

MODEL ENGINEER

Vol. 197 No. 4279

UK £2.50 | Australia \$8.60 | New Zealand \$10.70 | Canada \$8.25

4-17 August 2006

BUILD
THE OMC-3
ENGINE

**GREAT
ORME
TRAMWAY**

**USEFUL
INDEXING
TABLE**



**FASCINATING
HYPOCYCLOIDAL ENGINE**





PHONE FOR YOUR
FREE COPY!

CLARKE CL300M LATHE



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

QC TOOLPOST



C305 - £39.95

4 JAW CHUCK



7610721 - £65.00

FIXED STEADY



C301 - £19.50

TRAVELLING STEADY



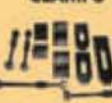
C302 - £19.95

FACEPLATE



C303 - £17.00

FACEPLATE CLAMPS



C304 - £8.50

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

CLARKE CMD10 MILL/DRILL



£281.95!!

MORE NEW ITEMS

INDEXING 4 WAY TOOLPOST - SUIT ML7



FWP2 - £22.00

160MM BACKPLATE SUITS BOXFORD



BPP160 - £39.95

6"/150mm WATERPROOF DIGITAL CALIPER



CODE SMT023 - £45.00

MINI METRIC TAP & DIE SET



1MM-2.5MM
CODE PRICE
MX38 £28.00!!

24" BENDING BRAKE

Suitable for more complex forming
Permits up to 135deg
bend in steel up to
1.2mm thick.

CODE - SMY016 - £125.00

NEW - LASER EDGE & CENTRE FINDER WITH A 6MM SHANK!



CODE - LCEF - £56.95

52 PIECE MILLING MACHINE CLAMP KITS

CODE	SLOT	STUD	PRICE
CG43A	3/8	5/16	£32.95
CG44	1/2	3/8	£36.95
CG45	5/8	1/2	£39.95
SMA0611	12mm	M10	£45.00
SMA0612	14mm	M12	£49.95
SMA0613	16mm	M14	£79.00



18" MINI BENDING BRAKE

Permits up to a full
90deg bend in steel up
to 1.6mm thick.

CODE - SMY015A - £24.95



NEW!

CR0188 "STIRLING HOT AIR ENGINES" - £32.95



2 GREAT
NEW
BOOKS!



WPS38 "TOOL & CUTTER SHARPENING" - £8.30

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

8PC HSS BLACKSMITHS DRILL SETS



CODE SET
MX50 9/16 - 1" 1/16 INCHMENTS £28.00
MX51 13/16 - 1 1/4 - 1 3/4 - 2 - 2 1/4 - 2 3/4 - 3" £28.00

SET OF HSS PRECISION GROUND DRILL SETS IN METAL CASES



POSILOCK MILLING CHUCK SET WITH 8 COLLECTS



PC38EB - 3MT - £85.00
PC28EB - 2MT - £85.00
PC28EB - R8 - £85.00

TAP CHUCK M4-M12 WITH A 2MT ARBOR



TC01 - £34.95

K4 MILLING VICE



CG6 - £69.95

DIGITAL MICROMETER 0-25MM / 0-1"



CODE - EDM25 - £39.95

CODE SET
MX40 19PC 1/16mm x 0.5mm £8.00
CG75 29PC 1/6 - 1/2 x 64th £16.00
CG76 25PC 1-13mm x 0.5mm £16.00
CG77 50PC 1-6mm x 0.1mm £20.00
CG78 41PC 6-10mm x 0.1mm £45.00
CG79 60PC 1-60 Number Drills £20.00
CG80 26PC A-Z Letter Drills £29.95

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!!



Model Engineer is published by
Encanta Media Ltd.

Berwick House, B-10 Knoll Rise, Orpington, Kent BR6 0EL
Telephone (+44) 01689 899200
Fax (+44) 01689 899266

SUBSCRIPTIONS

26 issues (annual) UK £65.00,

Europe £80.00,

US Airmail \$130.00

RoW Airmail £86.00

Make cheques payable to
Encanta Media Ltd.

UK ONLY

NEW, RENEWAL & QUERIES

Tel: 01689 899200

Email:

modelengineer@subscription.co.uk

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 Carpenter (01689-899255)

Technical Editor Neil Read
(01604-833670)

Production Editor Kelvin Barber

Associate Editor Malcolm Stride

Editorial Administrator (01689-899222)

PRODUCTION:

Designer Carol Philpott

Commercial Designer Ben Wright

Creative Services Assistant

Michelle Briers

Production Assistant Kelly Crafts

Printed by William Gibbons & Sons Ltd.

