quoted as $\frac{3}{16}$ in. reamed, but being a blind hole you will need a machine reamer to do this; a drilled hole should be quite adequate providing the mating part is made a close fit. Drill through a clearance for the screw and then reverse and counterbore for the screw head. Return now to the jaw plates and tap the two holes, assemble to check that all is well and that completes the jaws and jaw plates.

Adapter (6)

The drawings are dimensioned for mounting the chuck onto a Myford seven series lathe, if you have a different lathe,



5 Skimming the outer diameter of the chuck adaptor using a modified boring bar.

but still with a screwed on chuck it will just be a case of changing some dimensions.

Measure the diameter of the parallel portion of the lathe's mandrel and make a gauge to this dimension for checking the adapter whilst being made. Place material in chuck and skim one end, reverse and skim the other, bore the parallel portion followed by screw cutting the thread. The thread should be made on the loose side to ensure that it in no way affects the location of the adapter onto the lathe's mandrel, this being done solely by the parallel portion.

Remove the adapter from the chuck and the chuck from the lathe and screw the adapter to the lathe's mandrel. Hopefully all is well, if not it may be difficult to get the adapter back in the chuck sufficiently accurately to make minor adjustments, hence the reason for the gauge and the oversize thread.

With the adapter on the lathe's mandrel, face the end and skim the outer diameter. The drawings quote a diameter of 2.240in, obviously $2\frac{1}{16}$ in. having been skimmed a little. However, I was supplied with $2\frac{1}{16}$ in. material, so rather than spend time machining away metal, I skimmed this and made the body to suit.

It is probable that your saddle will not traverse sufficiently to machine up to the mandrel's flange. To overcome this I used a boring bar with a modified cutter as seen in **Photo 5**. Of course you only need to true up the first $\frac{1}{16}$ in. but it will look better if the whole length is machined. The drilled holes will eventually be positioned from the body.



In part two of this article, which will appear in the next issue, we will commence by dealing with the body, and then proceed with the other components.

References

1. **Hemingway Kits.** 126 Dunval Road, Bridgenorth, Shropshire, WV16 4LZ. Tel/Fax 01746 767739. E-mail info@hemingwaykits.com Website www.Hemingwaykits.com. Kit HK 1650 2-Jaw Independent Chuck 5in. diameter.
2. MEW Issue 32



1. Furnace connected to gas supply.



2. Dovetailed wooden flask.

CREATING A HOME FOUNDRY

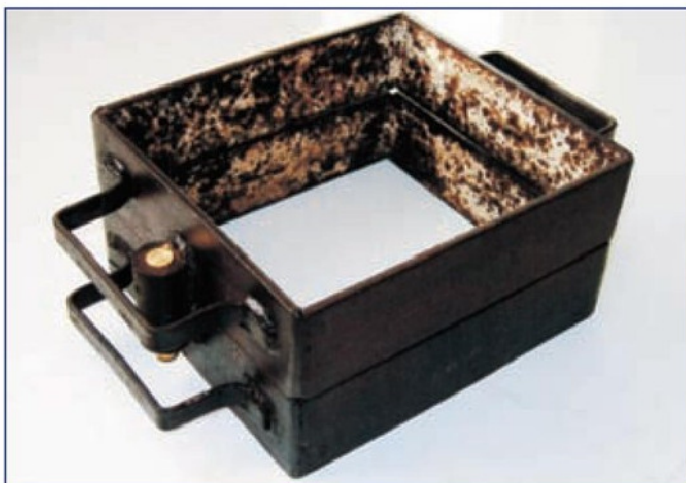
John Brittain describes the steps to getting started

It was just after I had prepared this article, that the excellent work by Alan Furness was published in MEW issues 110 and 111. With his extensive career in the aluminium industry, Alan was able to bring his considerable experience and depth of understanding of both the practical and technical aspects. For readers wishing a greater degree of detail on the metallurgical and chemical aspects, I would recommend reading these earlier articles. My own background includes teaching at secondary school over quite a number of years. Given that we produced many good castings with a zero accident record, I would hope to instill in the reader something of my enthusiasm for this activity, and encourage others to have a go.

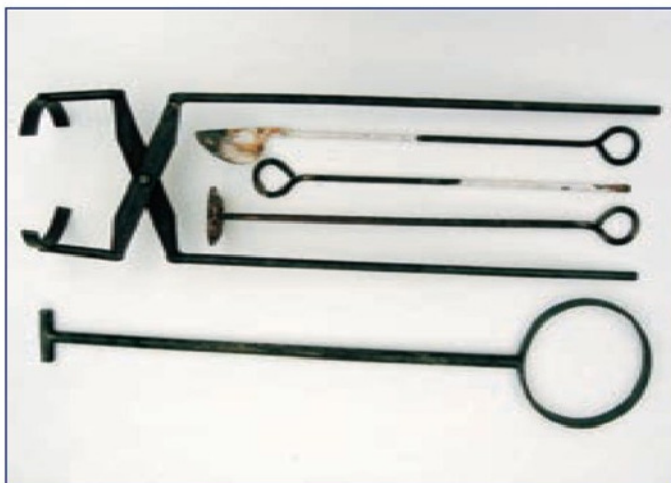
At the conclusion of my last article, I expressed the hope that, before the year was out, I was hoping to create my own foundry facilities and that I was looking forward to casting something before 2004 ended. I am happy to report that I managed both these aims within that time frame and I now possess a satisfactory set-up for the moulding and casting of aluminium alloy. Incidentally, I briefly considered buying a 'blown' furnace for casting in iron but ruled this out as being just too problematical. It's one thing to be handling molten metal at 600 degrees C, but quite another when attempting to cope with 2000 degrees C! - So, I leave that to the more intrepid types and will content myself with the production of aluminium castings only.

Search for furnace

Obtaining a suitable gas-fired furnace proved much more difficult than I had imagined and I visited a number of firms selling second-hand equipment without success. Electrically heated units were readily available but these were all far too cumbersome and with too small a capacity to be of any use to me. Finally, a call to 'Home and Workshop Machinery' revealed that they had a couple of gas furnaces in stock and so I took a trip down to their premises in Kent. Sure enough, the better example of the two seemed just what I needed and a deal was done there and then. Incidentally, the visit to these well-known stockists proved



3. Small all-welded flask.



4. Furnace tools.

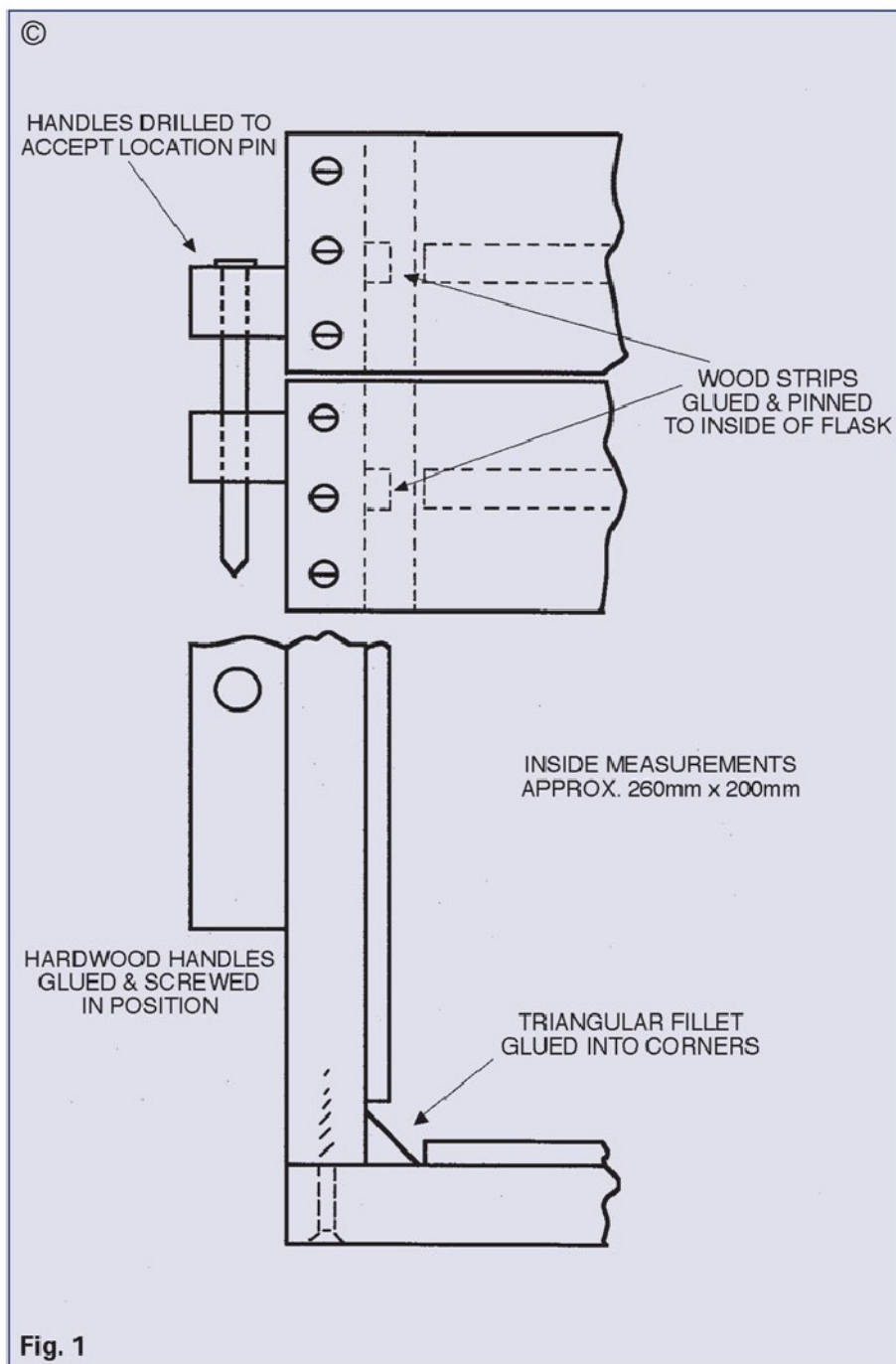


Fig. 1

most interesting, since their premises are very extensive and they carry a vast amount of stock. I thoroughly enjoyed wandering round acres of machinery and equipment and chatting to the staff before being helped to load up my car with my new acquisition and departing. (I might add that I have no other connection with the firm).

Having obtained my furnace, I was obviously anxious to try it out, so I took it to the area where a gas point awaited and coupled it up via a gas cooker hose with a bayonet connector (**photo 1**). All was well, I was pleased to note, the burner being easily and safely lit by means of an in-line 'wand' which was all part of the equipment. I was delighted to see how efficiently the whole set-up functioned and couldn't wait to make my first casting. However, this could not be done without quite a lot of additional equipment being made or purchased, so these tasks were given top priority.

Moulding box

A moulding box or 'flask' was first on the list and for this I used 25 mm softwood dovetailed together. Yes, I know that attempting this sort of joint is anathema to many metalworkers but I happen to enjoy dovetailing and it is undoubtedly the best joint to use in this context. The location pins were made from 12mm dia. b.d.s. and the brackets and handles cut from 50 x 50 x 3mm angle iron and 12mm dia. bms (see **photo 2**). Some means of preventing the sand from slipping out of the flask was needed, so semicircular grooves were "routed" in each of the inside surfaces of the "cope" and "drag" (top and bottom parts of the box) prior to assembly. Incidentally, the flask was made as a whole and sawn in half after assembly in order to ensure perfect mating. A couple of coats of varnish on the wood surfaces should have completed the job but, just when I was

ready to carry out this job, I discovered that no varnish was to hand so I ended up by sealing the wood with French polish - done in desperation, I hasten to add, rather than trying to elevate the job to cabinet-making status!

To use modern parlance, if dovetailing isn't your bag, then there are alternative approaches. Using 18mm plywood, it is straightforward to construct a suitable flask, which, although not as sturdy as the dovetailed variety, is nevertheless fairly adequate for the job. If this method is adopted, make certain that the edges are straight and square before gluing and screwing them together. Drilling pilot and clearance holes for the screws will help assembly considerably but check that the screws are positioned away from the half-way line in order for the box to be sawn in half. Triangular fillets glued in the corners give added strength and are to be recommended. (see **Fig 1**) The dodge of nailing strips of wood on the inside of the box in lieu of the routed grooves can be used but, of course, these reduce the inside dimensions. Handles can be just pieces of hardwood screwed in suitable positions on both cope and drag (as in diagram) but some sort of guidance will be required for separating the two halves of the flask; i.e. some form of location pin, however crude, should be employed (Large nails will do at a pinch). Failure to observe this will result in the pattern probably damaging the mould as the cope and drag are separated.

Perhaps a more obvious approach for metalworkers with welding facilities however is to construct an all-welded flask from mild steel. **Photo 3** illustrates a small but very handy sized flask (180mm x 150mm) that I made many years ago using 50mm x 4mm black m.s. To provide against sand slippage, I employed small runs of weld applied to the inside surfaces.

Other tools

I had purchased a crucible from H. and W. Machinery when buying the furnace and now I needed to make tongs and a ring tool or 'shank' to fit it, so I obtained the necessary black m.s. from my local sheet metal works and, having first specified the lengths (i.e. the pot circumference), got them to roll up the strips of 18 x 6mm material for both the ring and the tong jaws. It was then a simple matter of shaping the 30mm x 6mm crosspieces of the tongs before completing both tools using 12 or 16mm dia. black, m.s. and a spot of sawing, filing and welding.

A stirrer, skimmer and plunger were next on the list and these were easily formed from 8mm dia. black m.s. and 1.5mm sheet steel. Also, as a precaution against the possibility of accidental melt spillage, a 750mm square galvanized steel sand tray was made. A selection of these is shown in **Photo 4**.

There are two recognised ways of forming the runner and riser of a mould - one is to build in two tapered 'sprue' pins as the cope is being filled and the other is to cut them with the aid of a metal tube after the cope is completed. I rather favour the former method and so I turned up a couple of sprue pins (**Photo 5**) for this purpose. Meantime, I had already ordered



5. Rammer and sprue pins.

some moulding sand plus the necessary chemicals and parting powder and these duly arrived, together with quite a large bill! Never mind. I was almost ready to do a spot of casting!

I cleared one end of the bench in my garage and set this area up for the moulding process, placing the plastic bin (bought from B & Q) underneath it for my sand container. A rammer was turned and shaped to the traditional form before being sealed with French polish and this, together with a set of moulders tools that I had been given very many years ago and which hadn't seen the light of day for decades, (Photos 5 and 6) provided almost the rest of the equipment needed to make a start. I say almost because, ideally, one needs a robust pair of hand bellows in order to blow away any loose sand that will inevitably accumulate round the edges and inside the mould. The cost of such a piece of equipment is however quite prohibitive and I decided that I would go without until I could get round to making some. Meantime, my lungs would have to provide the necessary air pressure!

Safety

Positioning the furnace outside has meant that my casting activity will forever remain a fair-weather task but this shouldn't pose a problem provided that I watch the weather forecast beforehand! The great danger when handling molten metal of any kind is, of course, allowing moisture anywhere near it and this point cannot be over-emphasized. Even damp concrete can

cause trouble, so the utmost care must be taken in this respect. Having taught this subject for over twenty years without mishap, however, I can state that elementary and commonsense precautions should guard against any possibility of accidents. As with the use of either hand or machine tools, complacency is our biggest enemy.

Making a start

I already knew what I intended my first casting to be and had been working intermittently on an idea for some months before acquiring the furnace. After several abortive efforts at devising a carriage stop for the Super 7, I finally settled on a design that I thought might answer the purpose and committed myself to making the pattern. Now the time had arrived when everything was ready, the weather was fine and I could light the furnace with a purpose.

Whilst the metal was being melted I placed the sand tray down beside it, filled it with dry sand and placed all the tools to hand, the plunger, skimmer and stirrer (or rabbler) having been coated with a refractory wash in order to guard against iron contamination. The prepared mould was placed within the confines of the tray, the jars of chemicals stood nearby and I prepared to don my overalls, mask and gloves. All was now ready!

After half an hour or so, the charge was beginning to melt and become pasty, at which point a layer of "Coveral" flux was sprinkled on the surface. When the charge was completely melted and had taken on a very slight dull red glow, the furnace was turned off, a spoonful of grain refiner added and a lump of 'degasser' thrown in. This combination was all plunged to the bottom of the pot, after which a further sprinkling of Coveral was added before the melt was "rabbed" or agitated with the stirring tool. The resulting dross, which by now was glowing red hot, was skimmed off and the crucible lifted out of the furnace and placed within the ring shank laid in readiness. The mould was then carefully filled until molten metal appeared in the riser. At this point, I have always experienced quite a feeling of elation - quite unjustified of course since, until the casting is broken out of the mould, one



6. Moulding bench area.

never knows whether it is sound or a 'waster'.

Success

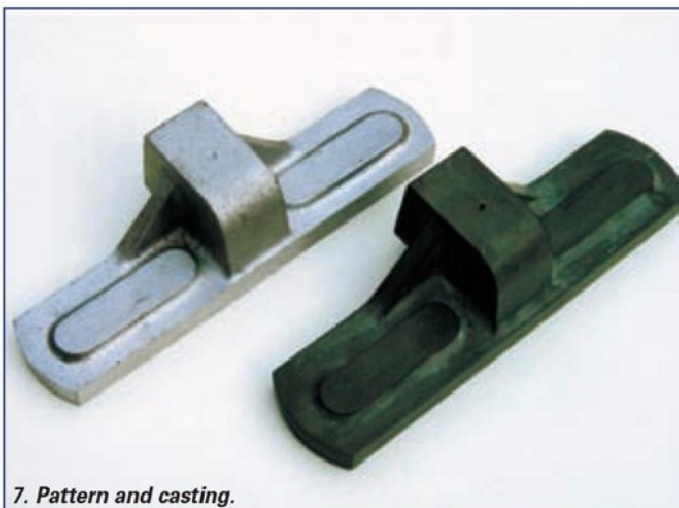
Photo 7 shows the pattern and the resulting casting. In this case, all was well, there being no obvious faults and so, since it was very late in the year, I decided to stow the furnace and equipment away for the winter months. Hopefully, it will emerge again in the spring, by which time another project should have been dreamed up! Since then I have constructed a low trolley (Photo 8) on which the furnace can be trundled back and forth from the garage to the foundry area with the minimum of effort. I have also acquired a leather coat from a car boot sale with the object of using it for making a pair of bellows. I have decided that shifting loose sand away by puffing and blowing until one is purple in the face is NOT advisable at my age!



Suppliers

Foundry equipment, tools, sand, ingots
- **John Winter & Co. Ltd.** P.O. Box 21,
Washer Lane Works, Halifax, HX2 7DP
Tel. 01422 330 493

Furnace - Kasenit Type no.25079 -
Home and Workshop Machinery,
144 Maidstone Road, Fooks Cray,
Sidcup, Kent, DA14 5HS
Tel. 202 8300 9070



7. Pattern and casting.



8. Furnace mounted on trolley.

SIMPLE AND PRIMITIVE HEAT



1. Heating a steel strip in a gas cooker flame, note the beginning of a piece of scale..

One of the most useful things a model engineer can do is some simple heat treatment. I don't mean anything complicated. It's useful just to be able to harden and temper small components, soften one when needed and perhaps do a bit of simple case hardening, nothing larger than a centre punch or a small chisel.

A little knowledge

What it needs is a little bit of know how, not enough to be dangerous, about how some of the steels we use behave when they are heated. It also needs a bit of simple equipment. As will be explained later, much can be accomplished with fairly rudimentary kit

The effect of heat on steels

The steels we will wish to heat treat will be those having between 1% and 1.4% of

carbon in them. These are the ones which will harden and are used for tools like files, punches, scribers and scrapers. The small amount of carbon has a magical effect. Simply heating a carbon tool steel to the right temperature of bright red heat and cooling it very quickly will make it very hard indeed. Complex changes happen to the structure, discussion of which is outside the scope of this article. Readers keen to explore the topic in more detail may wish to read about it in some of the excellent books on the subject. A good one is, "Workshop Technology" Part one by W. A. J. Chapman, if it is still in print. Another is "Hardening, Tempering and Heat Treatment" by Tubal Cain published as part of the Workshop Practice series. These will detail all the in's and out's. The crux of the matter is that the steel, which untreated can be cut, filed, machined and even bent a little, will be transformed when hardened into an extremely hard and fine-grained metal which will cut a lot of other metals. Not only that, the process can be reversed or modified.

Bob Loader offers guidance for the less experienced.

Hardening technique

For the magic to happen, there must be enough heat to make the changes, a temperature which the metallurgists call the critical range, starting at about 750deg.C. Quench from that and the hardening is done. Quenching is the method of cooling very quickly, more about that later. For many things the length of time the work is held at temperature, prior to quenching, may not be important, as we will be concerned with producing a hard cutting edge. However if it is necessary to achieve the hardened state all the way through the section, then the work needs to be kept at temperature for one hour per inch of thickness to ensure that the middle is sufficiently hot.

Ways of judging temperature

There are several ways of judging the temperature of a hot piece of steel, if the equipment is of the deluxe type it is easy because the heating will be done in an oven and there will be built in instruments to indicate the temperature and perhaps the time. We though, are more likely to be using more modest tackle and have to use other methods.

By colour

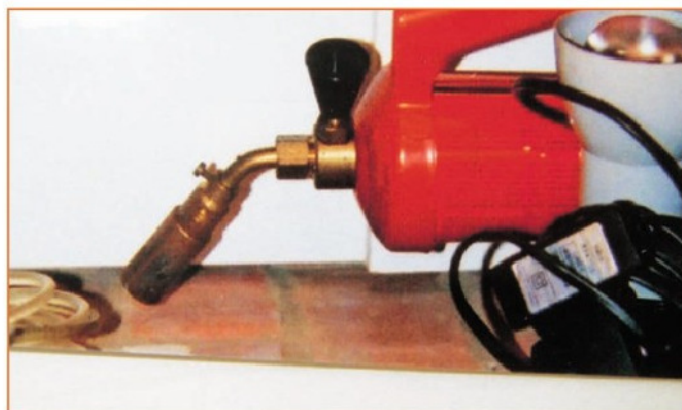
A good way and a fairly accurate one. The quoted colour is cherry red, which I think is a bit vague. There are many different cherries, some nearly black and some yellowish. I think the colour meant is that of the cherries which are in fancy drinks or decorating trifles.

By scale

My favourite method is to heat the steel till



2. Two correctly tempered punches. Photo by Pauline Loader.



3. The "Flammenwurfer", a splendid heating torch.

SOMETIMES AT TREATMENT



4. The flammenwurfer in action, tinning a piece ready for soft soldering.



5. Two mild steel templates which have been case hardened.

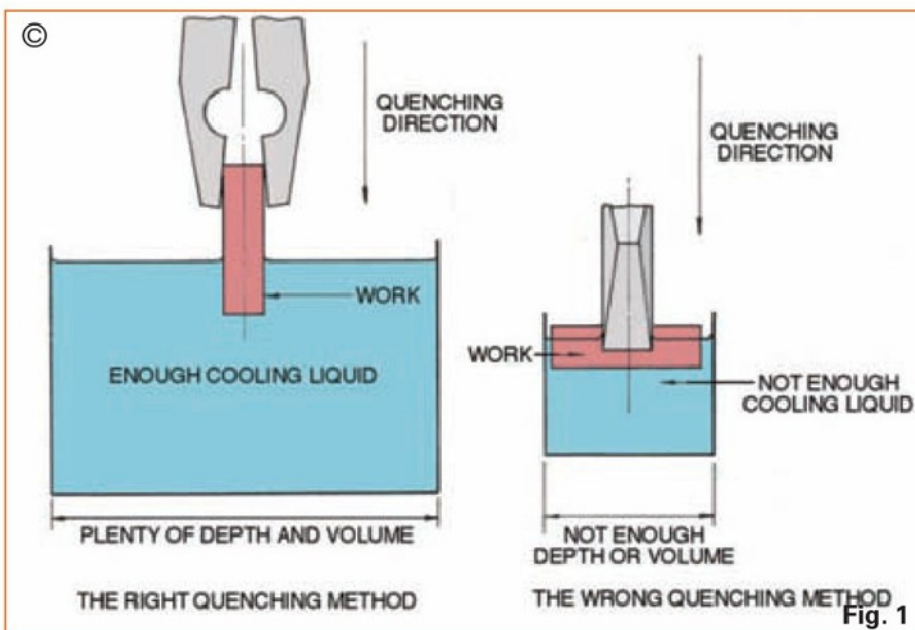


Fig. 1

it begins to scale, easy to see because light patches appear on the surface like the one in the bottom left corner of the strip in photo 1. When the steel scales it is time to quench.

By colour or scale is the best way I have found but there is another less well-known way. If the hot piece is continually tried with a magnet and quenched, when the magnet will no longer pick up, it will be time. The reason is that one of the effects of the transformation is that the steel becomes non-magnetic. I have never tried this method, so I cannot vouch for it.

Quenching

For the type of work we are likely to do, water is usually the best quench. The container needs to be big enough to hold enough to cool the work quickly and could be a small bucket or basin, preferably not a synthetic one. Be careful to always quench across the minimum section and not flat on. Fig 1 shows what I mean. Components which are long and thin should be held with the axis vertical, and plunged straight downwards. Some work, which has variations in shape or changes in section could benefit from quenching in oil. This is less severe than water, and less likely to promote cracks. Try to avoid sharp edges or abrupt changes in section, they can cause small cracks and small ones can get bigger. Luckily, silver steel, gauge plate and old files, (our normal sources for homemade tools and cutters), are fairly tolerant of the rough and ready methods we use. More sophisticated steels are best left alone because the treatment they need is different and quite complex. If quenching in oil, there is a fire safety issue to consider. It is imperative that the amount of oil must be adequate as a small amount of oil will not cool a large piece of steel, it will simply catch fire. The oil

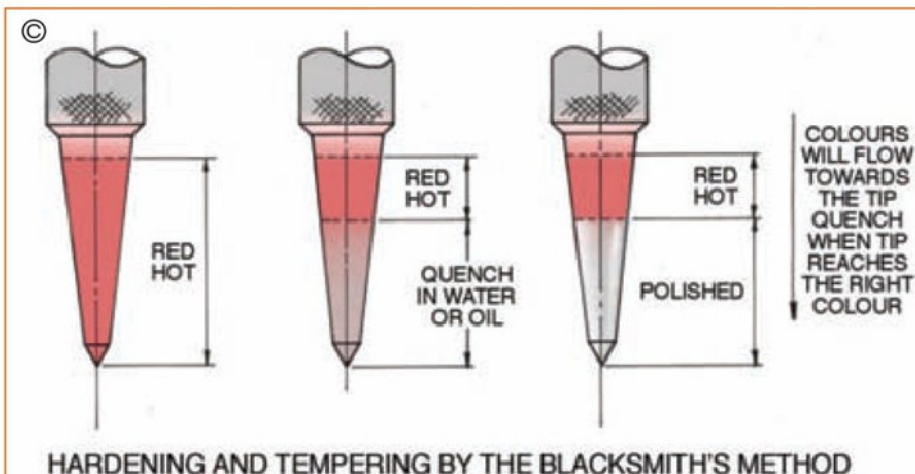


Fig. 2



6. A square file which has been softened and made into a centre punch by re-hardening.

should be in a metal container with a metal lid. For most of what we want to do, one of the large coffee tins seems about right, filled about two thirds full.

Tempering

Any carbon tool steel which has been heated and quenched will be very hard. Unfortunately, very hard also means very brittle and for most purposes the brittleness must be reduced by tempering. Tempering toughens the steel a bit and it is done by reheating and quenching when the right temperature has been reached. The heat is much lower than for hardening and the colour the component changes to is the guide. It must be polished first because the colour is from the oxide film on the metal. Once the right colour has been reached the component is quenched again. As a rough guide, the colours are, in order, coolest first, straw, brown, purple and blue. Some textbooks will list far more and include fanciful things like, pale straw and dark straw and brown with purple patches. It is one thing to write down lots of beautiful shades of this and that; quite another when you are squinting at a small object, quite often in poor light and waiting for the right colour to appear, which usually happens before you are ready.

Translating the colours into uses, straw is for cutting tools; brown for punches, scribes and rivet snaps; purple for cold chisels and blue for springs and screwdrivers. There are one or two exceptions, for example. I don't temper scrapers, flat ones that is, just heat the first ¼ inch and water quench it so that it has maximum hardness.

It is not always easy to get the colours right but easier if you use a couple of dodges. Firstly, always heat the tool or component well back from the cutting edge or the part which has to be tempered and let the colours flow towards the tip, this should give plenty of time to get it right, especially if the heat is not too fierce. Secondly, try the method used by my old friend Steamboat the blacksmith. Fig 2 shows what his all in one technique was. He part quenched the tool, leaving the butt end of it red hot, polished the tip and a bit more and waited for it to get to the right colour then quenched. Doing it this way gets exactly the right condition, a gradual increase in hardness towards the tip. Steamboat was always a useful man to listen to and I learned a lot from watching him and listening to his sayings, one of which is worth remembering, "you only 'ots the bit you wants to work on", so when heat treating something, concentrate on the bit which does the work and leave the rest alone. A centre punch, for instance, only needs to be hard for about the first ¼ in., the gradual reduction from

there acts as a shock absorber. Photo 2 shows two tempered punches.

When tempering, it is vital that, once polished, the metal is not touched again. If it is, the oxide film which shows the colour can be contaminated and false colours will appear, usually before they should. Some tempering jobs are more awkward than normal and I have had my share. One which drove me to despair was a number of flat springs of a complicated shape, a correct blue colour in one place was brown in another and so on. Steamboat had the answer.

Steamboat's toaster

His solution was to use his toaster, a slab of steel about 6 in. by 4 in. and ¾ in. thick. It was put into the forge about half an hour before dinner time, so that when the bell went it was glowing red hot. Any sandwiches which were to be toasted were placed on a grid and the hot steel held over them. It was easy to reverse the method and with the hot plate resting on a couple of blocks, a rack laid on the plate and my springs laid on the top, the problem was solved. It was just a matter of waiting for the right colour, nicely even and no trouble.

Heat sources

For most of my working life I have been lucky to have the use of torches with mains gas and compressed air in various sizes. Retirement changes all this and other ways and means have to be found. There are alternatives. The only thing to be careful about is that the chosen source isn't too hot, or too concentrated. It is possible to use too much heat without really being aware of what is going on. I got caught out once when I had to separate a sort of cross halving joint which was two pieces of brass wave guide joined by silver soldering. I got it much too hot and, as I used a little flux to help it along, I had hit exactly the right conditions for welding the two pieces together. My apprentice master made several comments about my lack of skill and it was a mistake I haven't made since, so suit the heat source to the job.

Heating devices

If you have a bottomless pocket and a well equipped workshop it will be no problem but this article is aimed mostly at those who, like me have neither. For those who can fork out without pain, there are plenty of quite expensive torches to choose from. For about £100 or so you can get a superb item, which will connect to a gas cylinder



7. A closer look at a selection of punches correctly tempered to brown.

and has more attachments than you can shake a stick at. You may also be able to find a small electric furnace; some if these are aimed at jewellery type work. There are, however more modest sources.

Blow torches

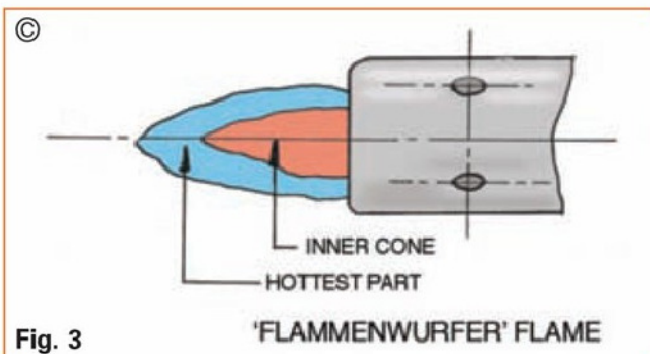
My favourite was the one I called my "Flammenwurf", it is the one in photo 3. The flame (Fig 3) is a bit ragged compared with some other ones but like any torch the hottest part is just in front of the inner cone. The gas comes from the canister it screws into and the pressure is enough to do all the small jobs and even a case hardening job, which I'll mention later. A blow torch like the flammenwurf can be bought in most Do-It-Yourself stores for about £10 and it is worth every penny.

Cook's blow torch

A smaller version of the flammenwurf. They are used by cooks for jobs like glazing the surface of cakes and similar fancy things to eat. Because of the small size and limited heat output, they are only suitable for small work but they are very good for small and intricate work. They are powered by a container of the sort of gas used for cigarette lighters, which gives about 60 minutes of use. The flame is very clearly defined and there is a safety shroud. An enlarged view of the business end is shown in Fig 4. They cost about £20.