SALES & MARKETING:

Marketing & Subscriptions Manager

Nicola Simpson (01689 899209)

Group Sales Manager

Colin Taylor (01689-899249)

Advertising Sales Executive

Jenni Collins (01689 899215)

MANAGEMENT:

Creative Director Nikki Parker

Commercial Director Jez Walters

Managing Director Owen Davies



ENCANTA MEDIA

© Encanta Media Ltd.

2006

All rights reserved

ISSN 0026-7325

The Publisher's written consent must be obtained
before any part of this publication may be
reproduced in any form whatsoever, including
photocopies, and information retrieval systems.

All reasonable care is taken in the preparation of the
magazine contents, but the publishers cannot be held
legally responsible for errors in the contents of this
magazine or for any loss however arising from such
errors, including loss resulting from negligence of our
staff. Reliance placed upon the contents of this
magazine is at readers' own risk.

IN THIS ISSUE

● Vol. 197 No. 4279 4-17 Aug 2006 ●

SMOKE RINGS

Editorial news, views, and comment.
PAGE 129

POST BAG

Letters to the editor.
PAGE 130

HYPOCYCLOIDAL DOUBLE ACTING ENGINE

Les Kerr from Australia describes an
unusual engine with a crankshaft design
steeped in history and mystery.
PAGE 133

BASIC TRAINING FOR MODEL ENGINEERS

Norman Billingham describes how a SMEET
training course helped him to complete a
working steam engine.
PAGE 135

I/C TOPICS

Nemett continues his description of how to
build his 15S four-stroke engine with the
tappets, valves, cam box, camshaft and
crankcase.
PAGE 136

CHANGING HINDSIGHT INTO FORESIGHT

Mick Appleyard brings his popular series to
a conclusion with advice on making valves,
jointing materials, and other hints for
your workshop.
PAGE 141

BUILDING A STUART MODELS PILLAR DRILL

Anthony Mount continues with the
construction of the Stuart Models
drilling machine.
PAGE 146

EDWARDIAN ELEGANCE GREAT ORME TRAMWAY

Ron Isted takes his talented pen to a little-
known national treasure, still working well
after more than a hundred years.
PAGE 148

LETTERS TO A GRANDSON

M. J. H. Ellis continues his discourse on the
history of measurement, and takes a third-
class compartment with Einstein.
PAGE 153

THE OMC-3 FROMENT ENGINE

Malcolm Stride reviews a new kit in the
popular series of models from the Old
Model Company.
PAGE 154

MODEL ENGINEER

Vol. 197 No. 4279

4-17 August 2006

BUILD THE OMC-3 ENGINE

GREAT
ORME
TRAMWAY

USEFUL
INDEXING
TABLE

FASCINATING
HYPOCYCLOIDAL ENGINE

On the cover ...

The Froment Engine was one of
the pioneering rotary electric
motors of the mid-19th Century,
which were eventually to
develop into the ubiquitous
power units so familiar today. In
this issue Malcolm Stride
describes how he built one of
these historic engines from a kit.
Thanks to everything being
visible, it makes both an
instructive and visually
appealing model.

(Photograph by
Malcolm Stride)

FOR YOUR BOOKSHELF

We review a number of books, covering
the bicycle, mechanical toys, Austerity,
8F, and diesel electric locomotives.
PAGE 155

SHAY LOCOMOTIVE

John Brooker concludes his project to
build a Shay geared locomotive to the
classic design of Kozo Hiraoka of Japan.
PAGE 157

A SIMPLE INDEXING TABLE

John Wilson describes how he
made a useful accessory for a new
milling machine.
PAGE 158

LILLIAN

Keith Wilson concludes his notes on
whistles, shares some letters, and
reminisces about the 1940s.
PAGE 160