Gas stove

The gas stove is a good heating device, Photo 1 shows it being used to heat a steel strip. It is useful for a lot of small jobs. A word of advice; a kitchen is just as much a working place as your workshop, so always ask permission first. You wouldn't like it if your wife turned your lathe on and started graunching away. So watch it and be considerate; especially, remember that any quenching in oil makes quite a



smother and smell, so if possible, do some things outside. If you have a small gas stove for camping, then it too could be pressed into service.

Plumber's blowlamp

The old-fashioned blowlamp is another option and will do anything from soft soldering to silver soldering and all the normal heat treatment jobs. The fuel is usually paraffin (although some use petrol) and it usually has to be warmed up on methylated spirits and then pressurised by pumping. I have used one for several jobs and found it most useful.

Most types of blowlamps need the very small hole the gas comes through kept clean. It does tend to get clogged from time to time and a pricker is supplied for cleaning. It has a very slender point to it and needs looking after, it is also easily lost; my solution was to stick it to the gas canister with sticky tape, then I always knew where it was. Notice from **Figs 3, 4 and 5**, that the hottest part of the flame is just in front of the inner cone.

These are a few of the heat sources available to those who have to make do with what is to hand, finally, don't forget a bunsen burner if you have a gas outlet somewhere, one big advantage of them is that they leave both hands free and they will make a lot of heat for their size. Once upon a time, I made a hand-held version which was quite good, hot enough to melt a brass 2BA. screw. It has since vanished, probably during one of my clear outs.

Remember that when steel, or any metal gets hot, it also goes soft, so when picking a job up with pliers or whatever, do not squeeze it too much. It is possible to leave the marks of the jaw serrations on the work, always where they show up badly.

Case hardening

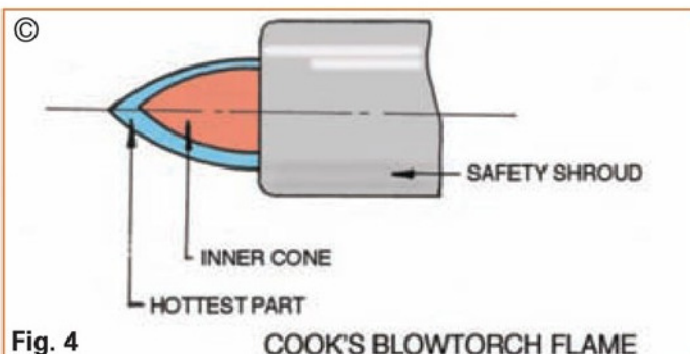
Although this is not easy to do with limited equipment, some small parts can be successfully done. It is ideal for those things which have to be very hard on the surface, like filing templates and anything which have to be wear resistant. The two templates shown in **photo 5** had to be casehardened so that the filing wouldn't rub too much off. The grotty finish is what most casehardened parts look like after quenching.

Proper casehardening is a complex process. Firstly, the mild steel has to be given the carbon it lacks so that it becomes a mild steel core with a thin outer layer of high carbon steel. Secondly, that carbon rich outer layer is quenched to give

the hard skin. It is really two processes in one, the carburising and the hardening. The component to be treated is heated to the usual bright red and covered with casehardening compound. The compound can be sprinkled on the hot piece or it can be put in a small steel box, an empty tobacco tin always does the job for me. As long as the part is red hot it will absorb the carbon rich compound. The compound will stick to the surface being treated and the process can be repeated several times. After several sprinklings the part is heated to bright red again and held at that temperature until the coating of compound stops bubbling and seething. Then it is quenched in clean cold water. The two samples in **photo 5** were 0.138in. thick and 2½in. by ¾ in.

Jobs like this are best done out of doors or in a shed. There are risks, from the smell of the compound and a fire risk from the extra heat needed. I was lucky to have a shed, which was made mostly from pre-cast concrete sections. All I had to do was move the compost bag off the few bricks it stood on and make the bricks into a hearth. It took a long time to heat up and badly frightened some spiders but it came out all right. The scaly finish on the finished parts in **photo 5** is the sort of appearance you get and it can be cleaned off as long as it does not remove too much metal. Remember that the hard skin is just that - a skin, take off a couple of thousandths or so and you will be back to soft steel. If you are thinking about proper case hardening with a deep hard case, forget it, because with the equipment I'm writing about you have no chance. Proper case hardening is quite an involved process and best left to the experts. Their process can give you a much greater case thickness e.g. 30 to 50 thous.

Two more heat treatments are worth a mention and could be within the scope of a large blow torch.



Softening

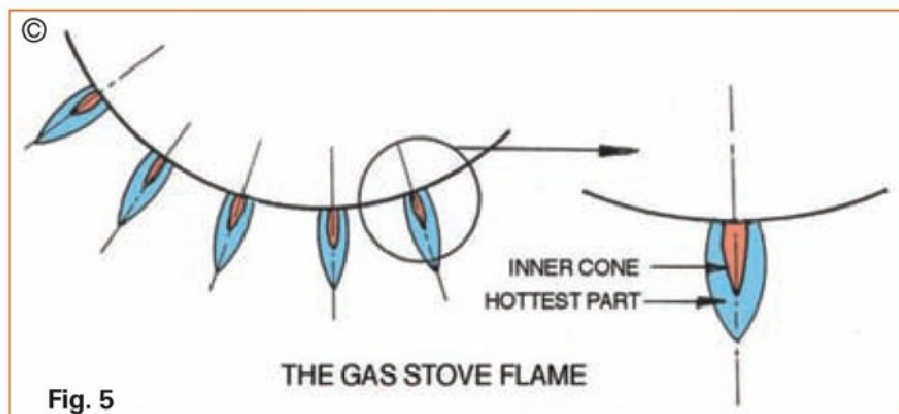
I've called it softening rather than annealing because it is a rather rough and ready version. The hardening process is reversed by heating the component to be softened to a bright red and leaving it to cool as slowly as possible, in the hearth where it was heated is the best place to do this. The punch in **photo 6** used to be a square file until it was re-cycled. Old files are a valuable source for high carbon steel and only need softening. If your house has a coal fire, then one method is to put the metal items in the fire late in the evening, allow them to get up to red heat, and cool down overnight as the fire dies down.

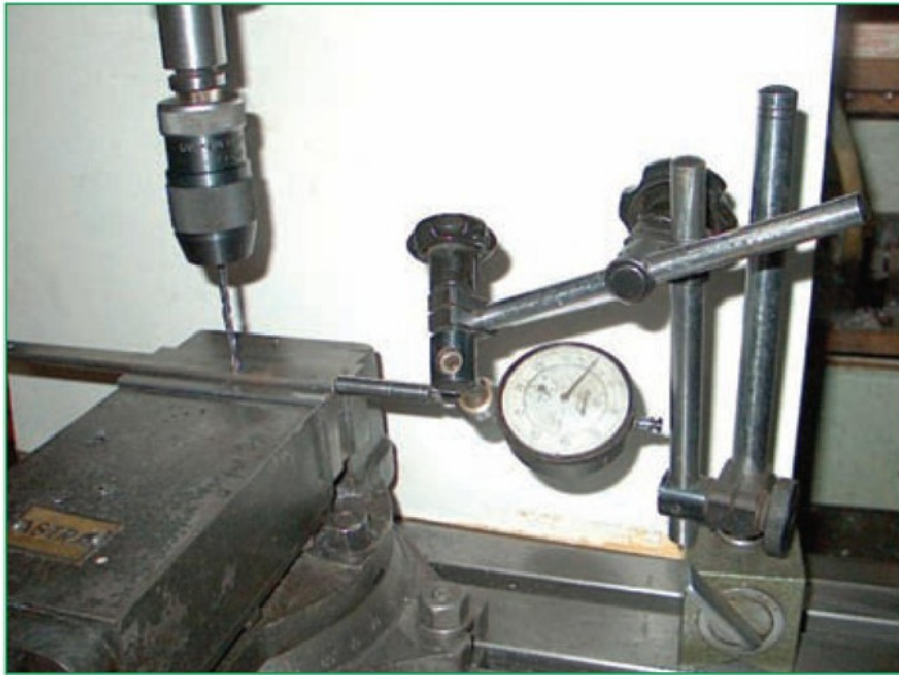
Blueing and oil blacking

These are two finishing processes which give a piece of work a pleasing look. In both cases the job must be clean and free from oil or grease. To blue a part it needs heating till it turns blue then quenching in oil.

Blacking is similar but is heated to dull red and then quenched in oil. Do not overheat it, at dull red it will give a lovely even black, if it is heated too much, it could begin to scale, leaving unsightly patches on the surface. "Blind Pugh" gave some excellent detailed advice on techniques for blueing and blacking in his article "Toolroom Tips (2)" (MEW issue 108), so rather than repeat the information, I would refer readers to his words of wisdom.

These are the basic heat treatments, which can be done with simple tools and equipment. Have a go, even if you only have a gas cooker to work with, you will be surprised how much you can do. Always remember though, to ask permission first if you are using kitchen facilities.





1. Setting piece in place, clock zeroed.

ANGLE SETTER

Fed up fiddling with that protractor set? Try this gadget described by Peter Rawlinson.

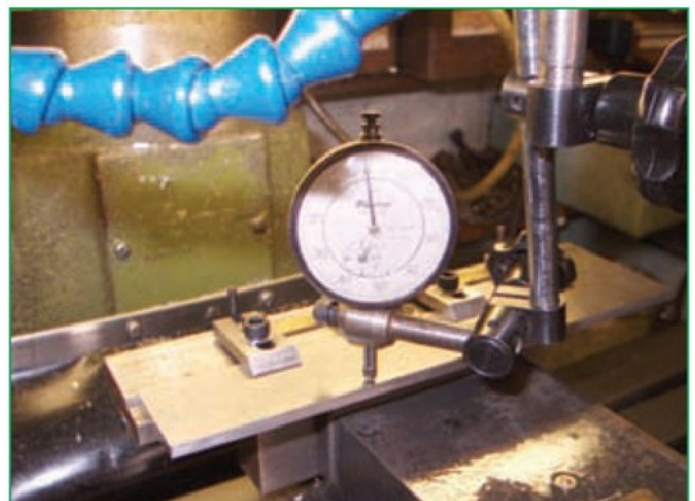
General design

I started to draw the Angle Setter and decided on a base length of 250mm and a height of 200mm, and as I did not fancy spending hours on making the protractor, I searched for something suitable and eventually found one in the catalogue of "Axminster Power Tool Centre". They supply three sizes and I chose the middle one which has a 120mm diameter, this

being the outer diameter of the protractor. It is also supplied with a longer base measuring approximately 150mm. (This is the size given in the catalogue.) which therefore saves the necessity of building on to it a pivot point bracket as this would be required on many other makes. It would, however, be possible to redesign the geometry to bring the pivot point to a position situated on the inside of the outer diameter.



2. Setting piece removed, work moved to zero clock reading.



3. Checking fixture for squareness and level.

Background

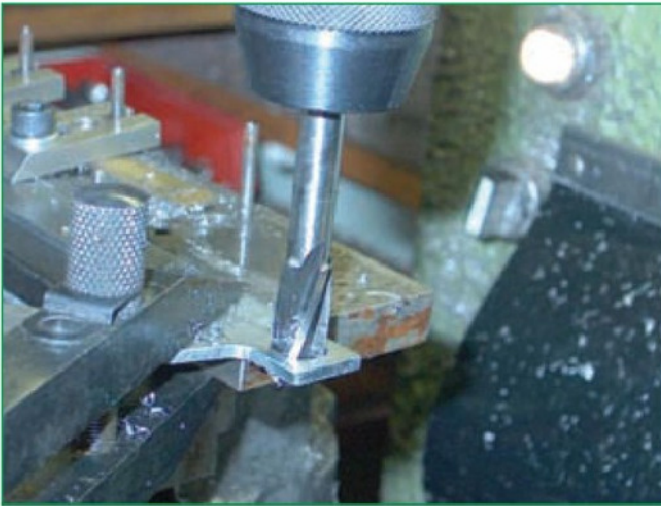
Some two years ago I saw a device being used to set up a saw and it struck me that it was a simple but very useful device. I then went through all the tool suppliers catalogues, looking for something similar but to no avail. Recently however I did find one in a catalogue of the company "Greenweld". However on purchasing one I found that it was made of plastic and was quite small in size. I felt therefore that it will not last any length of time.

To give a brief description, the device is an adjustable square but with a built in protractor. It is however, built in such a way, to allow measurements to be taken or set very close to the base. I would though note that article in question is patented in the U.S.A and the U.K. As has been discussed in these pages before, I have always been given to understand that the patents essentially preclude the production and sale of the items covered, although I am sure that it is more complex than this. My understanding is, that as individual engineers, we are able to reproduce a patented item but for ourselves only and not for other people and certainly not for sale. This apparently comes about as it is allowable to make a patented article in order to perhaps study and improve it.

At this time I also decided to give the instrument a base so that it would sit in a stable manner on to any flat surface without it having to be held in place. I also thought that it would be better to have a broader "Face", but either of these features can be omitted, I would point out that the base also allows the tool to be used against a straight edge for marking out.

Manufacture

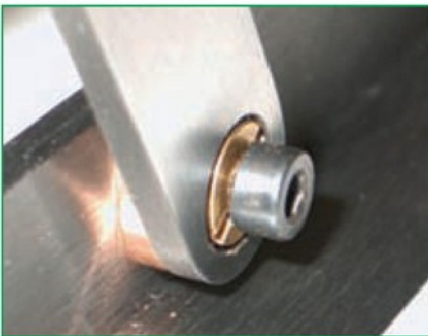
Making most of the parts is straightforward but accuracy is of paramount importance for the fit of the pivot pins and also the dimensions of the links. It is not necessary to stick religiously to the given dimension of 67mm. This can be any size as long as either all four parts



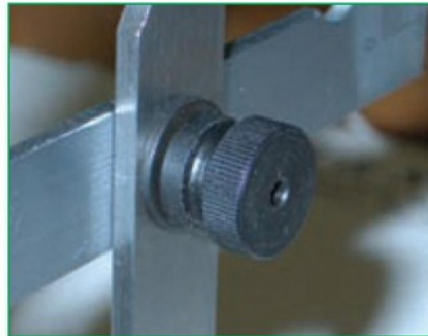
4. Boring new pivot in protractor scale.



5. Machining groove in base.



6. Lower joint showing temporary locking cap screw.



7. Knurled thumbscrew is a supplied item.



8. The commercial and home made compared.

are machined to the same dimensions, or at least each pair of opposite sides is equal in length giving an accurate parallelogram

I am lucky as I have a D.R.O on the Mill and therefore working to repeat dimensions as required here becomes very simple. The same result can also be achieved by using a dial gauge and a setting pin machined to the required

length. This has been previously described, but for those readers who do not know the system, the procedure is as follows. Firstly machine a piece of material to the centre distance of the pivot holes say 67mm. Mount the link in a vice and line up for the first hole. Machine this hole completely and then mount the dial gauge on the table and zero it in on the

end of the pin, while holding the pin between the dial gauge and the end of the link.

Next, remove the length pin, slacken the vice and slide the link through the vice jaws until it touches the gauge. Carefully adjust its position, and when the dial gauge reads zero, retighten the vice. **Photos 1 and 2** illustrate this sequence.

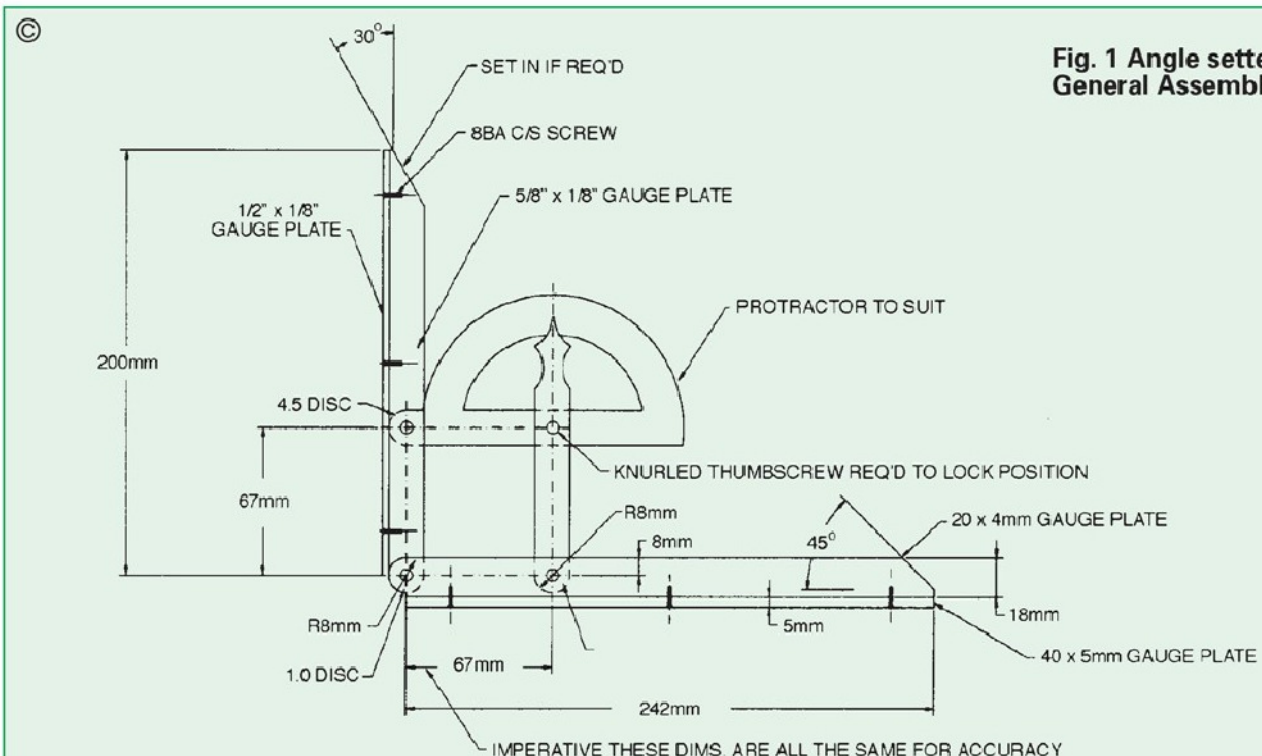


Fig. 1 Angle setter General Assembly

©

BRONZE DISCS x 14mm O.D.
2 OFF x 1.0mm THK
1 OFF x 4.5mm THK
1 OFF x 5.5mm THK

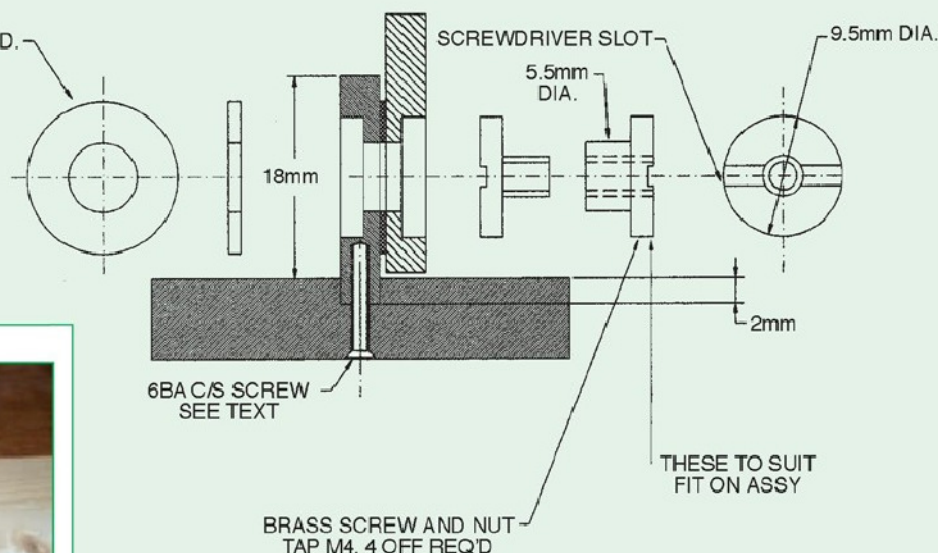


Fig. 2 Small parts and base details



9. Device used in marking out wood.



10. Application on mill.

It would also be possible to use the setting piece in conjunction with a stop set up on the mill table, again moving the

component back to the stop for the second position. The dial gauge theme may be developed further by mounting the clock on the quill. It is again zeroed using the length pin, then the procedure is exactly the same, remove the pin and instead of moving the part in the vice the whole table can then be moved until the dial gauge is again zeroed. It would also be very easy to move the table the 67mm or 2.638in. by reference to the table handwheels.

My own set up for working on this device also involved a vice fixture which, once set ensured that the strip components could be rapidly positioned knowing that they would be horizontal and at a known position on the Y axis. **Photo 3** shows the fixture being checked for level and **photo 4** shows the new pivot position being bored in the protractor.

The base has a groove machined to accept the 4 x 20mm upstand part (**photo 5**) and the holes drilled tapping size holes (2.3mm) at this stage. The part is then removed, the "T" fitted and the tapping holes drilled through using the base as a jig. The holes in the base are then opened out to 2.85mm (6BA clearance) and the

countersinks formed. The same is carried out on the front plate but here the screw size is 8BA, being more appropriate for the 1/8in. thick material.

The turning is all straight forward but again the pivots must be machined to be an accurate fit in the mating parts. I have incorporated screwdriver slots for adjusting the pivots. Once finally assembled and adjusted, a system of locking the pivot pin adjustment is required. Initially I was going to use Loctite but on second thoughts decided against as it could have locked up the whole joint. Instead it was decided to use grub screws, however these have not been fitted in the photographs as they would not be seen. Instead, for the photographs only, short M4 cap screws are fitted, as can be seen in **Photo 6**. These were replaced after all photographs had been taken. For clamping an angle setting, the knurled thumbscrew supplied with the protractor has been reused, as can be seen in **Photo 7**.

In use

The device works very well, can be used anywhere and saves considerable time in setting up; for either metal work or woodwork it has proved to be large enough or small enough for both, and is shown alongside its plastic commercial counterpart in **Photo 8**. Illustrations of particular applications are given in **Photos 9, 10 and 11**. As a possible improvement, I am considering fitting a second "T" stalk as this will improve its versatility for laying out work.

I hope it will be of interest to readers and as usual if I can be of help am happy to do so, but phone only please.

Peter Rawlinson, Charing, Kent.
01233 712158.



11. Used in setting saw.

Suppliers

Greenweld
01277 811042
Axminster Power Tool Centre
0800 371822

TRADE COUNTER

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

New Machine Mart Catalogue

"With hundreds of new products and lower prices, for all your tools and equipment look no further than Machine Mart's massive new Spring / Summer catalogue. With an amazing 364 pages packed full of top brand products at rock bottom prices, this catalogue represents Britain's number one range of power tools, hand tools, metalworking and woodworking equipment, construction, garage and workshop tools plus much, much more.

Packed with almost 500 new products and savings up to 20% the new Machine Mart catalogue is a real 'must have' for DIY'ers and commercial trade users alike."

For your free copy of the new catalogue simply call into any of Machine Mart's 49 Superstores nation-wide, phone the catalogue request line on 0845 450 1855, e-mail sales@machinemart.co.uk or visit their website at www.machinemart.co.uk



and from Enginewise -

whose latest catalogue comes in the form of a fold out wall chart giving details of almost all of the product range. Regular readers will know that the company specialises in supplying products related to corrosion protection, and thus they are of special relevance to workshop equipment, laid up vehicles, engines etc. One new product, too recent to make the catalogue, intended not for prevention, but removal, is "Rust Away", aimed as the announcement says "at those who did not apply Enginewise anti corrosion products in time". This is a liquid supplied in packs from 500ml to 5litres, and the directions are to immerse the rusty item for between 30 minutes and 24 hours, water rinse, immerse a second time, then leave to dry.

Amongst the prevention products, a single VapourSeal will give two year protection to a 100 litre tool cupboard, the VapourOil range is suggested for engines, gearboxes and fuel tanks, and silica gel sachets can be used to cut humidity in a 130litre volume.

Enginewise may be contacted at 3 Venture Business Park, Grimsby, DN31 2UW. or phone 01472 347 400. The website shop is www.enginewise.co.uk

Routout CNC

A recent phone call, from a reader, lead on to a discussion regarding CNC developments. He asked if I was familiar with Routout CNC. I had to admit that I was not and he went on to extol the virtues of the company and in particular, its principal, Mike Gaylor. The product was described as being very cost effective and relatively easy to grasp, also Mike Gaylor, as someone prepared to go that extra mile in matters such as telephone explanations to a relative novice.

All the hardware/software is designed - built - manufactured in the UK, which gives advantages of quick turnaround and high quality technical support for a variety of applications. As the name suggests, the system was developed with routing in mind, but can be configured for many applications for which up to three axis control is required. Existing applications already include standard CNC mill/routers, orthopaedic chair control, CNC foam cutters, dividing heads, mould machining, robotic control and air velocity measurements for a wind tunnel.

Routout CNC can be contacted by post to Routout CNC, Bryn-Yr-Odyn, Thornhill Road, Cwmgwili, Llanelli, SA14 6 PT, or phone 01269 841 230, or email sales@routoutcnc.com

IN OUR NEXT ISSUE

Coming up in Issue No. 116 will be



Vertical Spindle Alignment Table

A useful accessory from Peter Rawlinson

An All Steel Workshop

Dick Gays describes his approach to achieve comfort and security.

A Low Cost CNC Dividing Head

David Ross offers a cut price approach to electronic indexing.



Issue on sale 23rd June 2006

(Contents may be subject to change)

GRINDING AND MAKING LATHE TOOLS

1. Double ended grinder fitted with two rests.



Derek Cooke of Mount Pleasant, W. Australia, adopts a simplistic approach.

The accompanying **Table 1** gives the required height above wheel centre (to the nearest millimetre) for clearance angles from 4 to 15 degrees, with wheel diameters of 125mm, 150mm and 200mm.

Simple tool rest

Long before I acquired the first bench grinder, I had given to me one of those old grinding spindles consisting of a Y-shaped casting with a pulley between the arms of the Y. This had a 6in. x 1/2in. wheel, and I drove it with an ex-washing machine motor. Later it was given a 6in. x 1in. wheel to grind TC tipped tools, a job now taken over by the "good" end of the CP bench grinder. (The old spindle was again due for new bearing sleeves anyway). **Sk.2** shows the plan I adopted for its tool rest.

The closed end slots were made using drill, cold chisel and files. A steel plate was fixed to the bench top, with drilled and tapped holes for the tool rest and drill grinding jig. A tapped hole was provided near the top of the upright to secure the tool rest. 1/2in. hex screws with thick washers provided the grip. I followed this plan with the new bench grinder, but will probably add variable tilt rests when the mood takes me (I still have shingles!). I was fortunate in being able to purchase some 3in. x 2in. x 1/4in. angle iron, and with some 2in. x 3/4in. strip was able to fabricate a pair of sturdy rests with 6in. x 3in. "platforms". These make the rounding of a tool nose a piece of cake. Having one of those splendid though cheap oriental bandsaws, I made open-ended slots this time. Slack, but in old age the mere business of existence takes most of the daylight hours.

Grinding and honing

One of the beauties of hollow-ground tools is that with a little care, the edge can be honed virtually without risk of rounding it - several times before regrinding. One of those diamond hones, now relatively painlessly acquired, laid flat on the edge of the bench, and a gentle lowering of the business end of the tool from heel to cutting edge, a delicate application of a finger tip, and two or three traverses

In MEW 83, Mr Ted Wale described a rather super system for grinding lathe tools, and I know exactly why he went to such lengths. Recently, at an advanced age, and for family reasons I moved across this continent. Suffering from shingles, I left packing to the experts, so my beautiful Crompton Parkinson, 1/2 HP 8in. x 1in. bench grinder had its left shaft slightly bent, as a result of travelling on a bench top and suffering some unknown fate. So I bought another machine, which obviously came from the same stable as Ted's, though it has a local tool supplier's nameplate. The tool rests could only be described as pathetic (in polite society). Like Ted, I am a rank amateur, but of more than 70 years standing, and as a youngster I learned what could be done with hand tools. (I still own, but do not use, a breast drill!) 70 years is perhaps an exaggeration, as there were 6 years soldiering and rather more devoted to education. During the other years I graduated from a hand turned wheel, to the present day powerful bench grinders. 30 or so years ago I started grinding 1/2in. sq. HSS lathe tools for a small home-made lathe, and for twenty years have ground tools for a somewhat heftier machine. Even the C.P. grinder had to have its tool-rests modified. (The large platforms I provided extended over the edge of the bench, and one of them was driven into the L. wheel).

Hollow ground angles

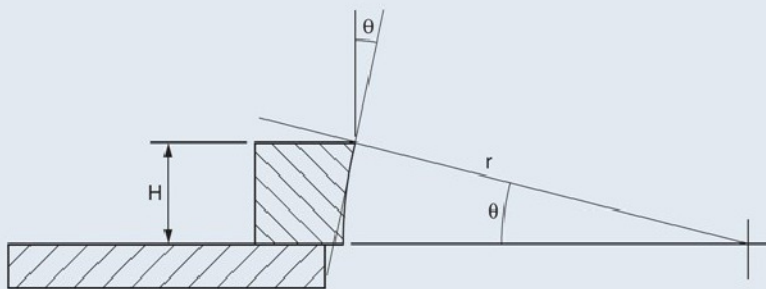
The angles for grinding tools aren't all that critical. The optimum for this piece of steel will probably differ from that for the next. I don't know about the rest of the world, but I use the cylindrical surface of a wheel, so tools are hollow-ground anyway. Not like the picture in the text-book. Where a steep rake is required, I use small section HSS and hold it in its lathe tool holder, or use a 5in. grinder which dates from earlier times, or use a simple holder. A horizontal platform of 6in. x 3in. (150 x 75 mm) is adequate for up to 1/2in. tools. It should have a notch cut to surround the wheel for about 10 mm (a couple of mm clear of the wheel, or less if you are a careful operator). Vertical movement is a must, and tilt round an axis parallel with the motor shaft is a nice addition.

From **Sk.1**, it will be seen that, taking a radian as being high enough 60deg, and remembering that for small angles, tangent, sine and angle in radians are very nearly equal, then if "H" be the height of the tool above the wheel centre line, then the clearance angle (in degrees) immediately below the lip of the tool is given by the formula:

$$\text{Clearance angle} = \frac{H \times 60}{r}$$

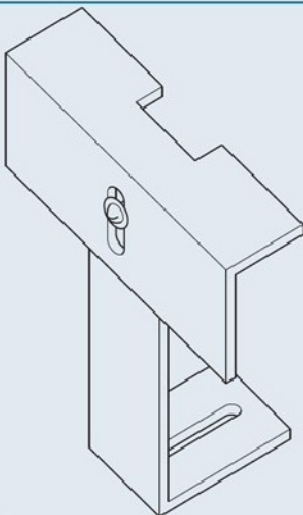
where r is the radius of the wheel.

©



Sk1

©



Sk2 Grinding rest

works. I hope I will not have to manufacture another!

And for tiny tools

One of the gadgets in my workshop which intrigues "proper" engineers, is a perspex eye-guard with a magnifying glass. This has a brass collar screwed to it, which fits spigots on the guards of the various grinding wheels (Not the new ones yet). The lens is an achromatic of about 2in. dia. and 7in. focal length and coated, and a great help when grinding small things. A "Woolies" one would be almost as good. A couple of weeks back, I was looking through the threading tackle for tools to cut 0.5 mm threads both ext and int, and came across the tools used to cut the nuts for new feeds to replace the commercial studding on my home-made lathe. The square threads were $\frac{1}{16}$ in. dia x 1 mm. pitch, and $\frac{1}{16}$ in. x 1.5 mm pitch, and the Acme was $\frac{1}{16}$ in. x 2mm. (Never mind the bastard sizes, I wanted metric feeds, and had imperial material available). The internal thread cutters were made from $\frac{1}{16}$ in. and $\frac{1}{8}$ in. round silver steel, the ends being forged to face at right angles, filed close to size, heat-treated, and then ground to size. I roughed out with these, and finished using home-made taps. The magnifier proved quite useful when grinding the tools! So, too, did replacing the 5in. x $\frac{1}{16}$ in. grinding wheel with one of those angle-grinder cutting off discs about 2mm thick, and mounted on a suitably turned adapter.