CLUB CHAT

News from model engineering clubs
around the world
PAGE 164

CLUB DIARY

Forthcoming events.
PAGE 164

TURN TO PAGE 168 FOR SUPER SUBSCRIPTION OFFERS

MODEL ENGINEER

AD INDEX

Avanquest PLC	Pg. 124
Bristol MEE	Pg. 120
Brunell Models	Pg. 124
Chester UK	Pg. OFC
Chronos Ltd.	Pg. IFC
Compass House Tools	Pg. 124
Engineers Tool Room	Pg. 125
G and M Tools	Pg. 123
G.L.R.	Pg. 128
Hemming Kits	Pg. 128
Home & Workshop	Pg. IBC
Jade Products	Pg. 128
Maxitrak	Pg. 128
Polly Model Engineering Ltd.	Pg. 125
Reeves 200 Ltd.	Pg. 122
Stuart Models	Pg. 121
The Old Model Company Ltd.	Pg. 120

THE MODEL ENGINEER EXHIBITION '06 Pg. 166

BRISTOL MODEL ENGINEERING AND HOBBIES EXHIBITION 2006



AUGUST
18TH
19TH
20TH

THE LEISURE CENTRE
THORNBURY
NEAR BRISTOL BS35 3JB



FRI & SAT 10AM - 6PM SUN 10AM - 4PM



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



SUPPORTED BY
LEADING
SUPPLIERS

SEE SUPERB DISPLAYS OF:

NOT A/C ENGINES
PETROL AND DIESEL IC ENGINES
WORKSHOP EQUIPMENT
MODEL CARS
CLOCKS
AEROPLANES & HELICOPTERS
TRACTION ENGINES 1" TO 6" SCALE
STATIONARY STEAM ENGINES
MARINE EXHIBITS
MODEL & MINIATURE LOCOMOTIVES
MANY RAILWAY ITEMS
WOODTURNING
BOATING POOL
MACHINE TOOLS
HANDICRAFTS
WORKING ENGINEERING WORKSHOP

"SUPERB
BRISTOL SHOW"

— MODEL ENGINEER
MAGAZINE 28 OCT 2005

ADULT £7.00
SENIOR £6.50
JUNIOR £3.00
FAMILY £16.00 (2+3)

3 DAY TICKETS ALSO AVAILABLE

FREE
PARKING

ORGANISED BY BRISTOL SMEE
REGISTERED CHARITY NO 1094274

FOR FURTHER INFORMATION PLEASE VISIT OUR WEBSITE:
www.bristolmodelengineers.co.uk OR CONTACT 0117 967 5878

ALL ATTRACTIONS CORRECT AT TIME OF GOING TO PRESS, BUT MAY BE SUBJECT TO CHANGE OR CANCELLATION

The First Electric Motors Build an Historic Model Engine Kit

OMC-1
ROCKING ENGINE

OMC-3 FROMENT ENGINE

OMC-2
BEAM ENGINE



All electro-magnetic and working on batteries. Based on original designs from 1836-1860. These fully working engine kits represent how electrical pioneers of the time, tried first to mimic steam engine technology and then made the break through to rotary motion that led to the modern electric motor.

A healthy learning experience from
£99.87 and made in England



The Old Model Company Limited

PO Box 455 Chichester, West Sussex UK PO18 9ZH

Tel and Fax: 01243 575403 email: oldmodels@btinternet.com
For much more information and history visit: www.oldmodels.co.uk



STUART MODELS

FOUNDED 1906

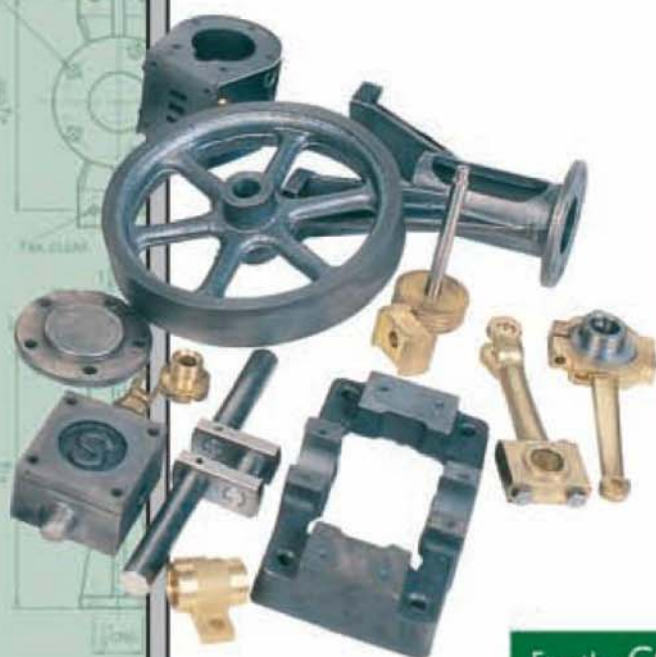
For the MODEL ENGINEER SETS OF CASTINGS

We offer Sets of Castings suitable for both those starting out in model engineering as well as those looking for a new and challenging project.



For the ENTHUSIAST PRE-MACHINED KITS

Many of our engines are available as Pre-Machined Kits allowing you to finish the model with a set of spanners and simple hand tools.



For the COLLECTOR READY TO RUN MODELS

The perfect choice for anyone who has an interest in steam. These models are assembled, painted and thoroughly tested in our workshop.



STUART MODELS
2003-2005

CATALOGUE - £5.00 80 PAGE FULL COLOUR

Please send £5.00 for our eighty page comprehensive full colour catalogue which covers our entire range of models and accessories.



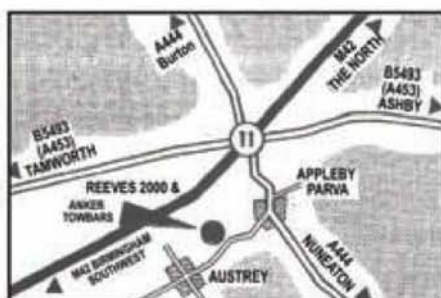
STUART MODELS

• DEPT. ME, BRAYE ROAD, VALE, GUERNSEY, UK, GY3 5XA •
• TEL 01481 242041 • FAX 01481 247912 • www.stuartmodels.com •

**Visit the Shop That's
Got the Lot!**

**REEVES
MODEL ENGINEERS
2000**

Castings,
Drawings,
Boiler Fittings,
Paint,
Transfers,
Drills,
Taps & Dies,
Bar Stock,
Rivets,
Bolts, Screws,
& Washers,
Spring Steel,
Brazing & Silver
Solders
and much more.....



Reeves 2000,
Appleby Hill
Austrey, Works,
CV9 3ER

9:00am-4.30pm Monday - Friday
9:00am-12.30pm Saturday

reilang

300ml, 200ml,
fixed spout,
flexible spout

**Oil cans
now
available
from**

**REEVES
MODEL ENGINEERS
2000**



The 'International Range' of Boiler Fittings



**The World's Largest Stockists
of Model Engineering Supplies**

**REEVES
MODEL ENGINEERS
2000**

Reeves 2000 are pleased to be able to offer, for sale, a selection of finished models,



**5" Gauge Bagnall
4-6-2T**

3" Scale Allchin



5" Gauge Hunslet



5" Gauge Diesel



All models available are on show in our extended shop

Trade Counter Now Fully Stocked and Open to Callers - ALL WELCOME

Reeves 2000
Appleby Hill
Austrey
Works
CV9 3ER

9:00am-4.30pm Monday - Friday
9:00am-12.30pm Saturday
Closed Bank Holiday Sat & Mon
Tel: 01827 830894 sales@ajreeves.com
Fax: 01827 830631 http://www.ajreeves.com

25th Edition Catalogue

UK: £7.00 inc p&p
Europe: £8.00 inc p&p
Rest of World: £12.00 inc p&p
New Price List 4 x 1st Class Stamps

gandmtools

Probably the best website in the model engineering world

Best to have a look at our website for up to date stocklist.

email: sales@gandmtools.co.uk web:www.gandmtools.co.uk

telephone: 01903 892510 fax: 01903 892221

MODELS & CASTINGS

Approx 16 Sets of Model & Workshop Equipment Castings
Comprising Stuart No1, Stuart No 5A, Stuart Reel, Stuart No 9, James
Coombes, Stuart Steam Hammer, Stuart Major Beam Engine, Stuart Beam
Engine, Stuart Vertical Boiler, Flame Licker
R & B Gas Engine, Kennet Tool Grinder, George Thomas Dividing Head, Pillar
Tool, Reeves Drill Casting, Westbury Vertical Slide & Dividing Head & Some
Others. All for sale as one lot only.
Is there no interest in this lot at £2750.00 plus vat? Make us an offer we can
not refuse, we like haggling....