At further risk of irritating Grandma on the subject of eggs: Don't let the tool roll inwards towards the wheel. It will arrive on the lathe ready-blunted. The large flat platform, coupled with $\frac{1}{16}$ in. square tools, and $\frac{1}{16}$ in. holders for small tool-bits should help to avoid this. Personally I prefer the sensitive touch of my arthritic fingers to a mechanical feed of the tool. I made a "Quorn" years ago, with a view to making gear cutters, but I wouldn't bother to grind a lathe tool on it - life's too short. I got as far as making a gear cutter to the idea, though not the design, of the late,

lamented David Lammas. I fear the urge to pursue the matter has rather vanished, as I have no need to make gears at present.

Brazed tip carbide tools

Some readers may wonder at home-made carbide tipped tools. My main reason for using them is that it saves hours of boring grinding. The first hurdle is to scrounge disposed-of carbide tips by ingratiating oneself with a local jobbing firm. (The tips without a hole in the middle are preferred.). When I lived on the Northern Tablelands of NSW, if the sheep or cattle markets took a dive our local graziers used to cut sleepers for the NSW Govt. Railways, and used swing saws, which had carbide teeth. One of their number used to refurbish these saws, and a grovel on the floor of his shed would produce a supply of very useful (ready "tinned") bits of TC. My earliest efforts were made with an LPG blowlamp, with the shank sunk in charcoal grains. The last were produced by a hefty kitchen stove which ran on seasoned hardwood and in winter ran the central heating as well as hot water and cooking. (Summer was solar hot water, and electrical cooking). When we moved to a relatively urban environment, I regretted the loss of the stove - particularly its efficacy as a large annealing furnace. Having done a "Tech" course on "Farm Welding" after my retirement, I felt confident enough to invest in Oxy-Acetylene after the move, which makes brazing tips much easier. Early in the piece, I used old-fashioned brazing spelter with a borax based flux, but later changed to silver solder. With the former, a carefully filed seat for the tip is quite adequate, but with the latter, I mill the seat in the lathe. If the shank is less than the max. permissible tool height by the thickness of the TC, I just braze the tip straight on in some cases. A reverse hand boring tool for doing some machining on the Quorn. rotating base, had its tip brazed directly on to its $\frac{3}{16}$ in. x $\frac{1}{16}$ in. steel shank, which had a suitable bend forged.

A scrounged TC tip needs de-greasing first, and then being held with a spot of "Blu-tack" on the end of a piece of dowel to have the brazing surface gently placed against the rotating side of a grinding wheel. Then pop it on a tin lid (for safe keeping) to apply braze material to the surface.

I imagine that Ted, like myself, occasionally rues the fact that he wasn't "brought up proper" by an apprentice master, and has had to learn a lesson the hard way. But on the other hand, we are not trammelled by the thought that, "we didn't do it that way at Rolleses and Royces", and find satisfactory methods of our own. I suspect that in the posher firms, the turners had their tools sharpened by the tool-room anyway!



Table 1 - Clearance angles θ and H above wheel axis for different wheels

Clearance angle deg.	4	5	6	7	8	9	10	12	15
H for 200mm Wheel	7	8	10	12	13	15	17	20	25
H for 150mm Wheel	5	6	8	9	10	11	12	15	19
H for 125mm Wheel	4	5	6	7	8	9	10	12	16

powered by the other hand, and Bob's your uncle. I must confess to very seldom honing a tool. A light final sweep across the wheel which is whizzing by at almost 5900 feet per minute, over 60mph, or 100 Kph - (8in. wheel) leaves a very smooth surface. I certainly don't bother to hone carbide tipped tools.

Grinding $\frac{1}{16}$ in. HSS inserts can be accurately carried out, if you usually use $\frac{1}{16}$ in. sq. tools, by boring a 9mm ($\frac{3}{16}$ in.) hole in the end of a piece of $\frac{1}{16}$ in. square steel, and making provision for a couple of set screws on one side. This will hold the toolbit so that its top is $\frac{1}{16}$ in. above the tool rest.

Blade type parting-off tools can be held against a piece of $\frac{1}{16}$ in. square steel to put relief on the sides. Hence the overlapping of the wheel by the tool rest. This overlap is also needed when grinding boring tools. I have nine of these with brazed tips (home made except for a hexagon shaft bought tool, and this has had a second tip brazed on) The two largest are on $\frac{1}{16}$ in. square section steel. The rest are on round section steel, and can be held for grinding in the square holders in which they operate. The clearance can be made in two steps, and then rounded, or not, to suit. At the top of the range, are some very hefty bars for boring or thread cutting, and these have inserted $\frac{1}{16}$ in. HSS bits. (Threading to fit the lathe nose means a $2\frac{1}{16}$ in x 8 tpi thread). The smallest boring tool is a piece of $\frac{1}{16}$ in. silver steel with a TC tip made from a discarded circular saw tooth, and mounted in a piece of $\frac{1}{16}$ in. square steel. (It's probably the wrong type of TC, but it

SADDLE STOP FOR THE MYFORD



1. Completed device fitted to Super Seven.

This item of tooling shown fitted in **photo 1** was made for a number of reasons, quite apart from its obvious usefulness in working to precise lengths and depths, which can be pre-set. It can be used in conjunction with slip gauges, or on its own within the capacity of its own micrometer, which has a 1in. range. One of my reasons for making the stop was simply to machine a relatively long fine pitch thread. Prior to having the bed and saddle reconditioned at 'Myford', I generally found that due to wear and tear on the bed and slides, parts which were intended to end up parallel, always had a slight taper giving rise to problems of fit when these parts were assembled. The threads machined in this little item, fitted perfectly over the entire length without any discernible slack or backlash, which gave me a feeling of

satisfaction and a new found confidence in the accuracy of the machine.

General design

The bracket material is mild steel. The dimension giving the centre height of the bore above the bottom edge of the assembly has been increased on the drawings, which will probably be noticed by some readers on one of the photographs. This was done to prevent possible contact of the sliding rod with the joint between the apron and the bottom of the saddle. (I found on a trial assembly that the top edge of the part to be bolted on to the side of the lathe bed had to be lowered to the height corresponding to the top edge of the rack to prevent fouling the saddle.)

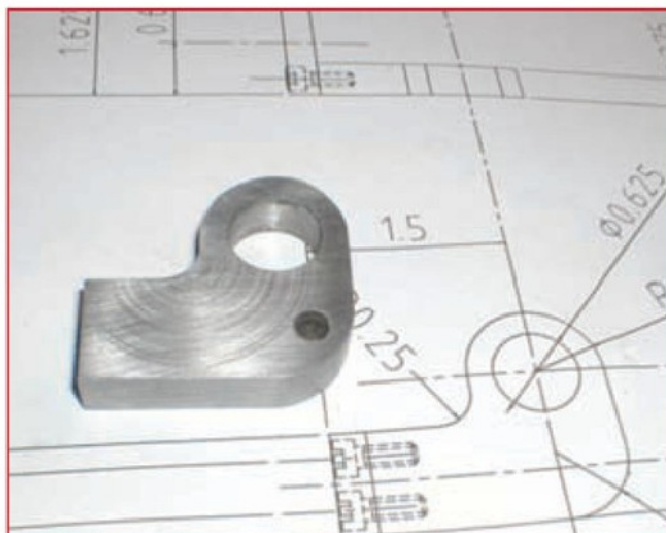
Dyson Watkins offers this neat design, which incorporates micrometer adjustment.

Bracket (Fig 2)

This was fabricated from two pieces, a length of 2½in. x ¾in. x ¼in. thick bright mild steel, and the other from a piece of ¾in. bright mild steel plate 2in. x 2in. Mark out the thicker part first, shown in **photo 2**, centre punch the hole positions and set up in the four-jaw chuck and drill/bore out the barrel-mounting hole. Then follow with the ½in. diameter hole to form the ¼in. radius. (**Photo 3**) Mark out and drill the holes in the thinner piece, finishing off each hole with a flat bottomed drill or counterbore. Do remember that the two smaller holes are counterbored on the opposite side to the two larger, and at this stage drill through for the two M4 screws at tapping size only. They will be opened up later. Complete the profile of the thicker part. If, like myself you don't have a milling machine, use the vertical slide, or be masochistic and do it with a hacksaw and file. The extra mystery hole in the thick piece visible in the photo, was there because I didn't have another piece without one! I plugged it later. Next drill and tap the M4 grub screw hole.

Thimble (Fig 3)

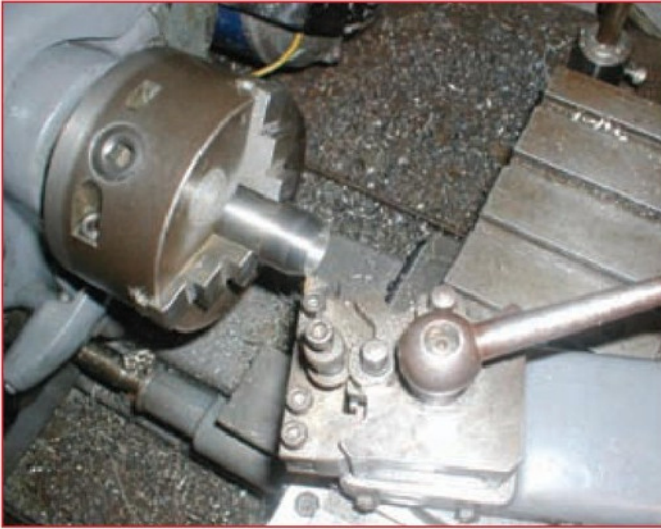
I used stainless steel for this part. Turn the O/D to size. Face, centre drill and ream right through to size. Drill and bore out the large diameter to give a clearance of about 0.010in. over the barrel. Turn the taper on the end and do not leave a sharp edge, but



2. Part of bracket, complete with extra hole.



3. Boring hole in bracket.



4. Turning the thimble.



5. Machining the barrel.

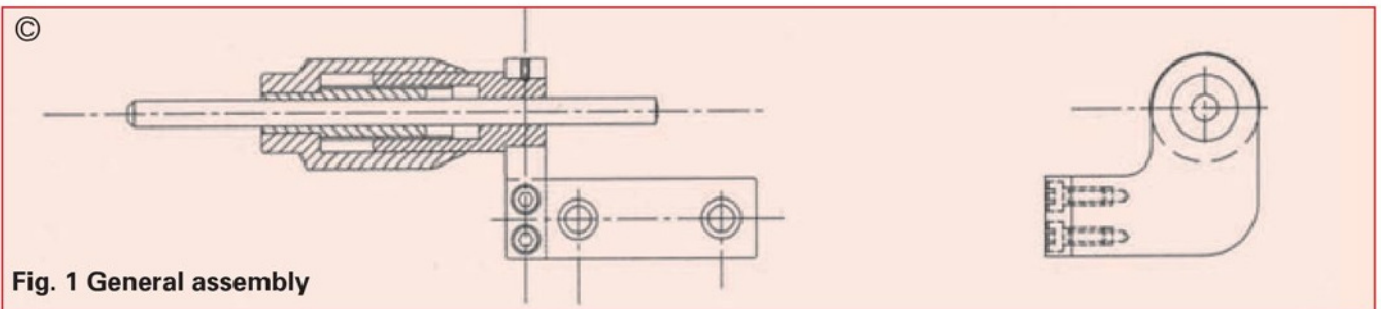


Fig. 1 General assembly

leave a flat of 0.02in. (Photo 4). Reverse in the chuck and turn the other end. Chamfer any sharp edges for comfort. At this point do not drill and tap the M4 hole for the sliding rod clamping grub screw. This is done later when the brass insert is installed in position. The grub screw will then prevent any movement of the insert relative to the thimble should the fit be insecure. If this is the case, a spot of "Loctite" retainer should help.

Barrel

(Fig 4 and Photo 5)

It is worth trying out the fit between the stop rod O/D and the reamed hole into which it is to be mounted. To do this, simply drill and ream a $\frac{1}{8}$ in. diameter hole in a bit of scrap and try the stop rod in the

hole. If satisfied, carry on. The barrel was made of stainless steel also. Mount the bar in the three-jaw chuck, face and centre. Turn the outside diameter to size. Drill and ream through to $\frac{1}{8}$ in. diameter. Bore out to 0.472in. diameter. Bore out an undercut of 0.510in. diameter for the last 0.25in. length of the bore to provide a run out for the screw cutting tool. Set up the machine to cut 40 tpi. and set up the tool with the same degree of care as with the external screw cutting tool. Move the tool gently into the bore until it touches the end face, and back off 0.2in. Mark the depth on the tool shank with a felt tip pen. I tend to wrap a piece of plastic insulation tape around the shank and mark the depth on this with a ballpoint pen. Take the first cut and listen carefully as well as watch the line. The hiss of the tool will stop abruptly as the point enters the undercut, at which

point disengage. Proceed until a depth of cut of 0.016in. is reached. Take a few extra cuts at the same setting to allow for the spring in the tool. Chamfer the leading thread. Move the tool out of the way, and using a fine scrap of wet and dry paper wrapped around a drill shank, run it carefully into and out of the bore a few times to remove any trace of roughness from the crests of the thread. Re-mount it in the four-jaw chuck with the other end projecting, and turn the shoulder to a good fit in the bracket. Clean the thread thoroughly removing all residue of swarf.

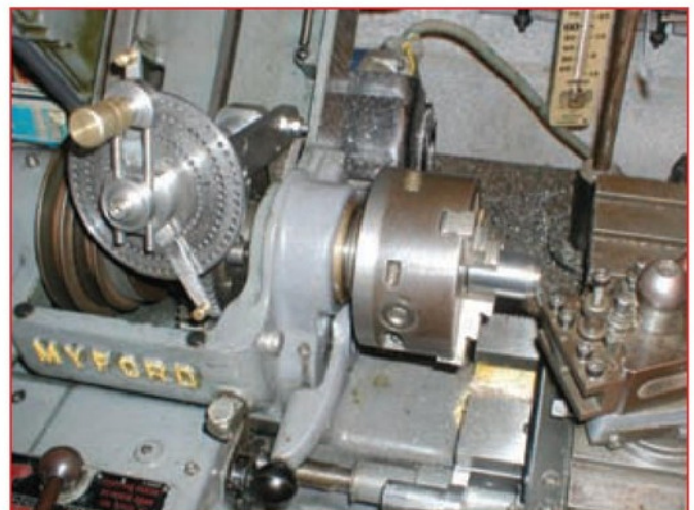
Threaded Insert

(Fig 5 and Photo 6)

Brass was my choice for this component with the view that it will provide smooth



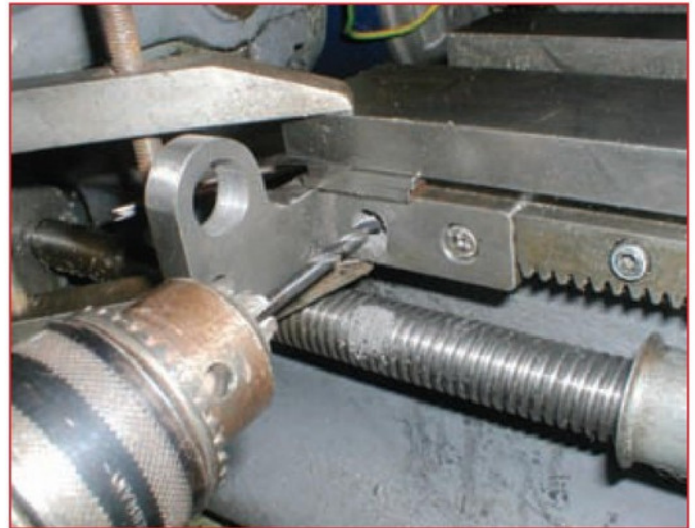
6. Brass was chosen for the threaded insert.



7. Using a Radford type dividing head for graduating the thimble.



8. Results of electrolytic etching trial.



9. Drilling the bed.

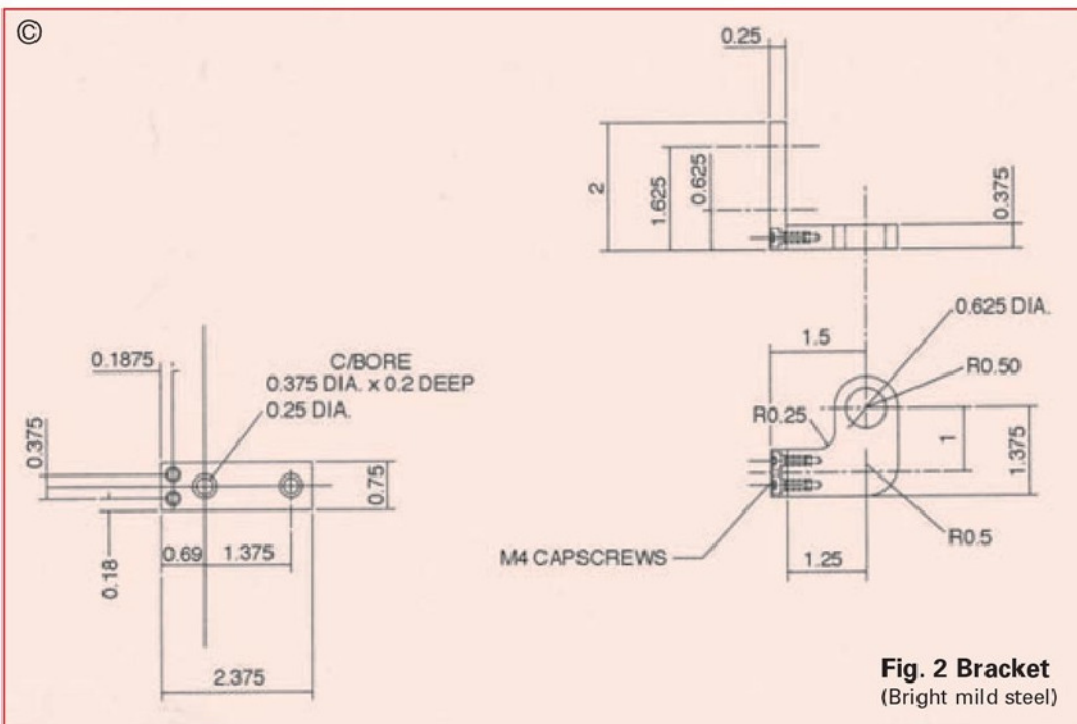


Fig. 2 Bracket
(Bright mild steel)

operation. Set up in the chuck with about $\frac{2}{4}$ in. projecting. Face and centre drill, followed by drilling and reaming a $\frac{1}{4}$ in. diameter hole right through. Turn the shoulder to provide the interference fit referred to above. Then clean off the O/D to 0.496in. This will give a slightly truncated thread. Sharpen the screw-cutting tool carefully, paying attention to the angle and clearances. The helix angle is small, being of the order of 0.9 deg. So a clearance angle of say 3 deg would be fine at the leading edge. Set up the tool with the use of a screw-cutting gauge and machine the thread, using the barrel as a gauge as the final depth is approached. When the barrel shows signs of fitting, clean the thread thoroughly and lubricate.

An old toothbrush is useful for the job of cleaning the thread. Retry the fit. Increase the depth in small increments, cleaning after each tool pass, until the barrel screws home. Press the brass threaded insert into position in the thimble, and then drill and tap the M4 tapped hole through both components into the centre hole. If the quality of fit between the two is not as secure as it needs to be, then apply a spot of Loctite retainer before assembly, but allow the Loctite to harden before cutting the 4B.A. thread in case the wet Loctite makes the tap seize in the hole.

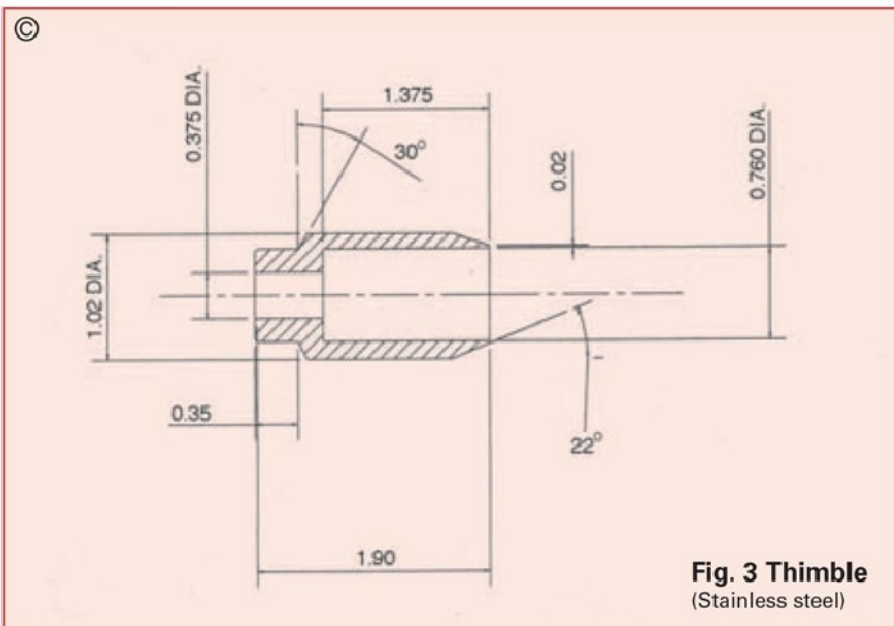


Fig. 3 Thimble
(Stainless steel)

Graduating thimble

Graduations on the thimble were straightforward in so far as the twenty-five division lines were concerned. The top slide was set over to the same angle as for the taper. A tool was ground up with a point angle of about 20 degrees, and the feather edge at the point was honed off with a slip stone. This was to

help to maintain the tip quality throughout the engraving procedure. The 25 divisions were obtained using a Radford type dividing head working off the bullwheel, which, having 60 teeth, meant indexing 2 turns plus another 24 holes on a 60 hole circle. (Photo 7). Another hint to maintain the tool tip in a useable condition, is to grind it without any top rake at all. I found that the top rake angle, if present, caused the tip to hook under the chip at the end of the cut, and caused breakage of the tip. The absence of any rake allowed the point an easier exit from the cut. I cut each line 0.1in. long with a groove depth of 0.003in.. Every fifth line was made 0.15in., which corresponded with the numbers 0, 10, 20, 30 and 40. It must be stated that I had some difficulty marking the numbers for which I had to use an engraver of the type used to make dog tags. My dog would have turned up his nose at any efforts I might have made to provide him with a tag of my making, and I had several attempts, skimming off each one, followed by another try.

- and barrel (Fig 6)

When faced with the job of engraving the barrel, the lines were engraved using the lead screw hand wheel to advance the cutter each increment of 0.025in. The lines cut to represent the 0.025in. divisions were done using the dividing head. The start and end of each line was thus easy to control, and the lengths of each line are given in the drawing. The numbers became a problem as before, so after just one attempt I decided to do a bit of experimenting using a printer. Earlier in the day, I had been to the local recycling depot with a trailer full of hardcore. I remembered noticing a quantity of computer junk in the skip reserved for electrical equipment. I therefore went back down, and, with the supervisor's blessing, came away with a discarded Panasonic printer that was equipped with a needle printing head. Amongst the relics of my teaching days, I had a few sheets of wax stencils used for typing master copies of student handout notes. These were used on a Gestetner printing machine. Although these were cut on old-fashioned typewriters, they should be possible on a needle printer. I experimented with differing font sizes and found that the 10-point Times New Roman font, had exactly the same spacing as the linear scale on the barrel, each digit being spaced from the next by 0.1in. Further trials at etching a suitable scale are shown on a sheet of stainless steel. (Photo 8) The electrolyte used was the same as that used for security marking and should be available from Pryor the metal number stamp manufacturer. The barrel was mounted in the vertical slide, and my previous attempts were milled away. The surface was then polished, and the numbers etched on. Although not perfect, the result was better by far than my previous free hand method.

Assembly

The bracket needs to be attached carefully to the lathe bed to ensure alignment with the bed. Another important point to

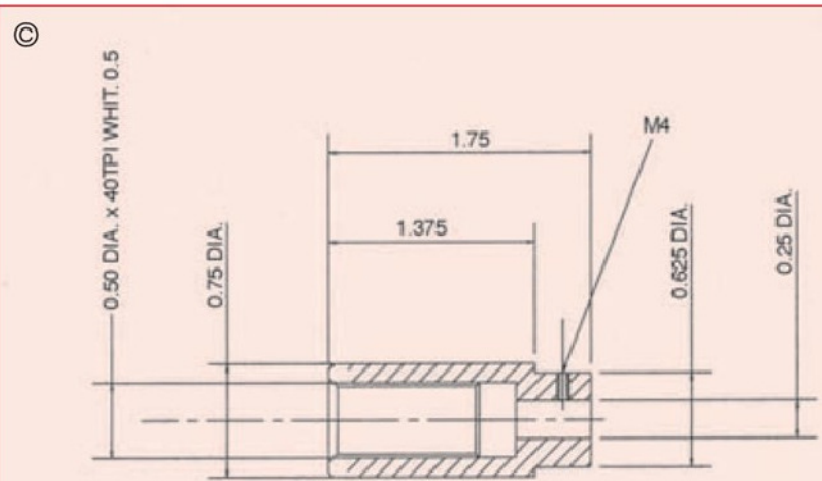


Fig. 4 Barrel
(Stainless steel)

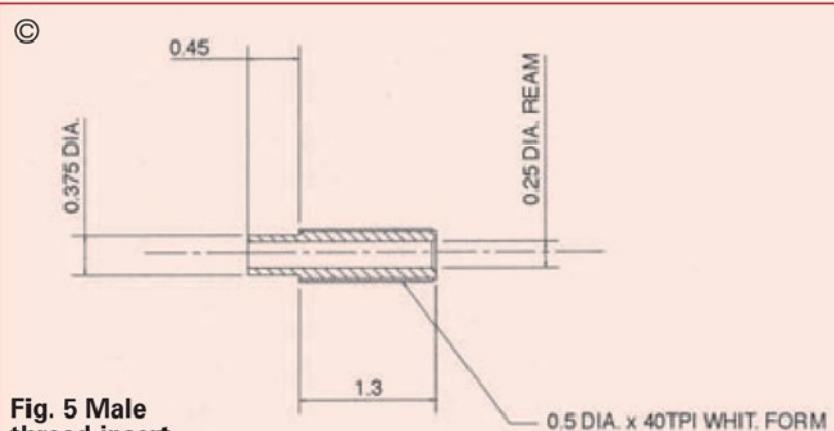


Fig. 5 Male thread insert
(Brass)

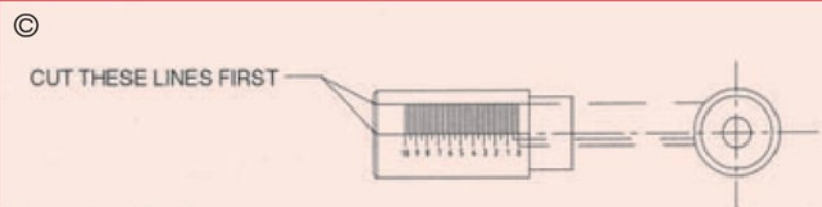


Fig. 6 Graduations

observe is that the upper edge of that part of the bracket to be screwed to the bed does not end up above the top edge of the rack. If it does, then the saddle will foul against the bracket. I inserted slips in between the bracket and the underside of the shear, and held the lot together using a

tool maker's clamp. (Photo 9). The tapping sized holes were then drilled with pistol drill. The bracket was removed to open up the holes to clearance sizes, and the holes in the bed were tapped. The assembled stop was screwed into place and the work was complete.

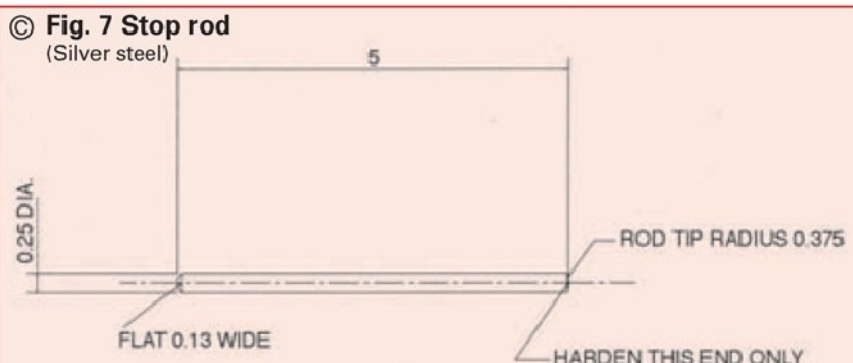


Fig. 7 Stop rod
(Silver steel)

FITTING AN ELECTRO TO A WARCO



1. Showing magnetically retained chuck guard and new control box.

Background

Having experienced the delights (and failings) of electronic speed control on a small lathe I had, it was clear that my Warco BH600 would have to be similarly equipped. The major failing I had encountered with the small lathe, admittedly on a fairly early version of the equipment, made me a difficult customer. I chose the Newton Tesla for no other reason than that it was advertised in the MEW and rang them for a discussion. I found John Newton to be most helpful and tolerant of my endless questions, my main one being about abuse of the equipment, such as arises from a dig-in. He assured me that the electronics were designed to cope with that and that it was not possible to damage the electronics by any misuse or overload. With that assurance I went ahead with the purchase.

Kit supplied

The items as delivered consisted of a 3-phase 2hp motor, with a frame exactly matching that of the existing BH600 single-phase motor, a white plastic box of about 150mm cube containing electronic gear, and a metal control box, all fitted with appropriate cabling. When altering anything I much prefer to arrange things so that I can revert to the original if necessary. The electronic equipment box had air-vents and it was obvious that it would need to be kept clear of swarf and oil. The best location for it would be that

Francis Langfield improved his BH600 with a Newton Tesla inverter drive.

occupied by the electrics box already existing on the lathe and I had to accept that, once the speed control was fitted, reinstatement of the original installation would be a major task.

Safety devices

Removal of the original electrics meant loss of the safety devices controlling the headstock gear cover, belt drive chamber and chuck guard and loss of the saddle mounted motor control lever. I saw no problem here. My workshop is not a factory and I am not governed, thank goodness, by health and safety regulations. In any event I had already disabled the chuck guard, which I found an unmitigated nuisance. I have had a lathe for the past 70 years, all very much second hand, the earliest being an 1895 Barnes, and all with open gearing and belting in the design of the day. I still have all my fingers. The chuck guard is now mounted on an arm clamped to the top of the headstock by a powerful magnet. It can be seen in **photo 1**. It can be moved and swivelled as needed to keep control of chips and turnings. It should be noted, that for those who might wish to reinstate all of the original safety features, the inverter is equipped to accept inputs from normally open or closed interlock switches, and Newton Tesla are able to give assistance with sorting out the circuitry.

Fitting

Removal of the electrics box was straightforward, although the box is surprisingly heavy, and it has been packed away just in case it should ever be needed. All the superfluous switches and cables were stripped out and also packed away. The wiring and switches of the saddle mounted motor control lever were left in situ, the cables being tucked away at the control box end, with a thought to possibly wiring it into the new system to retain the stop and start facility.

It was possible to use one of the screw fixing holes of the original electrics box for one of the new control box holes. That made it possible to spot through the other three, tap them M5 and secure the box - **photo 2**. The sheet metal cover over the motor pulley and below the control box was removed temporarily to give easier access to the motor. The motor sits on a hinged platform, which, as supplied, had the platform pulled down to the motor mounting frame and locked by a bolt. I found this made life very difficult when changing the belt between

pulley steps and removed the bolt to let the motor hang free relying on its weight to maintain belt tension. Removal of the motor is fairly straightforward - the main problem being handling its weight in the confined space underneath the headstock casting. The foot on the new motor can be fixed on any of the four sides of the motor and it was necessary to re-locate it to bring the cable entry to the top of the motor. Once this was done the new motor just dropped into place - **photo 3**.

The belt-changing information sheet was moved from the side of the headstock to underneath the belt chamber lid and the new control box containing the on and off buttons, the forward/reverse and run/jog switches and the speed control mounted in its place - **photo 1**. The single multi-core cable from the box was fed through a grommet fitted into a hole drilled in the top of the Norton gearbox and then routed along the course of the cable recovered from the original start and stop buttons.

The start and stop buttons on the Tesla box are each shrouded with a low surrounding rim. It seemed to me that the shroud might hinder the speedy finding of the stop button in an emergency, so the original and now redundant start and emergency stop buttons, mounted in the top of the Norton box, were interchanged with each other to bring the stop button to



2. Electronic box located to rear of machine. Also shows lathe mounted on castors for easy movement within garage.

ONIC SPEED CONTROL D 6IN. LATHE

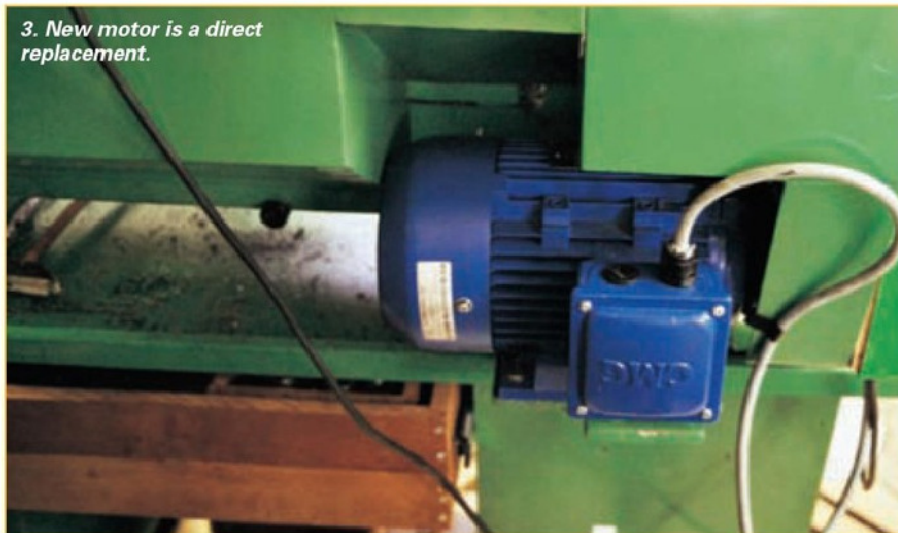
the right hand end where it would immediately be to hand. The buttons were then wired into the cable coming from the new control box, the start button being in parallel and the stop button being in series. Cutting the sheathing of the multi-core cable needed care to avoid damaging the fairly delicate conductors but once done the circuit diagram provided with the kit made it clear which cable was to be bared or cut and how the extra buttons were to be wired. I was unable to source a supply of the miniature terminals for the cut cable ends but John Newton readily forwarded a small quantity. The labelled face of the box as supplied was provided with a thin protective plastic film but this was removed and replaced with a sheet of 1.5mm clear plastic sheet which will last much longer and can more easily be kept clean.

The cables into the electronic equipment box were not supported in any way and just hung down. To remove the load on the terminals I fitted a wooden mounting block on the sheet metal cover guarding the motor pulley underneath the electronics box and anchored the cables to it, fitting a wooden lid over it. The box and lid was painted with Humbro enamel Emerald Green shade, which exactly matched the Warco green.

Experience

The system has been in use now for over a year and is excellent. Speeds, using the two step motor pulley and the three step mandrel pulley and back gear, range from 6rpm to 1350 but I use the high speed motor pulley and the middle mandrel pulley which gives me 480 to 1050 rpm.

3. New motor is a direct replacement.



This covers most needs and I have not needed to make any change. Jogging speed is 105 rpm and this is most useful for the occasional short requirement for a low speed for example such as screw cutting. Apart from anything else I now use the lathe for tapping. The taps are secured in the chuck and the item to be tapped pushed against the tap with the tailstock. Setting the control box to 'jog' enables one to control rotation exactly and the resultant tapping is square. It is most useful. Electrical power feeds to the lathe consist of one for the electronics gear and one for the halogen work light. I have a range of sockets mounted on the ceiling of the workshop and a cord pull ceiling switch controls one socket from which a cable drops to a twin socket mounted on

the side of the headstock pedestal, into which are plugged the feeds to the electronics box and the light. This minimises the number of cables from the ceiling.

I am not by background an engineer and real engineers looking at photo 2 will be horrified to see the lathe mounted on castors. The workshop, in a one-car garage built on the side of the house, is cramped and all my heavy gear is mounted on castors. This way I can quickly move machines to get to the wall against which are set the racks for my stores and drawers of small tools etc. The lathe is mounted on eight castors, which are rated at 100 kg each. The floor is very flat and level and I found no variation in the usual checks for accuracy wherever I pushed the lathe.



Fireside Reading

Tool and Cutter Sharpening

Harold Hall

A prerequisite for quality metalwork or woodwork is sharp tools. Changes in the make up of the workshop enthusiast population mean that we now have a greater proportion than used to be the case, coming from non-craft backgrounds. Whereas tool sharpening using an off hand or tool and cutter grinder would have been second nature to most second year apprentices many years ago, for many, such skills now have to be learned by a combination of study and experience. This book, Number 38 in the "Workshop Practice" series, addresses this, guiding the reader through the theory and practice for grinding a variety of tooling, and giving designs for a

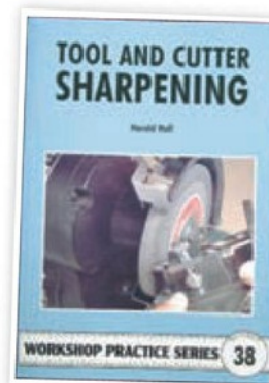
grinding rest and numerous accessories.

Chapter one introduces the general topic, considers various small grinders, the Quorn, Kennet, Vertex, Worden and Stent, provides information on wheel markings, and describes how excellent results may be obtained using an off hand grinder in conjunction with a versatile grinding rest. Chapter two deals in detail with sharpening drills, describing several attachments, also discussing drill point geometry. Chapter three covers the use of grinding rests, then chapters four to eight go into the detail of lathe tools, end mills, other milling cutters, small workshop tools and woodworking tools. (As a very occasional woodworker, I have to admit to finding this section most instructive.)

The latter chapters, nine to thirteen give descriptions and detailed drawings for

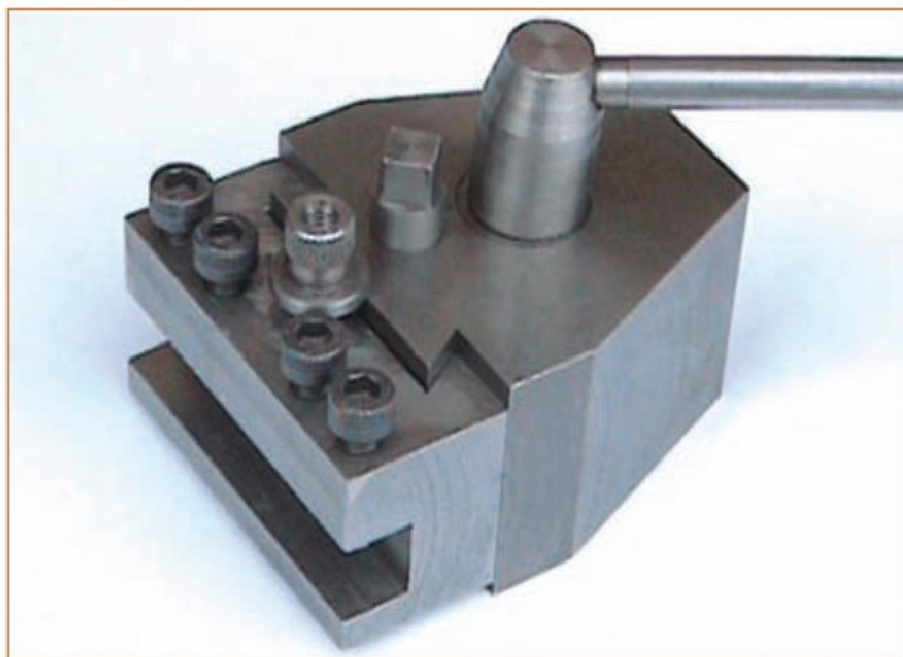
constructing the various accessories that may be needed to accurately sharpen just about anything in the amateur workshop. It is also quite probable that some professionals will find these useful, as much can be achieved without having to buy and accommodate a dedicated tool and cutter grinder.

Tool and Cutter Sharpening extends to 128 pages in 210 x 148mm paperback format and includes over a hundred black and white photos with numerous line drawings. The ISBN is 1-85486-241-3, and it is priced at just £6.95.



QUICK CHANGE TOOL POST

Will Bells suggests a design within the capabilities of many enthusiasts.



1. Completed Toolpost Assembly.

Background

Some years ago, having finally suffered enough with the standard Myford 'clog heel' top slide tool clamp on my ML7, I machined up a four way tool post. It was a step up from the original, but to be honest the frequent packing to change tools still fell way short of my ideal. It's not my intention to start weeks of acrimonious debate in the letters page from the die hard supporters of the four way tool post - I understand the theory of being able to fully load four tools and rapidly position at will. The snag was I could never actually use it like that; either I risked simultaneously machining the chuck or came perilously close to severing an index finger or two on the unused tools sticking out porcupine fashion. My failing I know, but I ended up just holding a single tool at any one time, which defeated the object somewhat. So, two years ago as a first project for my newly acquired Chinese vertical milling machine, and to avoid taking out a second mortgage to pay for a 'proper' quick release tool post I decided to design and make one.

Description

The better propriety designs (there are a few cheaper systems which also tend to use dovetails) have a number of advantages over that which can be produced in the average home workshop. For a start they are generally hardened, which in terms of rough handling and longevity is a big plus. Secondly the tool holder locates onto the body by means of a number of ground vertical faces angled

to provide rigidity when locked together. The tolerances required to achieve this for a number of holders are certainly well beyond the capabilities of my very average equipment, and I suspect the majority of readers of this magazine.

I therefore chose to use angled shears, clamped by a cam system; the result can be seen in **Photo 1**. I reasoned that if dovetail shears were adequate for the cross and top slides, then the tool post should certainly be rigid enough for

normal use. The down side of this approach, of course, is that a dovetail cutter is required which is an expensive item bought new. Fortunately they can be readily picked up from exhibition trade stands in good used condition for just a few pounds. Guess which option I chose. Harold Hall's excellent series on milling for beginners included a boring head with shears machined with an end mill. This could be an interesting alternative for someone wanting to redesign slightly.

The main body is machined from stock cast iron square section, normally cut to length by the supplier. It's not under any great stress and it's easier (although very much more messy) to machine than steel. The holders are all made from mild steel, as reasonable tensile strength is needed below the clamped tool to prevent breaking. Should one be feeling especially brave, both components could be made with advantage from tougher materials. The total cost of the main raw materials should come in below £10 for the body assembly and one holder, sourced from one of the suppliers advertised in this magazine.

The dimensions shown are designed around the Myford Series 7, but could no doubt be scaled up or down to suit other lathes. I felt it necessary to skim the top surface of my ML7 top slide for the four way holder which gave the system more capacity, although the primary reason was because using the original tool clamp had badly dented the surface. Prior to skimming, clearance to the lathe centre line was OK for normal $\frac{3}{16}$ in. bits, but just not adequate for my standard parting tool holder. My assumption is that the later Series 7 models are dimensionally similar, but I'm only guessing here.

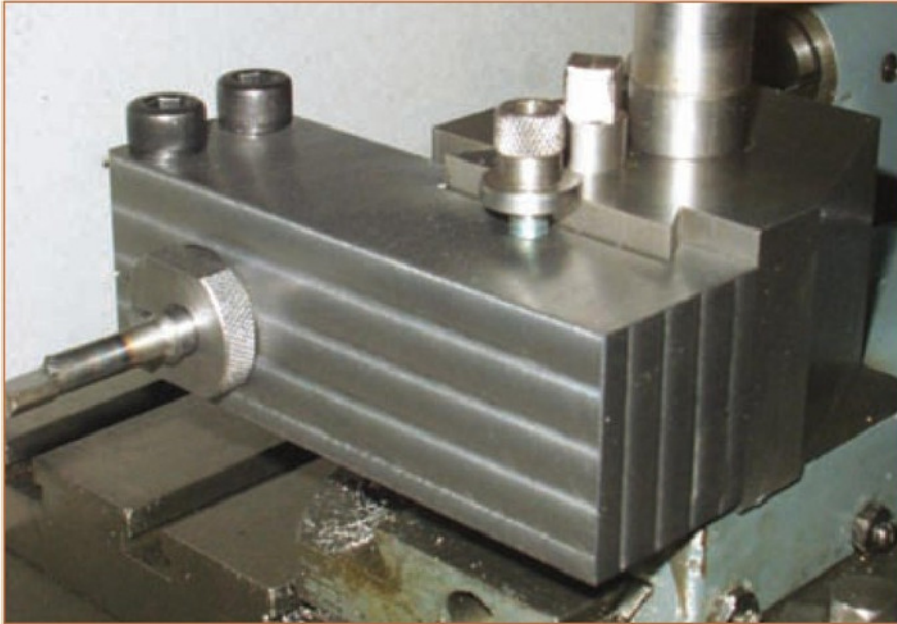
In use

After two years of amateur use (which included making a boring head, a rotary table and a Quorn), I have been pleased with the performance. Despite the lack of hardening the only sign of any wear or damage has been the square spanner flats on the end of the cam, which have been burred slightly, although I have been reasonably careful not to over tighten and to brush any swarf away prior to clamping. Initially I used the toolpost without making the spanner and I suspect that's when the damage occurred.

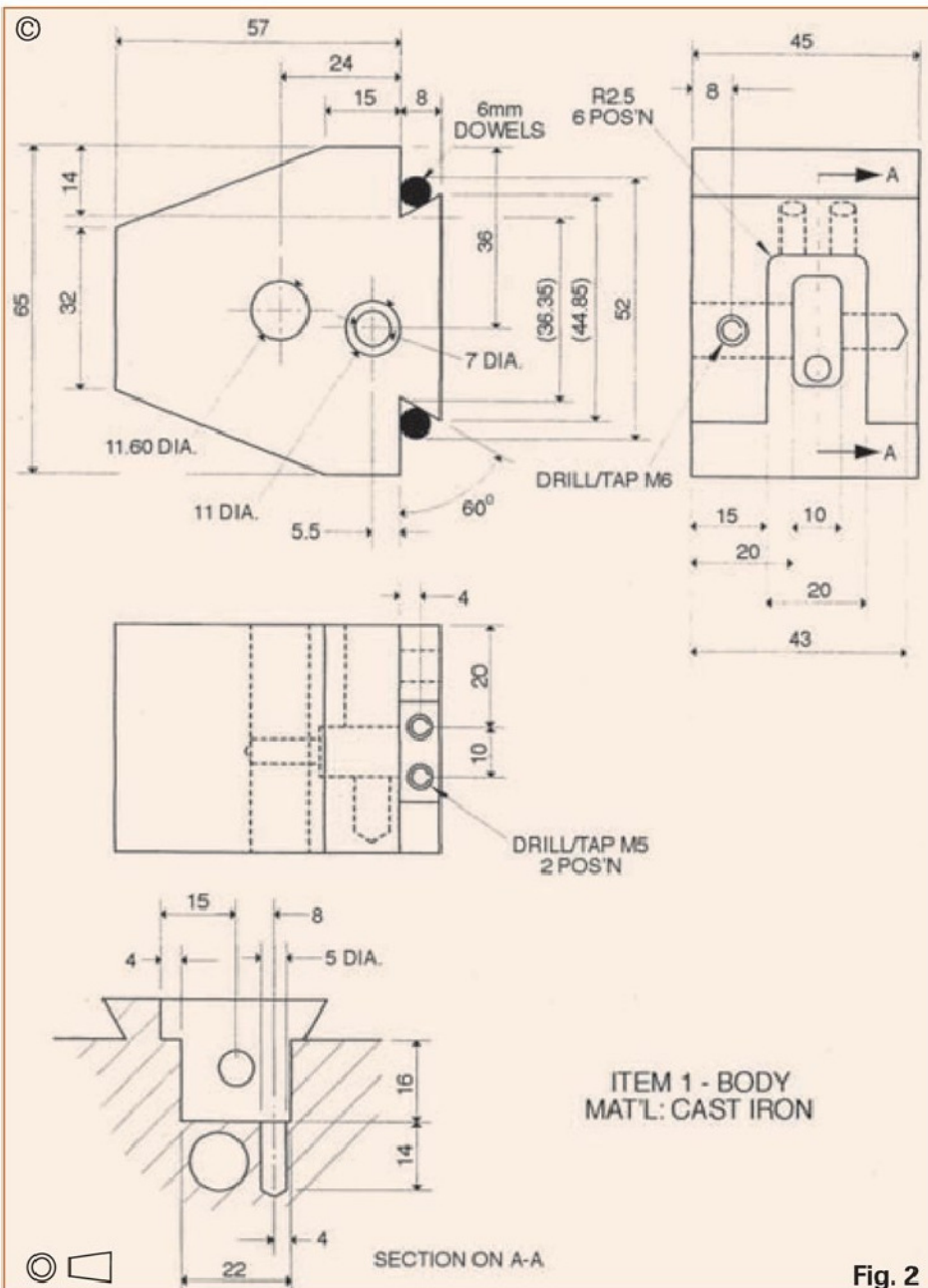
In hindsight (wonderful isn't it?) the position of the clamp should ideally be on the opposite shear to that designed. This would give the theoretical maximum rigidity in the normal turning position as opposed to facing. An alternative to this compromise could be to redesign the body to include two sets of clamping faces as per some of the proprietary versions to optimise both, but in truth rigidity has not been an issue.

I have not yet machined a huge range of holders - I have only three normal holders plus one to fit a range of boring tools using an adapter similar to the George Thomas system. I tend to keep two holders fixed with my favourite tools with the adjusting nuts locked to centre height with a grub screw, and one in which I frequently change tools. This covers 90% of my needs, although in use there have





6. Boring bar holder.



been occasions where I could not easily set the tool up close enough at the desired angle when using the rotating centre. I also encountered this with the previous four way set up, but to overcome this I will make an extended or angled holder when I get desperate enough.

Other fittings will perhaps be made when I have the opportunity such as a heavy duty boring bar holder, a knurling tool, and a parting tool holder.

Construction Notes

Body (Item 1)

This is the first and most time consuming component to tackle.

- Hold in four jaw chuck and face top surface
- Rotate, ensuring top surface is flat against the chuck and face the bottom surface. Drill and bore the through hole at the same setting to ensure body will sit squarely on the top slide (Photo 2).
- Blue and mark up top face checking the orientation.
- Clamping in milling vice, machine all none critical flat surfaces.
- Drill the two tapped holes for the clamp adjustment.
- Holding in the vice, machine the shears, then the clamp pocket and spring location details. Drill and tap M6 hole for the cam retaining screw
- Re-clamp in the vice to drill and ream the cam location bore.

Drill and bore the 11.6mm hole to suit – this diameter fits my Myford

The heavy machining of the surfaces was carried out using a face mill (Photo 3) supplied with the machine, which utilised HSS cutting tools. After this project I replaced the HSS tools with mild steel machined to take screwed carbide inserts which I happened to have in my 'someday drawer'. I wished I had converted this before starting this project - the difference in speed of cutting is huge and would certainly have reduced the machining time and the tool regrind frequency significantly.

A slight digression perhaps, but I lived with the Chinese mill/drill type of milling machine for 18 months before changing it for a second hand ex school British machine, which was actually cheaper. The Chinese machine was incredible value for money though – nothing failed and it did everything it said it would do on the box. But for me, the overall quality experience was just not there; the rigidity, the smoothness of the leadscrews, the cast in tee slots, the weak (and non retractable) adjustable table stops, quill backlash etc. Even the table seemed to be made of softer iron than my other machine tools.

Nothing however is ever perfect and after a number of unexplained errors in components made with the British machine, I discovered that the so called metric version had in fact imperial leadscrews with metric graduations on the dials giving 0.4 mm error for every 25 mm of travel. The air was blue for a couple of days I can tell you - the neighbours learned some new words and I learned not to take anything on face value.

Fig. 2

Anyway, continuing...

Before machining the shears ensure that the base of the block is set up square to the machine axis and double check that the head (if it swivels) is truly square to the table using a dial gauge on a bar held in the chuck and rotated against the table. Machine the excess material around the shears with an end mill, leaving a few thou for finishing. Using the dovetail cutter, (Photo 4) cut the angles taking it gently to keep the edges sharp and cutting just above the flat so as to cut on the angle only. Before taking the final finishing cuts on the angles, drop the cutter down to take a finish cut on the flat. Do both sides without adjusting the depth setting (this is most important because the flat load bearing surfaces must be that - flat), then up by one cigarette paper's thickness to finish the shears.

It's good for the soul to aim for the drawing dimensions however, should disaster strike most of the parts can be adjusted to compensate with a little thought. The width of the shears should be measured using dowel pins as shown, and yes, 0.1mm on the horizontal leadscrew gives 0.1mm measured difference across the pins. Silver steel rod would be an acceptable alternative although not quite as accurate.

The clamp plate pocket area can be milled out with a 10mm slot drill at the same setting, finishing the corners with a 5mm diameter slot drill.

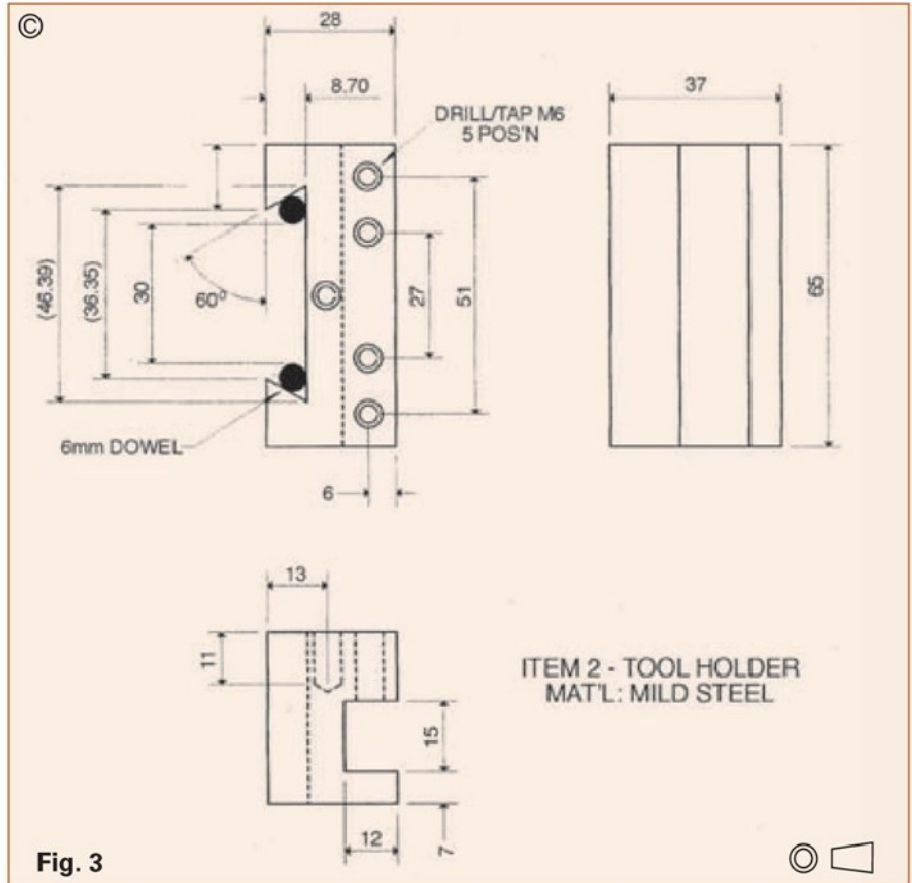
The cam location holes would ideally be bored and reamed if possible, although drilling and reaming should suffice. This is most easily set up on the mill (or vertical slide), held in the vice or clamped to the bed. The distance from the working face is important, so datum off the flats dimensioned 5.5mm and use the leadscrew dials to move into the correct position. I tend to use an edge finder (or wiggler) which kicks out of concentric rotation when the edge position is reached, but cigarette paper does just as well; a small piece wetted (licked!) and stuck onto the datum face will be whipped off by a rotating cutter 1 thou off touching. The centre is easily picked up to within a few thou by using a centre finder (or 'sticky pin') which is adequate. The 11mm diameter breaks through the side wall in the cam pocket area. Sorry, but it does no harm.

Finally, deburr and lightly chamfer all edges with a file before you cut yourself. This statement applies equally to all the following components

Tool holder (Item 2)

- Holding in milling vice, block up all non-critical faces.
- Machine shears
- Turn in vice and mill tool location slot
- Drill & tap M6 in 5 positions
- Screw and lock M6 stud in place with Loctite retainer or equivalent.

Machine the shears following a similar strategy to those on the body, but dimensional accuracy across the dowels is more important so that all holders lock in position in a similar manner. Mill the tool slot with a slot drill, taking several passes as rigidity of the machine allows. Theory says that to minimise cutter wear it is best to retain recommended cutter speed and



feed rate if possible and adjust the depth of cut to suit.

Adjustment Nut (Item 7)

- Hold bar in 3 jaw chuck and turn external diameters
- Knurl
- Face, drill and tap M6
- Part off

The turning is straight forward enough, but orientate so that the knurled end is nearest the chuck, thus ensuring that the bottom face has a good finish and is square to the thread. Knurling I find best done at

half normal turning speed, with lots of cutting fluid to clear away the debris. I used a 25 tpi diamond form which looks right. Take the time to let the knurl detail form, slowly feeding in the wheels and stop when the peaks have been fully defined.

Clamp (Item 3)

- Machine the block square to overall size
- Mark out
- Holding in vice, rough machine to shape
- Complete upstand dimensions, rear flats (7.6mm dimension) and 60 degree angle in one setting

7. Toolpost in use in lathe.



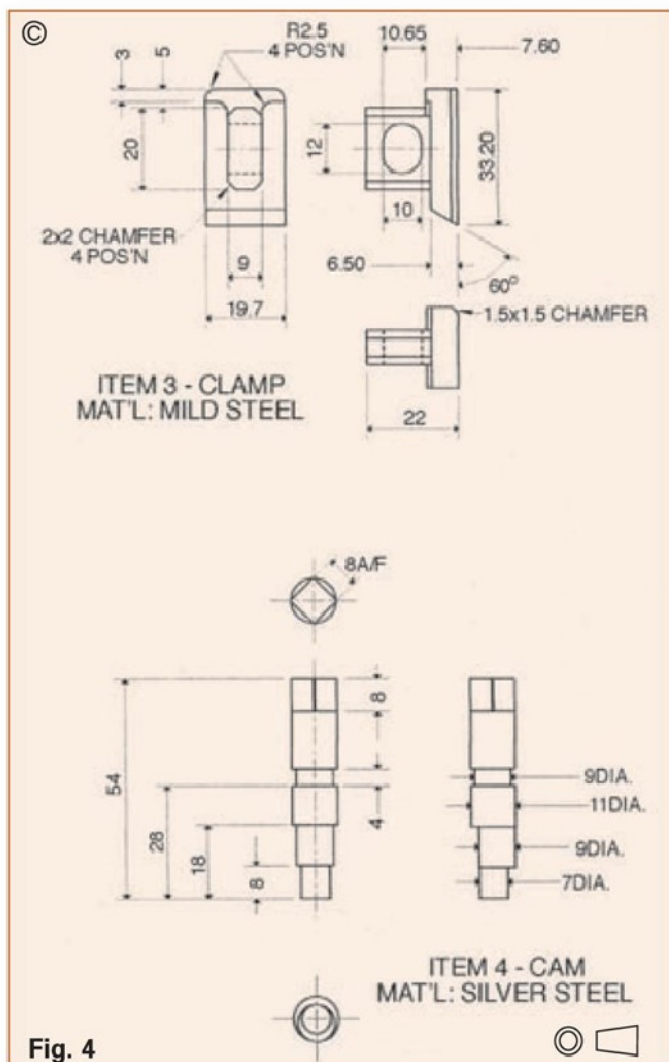


Fig. 4

- Reposition in vice and machine circular slot
- Machine chamfer on front face.

The first important aspect of this component is getting the angular relationship between the 60 degree angle and the two small flat areas at the rear so that the clamp pulls up squarely. The best way to ensure this if your mill has a swivelling head is in one setting. If not, reposition to machine the angle, setting up very carefully - it should be set square in all planes.

The second important aspect is the position of the circular slot, or more precisely the position of the face that the cam tightens on to. This can be marked out after all the other operations have been completed, using the two flats as a datum for the final finish cut. Some adjustment is provided by the two M5 grub screws on assembly. The area around the hole could be case hardened if felt necessary to minimise wear, although as stated earlier, this has not been necessary on mine.

It might also be possible to position the slot by making up a hard pointed rod 11.0mm dia. to be used as a punch in the cam bore after trial assembly. Not having used the method I cannot vouch for its effectiveness.

Cam (Item 4)

Chuck silver steel stock and turn concentric

diameters in single setting, supporting with rotating centre if necessary.

- Part off to length
- In four jaw chuck, hold to turn the eccentric cam
- Transfer to mill and machine flats

The length dimensions are not too critical, but ensure diameters are a nice sliding fit in the body without being too tight and protect when re chucking with a strip of paper wrapped around where the chuck jaws contact. Use a plunger type of dial gauge set normal to the lathe centre line to set the four jaw, setting so that it gives a total indicated reading (TIR) of 2mm. If you only have a lever DTI available, you could use it in conjunction with the cross slide by zeroing on the low cam portion then move the cross slide out by 2mm and check for zero on the high portion. Ensure the stylus is set normal and horizontal to the lathe centre line.

My method of machining the flats was to use the mill, holding the work vertically in the vice. Zero the table dials so that the spindle axis is concentric with the work (this is where the DTI comes into its own), and machine the flats using an end mill. Other methods will depend on the facilities to hand, and indeed, some may prefer to modify the design to suit commercially available sockets.

Handle

This is made in two parts and screwed together using Loctite retainer.

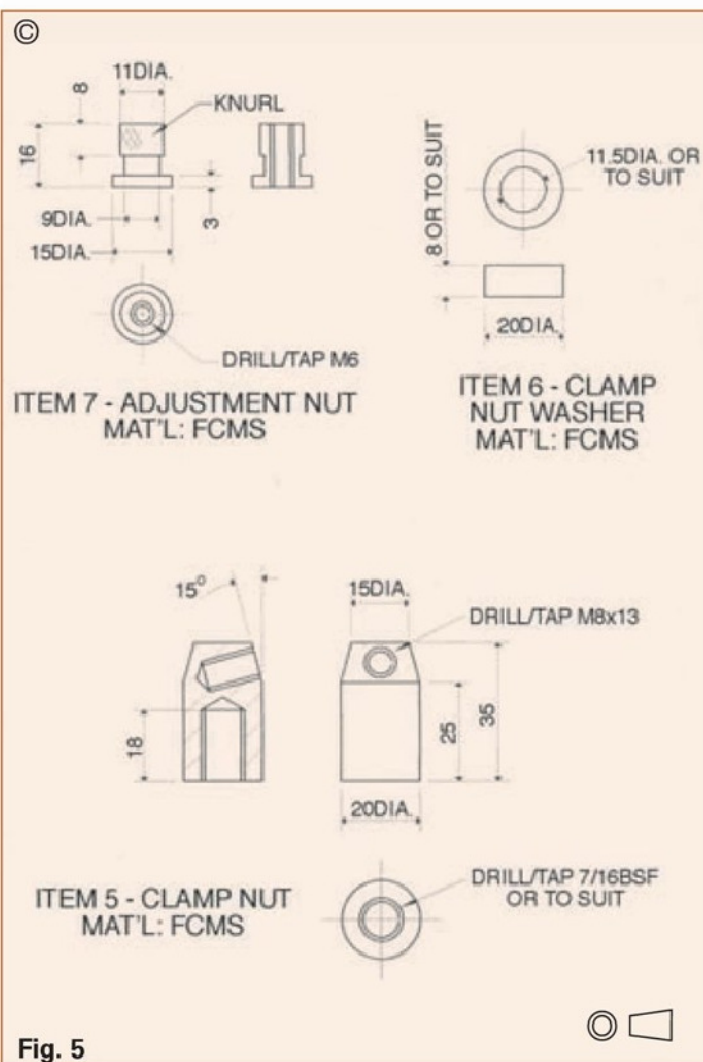


Fig. 5

Clamp Nut (Item 5)

- Hold bar stock in three jaw chuck and face end.
- Drill and tap $\frac{5}{16}$ in. BSF or to suit lathe tool post.
- Turn outside diameter and part to length
- Re-chuck to turn the angle and skim the parted end if required.
- Centre punch, hold in machine vice at an angle and drill and tap M8 hole.

Bar (Item 14)

- Cut to length 8mm bar, face in lathe and thread M8 one end
- Re chuck to face the other end then round and smooth with file.

Screws (Items 8 – 11 & 13)

No particular challenge here, just machine as per drawing - make sure the grub screws are soft or a carbide tool is used. The M5 grub screws should have squared ends to prevent biting into the cam.

Be mindful with the tool clamping screws that if the tips burr against the tool, removing them will be difficult. To avoid this, harden or machine a chamfer just smaller than the thread root on the end.