LATHES

Denford Starturn 4 CNC Bench Lathe, 1ph. £ 750.00
Boxford 280 Centre Lathe, 5" x 30", Geared head, Power
Feeds, Tooled, 3ph, VGC £2995.00
Boxford 330 Centre Lathe, Geared Head, Power Feeds, Tooled, 3ph. £2750.00
Boxford BUD 5" x 22" Centre Lathe, Tooled, 1ph, VGC £1650.00
Boxford BUD 5" x 22" Centre Lathe, Tooled, 3ph. £1250.00
Boxford CUD 4" x 22" Centre Lathe, 3ph. £ 325.00
Boxford CUD 4" x 18" Centre Lathe, 3ph. £ 325.00
Boxford CUD 4" x 22" Centre Lathe, 3ph. £ 325.00
Boxford CUD 5" x 22" Centre Lathe, 3ph. £ 650.00
Boxford CUD 5" x 22" Centre Lathe, 3ph. £ 650.00
Boxford CUD 5" x 22" Centre Lathe, 3ph. £ 650.00
Boxford TUD 5" x 22" Plain Lathe, 3ph. £ 275.00
Boxford 125TCL CNC Bench Lathe, 1ph. £1250.00
Boxford 240 TCL CNC Lathe with Tailstock, 1ph. £1250.00
Colchester Bantam 1600 Centre Lathe, Well Tooled, VGC, 3ph. £2250.00
Colchester Bantam 800 5" x 20" Centre Lathe, 3ph. £ 850.00
Colchester Bantam 800 5" x 20" Lathe, 1ph, Tooled £ 950.00
Colchester Bantam 800 5" x 30" Centre Lathe, 1ph, Tooled £1650.00
Colchester Chipmaster 5" x 20" Variable Speed Lathe, 3ph, Noisy. £ 850.00
Colchester Chipmaster 5" x 20" Variable Speed Lathe, 3ph. £ 595.00
Colchester Master 2500 6" x 40" Gap Bed Lathe, Well Tooled, 3ph £3250.00
Emco Maximat V10 Centre Lathe, Needs Attention, 3ph. £ 750.00
Emco Maximat V10 Centre Lathe with Milling Head,
Needs Attention, 3ph. £1000.00
Emco Unimat SL Bench Lathe with Accessories
Inc. Div Attachment, 1ph. £ 375.00
Harrison 9" Gap Bed Centre Lathe, with Tooling, 3ph. £ 650.00
Hobbymat MD65 Bench Lathe, 1ph. £ 525.00
Hobbymat MD65 Bench Lathe with Milling Head, 1ph. £ 750.00
Myford M14 Bench Lathe with Drive Unit, 1ph. £ 425.00
Myford M17 Bench Lathe, Complete but Needs Attention £ 400.00
Myford M17 Bench Lathe with Clutch, 1ph, Good Condition. £ 675.00
Myford M17 Bench Lathe with Clutch, 1ph, Good Condition. £ 550.00
Myford M17R centre Lathe with Cabinet Stand,
Good Condition, Tooled, 1ph. £1650.00
Pultra 1770 Cabinet Mounted Instrument Lathe,

Needs Drive Unit, 1ph. £ 975.00
Pultra Bench Instrument Lathe with Motor, 240 Volt, £ 350.00
Pultra Capstan Lathe on Cabinet Stand, Needs Refurbishment, 3ph. £ 650.00
Pultra Cabinet Mounted Capstan Lathe, 3ph, Some Tooling £1250.00
Raglan Training Lathe £ 200.00
Schaublin 70 Instrument Lathe on Stand, 3ph, Collets Etc. £2250.00
Toyo ML-210 Modellers Bench Lathe, 1ph. £ 350.00
Viceroy Plain Lathe on Stand, 3ph. £ 150.00

MILLING MACHINES

Denford Starturn CNC Bench Vertical Mill, 1ph. £1250.00
Aiera F3 Vertical/Horizontal Mill, (no horizontal arbor), 3ph. £1500.00
Deckel LK Jig Borer with Grinding Head, 3ph. £3500.00
Emco F1 CNC Bench Vertical Mill with Tooling, 1ph. £2000.00
Emco Unimat 3 Mentor Bench top Mill/Drill, 1ph. £ 250.00
Gravograph Model IM2 Bench Pantograph Engraver, 1ph. £ 250.00
Gravograph Pantograph Engraver, Floor Standing, Type, 1ph. £ 550.00
Greenbank Horizontal Broaching Machine, 3ph. £ 850.00
Mark V11 Mill/Drill on Stand, 3ph. £ 750.00
Scripta SA Three Dimensional Engraver/Diesinker £ 675.00
Tom Senior M1 Horizontal Mill, Needs Attention, 1ph. £ 350.00
Tom Senior M1 Vertical/Horizontal Mill, Tooled, 3ph. £1250.00
Tom Senior M1 Mill, Vertical Head Attachment Only, 3ph,
Choice of 3 £ 600.00
Alexander 2A Die Sinker/Engraver, Single Phase, 240 Volt, VGC. £ 500.00
Boxford 165HMC CNC Horizontal Machining Centre £1450.00
Tom Senior Vertical Milling Head, 2MT £ 500.00
SIP Mill/Drill, NEW, 1ph, 3MT £ 799.00
Stand For Above £ 145.00
AEW Viceroy Horizon Vertical Mill, Power Feed, 30 INT, Vice, 3ph. £1200.00

BOXFORD SPARES & TOOLING.

10 various Boxford Collets £ 50.00
Boxford 4" & 5" Tailstocks £125.00
Boxford 4" Travelling Steady £ 48.00
Boxford 6" jaw Chuck with Key and Backplate £125.00
Boxford 5" Catchplates £ 15.00
Boxford Tumbler Reverse Mechanism, Complete £ 65.00
Boxford T-Slotted Boring Table £135.00
Boxford T-Slotted Cross Slide (Fits all Models) £ 85.00
Boxford Change Gear Quadrant £ 15.00
Boxford Change Gear Cover £ 40.00
Boxford Lathe Stands with Integral Coolant Tank & Cupboard £125.00
Huge Selection Of Boxford Change Gears, Please Ask £POA
Boxford Metric Top Slide £ 55.00
Boxford Lathe Main Spindle £ 35.00
Boxford Drive Unit for Underdrive Machines, AUD, BUD, CUD Etc. £ 75.00
Unmachined Casting for Boxford Fixed Steady £ 35.00
Unmachined Casting for Boxford Travelling Steady £ 20.00



Boxford 330 6 1/2" x 40" Geared Head Lathe, Very good Condition, Tooled, 3ph, £2995.00 plus vat.

Boxford CUD 4 1/2" x 18" Centre Lathe, Chuck and Toolpost, 3ph, £325.00 plus vat.



Flamefast DS330 Ceramic Chip Forge with Hood, 1ph, £425.00 plus vat.

Jun-Air Compressor, 1ph, £135.00 plus vat.



Denford Starturn 4 CNC Bench Lathe, 1ph, £1250.00 plus vat.

Boxford 240TCL CNC Lathe with Tailstock, 1ph, £1250.00 plus vat



Boxford 125TCL CNC Bench Lathe, 1ph £650.00 plus vat.

Boxford 280 Centre Lathe, 51/2" x 30" Geared Head Lathe, Excellent Condition, 3ph, £2995.00 plus vat.



Denford Starturn CNC Vertical Bench Milling Machine, 1ph £1250.00 plus vat.

Flamefast DS320 Brazing Hearth/Forge, 1ph, £500.00 plus vat.

TELEPHONE ENQUIRIES WELCOME ON ANY ITEM OF STOCK. WE HOLD HUNDREDS OF ITEMS THAT ARE NOT LISTED, FULL STOCKLIST AVAILABLE. ALL ITEMS ARE SUBJECT TO AVAILABILITY. ALL PRICES ADVERTISED (WITH THE EXCEPTION OF BOOKS AND MANUALS) ARE SUBJECT TO CARRIAGE AND VAT AT 17.5%. WE DELIVER TO ALL PARTS OF THE UK AND WORLDWIDE. OVER 7000 SQUARE FEET OF TOOLS MACHINES AND WORKSHOP EQUIPMENT.

PLEASE NOTE AS FROM APRIL 1ST 2006 WE WILL ONLY BE OPEN UNTIL 12 NOON ON SATURDAYS.