Spanner

This is also made in two parts and clamped together with a grub screw and a liberal

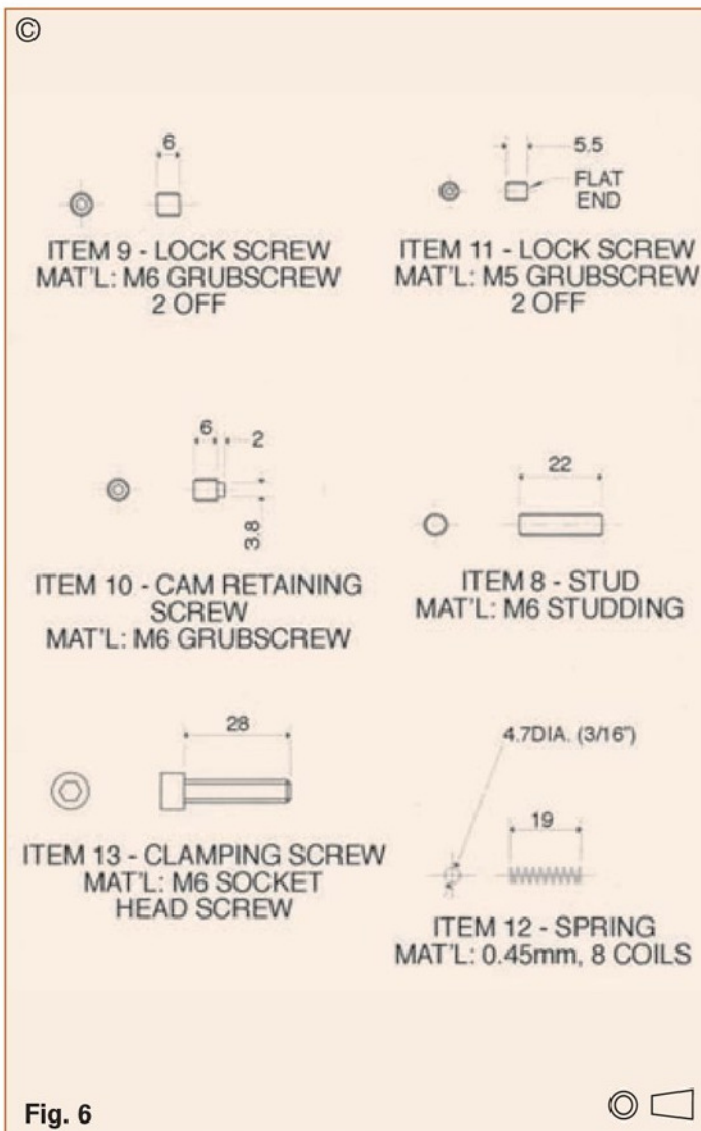


Fig. 6

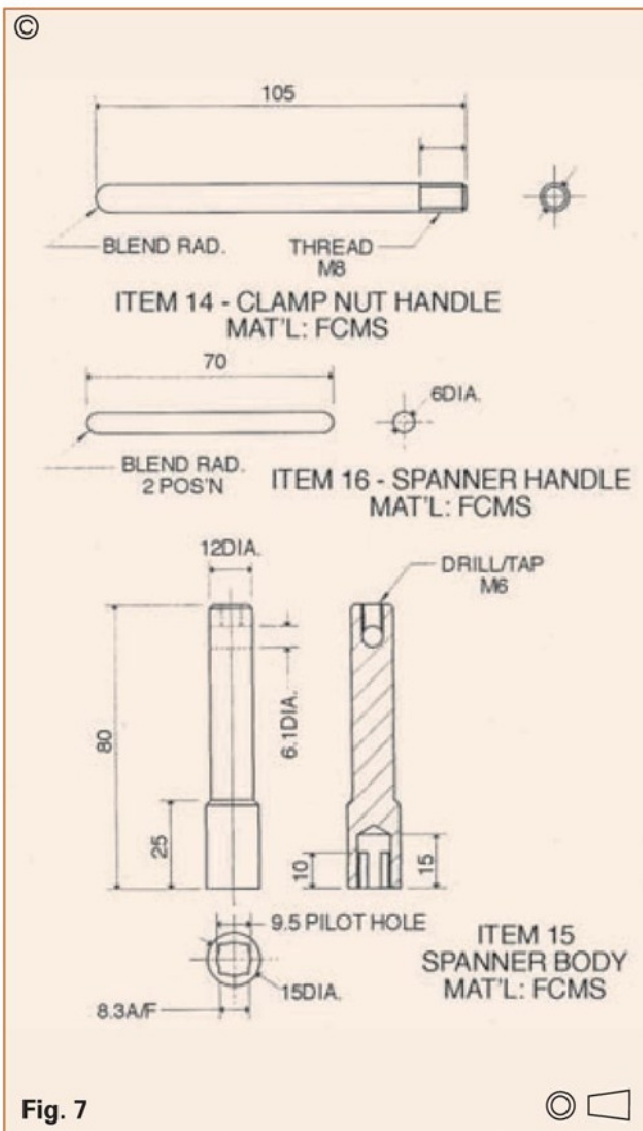


Fig. 7

dose of Loctite retainer for good measure.

Spanner Body (Item 15)

- Cut 15mm bar to length and face both ends.
- Drill 9.5mm pilot hole.
- Remove from lathe and form square socket.
- Re-chuck and turn 15mm diameter
- Re-chuck, holding 15mm diameter, centre and support end with rotating centre.
- Turn and complete 12mm diameter and tapped hole.
- Centre punch and drill 6mm hole 9mm from end.

Bar (Item 16)

- Cut to length 6mm bar, face each end in lathe and round and smooth with file.

It took a bit of experimenting to get the square socket to form successfully. Eventually a male punch was made from 1/2in. mild steel a couple of inches long and an 8mm square machined on one end. The leading corners were rounded to help the punch force its way in. The spanner was then held in the vice, the end was heated to bright red and the square punch hammered in and waggled back out whilst still hot. Turn the outside

after this to remove distortion and oxides.

Drill the 6mm diameter so that it's a good fit on the handle. The spanner could, with advantage, be case hardened around the socket end, but as with the cam I didn't.

Other approaches are possible to create the drive end of the spanner. The subject of drilling square holes was discussed by Giles Parkes in MEW Issue 112. Other methods include drilling, then cutting by reciprocating action as for internal keyways. Alternatively, a commercially available socket spanner may be used, and the end of the cam sized to suit.

The principal parts of the toolpost and one holder may be seen in **Photo 5**, with the boring bar holder in **Photo 6**.

Assembly

Final Body assembly sequence is as follows:

- Insert spring into 5mm hole.
- Apply grease to area around slot in the clamp and place in position in body.
- Smear cam with a little grease and insert, rotating whilst carefully pushing to ensure correct positioning.
- Insert the cam locking screw

applying Loctite Threadlock sparingly. Do not tighten against the cam. It should allow free rotation of the cam and sit underflush with the body surface.

- Insert clamp adjusting screws, again with a little Threadlock and adjust.

Trial the assembly before applying Loctite etc. to identify any areas of tweaking required.

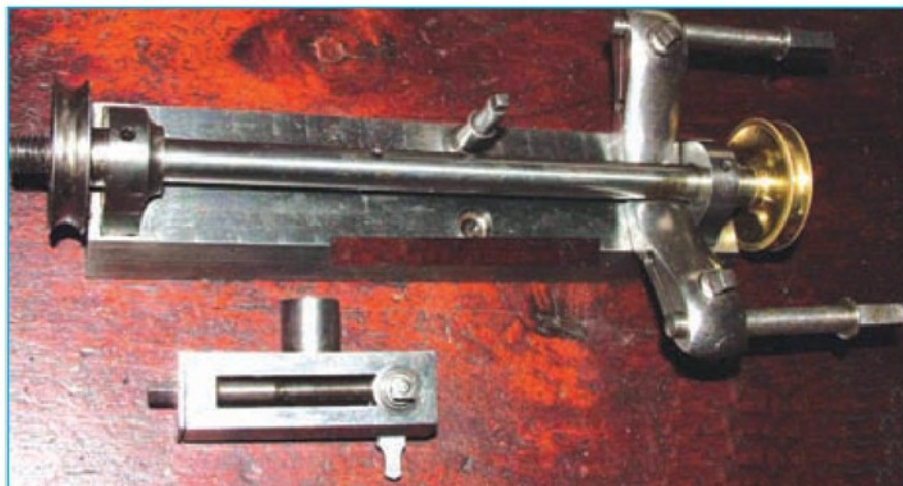
For guidance, the adjusting screws should be tightened just so that the cam rotates to the 10 o'clock position with the tool holder assembled and light torque applied. Ensure that both screws are adjusted equally by comparing the pin dimensions top and bottom of the clamp. There is only small amount of available adjustment and if more is required it may be necessary to increase the clamp slot width (12mm dimension).

Assemble M6 socket head screws to the holder along with the adjusting nut and a grub screw to lock the nut when required. As already mentioned avoid excessive tightening forces on the cam as the mechanical advantage produced by this type of system is huge.

The completed device is shown in use on the lathe in **Photo 7**. And finally, happy turning!



ORNAMENTAL TURNING 5



1. Detachable head type eccentric cutting frame.

The conventional type

The old tried and tested method devised by J. H. Evans over 100 years ago is probably as good as any. This type has plain bearings at each end of a long spindle to provide maximum stability. When it was first invented in the mid-19th century, the instrument was a screw-on attachment for the already existing Drilling Spindle (see **photo 1**).

This idea worked quite well for a while, particularly on those with short heads (with a maximum cutting radius of one inch) but it was said that the heads became inaccurate through wear on the screw thread from the head being screwed on and off. This problem was overcome by forging the head and spindle from one piece of steel. The forging must be done by a blacksmith or, if this service is not available, two parts silver soldered or glued together with heavy duty Loctite should be sufficiently rigid.

A general arrangement of the Eccentric Cutting frame is shown in **Sketch 1**. The various parts of the device (see **photo 2**) may be case-hardened so as to take a good polished finish and be less susceptible to dents and scratches. If the spindle is to be case-hardened it must be done sufficiently deeply to allow for any necessary grinding and it must be remembered that silver-soldered joints will fail if subjected to hardening temperature. Conversely, a hardened spindle will lose its hardness if subjected to silver-soldering heat; I have been told that the latter can be avoided by pushing the spindle through a raw potato with only the head end protruding upright. Thoroughly cleaned, smeared in flux, with a piece of solder on top and the head on top of that; heat may be applied until the solder melts; then a light tap to seat it firmly on the taper and the joint should be good without spoiling the spindle. If this method seems doubtful make the components in mild steel, have them case-hardened and then join them

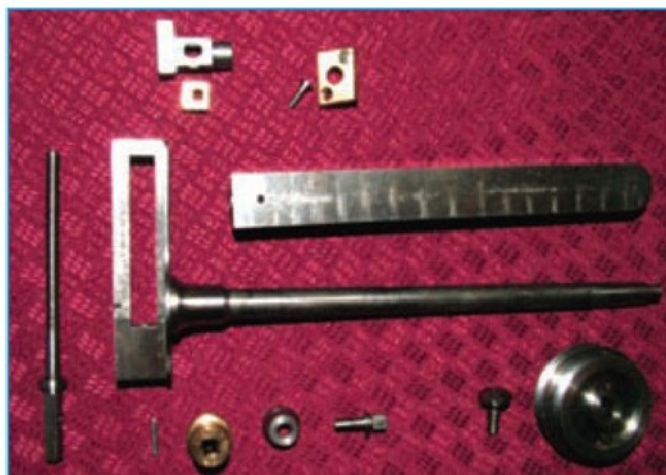
John Edwards describes the conventional Eccentric Cutting Frame

with a heavy-duty Loctite.

The head

This is made from a piece of hardenable steel 0.800in. x 1.200in. x 2.500in. long (or longer as required). **Sketch 2** illustrates this, the dashed outline showing the basic block size. It needs to be 1in. longer than the desired cutting radius. Lines are scribed all around 0.750in. from the end and longitudinal lines are scribed along the centres of all sides and faces. The piece is mounted in the 4-jaw chuck, so that it runs true to the scribed centre, and almost half of the material is turned away to leave a spigot of 0.500in. diameter x 0.600in. long; with a radiused neck for strength. A decision is required at this stage. You may either fit this spigot into a hole bored accurately in the centre of the disc on the cutting frame described in my previous article or, make a complete new cutting frame in the conventional style.

If the first course is chosen the spigot is simply let into the disc and two holes drilled, countersunk and tapped 4BA or similar, through the back of the disc into the head where the screws will not interfere with any moving parts. If the second course is chosen the spigot is next bored to fit the spindle. Those with a reliable taper turning attachment may improve the accuracy of the fitting by turning a slight taper, say about 2deg. inclusive, both in the socket and on the head end of the spindle. The taper on the spindle must be slightly shorter than the taper bore in the head so it will seat firmly.



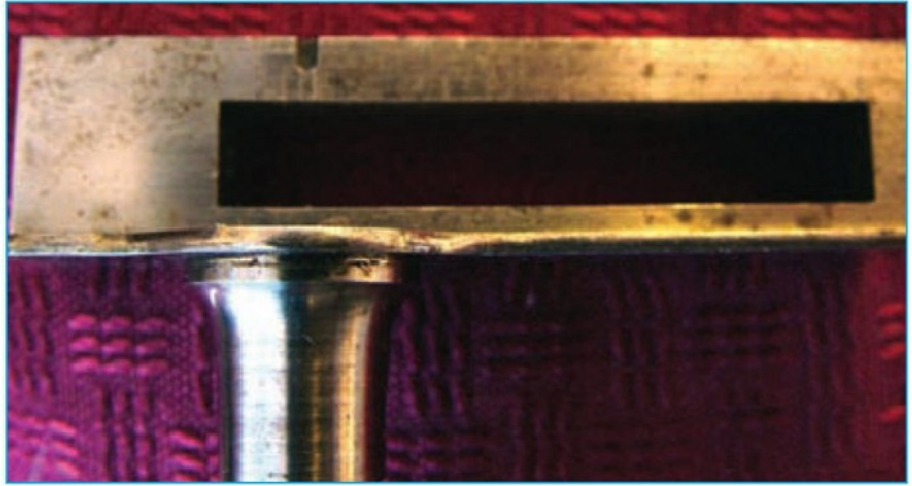
2. Component parts of conventional E.C.F.



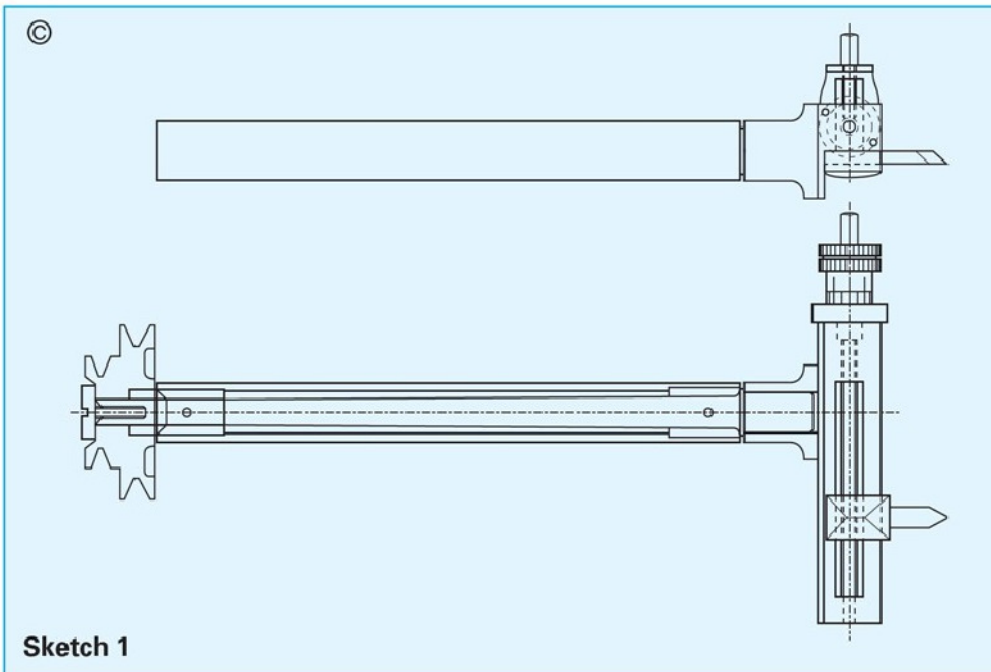
3. Pulley and screw.



4. End view of shank showing hardened bush.



5. Detail of slot in head.



0.400in. long and 0.200in. across flats for locking onto the drive pulley.

A further problem is: how to harden the bearing surfaces without distorting the spindle or, how to correct any distortion occurring during hardening. Those with access to a spindle grinder should be able to make the spindle slightly oversize so that it may be ground true after hardening and fitting of the head. The neck of the spindle should also be ground true and parallel; some were turned tapered, but at a later stage it may be desired to fit a balancing weight and/or a front-end pulley, for which a straight neck is preferred.

With the spindle hardened and the head fitted, the spindle is mounted to run true in the 4-jaw chuck and a small centre hole is drilled in the head. The spindle is then mounted between centres, the front face of the head turned at 90° to the spindle axis and the bearing surfaces ground true.

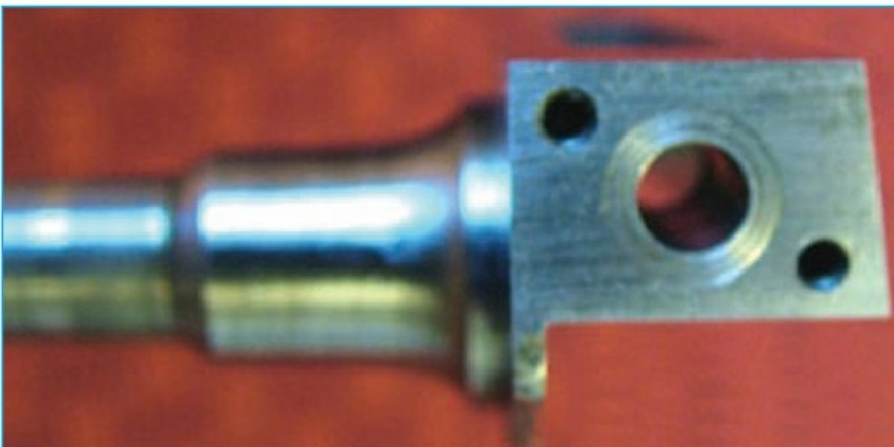
Spindle (see photo 2)

The spindle may be made from mild steel (for case-hardening) or from other hardenable steel. It is centred at each end; the centre at the tail end being enlarged to almost the full diameter of the spindle then a hole about 0.500in. deep drilled and tapped (2BA or similar) to receive the

retaining screw. The spindle is then mounted between centres, supported by a steady and turned to the required profile (more than 0.325in. at the head end and reduced to more than 0.280in. at the pulley end; the bearing surfaces need to be slightly oversize to allow for case-hardening, grinding and lapping). The tail end of the spindle is then milled or filed on two opposing sides to form a tang about

The pulley

This should be made at this stage so that the grooves may be turned true while there are still two centres remaining on the spindle and head. It is made from 1½in. diameter mild steel about 0.600in. thick, usually with two 'V' steps cut at 1.000in. and 1.200in. inner diameters to take standard 3 mm round drive belt. This is faced off and 'dished' (weight reducing concave depressions cut inside the rims)



6. End view showing location for leadscrew.



7. Leadscrew, nut and cutter box.



8. Micrometer head, pin, endplate and screws.

process to take up any slight wear.

The shank

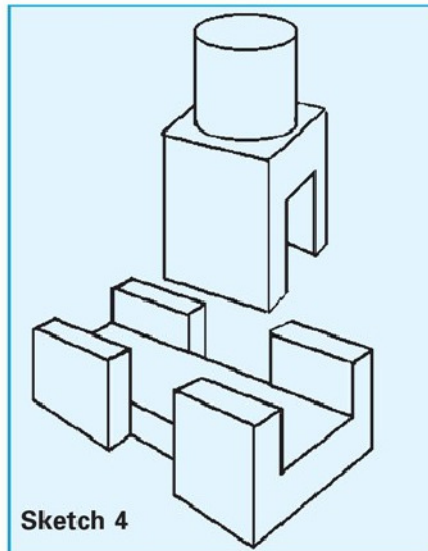
Also known as the stem of the tool, this is made from a piece of steel $\frac{1}{8}$ in. square by 5in. long, (see **photo 2**) mounted in the lathe to run true, drilled half-way through then reversed and drilled $\frac{1}{8}$ in. throughout or slightly more (to provide clearance to the spindle) and bored 0.425in. at each end to take hardened steel bushes (or collar-bearings) coned at the open ends (see **photo 4**), pressed into each end. The bushes are, for the shank: 0.600in. long x 0.425in. outer diameter both with female cones at 45deg.; the bush in the pulley is 0.250in. long including a male cone protruding 0.050in. (so the pulley is counter-bored 0.200in. deep to take it). The front bush is bored to an inner diameter of 0.325in. and the rear bush bored to 0.280in. The spindle should be ground to these sizes then the bushes lapped onto it. To avoid the extra work of making bushes some cheaper versions had the shanks made in one piece with the ends hardened, but they sometimes suffered distortion in the hardening process. Also, from a cosmetic viewpoint, the finished instrument when polished would be brighter at the ends than in the centre. The bushes should, ideally, be pressed into their places but, in the absence of a

suitable press, they may be fixed with heavy duty Loctite. Oil holes are drilled through the top face of the shank, about 0.250in. in from each end (see **photo 2**). A hard-tipped drill will be necessary for this job as it has to cut through the hardened steel bushes.

Back to the head

We now return to the head of the instrument. This is aligned by the spindle centres on the milling machine and the lower surface is machined parallel with the spindle centres; this provides a datum surface. It is then mounted by this datum surface on a surface plate and scribed along the front face and both ends exactly on the centre line (spindle axis). The ends are also scribed across at 0.300in. in from the front face so that the holes for the leadscrew may be drilled at the points where the scribed lines cross. (Some conventional types are made slimmer with the line 0.250in. from the front and the slot for the leadscrew being 0.250in. wide.) It is then mounted by the lower (datum) surface on the mill on a truly flat piece of scrap metal for packing; the packing piece is necessary to protect the milling table as a slot will be milled right through the head.

The upper face is milled exactly across the centre, removing half of the centre hole (see **photo 5**), but leaving a supporting back wall about 0.050in. thick for the back of the cutter to butt against; (this may later be filed to a fancy curve as seen later in **photo 14**). It is most important that the finished surface be exactly on the centre line (spindle axis) and it may be necessary to mill it to within 0.001in. of centre so that it may be finished later by grinding or filing. A slot 0.300in. wide to accommodate the leadscrew is next milled out to full depth on a line 0.300in. from the front face; this will also be finished and the corners squared off later by filing. The head is re-mounted on the milling machine with the spindle horizontal and with the left end uppermost and a hole is drilled for the small end of the leadscrew; the piece is then reverse mounted so that the right end is uppermost and the second, larger leadscrew hole is drilled and counter-bored 0.100in. deep to receive the collar of the leadscrew (see **photo 6**). These holes should be made a close fit to the



Sketch 4

leadscrew, which should be lapped in to run smoothly.

For some unaccountable reason the front face of the conventional head is then milled to provide a clearance, which varies between 5deg. and 10deg.; this may be seen also on the end-plate (see **photos 6 and 8**). In use the cutter protrudes beyond this front edge so the clearance is unnecessary.

If a milling machine is not available the slots in the head and cutter-box must be drilled out and filed up by hand. Skilled men of the 19th century made these parts by hand as a matter of course and produced phenomenally accurate and fine work.

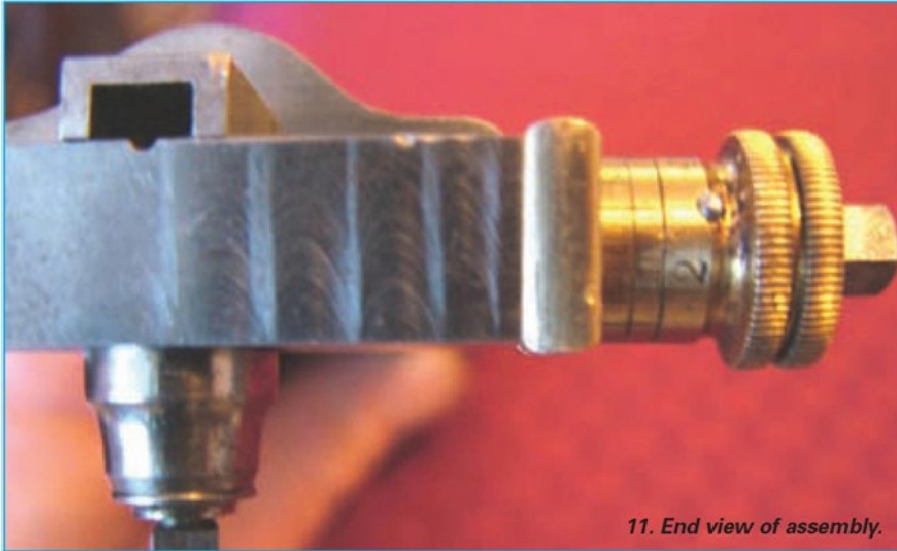
The making of the leadscrew and nut (see **photo 7**) presents a difficult choice: the threads must be 10 t.p.i. or a multiple thereof because all ornamental turning patterns are calculated in tenths and hundredths of an inch. As the leadscrew cannot be much bigger than 0.125in. in diameter it can only be 10 t.p.i. if it is a four-start thread; or it can be 40 t.p.i. if it is a single-start thread. The quandary is: whether to take the easy route and make a simple 40 t.p.i. screw which will then be a constant nuisance because it will need to be rotated so many times in use; or, to



9. Clamp and screw.



10. Cutterbox and nut.



11. End view of assembly.

face the more difficult task of making the conventional four-start leadscrew and a tap for the nut. There are several ways of cutting a four-start thread. One way, if you have a change-wheel lathe, is to ensure one wheel of the gear train has a number of teeth divisible by four and mark this gear at four points and mark the two adjacent gears with corresponding marks; then after each pass carefully move the marked gear one quarter turn, taking care not to lose the relative positions of the other gears. A simpler method is to use a Dividing Chuck or an Eccentric Chuck with a dividing facility (as described in the earlier article in Issue 110). A third method is to make an adjustable cutter-bar so that, after each pass, the cutter may be adjusted to be $\frac{1}{4}$ th of an inch (0.025in.) nearer to the lathe head. This can be a simple bar with a square-ended slot at least 0.100in. wider than the cutter and a grub-screw in one side to press against the cutter. Four shims are necessary, each 0.025in. thick;

all four shims are placed in the slot, followed by the cutter which is bedded tight to the end and the grub-screw nipped up tight. All four threads should be cut one pass at a time in rotation to ensure equality; one shim being removed after each pass to give the four starts. A threaded tap should be cut first then measured after being hardened so that the leadscrew may be screw-cut very slightly undersize (say, by 0.001in.) so as to fit well in the nut.

The leadscrew (see photos 2 & 7)

0.250in. steel rod is used here, centred and skim-turned true at the large end; a shoulder about 0.125in. long is left to fit into the recess to be cut into the short end of the head, the screw section turned down to its outer diameter of, say, 0.125in.

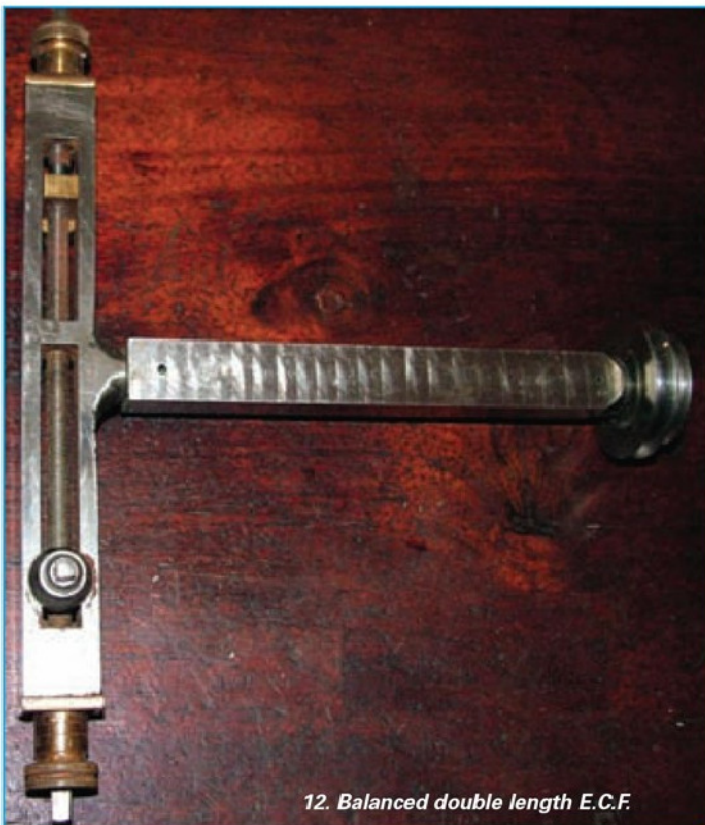
and the thread is cut. The small end of the screw is reduced to the inner diameter of the thread so it will pass through the small hole drilled in the long end of the head. The large end of the leadscrew is turned down to 0.200in. and all but 0.150in. of its length milled down to a square section about 0.150in. across and filed to a very slight taper.

The end-plate

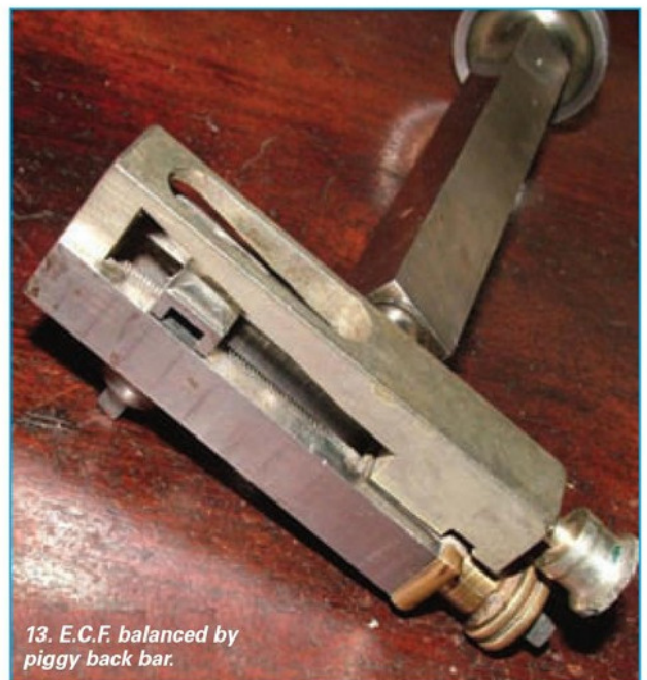
This is made from a piece of bronze or brass 0.160in. thick filed to a rectangle to fit over the end of the head with a central hole drilled through and counter-bored 0.025in. deep, fitted to accept the shoulder of the leadscrew and embrace it so that the leadscrew will just turn without play. The end-plate (see photo 8) is temporarily glued into position over the leadscrew and on to the head. The holes are drilled and countersunk in two diagonal corners and tapped to receive suitable small screws, (perhaps 6BA). The glue is removed and the end-plate adjusted by lapping or polishing until the leadscrew turns easily but without play.

The micrometer head

I made this from a piece of bronze or brass turned to a cylinder 0.550in. x 0.500in. long, drilled 0.150in. through the centre. The drilled hole is slotted square until it fits the tang of the leadscrew tight up to the end-plate. In this position a small hole (about 0.050in.) is drilled right through both the side of the micrometer head and the centre of the tang and this hole is taper reamed so a taper pin may be fitted. The head is disassembled and the micrometer pinned back on to the leadscrew; the leadscrew replaced on the lathe between centres and the micrometer head finish turned down for 0.300in. of its length to 0.400in. diameter, leaving a double rim of 0.200in. long at the larger diameter to be knurled for rotating by hand (see photo 8). The square tang will protrude from the end a sufficient length to be turned by a key if necessary.



12. Balanced double length E.C.F.



13. E.C.F. balanced by piggy back bar.



14. E.C.F. balanced by adding arms and weights.

The screw and clamp

for the cutter box are made next. The screw may be made from a piece of 0.375in. silver steel rod with a thread 3BA or similar by about 0.400in. long (see **photo 9**). After the thread is cut, an allowance of about 0.300in. is left for the head then the piece is parted off and screwed into a piece of scrap metal held in the lathe and drilled and tapped to receive it. The head is then turned; the screw in its temporary holder is mounted on the milling machine and the four sides of the head cut to a square of 0.150in. across. A special key may be made, for this screw (and also the 0.150in. square tang on the leadscrew) or a small clock key may be used. The typical ornamental turning key also has a taper wedge at its back end for ejecting stuck cutters (by insertion into the half-round groove in the cutter box seen in **photo 10**).

The clamp is made from a piece of rod about 0.500in. in diameter; faced off and drilled to 3BA clearance through the end to a depth of 0.400in. and counter-bored to 0.255in. to a depth of 0.300in. so that it will fit easily over the spigot of the cutter box. If desired the outer cylinder can be turned to a fancy profile (see **photos 9 and 11**) then it is parted off to a length of 0.300in. and the parted-off end is turned off clean.

Evans made the cutter-box (see **photos 7 and 10**) from a piece of stock 0.375in. x 0.750in. by about 2in. or more long, faced off at one end. Lines are scribed all around at distances of 0.200in., 0.600in. and 0.775in. from the faced end. Lines are scribed across the centre of the faced end and around the sides of the 0.375in. dimension to divide the face at 0.075in., 0.225in. (which becomes the new centre), 0.375in. (already marked as the old centre) and 0.600in.; the 0.075in. and the 0.600in. lines are extended around the sides to the 0.600in. shoulder line (see **sketch 3**). It is punched carefully at the new centre and the piece is mounted in the 4-jaw chuck so it runs true to the new centre then a spigot is turned 0.200in. long and 0.300in. in diameter (the finished size will be required to pass through the milled slot in the head) then the spigot is drilled to a depth of 0.300in. and tapped (3 BA or similar). The piece is then mounted in the vice of the milling machine with the spigot uppermost and aligned by the tapped hole. A 0.125in. hole is drilled to a depth of 0.600in. on the centre of the scribed line at 0.375in. from the centre of the

tapped hole. This hole will be milled across into a half-hole eventually and it will provide the means of inserting the taper wedge end of the key (see engraving) to eject a stuck cutter. The half hole is visible in **photo 10**. [Although all conventional ECFs have this 'ejection' facility, I have never found or heard of it being necessary; if a cutter can be inserted by hand it should be possible to remove it by hand.] The sides are then reduced to the scribed lines all around while the piece is at the same setting in the milling machine. The piece is then mounted lengthwise in the vice of the milling machine with the 0.375in. dimension uppermost and a slot 0.215in. wide and 0.425in. long is milled right through to within 0.050in. of the root of the spigot and, at the other end, away from the spigot, to the scribed line at 0.710in. (shown in **sketch 2** as 0.200in. + 0.400in. + 0.110in.). The slot is filed out cleanly and the corners are filed square. Unless your milling machine is very accurate you may wish to cut some of the dimensions slightly oversize and finish them by filing so that the piece fits well and runs smoothly in the slot in the head (see **photo 11**). If the standard cutter box is too difficult to make, a simpler version may be made from two pieces fixed together by hard silver solder (see **sketch 4**). This would mean the slots could be simply milled out without the need for filing the corners square, but it could not be case-hardened.

The nut

The preferred material is made from a piece of bronze milled and filed to fit tightly into the slot with sufficient space left at the end furthest from the spigot to accommodate a cutter loosely. The head is lined up in the milling machine (this can be done with a drill passing through the two leadscrew holes), the cutter box with its bronze nut inserted is then fitted into the slot in the head, a cutter placed in its slot, the cap and screw tightened, thus clamping the cutter in place, then a hole equal to the core diameter of the leadscrew is drilled right through the cutter box and nut in line with the leadscrew holes. The cutter box is removed then replaced without the bronze nut and the hole in the cutter box is enlarged to an oval to clear the outer diameter of the leadscrew. The cutter box is again removed and the drilled holes are extended to an oval shape by filing away from the cutter slot and towards the spigot (as seen in **sketch 3**). The nut is polished on each side so that it will now float up and down within the cutter box but without any play. The extended holes in the cutter box allow the nut to float so that the leadscrew is not strained or bent when the clamp screw is loosened. A cheaper version was made without a separate nut; the cutter box was slotted only sufficiently to make room for the cutter and the screw thread was cut straight through the solid part. The top of the threaded hole (nearest the spigot) was then filed away to make the hole oval so the leadscrew would not be bent when the clamp was released. The best makers used a floating brass nut, so this short-cut is not recommended because I believe it allows the possibility of the thread being stripped. The finished cutter box is parted off to leave a thickness of about 0.150in. below the cutter, which is then filed into a cushion shape to look pretty.

The final operation is to engrave the micrometer head. With an equal-sided point cutter in the cutter box and set to cut precisely on centre, the top centre of the end-plate and the reduced part of the micrometer head are scribed across with a datum line. The micrometer head is then divided and scribed around in 5ths, 10ths and 20ths and figured at 0, 2, 4, 6, 8, so the instrument may be adjusted by as little as 0.005in. (or even less by careful use of the spaces between the scribed lines).

The unbalanced version of the Eccentric Cutting Frame works quite well but, for perfect results and long life, it is better to be balanced. There are several methods of doing this; the first was shown in my previous article, which described a type with a large front-mounted pulley with a balance weight screwed onto the front disc. A second type was made double-length with the leadscrew having left and right hand threads so that, as the cutter radius is increased, so the radius of a counterbalance weight is also increased. (see **photo 12**). This is a fearsome instrument and, when it is running at high speed (1500-2000 r.p.m.), a wise operator would wish to be in the next room. Another type has a piggy-back bar screwed to the cutting head with a screw and weight equal to the combined weight of the cutter box with a cutter inside it; when the cutter-box is moved the weight can be moved in the opposite direction to counterbalance it. (see **photo 13**). A fourth and very simple method is to make a short steel cylinder, bore it to fit over the neck of the spindle, make a saw cut from the edge into the bored hole, drill, counter-bore and tap a hole across the saw cut and insert a grub screw to clamp the cylinder to the neck. Radial holes may be drilled at intervals around the cylinder and tapped to receive screwed arms with weights on. (see **photo 14**). Two such arms are sufficient and when placed so as to make a triangle with the long end of the cutter head, they constitute a most effective balancer. One word of caution: the screw arms should be soldered or fixed in place with Loctite and the screwed ends well burred over. When I first used this method, one of the screws came loose and I was fortunate that instead of losing an eye I merely suffered a deep dent in my ceiling.

It is a rather complicated project but the design is well-proven. I hope the photographs and sketches will be sufficient to show how this item can be made. They come in all shapes and sizes so the dimensions are not particularly critical and you can introduce variation according to the materials available. However, I do recommend that the shank be made $\frac{1}{8}$ in. square to fit the standard O T tool-slide; the leadscrew to be 10 t.p.i. or, a suitable multiple like 40 t.p.i.; and the rectangular slot in the cutter-box to be made to the stated dimensions to fit standard O T cutters. The reason for these suggestions is that if you become hooked on ornamental turning, you may one day acquire some original equipment and it would be convenient to have everything compatible. I would be happy to discuss any problems or alternative methods with readers. I can be contacted by telephone on 01732 355 479 or by email at johnf.edwards@virgin.net

My next article will discuss some variations of the Ellipse Chuck.



A RECIRCULATING CLEANER FOR AIRBRUSHES

"Smac" goes back to the scrap box for a low cost solution

A smelly, messy job

I assume that many of you from time to time make use of an airbrush, be it to paint a model or revive an aging piece of machinery or workshop storage or perhaps as part of a high tech manicure, paint nails for senior domestic management. The airbrush has become a useful piece of gear for many of us. Gone to some extent are the bristle brushes but alas like its forebears the new incumbent still requires cleaning. This to some extent is less arduous than the jam jar full of turps but there is still the residue to dispose off. The legs of my steel workbench almost resemble the colour of my kilt, where over the years I have deposited the cleaning fluid from the airbrush. It can be a smelly, messy job and it does consume a moderate amount of the relevant cleaning fluid.

Inspiration and evolution

Whilst searching the Internet for a new air hose for my airbrush I came across a commercially produced cleaning reservoir. Whilst not being excessively expensive it looked quite simple and being a model engineer I subscribe to the philosophy why buy it if you can make it, so off to the scrap box.

The main requirement was a container and I had to resort to the domestic empire for this, which produced a glass jar with a screw top. The next part was a separator; a piece of 50mm diameter aluminium tubing fitted the bill. The only other major part was a funnel to act as the receiver for the cleaning fluid expelled from the airbrush. Again in the domestic department I found

a plastic liquid soap dispenser.

Having obtained almost all the raw material I progressed to the construction phase. Bearing in mind that this concept was totally contained within the grey cells, with not even a pencilled scribble on the back of my bus pass, the article evolved rather than was designed. The idea was to produce a container that would hold the cleaning material, which would be fed to the airbrush by a delivery tube and then be expelled into the funnel and returned to the original container. Alas the work bench will never again receive its rainbow touch up.

Manufacture

The only alteration to glass jar was the attachment of the aluminium tube. Prior to super gluing the tube to the base of the jar the lower 12mm was perforated round the circumference. The tube and jar are shown in **Photo 1**.

The lid required two 6mm diameter holes to be drilled; one in the centre and one near the edge. Two tubes were then made from short lengths of 6mm threaded rod drilled through with a centre hole 4mm dia. These were inserted in each of the two holes and secured either side with a nut and washer. A length of brass tubing was soldered through each threaded tube. The length of the tubing will depend on the type of jar you use. The centre tube is the return feed so the length should be sufficient to enter the 50mm aluminium tube. The tube nearer the edge is the delivery tube, so its length should almost reach the bottom of the jar. Radially it should be located between the outer wall of the aluminium tube and the side of the jar. The completed lid can be seen in **Photo 2**.

The base of the soap container was removed and the stopper filled with

plastic metal with a short length of brass tube protruding from its centre. The inner end of the tube was located in a shallow dished area of the plastic metal to facilitate drainage.

A stainless steel rod was bent to accommodate the neck of the filler and then attached to the side of the jar using builders banding. For those of you who have not encountered this it is worth putting a reel in the scrap box. Basically it is 13mm wide galvanised tin with a series of holes that comes on a 10m reel costing about £4, very useful for clips and brackets. But I digress. The rod holds the filler at roughly a forty-five degree angle on top of the receiver.

Apart from attaching all the tubes to their relevant parts with model aircraft fuel line tubing the only other requirement is to fill the bottom of the aluminium tube with face mask gauze or some other filtration material to a point above the 12mm perforation line. The finished cleaner is shown in **Photo 3**.

Operation

Having filled the "cleaner" some two thirds full of cleaning fluid and attached the lid you have just created a recirculating device to clean the airbrush. The principle of operation is to fit the delivery tube to the supply port on the airbrush, point the airbrush into the collector funnel and operate in the normal way. The cleaning fluid is drawn up through the airbrush and expelled into the filler where it drains back into the inner chamber of the cleaner and is filtered through the gauze and recirculated. Not only does this unit save on cleaning material, but it seems the vacuum created by the expulsion of the fluid to the airbrush creates a suction effect in the collector which reduces the over spray and smell to some extent.



1. Aluminium tube superglued to base of jar.



2. Underside view of lid showing delivery and return tubes and threaded parts.



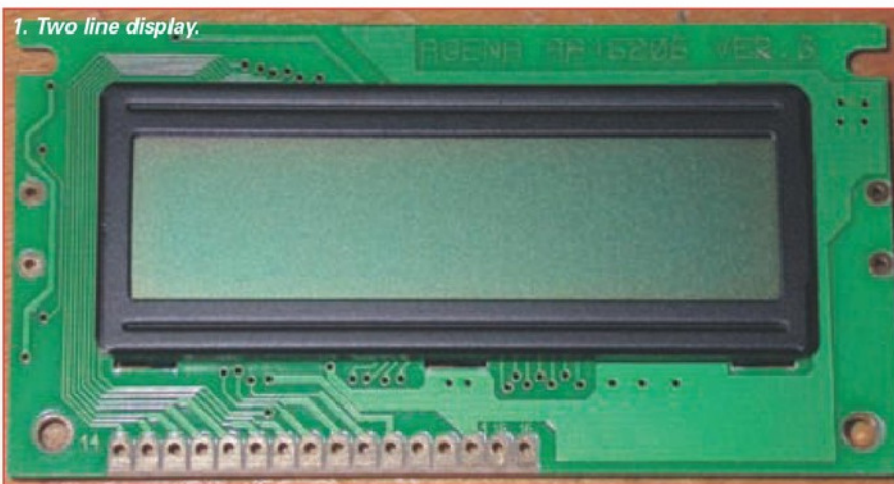
3. Completed cleaner linked up to airbrush.

Many of the new machines that are being imported from the Far East come fitted with variable speed drives, and owners are converting old machines fitted with three phase motors to use variable speed 3-phase "VFD" drive systems. These machines give us the ability to infinitely vary the spindle speed without the need to change belts. With some such systems, and my Taig mill with its variable speed spindle drive borrowed from a Sherline mill is a good example, the range of useful speeds obtained with a single pulley position is such that it is rarely necessary to change the belt over to a different set of pulleys even if different speed ranges are available. I have my Taig almost permanently set on the third from slowest of 6 speed ranges, which gives me a useful range of dead slow to 5,000 RPM; I have tried it on its fastest pulley combination, which gives in excess of 15,000 RPM with the Sherline motor, but only to demonstrate how fast it will go as the headstock bearings would probably not stand such abuse for long.

With most of these systems the common factor is that, although you can adjust the spindle speed, you no longer have any clear idea of what the actual spindle speed is at any point in time. Hence this project; a simple tachometer or rev counter that can be readily fitted to a wide range of different machines, and will give a useful range of RPM measurement. An article that I wrote on spindle and surface speed measurement for issue 60 of MEW introduced some techniques for measuring spindle speed with the aid of a digital multimeter with a frequency scale; this project makes use of some of the sensing techniques discussed in that article, but describes a dedicated tachometer unit with its own LCD display.

The description that follows should give sufficient information for anyone who has reasonable soldering skills to construct a finished unit entirely from scratch, including etching a board if necessary; however, as the circuit is constructed around a PIC 16F84 single-chip microcomputer, anyone wanting to do the whole job themselves would need access to a PIC development system in order to develop the firmware and program the chip. As this is a non-trivial exercise unless you are familiar with programming languages and their development systems, pre-programmed chips will be made available by L.S. Caine Electronic Services, as well as etched PCBs and component kits of varying levels of completeness. For those constructors that are able to make sense of a "C" program or have the ability to programme PIC chips using standard HEX files, I will provide the "C" and HEX files by email – see contact details at the end of the article.

Before getting into the detail of the rev counter itself, I have included a bit of background information on these PIC devices, and some of the development tools that are available (at very reasonable prices) for them. These early sections are probably only of interest to people that feel comfortable enough with electronics and programming to "have a go" at developing something themselves, so if you don't find yourself in that category and want to cut to the chase, please feel



1. Two line display.

REVMASTER

A Simple Tachometer

1

Check your spindle speed - Tony Jeffree tells how.

free to fast forward to the project details, which start with the heading "Circuit Design" below.

Anatomy of a PIC

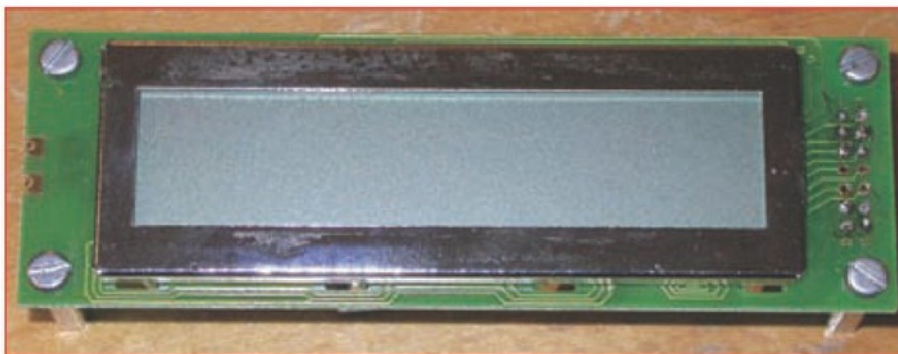
The PIC micro controller family is very large, and is expanding almost weekly as Microchip Technology, Inc adds new devices to the range. I will not try to get into a description of the full range, as life is considerably too short for that; rather, I will give a flavour of what these devices can do by using the two examples of the family that I have used so far.

Common to all of the PIC devices are the following basic components and capabilities:

1 A central processor unit (CPU) that performs programme execution;

2 Some programme memory for storing the device's control programme – generally some form of PROM (programmable read only memory), but many devices use "Flash" memory that can be erased and reprogrammed electrically, without the need for UV erasers that are needed for erasing PROM devices. This is non-volatile memory, i.e., the values in memory are retained when the device is powered off. Flash programmable devices can be re-programmed many times (generally up to 1000 erase/write cycles), making them ideal for prototyping and development work, or for products where it is desirable to be able to upgrade the "firmware" in the device in the future;

3 Some RAM (random access memory) for storing the variables used by the programme. This is volatile memory, i.e., the contents of this memory disappears when the device is powered off;



2. One line display.

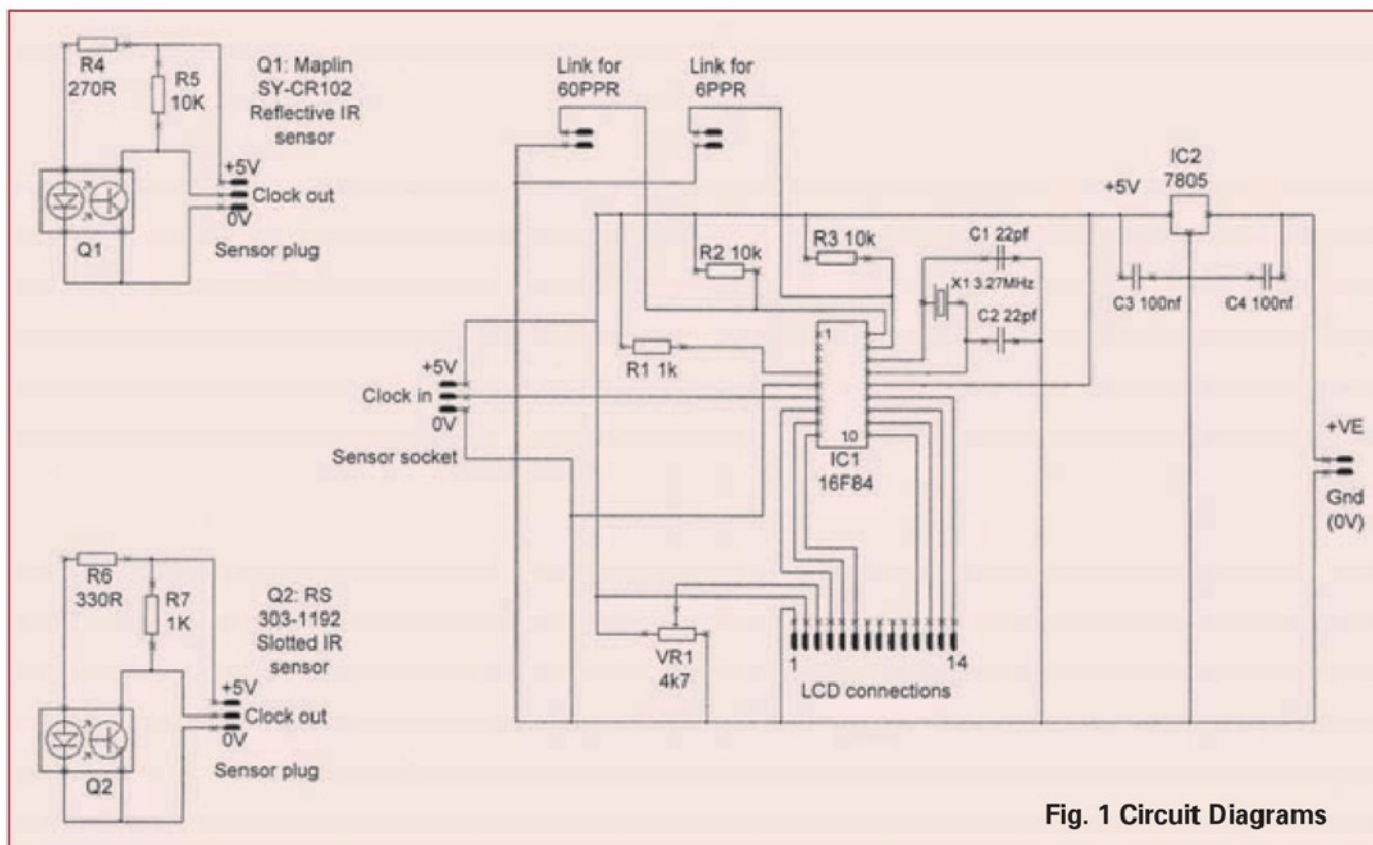


Fig. 1 Circuit Diagrams

4 Some EEPROM (electrically erasable PROM); this is non-volatile memory used for storing variables that are to be retained when the device is switched off – for example, configuration values that the programme can access and change, but that are desirable to be retained during power-off so that the next time the device is used, its configuration is as it was the previous time it was powered on. This memory area is slower to access than the RAM area, and has a limited life (generally around 1 million erase/write cycles per location), so it is mostly used for configuration variables that are changed infrequently and that can be read into RAM on programme start-up;

5 A number of input/output ports, allowing digital inputs, digital outputs, analogue inputs, serial data streams, and so on to be handled by the device. The capability of each PIC device varies, both in the number of I/O ports and in the capabilities of those ports;

6 Provision for generating the CPU's "clock" oscillator by the addition of a very small number of external components – one resistor and one capacitor for a simple R/C oscillator where frequency stability is not important, or a quartz crystal and 2 capacitors where it is important for the device to be clocked at a known speed;

7 Some form of interrupt processing. Computers are serial devices – the CPU processes the programme instructions one after the other; this can be inconvenient if you wish to handle external events that can happen at any time – and usually, as sod's law dictates, when the programme is doing something else. Interrupts allow the external event to interrupt the normal flow of programme control, to invoke an interrupt handler that can process the event before resuming the normal programme where it left off;

8 Some means of programming the programme memory and EEPROM areas, by applying voltages and serial data streams to appropriate I/O pins of the device. In most cases, it is possible to programme these devices "in circuit" if need be.

Because all of these features exist in a single chip, it is very easy to build simple projects around a PIC – literally all that is needed to get a PIC running is a power supply and the 2 or 3 components required to create the clock oscillator. A small number of additional components will be needed in order to make use of the I/O capability, and to provide in-circuit programming, reset buttons, and the like, as necessary for the particular project.

Peripheral devices

It is a relatively simple matter to interface external, peripheral devices to a PIC, as the I/O lines are able to accept TTL-compatible logic signals. Examples of the kinds of peripherals that can be used with these devices include:

1 Push buttons, keypads, limit switches and the like, to provide inputs to the PIC. A 16-key keypad, arranged as a 4 by 4 matrix, can be interfaced to a PIC by using 8 input lines (4 to address the rows, 4 to address the columns), for example.

2 Digital input lines can also be used to deal with pulse trains or serial signals – for example, counting the number of pulses per second to derive an RPM measurement, or decoding serial data signals received from other devices or computer systems. In the latter case, some PICs have their own built in serial I/O processors (known as USARTs) for this purpose.

3 Relays, stepper motors, activation signals, and the like can be driven by the PIC's digital outputs. Stepper motors can be driven by using 4 digital output lines to control individual driver transistors (or power stages) for each phase of the motor, or 2 outputs can be used to control one of the proprietary "step-and-direction" stepper motor controllers. A single output line, driving an "open collector" transistor stage, can switch a relay on and off; in turn, the relay could be used to start/stop a spindle motor, etc.

4 Small LCD displays are available at very realistic prices, and using a widely accepted interface based on a Hitachi chipset. Interfacing a PIC to the display uses a minimum of 7 I/O lines, 4 for data, and the other 3 to control the operation of the device. Bitmapped (as opposed to character oriented) LCD displays are also becoming available and are similarly easy to interface.

5 PICs that provide ADC (Analogue to Digital Conversion) capability can be used to measure a voltage generated by a transducer of some kind, and convert that voltage into a digital form. For example, a temperature or pressure measurement could be made by attaching a temperature or pressure transducer to one of the ADC inputs on the PIC, and the measurement displayed on a screen or used to determine some controlling action (turning on the central heating, turning down the burners on a boiler, etc.). The ADC input expects its signal to be presented as a voltage in the range 0-5 volts, so the transducer output needs to be suitably "conditioned" to make it fall within this range.

6 Where the on-chip memory provided for the PIC is a limitation, it is possible to interface additional RAM and EEPROM devices to the PIC in order to extend its versatility.

7 More complex peripherals can be handled too – one of the electronics hobby magazines has just recently published an article on how to interface a PIC to an Epson parallel printer, in order to use the printer as a data plotter.

This begins to give a flavour of the types of device that can be connected to these micro controllers, and to give some ideas as to the possible ways that these devices might be deployed. Motion control applications, home automation, burglar alarms, and so on, are just the tip of the iceberg here – the potential uses are limited only by your own imagination.

The PIC 16F84

This is the PIC device that I have chosen for the rev counter. It comes in a plastic, 18-pin dual in-line package, so is physically fairly small (see photos of the board layout later). The 16F84 has 1K (1024 words, 14 bits wide) of flash programme memory, 68 bytes of RAM and 64 bytes of EEPROM. The chip can be clocked at speeds of up to 10 MHz; I used a 4 MHz chip for the rev counter, clocked at 3.27 MHz as this made it easy to divide the processor clock down to create a 1-second "tick".

The chip has 13 digital I/O lines; these can be programmed either as inputs or outputs, and with careful design, it is even possible to make a single line do double duty, acting as an input at some times and as an output at others. This is a relatively small device, but is still capable of performing some fairly complex tasks.

The PIC 16F877

This is one of the larger (although by no means the largest) of the PIC family. It has 8K of flash programme memory, 368 bytes of RAM, and 256 bytes of EEPROM. This device can be clocked at up to 20 MHz, has 33 digital I/O lines, 8 of which can be used as analogue inputs to the chip's 10-bit ADC, and has an on-chip USART.

The additional memory and I/O capability available on the 16F877 lends it to larger and more complex projects – hence my decision to use this as the basis of my "DivisionMaster" indexer, where it is dealing with a 16-key keypad, a 2-line by 16-character LCD display, further digital inputs and outputs for stepper control, emergency stop, etc., plus an analogue input to allow LCD display of the current limit (in amps) for the stepper motor driver.

Development and support

I have included a list of contact addresses, websites and so on at the end of the article. As with most things these days, there is a wealth of information and support to be had from the Internet.

Microchip Technology market a variety of development tools for the PIC devices, and there is a very active "after-market" that supplies the hobby trade as well. Everyday Practical Electronics magazine

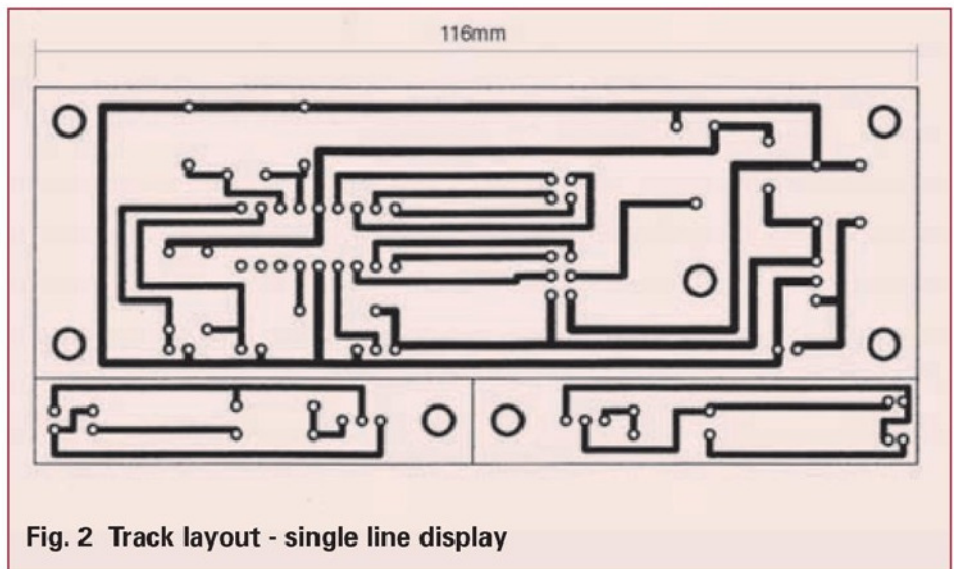


Fig. 2 Track layout - single line display

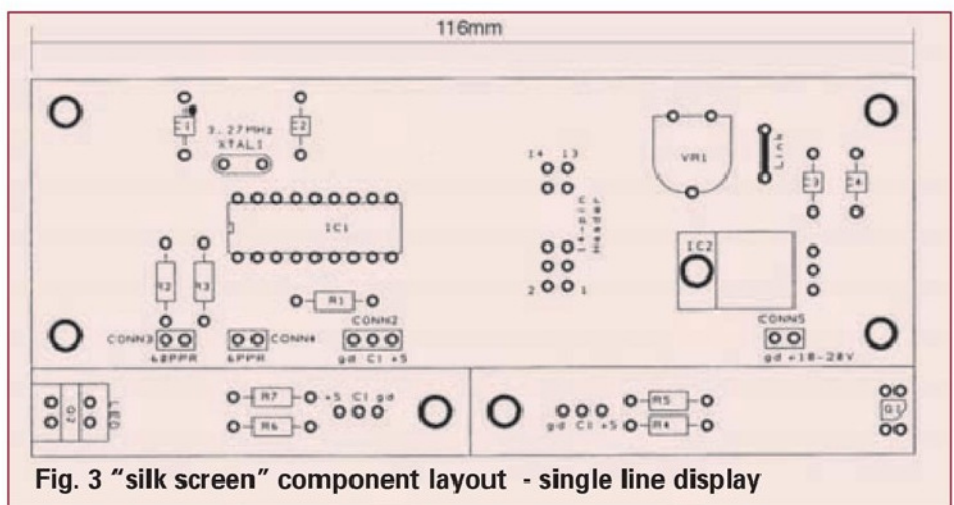


Fig. 3 "silk screen" component layout - single line display

publishes constructional and tutorial articles on the PIC, and is a good source of adverts for development tools. Programme development software is available for use on PCs; there is a wide variety of these to choose from, including assemblers, Basic compilers and "C" compilers. Unless you are familiar with the peculiarities of assembler level programming, I would recommend starting off with a development system based on "C" or Basic. It is also worth thinking about what kind of development you are likely to get into; some of the Basic compilers have great facilities for handling peripherals, others have the ability to handle large variables, and so on.

For the work that I have done so far, the following have proved to be extremely useful:

1 Microchip Technology distribute their "MPLAB" software for free; it can be downloaded from their website. It includes assembler tools and software to interface to their PIC programmers, in-circuit emulators, debuggers, and so on. Their website has a vast store of datasheets, application notes, and other useful information, as well as links to other suppliers.

2 Magenta Electronics Ltd. sell a variety of PIC-based project kits, PIC programmers, development boards, and in-circuit debuggers. Their kits offer an

easy introduction to these devices, and are keenly priced. One of these kits is called "Icebreaker"; this is a development system aimed at the PIC 16F877, with in-circuit debugging capability, plus various peripheral devices in a "breadboard" arrangement, allowing a prototype to be constructed very rapidly. The system is driven from a Windows system (95, 98 or ME; not Windows 2000 unfortunately) via a serial port. The only significant limitation with Icebreaker is that the in-circuit debugging code occupies the top 4K of programme memory, reducing the available memory on the PIC to only 4K. This is probably fine for assembler programming, but I found it a limitation when using a "C" compiler.

3 Forest Electronic Developments (FED) sell a variety of tools for the PIC. They have developed a "C" compiler system, running on a Windows PC, called "Wiz C", which can generate code for most flavours of PIC. This package allows the user to emulate the PIC on the PC screen, and even allows the attachment of emulated peripherals (LCD displays, keypads, etc.) to the emulated machine. This allows the functionality of the software to be established without having to wield a soldering iron; once you have the programme running, you can build the circuit up using one of their development boards, or build it on stripboard, in order

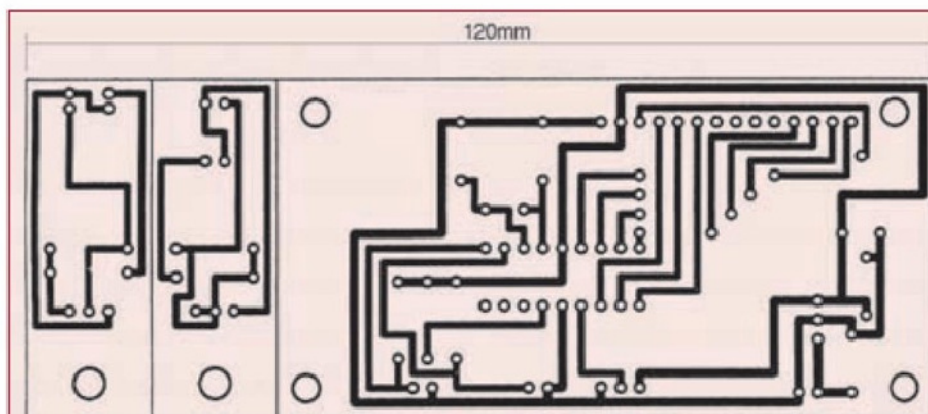


Fig. 4 Track layout - two line display PCB

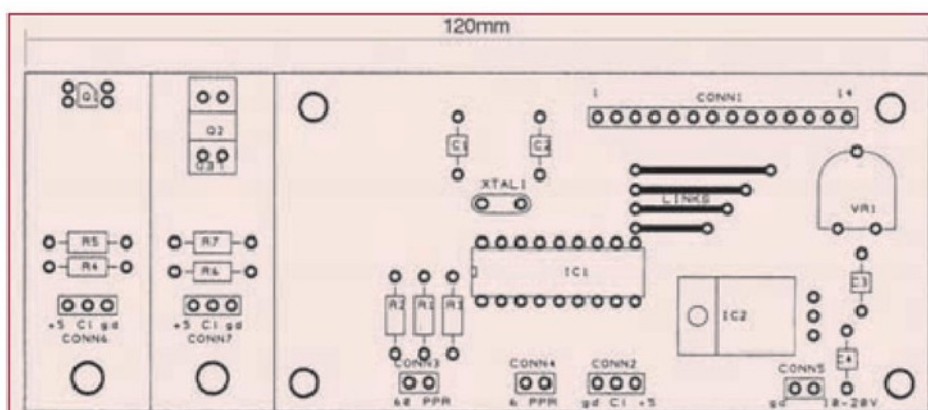


Fig. 5 Track layout - "silk screen" component layout - two line display

to do final testing. This approach is very effective indeed, and has speeded up the development of my PIC projects quite considerably. Recent versions of this system have added rapid application development techniques to the "C" compiler, meaning that you can "drag and drop" peripheral devices into the project, and the system automatically plugs in the "C" library code needed to support the

peripherals concerned. The latest versions of their "C"-based development systems support 8-bit, 16-bit and 32-bit integer variables, and also support floating point variables; this, along with their good support library and their emulation system, makes a very powerful combination. FED also supply PIC programmers and an in-circuit debugging system that integrate with their software development tools.

4 PIC devices and associated components and development systems can be obtained from Magenta, FED, and the usual electronics components houses, such as Maplin and RS.

Circuit design

Three prototypes for this tachometer were designed and constructed in 2001 using strip board, and they have been in use in my workshop since that time. However, as strip board is a pain to use, I have laid the circuit out in a form that can readily be etched onto copper clad board – I will describe a simple process for etching boards later in the article that can produce usable boards at minimal cost.

Figure 1 shows the schematic for the tachometer and for two alternative sensing devices. The 7805 chip, IC2, and its attendant capacitors, C1 and C2, provide the board with a stabilised 5 volt supply to drive the logic circuitry; any spare "wall wart" power supply that provides an unregulated output of between 10 and 20 volts DC will work just

fine as the power supply for the circuit. I seem to accumulate surplus "wall warts" from defunct bits of electronic equipment and so finding suitable ones wasn't an issue for me; they are also readily available from supply houses such as Maplin and RS Components. However, be sure that the one you are using gives a DC output; I found that one of mine had an AC output and so I had to add a bridge rectifier and smoothing capacitor to make it usable.

Increasingly, the world seems to be moving over to using switch-mode power supplies for this kind of application, as the older style linear power supplies consume more current for a given power output; if you are able to find a 5V switch-mode supply, or a regulated 5V supply, then you may be able to dispense with the on-board regulator circuitry.

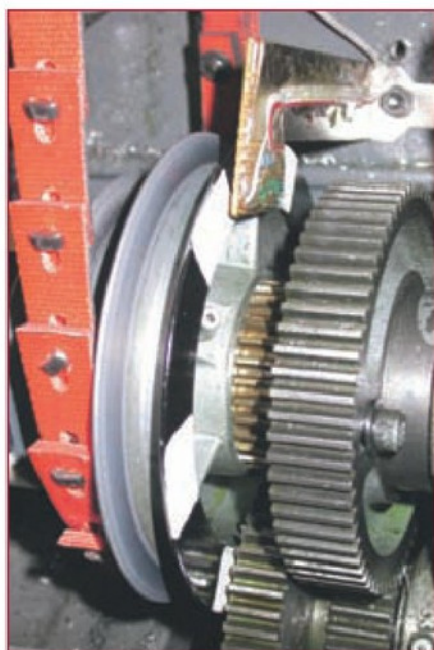
The main bulk of the circuit is taken up with IC1, the PIC 16F84, and its attendant components. This chip does two jobs; firstly, it counts the pulses generated by the sensor circuit, and calculates from the number of pulses per second the speed in RPM of the shaft, and secondly, it performs the necessary interfacing functions that are needed to drive the LCD display that will show the operator the results of the RPM calculations.

C2, C3, and X1 form a crystal oscillator that generates a 3.27 Mega Hertz clock to drive the PIC chip. By dividing down the processor's clock signal, the software is able to generate an internal 1-second clock "tick"; in the interval between successive "ticks", the software counts how many times it sees a 5V pulse on the "clock in" pin of the sensor socket (pin 2).

Two further inputs to the PIC allow the user to set links to determine how many pulses will be generated for a complete revolution of the shaft. If neither input is connected to ground, R2 and R3 hold the inputs "high" (+5V), and the software assumes that one input pulse from the sensor equals one full revolution of the shaft. If the link connected to R3 is shorted to ground, then the software assumes 6 pulses per rev (PPR); if the other link is grounded, then the software assumes 60 PPR.

VR1 and the 10 active pins of the LCD display connector form the interface to a "standard" LCD character display. These are readily available in a variety of formats, based around a Hitachi display driver chipset. I have used two variants in this project; one is a 16 character by 2 line display, the other is a 20 character by 1 line display. Both are available from Magenta Electronics. As the 20 character display is internally constructed as two lines of 10 characters joined end to end, it actually behaves from the software point of view as if it is a two line display, so I have arranged the firmware in the PIC to be able to drive either variant interchangeably. Which one you choose is a matter of price and performance; the 16 X 2 display costs more, and has better contrast and viewing angle than the 20 X 1 variant.

VR1 allows adjustment of the contrast setting on the display for optimum viewing. **Photos 1 and 2** show these two display circuits; **Photo 1** is the two line display version. For those that are interested in looking at the electrical and



3. Sensor fitted to Myford with Black/White patches.



4. Sensor fitted to Taig mill using slotted disc.

command characteristics of these devices in detail, there are data sheets on the Magenta website, and much useful information can be had via the Web. The sensing devices are supplied with 0V and 5V lines from the main board, and use two types of infra red detector to generate a 0 to 5 volt "clock" signal to the PIC. The first of these sensors is a SY-CR102 device from Maplin; this is a "reflective" sensor that generates an infra red light beam from an LED in one half of the device, and the other half of the device is a photo transistor that detects received infra red light. If you bring the device to within a couple of millimetres of an IR-reflective surface, such as a piece of white paper, then it will generate a signal. This device can be used very readily to "sense" a shaft's rotation if alternating black and white patches are painted on the shaft, or a printed black and white sensor disk is printed on paper and stuck onto the face of a pulley, for example. **Photo 3** gives an example of one of these sensors being used with a pattern of black and white patches painted onto the face of a Myford lathe pulley. I have found that Humbrol black and white enamel paint works very well with this sensor. Interestingly, aluminium, steel and cast iron don't seem to be particularly IR reflective in my experience, even when shiny, so you generally can't get away with just painting/sticking on the black bits, you have to add the white bits too.

The second sensor is based around a slotted infrared sensor supplied by RS Components – part number 303-1192. This again consists of an IR-emitting LED and a phototransistor; this time though, the LED is pointed straight at the sensor, so the light beam has to be interrupted to generate a signal. Typically this is done by taking a disc of opaque material (metal or plastic for example), cutting a number of slots or holes in its periphery, and attaching this to the shaft; the sensor is then positioned to straddle the edge of the disc so that the beam is alternately

Table 1

Component	number	Value Comments
R1	1K Ohms	¼ Watt
R2	10K Ohms	¼ Watt
R3	10K Ohms	¼ Watt
R4	270 Ohms	¼ Watt (Reflective sensor)
R5	10K Ohms	¼ Watt (Reflective sensor)
R6	330 Ohms	¼ Watt (Slotted sensor)
R7	1k Ohms	¼ Watt (Slotted sensor)
IC1	PIC 16F84	Pre-programmed from L.S. Caine Electronics
IC2	7805	5V linear voltage regulator
C1, C2	22 pico Farads	
C3, C4	100 nano Farads	
X1	3.27 Megahertz	DO NOT substitute a different frequency, as this will make the readings inaccurate!
VR1	4.7K Ohms	Miniature PCB mounting type
Q1	Maplin SY-CR102	Reflective sensor
Q2	RS 303-1192	Slotted sensor
LCD Display	16 chars X 2 lines or 20 chars X 1 line	Magenta
Box	RS 281-6835	For single-line display
Box	RS 281-6829	For two-line display

allowed to shine through or is interrupted. **Photo 4** gives an example of one of these sensors being used on my Taig (Peatol) mill, with a slotted disc attached to one face of the headstock pulley. The platters salvaged from defunct PC hard disk drives can be useful as a starting point for making a suitable slotted disk.

If you already have a sensor that can be made to generate a stream of 0-5V pulses, then this can be substituted for the ones described.

PCB layouts

I have laid out two sets of single-sided PCBs for this project; one is laid out to the same dimensions as the single line display (**Figures 2 and 3**); the other the same dimensions as the two line display (**Figures 4 and 5**). The two figures in each case give the track layout, and the "silk screen" information that shows where the various components fit, both arranged as they appear from the non-copper side of the board. The track layout is therefore a mirror image of the layout as you would see it when looking at the copper side.

Apart from the dimensional differences, the two boards (and the two displays) differ in the arrangement of the connection points for the connections between board and the display; the 2-line display has a single row of connecting pads (numbered 1 through 14, but note that pins 15 and 16, which can be used for backlighting, appear just to the right of pin 1 and should be ignored) whereas the single line display has 2 rows of 7 connections (again, numbered 1 through 14). Consequently, on the two PCBs, I have provided corresponding connection points in the same format, laid out so that when the LCD is placed above the component side of the PCB, the correspondence of the connections is direct and obvious.

Both board layouts include layouts for the two variants of the sensor circuit; these differ only in their dimensions, and which

you choose to use is dependent upon the physical space that they will occupy on the machine rather than which display you are planning to use. Layouts for these boards will be printed slightly less than full size. Reference dimensions are however given and these will allow corrective enlargement at the photocopy stage.

The accompanying **Table 1** gives a list of components for the project, and in the next issue we will look first at the a non standard method of creating the pcb's, and proceed with the detail of etching and construction.



Suppliers and other contact details:

1. For copies of the "C" code and HEX files for this project, or for PDFs of the PCB layout diagrams, email the author at tony@jeffree.co.uk
2. "C" development systems and PIC programming tools used by the author can be obtained from Forest Electronic Developments (FED), 12 Buldowne Walk, Sway, Hampshire, ENGLAND, SO41 6DU, Tel: 01590 681511 Website: <http://www.fored.co.uk>
3. RS Components. Tel: 01536 201201 Website: <http://rswww.com/>
4. L.S. Caine Electronic Services, 25 Smallbrook Road, Broadway, Worcs, WR12 7EP. Tel: 01386-852122 Website: <http://home.lscs.co.uk/ModelEngneersDigitalWorkshop/index.html>
5. Maplin Customer Service: 0870 429 6000 Website: <http://www.maplin.co.uk/>
6. Magenta Electronics Ltd., 135 Hunter Street, Burton-on-Trent, DE14 2ST U.K., Tel: 01283 565435 Website: <http://www.magenta2000.co.uk>
7. Microchip Technology Inc – website: <http://www.microchip.com>

Scribe a Line

Laurie Tedcastle writes:

Following a number of references, including in Harold Hall's *Milling Projects for Beginners* (MEW 92), I finally got around to tracking down a copy of *Precision Grinding Techniques* published by Jones & Shipman plc. The ISBN quoted in Harold Hall's article was incomplete, it should be 0-9509373-0-4, but my local bookshop was still unable to trace it. So I phoned Jones & Shipman +44 (0) 116 201 3000 (ask for Sales) and was sent a copy free of charge. Amazing service. The cover price of this little book is only £3, but it's worth at least £10 - £12. Half the book is devoted to tool grinding. No doubt some reader will be able to explain how a book can have an ISBN allocated and then not appear in a bookseller's ISBN computer database.

On another topic, I recently purchased from separate suppliers, both regular MEW advertisers, sets of metric counterbores (for socket head cap screws) and countersinks at what appeared to be advantageous prices. Buyer beware, there is no manufacturer identification, so I assume they are of far eastern, possibly Chinese, manufacture.

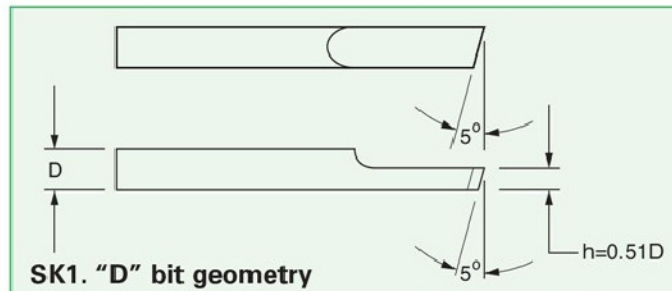
Both sets are of three flute design. Comparing the pilot sizes, a little difficult since the runout of the cutter lands form grooves through the pilots, I came up with the following sizes (in mm):

Nominal dia	Counter-sink pilot	Counter-bore pilot	Std Drill clearance
3	3.2	3.35	3.1
4	4.28	4.45	4.1
5	5.25	5.44	5.1
6	6.32	6.56	6.1
8	8.35	8.93	8.2
10	10.45	10.94	10.2
12	12.92	13.43	12.2

Apparently, one has to drill significantly oversize in order to be able to use these cutters. I'm surprised at the difference in the pilot sizes. Are there recommended standards for pilot sizes and if so how do these compare?

John Summers of Lochgilphead writes:

In reply to Fred Taylor of Auckland (Scribe a Line MEW Issue 113) requesting details of D drills and about deep hole drilling, see below details of the D-bit drill as taken from page 28 of Tubal Cain's book "Drills, Taps and Dies", number 12 in the Workshop Practice Series ISBN 0-85242-866-9



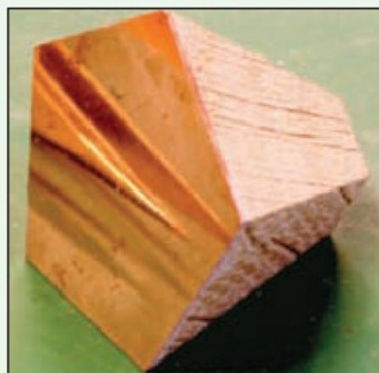
"This type of drill is really a guided boring bar. The body is very slightly less in diameter than the desired hole - a "running fit" to it - and is flattened on one side so that there is just over half the circle remaining. The drill cuts only on its front edge, which has relief as shown. Provided the finish on the body is good, such drills will work to reamer size and finish, but

they must be started by drilling a hole of the required size, of depth around half the diameter. These drills are frequently made from silver steel, but the ground finish is not always good enough - —"

Regarding deep hole drilling, Fred should read Lindsay

Publication Inc's reprint of "Making Rifle Barrels" ISBN 1-55018-280-6 pages 5 and 33 which describe drill shapes and reasons why the workpiece should be rotated rather than the drill. Another useful reference is the information sheet No 3567 from Sandvik Ltd. from which page 5 gives gun drilling geometry for deep hole drilling.

Jack Cox of Crowthorne, writes:



1. Wooden pentagonal segment.



2. View showing unequal sizes.

Occasionally, working in wood demands a degree of accuracy comparable with that of working in metal. The two photographs of wood segments (Photos 1 and 2) represent a case in point. They are individual examples of a total of twenty hexagonal and twelve pentagonal machined segments comprising a geometric Archimedean solid known as the 'truncated icosahedron' (the modern football pattern). The hexagonal and pentagonal profiles must be highly accurate in terms of side length and included angles, and the mitred flanks must also be accurate in terms of angle relative to the faces, in order that all components fit precisely. Further, the hexagons require two slightly different mitre angles on alternate faces, an effect visible in Photo 2. If this were not enough, assembly of the total of thirty-two segments must be carried out with equal care and accuracy.

After one or two abortive machining attempts, I eventually used the idea shown in Photo 3. The mitre angles are taken care of by the horizontal table, and the polygonal faces by the Myford dividing head mounted upon it via a home-made adaptor. Fortunately the Chester mill has a large knee travel and will accommodate both ancillaries, and still leave a fair working space for a milling cutter.



3. Set up for machining.

Tom Smith of Stockport writes:

Following on from the taper setting gadget described in issue 113, the attached print (photo 4) and explanation should, I hope, reveal all regarding my low tech device meant to make life easier for old turners like me. It cuts out some of the thinking process, which I find leads more and more to headaches, and eliminates the problem of remembering the last readings on the DTI.

Setting up time cannot be more than about five minutes, and accuracy and repeatability are guaranteed. The prototype (which is also the first production model) was made from two items from the scrap box, and it worked without any further development other than the usual polishing with emery cloth. It was made in about one hour, as outlined below. Material details will depend on your scrap box.

Material list

1. Plate 5mm x 45mm x 110mm approx. Mine was made from sheared black mild steel, partly smooth filed as required and checked for overall thickness with a 1in. micrometer.
2. $\frac{1}{2}$ in. x $\frac{1}{2}$ in. x 2in. approx. square BMS bar.

Notes. Item 1 can be almost any material (I feel that gauge plate would be better, but any stiff plate would suit)

Assembly. Front edge of plate should be approx. level with front edge of cross slide. Use small drill or similar to raise bottom edge of plate (This will leave gap after assy. to allow for clamp bolt washers, swarf etc.) Clean off all paint from inner vertical edge of top slide prior to above.

Scribe a line along plate to locate top inner corner of top slide. Clean and degrease parts and bond with epoxy or similar. When joint is fully hard, leave parts clamped together, drill 2 x $\frac{1}{8}$ in. holes through plate into block, and bond in suitable pegs. ($\frac{1}{8}$ in copper coated welding rod is a perfect interference fit;) Clean off resin beads where necessary.

Finally scribe lines on upper edge at 100mm and 4in. from front corner. Fit test bar between centres and set up your own slopes or angles using wire sizes by micrometer, drills, or W.H.Y. to any angle of which the lathe is constructionally capable, and with a degree of accuracy far better than trying to read the engraved markings, on the quadrant. Happy turning.



4. Angle setting gadget from Tom Smith.

John Garnish writes:

Many thanks for giving a further plug to REMAP in issue 113 of "Model Engineers' Workshop". I know that many of the panels could use more volunteers -

especially some who may be slightly less elderly.

My main reason for writing was to add a comment to the recent editorial re condensation and electronics. I have a Chinese 18in. digital scale fitted to the table of my milling machine and,

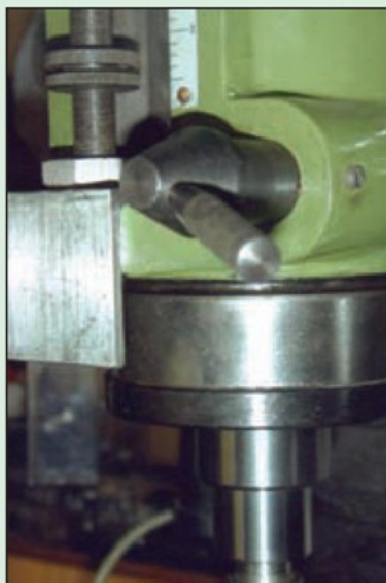
following a bout of condensation in mid-January, about one-third of the scale (around mid section) apparently died. In the dead zone, not only would the display freeze but it was impossible even to zero it or switch between metric and imperial. Oddly enough, the scale continued to work fine at either end.

The cause must have been a build-up of condensation between the cover strip of the scale and the underlying printed circuit. I restrained myself from trying to strip off the cover strip so it took a while to dry out but, sure enough, after about a fortnight it restarted and now appears, to be as good as new. Hope this may reassure someone else.

Brian Warner writes:

Enclosed are a couple of photos (photos 5 and 6) of a very simple angle bracket I have made for my VMC mill. This acts as a base on the vertical head for mounting a mag base clock for aligning work on the table. It is held in place by a new nut that clamps it to the bottom of the screw stop system for the vertical sleeve slide. It has no effect on the stop system whatever. The nut, 25mm a/f x 6mm thick, was a special as the screw had a rather odd thread - 11.62min (0.457in.) O/D x 1mm or 26 TPI (probably CSTD - "Chinese Standard Thread of the Day"!) The bracket was a bit of MS angle 35 deep x 45 high x 55 wide x 3 thick, but I shall probably remake the bracket to 35 x 60 x 60 when I find that bit of angle that is hiding from me! Before making the bracket I found it very difficult to mount my mag base clock or mag base Locline coolant system. Now it's a doddle! It was only a half-hour job to make and has proved to be a real asset.

Hope it may interest others.



Two views of Brian Warner's angle bracket.

LINK UP

Would readers wishing to make use of this facility please note that the maximum total value of items accepted for a 'For Sale' entry is £50.

To advertise goods of a greater value, please contact our Classified

Advertisement Department. Please indicate clearly if an item is intended for Link Up.

FOR SALE

- For Sale - motor reversing switch suitable for lathes and other machines. Brand new with fitting details £16-00 plus p&p Please phone 01723 362 537

Dead200558004 7/9/05 12:09 pm Page 1

email colin.taylor@encanta.co.uk

**BRITISH
WARRIOR
BRAND**

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

Full range of accessories available

ONLY **£649.95** EX VAT
£763.69 INC VAT

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

Shown with optional floor stand & tray

ONLY **£119.95** EX VAT **£140.94** INC VAT

ALSO AVAILABLE:
CL430 - As above but without the Mill/Drill head.
£539.95 EX VAT **£634.44** INC VAT

Clarke BENCH GRINDER STAND

BGS1

Complete with bolt mountings & feet anchor holes

ONLY **£24.99** EX VAT
£29.98 INC VAT

Clarke BENCH GRINDERS

CBGW (wet) features 8" wetstone & 6" drystone.

FROM ONLY **£12.75** EX VAT
£14.98 INC VAT

6" & 8" AVAILABLE WITH LIGHT

Clarke MIG WELDERS

FROM ONLY **£119.95** EX VAT
£140.94 INC VAT

Includes free:

- Face mask
- Earth clamp
- Gas regulator
- Pro90-150TE also inc:
- Welding wire
- CO₂ gas bottle

OTHER SIZES & ARC WELDERS AVAILABLE

MODEL	AMPS	WAS INC VAT	EX VAT	INC VAT
Pro 90	24-90	-	£119.95	£140.94
YOGE	30-100	-	£139.95	£164.44
135TE Turbo	30-130	-	£159.95	£187.94
150TE Turbo	30-150	£211.44	£169.95	£199.69
165TE Turbo	30-155	-	£239.95	£281.94
175TE Turbo	30-170	-	£299.95	£352.44
205TE Turbo	30-185	-	£329.95	£387.69

*Turbo fan cooled for longer welding at full output

Clarke DRILL PRESSES

Tables tilt 0-45° left and right

Depth gauge

Chuck guards

Full range of Drill Vices available

MODEL	WATTS	WAS INC VAT	EX VAT	INC VAT
CDP500	250/5	-	£29.95	£35.19
CDP101B	245/5	-	£49.95	£58.69
CDP151B	300/5	-	£79.95	£93.94
CDP108	370/12	-	£89.95	£105.69
CDP201B	370/12	-	£99.95	£117.44
CDP15F	370/12	£135.07	£109.95	£129.19
CDP301B	510/12	-	£134.95	£158.57
CDP351F	510/12	-	£149.95	£176.19
CDP401B	510/16	-	£159.95	£187.94
CDP451F	510/12	-	£189.95	£223.19
CDP501F	980/12	-	£279.95	£346.44

Clarke POLISHING KITS

Kit includes: Tapered spindle, Coloured mop for initial cleaning, pure cotton mop for high polish finish

6" & 8" available

FROM ONLY **£16.99** EX VAT
£19.98 INC VAT

Clarke MECHANICS TOOL CHESTS & CABINETS

Robust steel construction

1 piece roll formed friction slide drawer runners

MODEL	DESC.	DR. WAS	LOAD INC VAT	EX VAT	INC VAT
CTC600	6 Drawer chest	19kg	-	£39.95	£46.94
CTC900	9 Drawer chest	19kg	-	£49.95	£58.69
CTC300	5 Dr. cabinet	35kg	-	£84.95	£99.82
CTC800	8 Dr. Chest/cab	19kg	£99.82	£83.95	£98.64
CTC700	7 Dr. cabinet	35kg	£117.44	£98.95	£116.27
CTC1300	13 Dr. Chest/cab set	19kg	£164.44	£134.95	£158.57

Clarke PROFESSIONAL TOOL CHESTS & CABINETS

THE ULTIMATE IN TOOL CHEST STORAGE!

Extra heavy gauge double wall steel construction

MODEL	DESC.	DRAWER LOAD	EX VAT	INC VAT
CB8204	4 Dr chest	38kg	£69.95	£82.19
CB8205	5 Dr chest	38kg	£89.95	£105.69
CB8206	6 Dr chest	38kg	£86.95	£102.17
CB8209	9 Dr chest	38kg	£119.95	£140.94
CB8203	3 Dr step up	38kg	£56.95	£66.92
CB8215	5 Dr cab	43kg	£169.95	£199.69
CB8217	7 Dr cab	43kg	£199.95	£234.94
CB8212	3 Dr cab	43kg	£134.95	£158.57
CB8213	3 Dr cab	43kg	£159.95	£187.94

Clarke CORDED DRILLS

Variable speed control

Anti slip grip

Depth stop gauge

HUGE CHOICE OF CORDED DRILLS

MODEL	VOLTAGE	WEIGHT	EX VAT	INC VAT
Clarke CHD820	820w	2.4kg	£16.95	£19.62
Black & Decker KR550CORE	550w	2.13kg	£24.95	£29.32
Bosch PSB650RE	650w	1.7kg	£34.95	£41.07

Clarke MICRO MILLING & DRILLING MACHINE

CHD10

150W/230V motor

Variable speed 1000-2000rpm

MT2 Spindle Taper

Face mill capacity 20mm, end mill 10mm

Table cross travel 90mm, longitudinal travel 180mm

ONLY **£239.95** EX VAT
£281.94 INC VAT

Clarke VARIABLE SPEED LATHE & SEPARATE MILL DRILL HEAD

CL250M

250mm between centres

153mm swing over bed

Power feed

Screw cutting facility

Transforms the CL250M into a superb Lathe/Mill

10mm max drill capacity

Variable 30mm travel for drilling spindle

ONLY **£149.95** EX VAT
£176.19 INC VAT

Clarke GAS TORCH KIT

Includes:

- Soldering wire
- Tip cleaning sponge
- Storage case
- Max Temp 400° no flame
- 1300° with flame
- Approx 60 mins per fill

ONLY **£19.95** EX VAT
£23.44 INC VAT

Clarke MEASURING INSTRUMENTS

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£8.49	£9.98
CM180	0-25mm Micrometer	£9.95	£11.69
CM145	150mm/6" Digital Vernier	£19.95	£23.44

Clarke AIRBRUSH KITS

FROM ONLY **£7.99** EX VAT
£9.39 INC VAT

DIY KIT - CABIH

Spray pattern adjustable

ONLY **£7.99** EX VAT
£9.39 INC VAT

PRO KIT - CAB2P (pictured)

Double action trigger for accurate air/paint control

Precision machined nozzle

Special lightweight hose

ONLY **£23.95** EX VAT **£28.14** INC VAT

Clarke TAP & DIE SETS

High quality tungsten steel

Supplied in metal storage case, except 1 piece

TYPE	EX VAT	INC VAT
16pc Metric	£1.29	£1.52
19pc UNF	£1.49	£1.77
24pc UNC/UNF/NPT	£1.95	£2.34
28pc Metric	£1.95	£2.34
33pc Metric/UNF/BSP	£2.95	£3.51

*28pc Best Budget Buy, 33pc Recommended Practical Classics

Clarke ROTARY TOOL SYSTEM

CRT40

Kit includes:

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

ONLY **£24.95** EX VAT
£29.32 INC VAT

Clarke SHEET METAL NIBBLER

Operate from electric or air drill

Cutting cap: Mild steel 1.6mm, Brass 2mm, plastic 2.6mm

Replacement parts available

ONLY **£36.95** EX VAT
£43.42 INC VAT

Clarke SOLDERING KIT

ONLY **£12.49** EX VAT
£14.68 INC VAT

CSK100

- Instant heat & trigger operated for controlled application
- Hands free magnifier
- De-solder suction tool to remove excess from joints
- Scraper/probe tool
- Spare gun tip

Machine Mart

49 SUPERSTORES NATIONWIDE

Where Quality Costs Less

Clarke METAL LATHE - CL300M

300mm between centres

LH/RH thread screw cutting

Electronic variable speed

Self centering 3 jaw chuck & guard

Gear change set

Power feed

ONLY **£359.95** EX VAT
£422.94 INC VAT

FULL RANGE OF ACCESSORIES AVAILABLE

Clarke 12 SPD MILL/DRILL

CMD1225C

Precision engineered with cast iron head, base & column

Spindle speeds 100-2150rpm

1 Ph motor

Accessories available

63mm milling cutter

16mm chuck

Table size 585x190mm

ONLY **£599.00** EX VAT
£703.83 INC VAT

Clarke WIZ MINI AIR COMPRESSOR

ONLY **£54.95** EX VAT
£64.57 INC VAT

Compact, ideal for brush work

Quiet operation

Oil-free diaphragm

1.58cm - 2.8bar

Clarke TURBO AIR COMPRESSORS

FULL RANGE OF AIR TOOLS & SPRAY GUNS AVAILABLE

TIGER 8/40

7 dm displacement

1.5Hp - 24Ltr

Clarke rubber air hose (10m) FROM ONLY **£9.95** EX VAT **£11.69** INC VAT

OTHER MODELS IN THE RANGE

MODEL	MOTOR	CFM	TANK	EX VAT	INC VAT
8/45 a/t	1.5hp	8.3	24ltr	£84.95	£99.82
Panther 25	2Hp	8.2	24ltr	£129.95	£152.69
Panther 50	5Hp	8.2	50ltr	£169.95	£199.69
10/70T	2.0Hp	9	50ltr	£254.95	£299.57
15/75	3.0Hp	14	50ltr	£259.95	£305.44
15/65T	3.0Hp	14	50ltr	£359.95	£422.94

Belt Driven

Clarke ARC WELDERS

Ideal for general repairs & light fabrication

Simple to operate

Supplied with face mask plus welding & earth leads

FROM ONLY **£39.95** EX VAT
£46.94 INC VAT

Clarke BOLTLESS SHELVING

Also available in red, dark grey & blue.

from only **£29.95** ex. VAT
£35.19 inc. VAT

FROM ONLY **£25.95** EX VAT
£30.49 INC VAT

CAN BE ASSEMBLED AS A SHELVING OR BENCH UNIT

MODEL	SHELF DIMS	CAPACITY	EX VAT	INC VAT
CS5150	800x300x1500mm	150kg	£25.95	£30.49
CS5350	900x400x1800mm	350kg	£39.95	£46.94

Clarke ENGINEERS STEEL WORKBENCHES

NEW RANGE

Sturdy lower shelf

Durable powder coated finish

INCLUDES SINGLE LOCKABLE DRAWER

Shown fitted with optional 3 drawer unit

ONLY **£79.95** EX VAT **£93.94** INC VAT

MODEL	SIZE (LxWxH)	EX VAT	INC VAT
CWB1000B	1000x650x880	£119.95	£140.94
CWB1500B	1500x650x880	£159.95	£187.94
CWB2000B	2000x650x880	£184.95	£217.32

Clarke VISIT YOUR LOCAL SUPERSTORE

OPEN MON-FRI 8.30-6.00, SAT 8.30-5.30

LOCATION	ADDRESS	PHONE
BARNLEY	Pontefract Road, Barnley	01226 732 297
B'HAM GREAT BARR	0121 358 7977	
4 Birmingham Road, Great Barr		
B'HAM HAY HILLS	0121 771 3433	
1152 Coventry Road, Hay Mills		
BOLTON	01204 365799	
1 Thynne Street		
BRADFORD	01274 390962	
105-107 Mannings Lane		
BRISTOL	0117 935 1060	
1-3 Church Road, Lawrence Hill		
CARDIFF	029 2046 5424	
44-46 City Road		
CARLISLE	01228 591666	
85 London Road		
CHESTER	01244 311258	
43-45 St. James Street		
COVENTRY	024 7622 4227	
Bishop St		
COLCHESTER	01206 762831	
600 Station Road		
CROYDON	020 8768 0640	
423-427 Brighton Road, South Croydon		
DARLINGTON	01325 380841	
214 Northgate		
DEAL (KENT)	01304 373 434	
182 - 186 High Street		
DERBY	01332 290931	
Derwent Street		
100 The Highway, Docklands		
EDINBURGH	0131 659 5919	
24-26 Trades Lane		
GATESHEAD	0191 493 2520	
50 Lobbly Hill Road		
GLASGOW	0141 332 9231	
280 Gt Western Rd		
GLoucester	01452 417 948	
221 A Barton Street		
GRIMSBY	01472 354435	
Ellis Way		
HULL	01482 223161	
8-10 Holderness Road		
ILFORD	0208 518 4286	
746-748 Eastern Ave		
LEEDS	0113 231 0400	
227-229 Kirkstall Road		
LEICESTER	0116 261 0688	
69 Melton Road		
LIVERPOOL	0151 709 4484	
88 London Road		
LONDON	020 8803 0861	
6 Kendal Parade, Edmonstone N18		
505-507 Lea Bridge Road, Leyton, E10		
LONDON	020 7488 2129	
MAIDSTONE	01622 769 572	
57 Upper Stone Street		
MANCHESTER	0161 941 2666	
71 Manchester Road, Altrincham		
MANFIELD	01623 622160	
169 Chesterfield Road, South		
MANSFIELD	01462 677881	
Mandale Triangle, Thornaby		
NORWICH	01603 766402	
Hingham Street		
NOTTINGHAM	0115 956 1811	
211 Lower Parliament Street		
PETERBOROUGH	01733 311770	
417 Lincoln Road, Millfield		
PLYMOUTH	01752 254050	
58-64 Embankment Road		
POOLE	01202 717913	
17-19 Bournemouth Road, Parkstone		
PORTSMOUTH	023 9265 4777	
277-283 Copnor Road, Copnor		
PRESTON	01772 703263	
53 Blackpool Road		
SHEFFIELD	0114 258 0831	
45-53 London Road, Heeley		
SOUTHAMPTON	023 8055 7788	
516-518 Portwood Road		
STOKE-ON-TRENT	01782 287321	
382-396 Waterloo Road, Hanley		
SUNDERLAND	0191 510 8773	
13-15 Ryhope Road, Graingerstown		
SWANSEA	01792 792969	
7 Samlet Road, Llansamlet		
SWINDON	01793 491717	
21 Victoria Road		
TWICKENHAM	020 8892 9117	
83-85 Heath Road		
WOLVERHAMPTON	01902 494186	
Parkfield Road, Bilston		
WOLVERHAMPTON	01905 723451	
WROXETER		
85a Upper Wything		

Clarke ORDER ONLINE

www.machinemart.co.uk

OVER 3000 PRODUCTS - SEE THE FULL RANGE

24hr TELESALLES

0845 450 1800

0845 450 1801

4 SUPERSTORES

TELESALLES

WEBSITE

WAYS TO BUY

FAX

NEW SPRING/SUMMER CATALOGUE

Machine Mart

ALMOST 500 PRICES SLASHED

Collect from your local branch

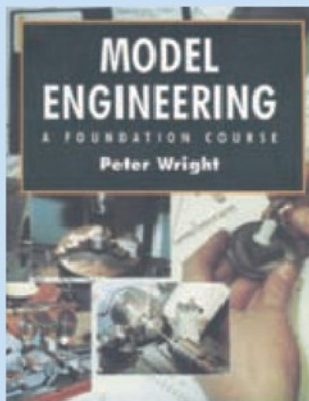
Order from www.machinemart.co.uk

e-mail: sales@machinemart.co.uk

TELEPHONE 0845 450 1855 (LOCAL RATE)

beginners start here...

WHAT BETTER WAY TO FOLLOW ON FROM A FOUNDATION COURSE THAN BUILDING A SIMPLE STEAM ENGINE? BUY *MODEL ENGINEERING A FOUNDATION COURSE* AND PAY FOR *BUILDING SIMPLE MODEL STEAM ENGINES* AND WE'LL GIVE YOU VOLUME 2 FOR FREE



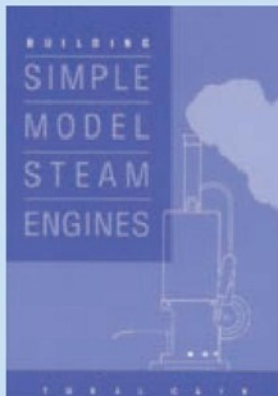
MODEL ENGINEERING - A FOUNDATION COURSE

Peter Wright

A new book by an experienced model engineer covering all the basic techniques: understanding engineering drawings, buying materials, marking out, sawing, filing, bending and forming metals. Includes a review of engineering, materials, the making of cutting tools in the home workshop and much more. A must for those practical people who have little experience of working in metal.

1997 1-85486-152-2 236 x 189mm

416 pages *Illustrated paperback* **£16.95**



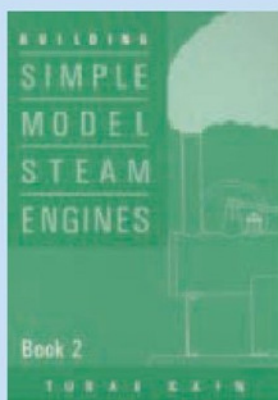
BUILDING SIMPLE MODEL STEAM ENGINES

Tubal Cain

The sheer simplicity of miniature oscillating steam engines has an enduring fascination for all marine and model engineers. This book shows how to build four model steam engines and features designs and plans that even a beginner will be able to follow.

1993 1-85486-104-2 210x148mm

112 pages *Illustrated paperback* **£5.50**



BUILDING SIMPLE MODEL STEAM ENGINES II

Tubal Cain

Since the publication of the first book dealing with these fascinating little engines, the author has designed and built several more ranging from a delightful little turbine to a larger engine in the style of the magnificent 'Steam Engines of the Highest Class' offered by toymakers before WW1. Fully detailed methods of construction with the beginner in mind.

1997 1-85486-147-6 210x148mm

112 pages *Illustrated paperback* **£5.95**

Please add £1 p&p for single book orders and 50p for each additional book ordered

Send payment with your name, address and telephone number to:
Customer Services, Encanta Media Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL.
Cheques made payable to Encanta Media Ltd.

Telephone Customer Services on 01689 899228/899229.
Don't forget Valid From, Expiry Date and Issue Number details if you're paying by credit card.

**Subscribe
for ONLY £12.99***

Save 20%, when you pay by quarterly Direct Debit

- Pay only £12.99 every 3 months
- FREE delivery straight to your door
- Never miss an issue

 BY PHONE: **0870 837 8600**, quote ref. E036

 ONLINE: www.subscription.co.uk/mde/E036

 BY POST: Complete the form below



☐ I would like to subscribe to *Model Engineer* with a one-off payment

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

Do you want to sell our magazines?



If you're a shop, club or society, you could earn extra revenue by stocking copies of ***Model Engineer*** and ***Model Engineers' Workshop*** or any of our other leading magazines.

- We will arrange delivery
- No risk - sale or return
- Order both ***Model Engineer*** & ***Model Engineers' Workshop*** and get a **FREE** display stand



Covering a broad spectrum of everything military - in model form, backed with illustrated features on the real hardware, uniforms and history.



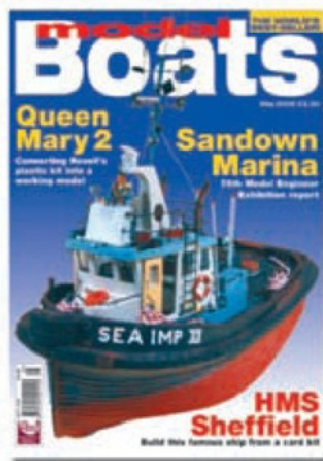
Established over 100 years ago, *The Woodworker* is the resource for enthusiasts, from intermediate to professional. It's seen as the authoritative voice of woodworking.



Packed with projects and techniques, as well as tool tests and tips, *Practical Woodworking* is an essential companion for beginners and enthusiasts alike.



RCM&E is the UK's market-leading R/C title covering radio control model flying in all its various forms. It's the RC magazine with attitude!



Model Boats is the world's leading monthly model boats magazine. From radio control warships to stately galleons, this is a must read!



Gardens Monthly offers inspirational garden styles and ideas, expert advice, hints and tips and plants to suit every season!



Popular *Patchwork* is the premier magazine for all patchwork enthusiasts. Every issue is bursting with projects for all skill levels.

Sell our publications at your shop, show, club or class and earn extra money! Just fill in the slip below...



ENCANTA MEDIA

WANT TO KNOW MORE? Contact Louise Cribbs - By telephone: 01689 899 212)

By post: Please complete the coupon in BLOCK letters and send to WWMD Department, Encanta

Media, Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL. **By e-mail:** WWMD@encanta.co.uk

Please tick next to the magazines that you are interested in:

Model Engineer	☐
Model Engineers' Workshop	☐
Model Boats	☐
RCM&E	☐
Military Modelling	☐
The Woodworker	☐
Practical Woodworking	☐
Gardens Monthly	☐
Popular Patchwork	☐

Title: Mr/Mrs/Ms/Miss Surname:

Address:

Post Code:

Telephone:

Email:

Encanta Media would like to keep you informed of up-and-coming events, magazine new and other activities that we feel maybe of interest to you. If you would like to receive this information please tick the box. ☐

NB: This information will not be shared/sold to any 3rd parties

MODEL ENGINEERS' WORKSHOP



CLASSIFIED Advertisements



Send to Model Engineers' Workshop Classified Department, Encanta Media Ltd.,
Berwick House, 8/10 Knoll Rise, Orpington, Kent. BR6 0EL Tel: 01689 886650 Fax: 01689 886666
All Advertisements will be inserted in the first available issue. There are no reimbursements for cancellations.
All advertisements 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

MODELS - MATERIALS - EQUIPMENT

CALL JENNI ON 01689 899 215

TRACTION ENGINE SPECIALIST

**Wanted - ALL Traction Engines,
ALL Sizes 1" to 6" including Minnie,
Royal Chester, Thetford Town, Burrell, agricultural
engines, rollers and steam wagons.**

**Any condition - part built included,
OR JUST PLAIN WORN OUT!!**

Will collect anywhere and PAY CASH.

For an informal chat Tel: 01507 606772

ALSO COMPLETE WORKSHOPS CLEARED

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,BSCycle,WF,BSB,BA,Model Eng

Over 1000 Wooden boxes
British-made (designed by us)
in ALL above types on the shelf
3 boxes = **ME5** (30pc) + **ME4** (27pc)
+ **BA2** (35pc) covers **EVERY** type & size
of Model Eng taps & dies

ME5 = 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)
BA2 = 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 = £22.95 box = £16.50, 36 box = £13.86
Dies: 1 box = £35.95 box = £26.25, 36 box = £22.05
World delivery, Bankcards, **SAME DAY** post/VAT

1000's of all other types/sizes

Also: Drills, Reamers, Endmills, Slotdrills
Sitting Saws etc - No Minimum order

www.tapdiele.com

THE TAP & DIE CO

445 West Green Road, London N15 3PL - UK
Tel: +44 (0)20 88881865 Fax: +44 (0)20 88884613

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**

MAKE THAT CALL TODAY

TOOLCO

The home of good quality used tools and machinery

www.toolco.co.uk

or send for full itemised stocklist.

Unit 4, Ebley Ind Park, Ebley, Stroud, Glos GL5 4SP

Important: Phone for opening times before travelling.

(Just 4 miles J13 M5 Motorway) Tel: 01452 770550

E-Mail: sales@toolco.co.uk Fax: 01452 770771

R.A. ATKINS

MYFORD ML10 BENCH LATHE	£495
MYFORD ML7 BENCH LATHE	£525
MYFORD SUPER 7 CABINET LATHE	£750
MYFORD SUPER7B PXF CABINET LATHE	£2650
MYFORD 254S CAMLOCK LATHE	£2750
LORCH LAS SCREW CUT LATHE TOOLED	£2650
BOXFORD AUD MKIII 5"X22" LATHE	£975
KERRY 11 X 24 CABINET LATHE TOOLED	£450
HOBBYMAT UNIV LATHE TOOLED AS NEW	£475
BCA JIG MILL INBUILT 8" ROTARY TABLE	£975
CENTEC 2C UNIV MILL JOINT QUILLHEAD	£975

MYFORD VM - E TURRET MILL RB	£1775
CORONA H5 PREC 1/8" BENCH DRILL	£100
MEDDINGS M4 7/8" BENCH DRILL	£225
FOBOC STAR 1/2" PILLAR DRILL	£150
NEW MYFORD SWIVEL VERT SLIDE	£195

**WE URGENTLY REQUIRE TO BUY SINGLE MACHINES OR COMPLETE
WORKSHOPS. PROMPT INSPECTION SETTLEMENT. ESTABLISHED OVER
35 YEARS.**

**HUNTS HILL HOUSE, HUNTS HILL,
NORMANDY, GUILDFORD, SURREY GU3 2AH
Tel: (01483) 811146 Fax: (01483) 811243**

BA FASTENERS IN BRASS STEEL & STAINLESS



**SPLIT PINS, TAPER PINS,
ROLL PINS, TAPS, DIES, DRILLS,
NUTS WASHERS,
RIVETS, MATERIALS**



Send Stamped addressed envelope plus four first class
stamps for 28 Page List (Overseas £2.50) Quote MEW.

"ITEMS" MAIL ORDER LTD,

**46, ST. MARTINS ROAD, NORTH LEVERTON,
RETTFORD NOTTINGHAMSHIRE DN22 0AU
Telephone 01427 884319 Fax 01427 884319**

(24 hr update) **www.tradesalesdirect.co.uk** (Trade Prices)

Don't wait for the next issue! Check out the Internet Web Site above. It contains a stocklist of used lathes, millers, grinders, drills, saws, miscellaneous machinery, accessories, items of interest, etc. A stocklist is also available 'FREE' by post.

Contact: David Anchell, Quillstar Ltd, Lower Regent Street, Beeston, Notts. NG9 2DJ
Tel 0115 9255944 Fax. 0115 9430858 or you can send an e-mail to: david@tradesalesdirect.co.uk.
WORLDWIDE SHIPPING. TRADE SALES DIRECT IS A SUBSIDIARY OF QUILLSTAR LTD.

ALL LOCOS AND STEAM ENGINES REQUIRED 3 1/2" - 5" - 7 1/4"

Part built or Finished in any condition. Complete collections purchased

FOR CASH - Distance no object, available 7 days a week

Please telephone Kevin on 01507 606772 for a friendly and informal chat

www.arceurotrade.co.uk

Unbeatable Value Engineering Products by Mail Order

Shop on-line or call us on 0116 269 5693 for Catalogue No.4

Arc EuroTrade

LOOK

MODEL MAKING METALS

1/2 in. to 12 in. dia. bright steel, stainless steel, bronze, spring steel, brass, aluminium, silver steel, steel tubes, bolts, nuts & screws, tap dies + drills, white metal casting alloys. Fine materials, chain, plastic, Lathe milling machines and equipment, new and secondhand.

Mail order nationwide and worldwide callers Mon.-Fri. 9-5pm.
Access/Visa welcome

Send now for a free catalogue or phone:

Milton Keynes Metals, Dept. MEW,
Ridge Hill Farm, Little Horwood Road, Nash, Milton Keynes,
MK17 0EH Tel: (01296) 713631 Fax: (01296) 713032
www.mkmetals.sageweb.co.uk
email: sales@mkmetals.co.uk

www.powercapacitors.co.uk

Transwave
CONVERTERS
THE ONE-STOP CONVERTER SHOP

The ONLY Phase Converter Manufactured to BS EN ISO 9001/2000

3 YEAR WARRANTY

Local Call: 0844 7700 272
sales@transwave-online.co.uk

Laser cut parts for locomotives and traction engines. All scales and gauges, frames, tenders, hornplates, spokes, etc. Tel: 01302 721611 (Doncaster).

**TO ADVERTISE
HERE
PLEASE CALL
JENNI ON
01689 899 215**

The Workshop
3 Axis CNC Kit

Whether you are building your own CNC Machine/ converting an existing machine or you have simply bought a kit, 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
- ★ Routout CNC Software
- ★ Easy LPT Breakout Board

Only £120.00
Tel (01269) 841230
Order Online www.routoutcnc.com

Laser cut parts. All gauges and scales. Frames, cabs, tenders, spokes, etc. Tel: 01302 721611 (Doncaster).

Perfecto Hand Shaping machine. Good condition. Buyer to collect. £50 no offers. Tel: 01942 813429 (Lancs).

Portass screw cutting lathe with accessories. Bench or free standing. Photo available. Buyer collects. Offers. Tel: 0161 4392021 (Stockport).

Colchester Bantam lathe 140 x 510. Well equipped. Phone for details. £850. Tel: 01580 850691 (Kent).

No. 5 Flypress with operating arm. No weights. Tatty but working. £30. Buyer collects. Tel: 0121 550 0919 (West Midlands).

Myford vertical 5i swivel slide £45. **Tajfun planema radio arm** plus table whole circular saw/angle grinder £80. 01213544915

THINKING OF SELLING YOUR LATHE, MILL OR COMPLETE WORKSHOP

and want it handled in a quick, professional
no fuss manner? Contact David Anchell,
Quillstar (UK) Ltd (Nottingham).

Tel 0115 9255944 Fax 0115 9430858

ENGINEERS TOOL ROOM

*The tool supplier for Professional &
Model Engineers*

CUTTING TOOLS: HSS – COBALT –
COATED

Drills: Metric, Fractional, Jobbers, Long
Series, Boxed Sets

Reaming: Metric, Fractional Hand and
Machine.

Threading: Taps, Straight Flute, Spiral Flute,
Boxed Sets, Metric, Imperial, Unified, BA.

Dies: Split Dies, Solid Dies, Die Nuts, Metric,
Imperial, Unified, BA.

Milling: End Mills, Slot Drills Plain and Screw
Shank, Horizontal Cutters, Slitting Saws,
Collets.

Turning: HSS Tool Bits, Tungsten Carbide
Tipped Turning Tools, Insert Tools, Collets.

Measuring: Micrometers, Verniers, Dividers,
Callipers, Setting up Tools

Workshop Machinery: Lathes, Milling
Machines, Pillar Drills, Band Saws

Machining Services: full machining service
available, turning, milling, grinding, wire and
spark eroding, tool and mould making

**"New" Tool Catalogue available FREE –
Send for one today**

**CHECK OUT OUR SPECIFICATIONS & PRICES
BEFORE ORDERING YOUR MACHINES – Contact
us for a Quotation**

Part Exchange on some machine tools welcomed

Tel: 01443 442651 Fax: 01443

435726 Mobile 07770 988840

Web Site: www.engineerstoollroom.co.uk

Email: regpugh@aol.com

**UNIT 28, ENTERPRISE CENTRE, LLWYNPIA
ROAD, TONYPANDY, RHONDDA CF40 2ET**

Woolston Engineering Ltd.

USED MACHINERY

Myfords / Boxford etc.

New and used tooling

Materials Steel/Brass/Stainless

Fasteners and Consumables

Electrical Products,

Oils and Lubricants etc. etc.

Please phone or fax for current illustrated lists.

Tel: 01925 851050

Fax: 01925 821201

PROJECT MACHINERY

VISIT OUR WEB SITE -

www.projectmachinery.co.uk

A sample of our current stock includes:

Lathes

Myford ML7, single phase, equipped, good usable machine£495

Harrison L5, 5" x 25"+ gap bed, Gearbox, clutch, equipped£695

Colchester Bantam 2000, 6" x 30" gap bed, dual dials, equipped£1950

Colchester Master 2500, 6 1/2" x 25" gap bed, clutch etc, equipped£2250

Colchester Chipmaster, 5" x 20", vari speed, clutch, well equipped£1500

Colchester Triumph 2000, 7 1/2" x 50", clutch etc, equipped£1750

Mills

Excel mill/drill, choice of 2, please enquire£495

Aceria mill/jig borer, 22"x 12" T, superb capacity-minimum footprint, tooled £1950

Tom Senior Major, vertical/horizontal, 31" x 7" T, power feed, quill head.£2150

Bridgeport, 36" x 9" T, power feed, 3 axis DRO, crome slides£2250

Condor, (Large Bridgeport Copy) 50" x 10" T, power feed, Vari speed, DRO.£1400

Warco (Bridgeport Copy) 42" x 9" T, power feed, vari speed head, DRO etc.£1750

Comet universal, horizontal/vertical, tilt/swivel table, power feeds, superb.£2250

Various

Elliott 10M shaper, single phase, compact machine£295

Meddings MB4, 10 speed 2 morse taper British bench drill, exceptional ...£295

Jones & Shipman 540 surface grinder, c/w mag chuck & dust extractor£850

3ft Edwards Guillotine £395. Edwards- 2ft Box Pan folder £575, 3Ft Box

folder£750

4ft Box Pan folder, £875. Alaxander 3A pantograph engraver/die sinker, c/w
type face collets etc.£375

Vanco single phase vertical bench top finisher £175. RJH horizontal finisher,
.....£175

Part exchanges always welcome, other machines available, can deliver nationwide (High Wycombe)

Telephone 01844 350211 (day & eves)

Mobile 0775 2659904

www.simplycnc.com

**Have you seen our
Sister Magazine,
Model Engineer Yet!!!!**

MAKE THAT CALL TODAY

**Quality Machines
and Tooling**

NEW MACHINERY IN STOCK

Denford Viceroy Lathe with gear box and tooling	£950
Myford mini cop lathe	£250
Edwards 3ft Treadle Giffoline	£300
Vicoroy Milling Machine vertical 30int good condition, excellent daylight	£1400
Tom Senior vrt/horiz milling machine excellent condition, one mark in table, 1 phase	£1200
Large Ajax power hacksaw	£400
Casto 8 inch power hacksaw	£300
Abwood Vertical spindle surface grinder	£500
Garbo Metal shear on stand	£180
Vicoroy Sharp Edge lathe as new	£275
Elliott Progress Pillar Drill 2mt geared head, excellent condition, one phase	£450
Colchester Master Lathe complete but untidy	£650
3 Off Bridgeport milling machines	£2000
Harrison LSA Lathe	£650
Colchester Master sq head longbed with tooling	£1500

Boxford taper turning attachment	£150
HMYof Minicop copy turning lathe on cabinet	P.O.A.
Wadkin Universal Cutter Grind type N.H. with lots of tooling	£1,500
Harrison LS Lathe Gap Bed with Tooling	£800
3 x Harrison LS lathes tooling	£700 each
Grinnell drill floor stand with tapping plus x-y compound table	£850.
Colchester master straight bed lathe with clutch. Has electrical fault.	£600

Schaubling Vertical Head as new	£800
Ferson tool, tool cabinet	£150
3 Point steady for Boscawen and Gifford	£200
3 Point steady for Dean Smith and Gifford	£200
3 Point steady for Colchester Master model 2500/student 1800	£200
Colchester student collet chuck	£120
Colchester student capstan hardly used	£300

CONTENTS OF A COLLEGE * COMING SOON * PLEASE WATCH THIS SPACE

More machines always in stock. Tel: 01274 402208 & 780040 Mobile 07887 535868 4 Duchy Crescent, Bradford, BD9 5NJ

**TO ADVERTISE PLEASE CALL
JENNI ON 01689 899 215**

No reimbursements for cancellations.

PLEASE TICK ONE BOX ONLY

GENERAL

PRIVATE SALE/TRADE SALE (DELETE NON-APPLICABLE)

TEL. NUMBER					

ALL ADVERTISEMENTS MUST BE PRE-PAID. NO REIMBURSEMENTS FOR CANCELLATIONS.

I enclose my Cheque/Postal Order* for £forinsertions.

made payable to Highbury House Communications

(*Delete as necessary) or Please debit my Mastercard/Barclaycard No.

Expiry Date

Name.....

Address

Post Code

Daytime Tel. No

email@.....

Signature Date

£ for insertions.

PRICE GUIDE – Tick one box

PRICE GUIDE —
18 words or less

FREE!! (private sales only)

18-25 words, in colour
only £10

26 words +
in colour **£15**

Private ad, in box, full colour, endless

word count – 2.5 x 1 £25

3 x 1 2x30

3.5 x 1	£35
---------	-----

Subscribe for ONLY £7.99*

HURRY!
Offer ends
22 June

*every 3 months

Save 14%, when you pay
by quarterly Direct Debit

Don't miss out...

- Pay only £7.99 every 3 months
- FREE delivery straight to your door
- Never miss an issue

Subscribing couldn't be easier...

BY PHONE: **0870 837 8600**, quote ref. E037

ONLINE: www.subscription.co.uk/mew/E037

BY POST: Complete the form below



☐ I would like to subscribe to *Model Engineers' Workshop* and **SAVE 14%**, paying £7.99 every 3 months by Direct Debit (UK ONLY)

Please complete form opposite

☐ I would like to subscribe to *Model Engineers' Workshop* with a one-off payment

UK (SAVE £10%) ☐ £33.75 Europe (incl Eire) ☐ £42.00 US Airmail ☐ £40.00 ROW Airmail ☐ £44.00

☐ Postal Order/Cheque ☐ Visa/Mastercard ☐ Switch ☐ AmEx
Please make cheques payable to Encanta Media Ltd and write code E037 on the back

Cardholder's name

Card no

.....

Expiry date Switch issue no/valid date

Signature Date

YOUR DETAILS:

Name Mrs/Ms/Miss/Mr

Address

.....

Postcode Country

E-mail

Tel Mobile

TO SUBSCRIBE BY DIRECT DEBIT YOU MUST COMPLETE THIS BOX

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

☐ Pay £7.99 every 3 months by Direct Debit



Name of bank

Address of bank

.....

.....

..... Postcode

Account holder

Signature Date

.....

Sort code Account number

.....

Instructions to your bank or building society: Please pay Encanta Media 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 Encanta Media 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 22 June 2006. Subscriptions will begin with the first available issue. Please continue to buy your magazine until you receive your acknowledgement letter. Refund requests must be in writing to the Publisher and will not be given on accounts with less than £20 credit. A £5 admin charge will apply and will be deducted from any refund. Refunds will only be given for non-receipt of issues or at the Publisher's sole discretion. Encanta Media Ltd, publishers of *Model Engineers' Workshop* may share information about you with other reputable companies so that we may let you know about products and services that may be of interest. If you would prefer not to receive this information, please tick this box ☐

Photocopies of this page are acceptable

Code E037

SEND TO: MODEL ENGINEERS' WORKSHOP SUBSCRIPTIONS, TOWER HOUSE, SOVEREIGN PARK, MARKET HARBOROUGH, LEICS LE16 9EF

GENUINE MACHINES AND TOOLING

HOME AND WORKSHOP MACHINERY

QUALITY USED MACHINE TOOLS

144 Maidstone Road, Fools Cray, Sidcup, Kent, DA14 5HS.

Telephone 020-8300 9070 – Evenings 01959 532199 – Facsimile 020-8309 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



Harrison
140, 5 1/2"
x 24" lathe

£1400



Myford 254 Plus. As new
complete with chucks and
splash back, in metric

£3650



A selection of tinman's stakes

From
£10
each



Boxford AUD 4 1/2" x 20" gearbox,
power cross-feed + Jaguar Cub
Inverter fitted

£1350

BGA jig borer on stand + collets and tailor made Transwave
converter £1125
Tom Senior M1 vertical / horizontal milling machine £1250
Tom Senior M1 / Major slotting head as new £475
Marico broach sets just in from £175
Raglan / Littlejohn accessories just in £425
Clarkson radius attachment £145
Rapid hacksaw £25
Col. Student round head travelling steady/bottom fixing from £140
Myford vertical slides (Not Copies) each £12
Boxford collets (Not Copies)
To Clear / As Is £495
Myford ML7 £495 Boxford TUD £300 Viceroy £495



Myford Super 7B lathe &
gearbox, hardened bed

£2950



Bridgeport
mill, 1994,
v/s head,
DRO &
powered
head

£3650



Hardinge short dovetail bed
lathe ideal 'for one off jobs'

£750



Harrison vertical milling
machine, 30 INT head +
30" x 8" powered table
& coolant

£1750



Startrite 20RWH
(hydraulic) vertical
metal cutting bandsaw

£2250



Emco Unimat SL lathe

£175



Startrite
metal
cutting
bandsaw
(8 speed)

£625

Tom Senior
'E' type
milling
machine,
extremely
rare and
sought after



£3250



Myford Super 7B lathe 3 1/2"
x 19" lathe

£1250



Myford
254 fitting
VMA
milling
head,
including
table &
chuck

As new
£1500



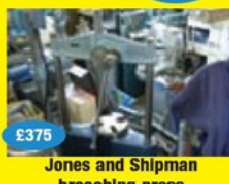
Boxford VM30
milling machine, 30
INT head + 3 Way
DIGITAL READ OUT

£1950



Myford Super
7B gearbox,
power cross
feed, cabinet
stand in
original
paintwork

£3250



Jones and Shipman
broaching press

£375



Boxford 1130, 5 1/2" x 30"

£2450



Wellsaw 4" hacksaw

£375



Elliot Victoria Junior
complete with Elliot
quill type head and
horizontal gear

£2450



Smaller
machine tools



Boxford 240 TCL CNC
slant bed lathe

£2450



RJH 4"
finisher
complete
on dust
extraction
cabinet
stand

£625



Harrison M300 lathe
complete with gap bed
and tooling

£2950



Viceroy buffing
machine
complete
with built
in
extractor

£475



Marlow
vertical
milling
machine
complete
with 28"
x 6 1/2"
table

£950



Harrison Union Graduate
wood lathe

£950



One of many different size sets
of keyway broaches

£245



Harrison
Jubilee
polisher

£145



Crompton Parkinson Motors
NEW 3/4HP Ideal for Myford &
Boxford etc.

£150
Each



Myford ML7R 3 1/2" x
19" + clutch / lever
tailstock

£1625



Boxford 260VMC
3 axis vertical
milling machine

£2450



Raglan 5"x24" lathe
complete with gearbox,
variable speed & power
cross feed

£1400



Tom Senior ELT Universal
swivel variable power feed
36"x8" model complete with
knuckle head

£3450



Norton
No.6
flypress
complete
with
Hunton
bolster

£665



PLEASE PHONE 020 8300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST

DISTANCE NO PROBLEM!! DEFINITELY WORTH A VISIT ALL PRICES EXCLUSIVE OF V.A.T.

We also have a
massive range of
small tooling far too
much to list!!

Just A Small Selection Of Our Current Stock Photographed!!

CHESTER UK

Annual Open Days 2006



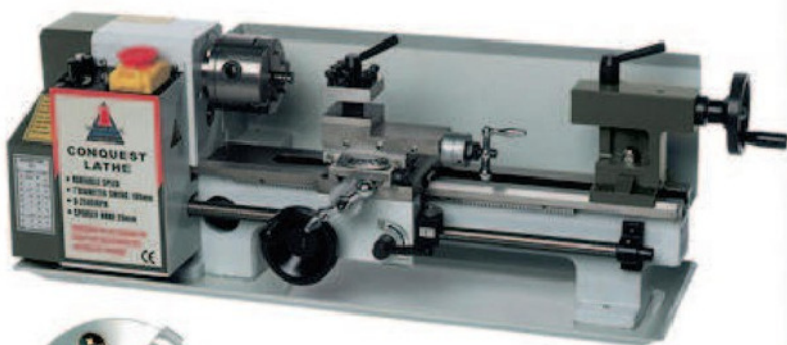
OPENING TIMES

Thursday 16th June 10am - 6pm

Friday 17th June 9am - 5pm

Saturday 18th June 9am - 4pm

- Massive Discounts on all Tooling
- Machine Demos & Model Displays
- Cut price 2nd hand Machines & Ex-Demo Machines Available
- Fantastic offers on our Full range of Machine Tools



Chester UK Ltd
Clwyd Close
Hawarden Industrial Park
CH5 3PZ

Tel: 01244 531531
Fax: 01244 531331
e-mail: sales@chesteruk.net
website: www.chesteruk.net