Opening times Monday – Friday 9am-1pm & 2pm-5pm. Saturdays 9am – 12.00 only. Closed Sundays.

email:sales@gandmtools.co.uk web:www.gandmtools.co.uk

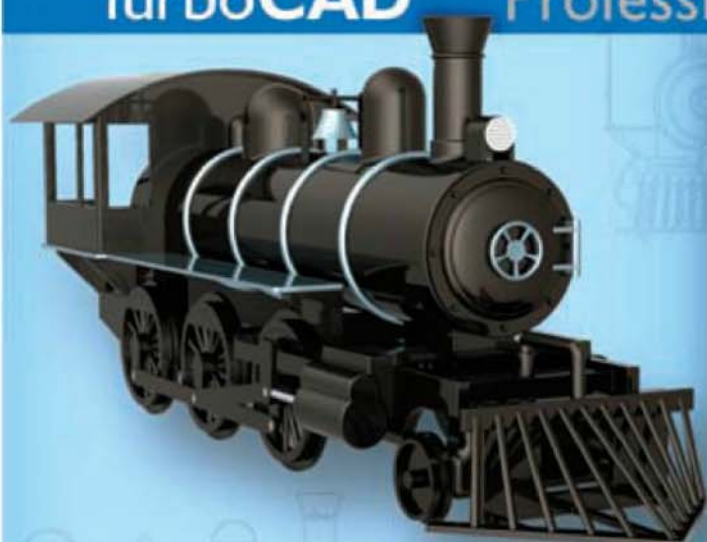
Telephone 01903 892510

Fax 01903-892221



TurboCAD[®] Professional 12

EMST



Donald B. Cheke ©2006
www.textualcreations.ca

For further information on TurboCAD and details on how to draw the illustrations shown please visit www.turbocad.co.uk

- Draw in 2D or 3D
- Free 15 day trial download from www.turbocad.co.uk
- Free advice and support during office hours
- Convert 3D designs into orthographic views in seconds
- 25% discount for Model Engineer Readers
- View 3D drawings as wire frame or solid form any angle or perspective



For all sales and enquiries call Paul Tracey at Avanquest on 01962 835081 ptracey@avanquest.co.uk

Avanquest

BRUNELL MODELS

GRASSHOPPER BEAM ENGINE

The 'Grasshopper' Type Beam Engine has been based on one in a well known steam museum. It is relatively easy to make and assemble, and makes a very attractive model which is quite fascinating to watch when working. We have found it will run well on very low pressure of about 15lbs sq.in.

The early steam engines have always held a fascination for model engineers from when the engines first became self contained, developed from the practices of using the the engine house structures as engine supports, and ceasing to use wooden beams in favour of all metal construction.



MARSHALL 7 NHP TRACTION ENGINE



SEND NOW for our fully illustrated A4 catalogue with 54 models, some in full colour
UK £5.50
Europe £7.50
Rest of world £9.50

Sterling cheque/credit card only. All incl. p&hp.

Order on line at:

www.brunell.com

Shown above is the 1" scale MARSHALL 7 NHP single cylinder general purpose Traction Engine of 1810 'PRIDE OF THE ROAD' measured up from the full size Marshall number 54587/10. For Model Engineers who wish to build a relatively straightforward model, which is a true replica of an actual engine at the same time powerful and robust enough time to use on a rally field. Just one from our range of 2" to 4" scale T.E. for which we supply drawings, castings, finished and insurance tested boiler, boiler kit laser cut spokes, crankshaft, transfers, brasses, gear cutting, machining, fittings etc.

Brunell Models, Unit 22, Heysham Business Park, Middleton Road, Heysham, Lancs. LA3 3PP
email: sales@brunell.com Fax/Ans 01524 855887



COMPASS HOUSE MODEL ENGINEERING



5" Gauge Class 23
"Baby Deltic"
Features
4 Axle hung motors
Sprung bogies
Electronic controller
Ready to Run*
From £1495.00

BATTERY ELECTRIC LOCOMOTIVES

7 1/4" Gauge Class 35 "Hymek"



With its four axle hung 280 watt motors and 150 amp electronic controller our "Ready to run" Hymek" will pull a three car train all afternoon!

From only £2995.00 on the track!

*Requires two batteries "Not included"

Colour Catalogue £2.50 Post paid
HIGH STREET, ROTHERFIELD, EAST SUSSEX, TN6 3LH, UK
PHONE: 01892 852968 - 07711 717067
www.compass-house.co.uk
E-Mail: sales@compass-house.co.uk

BMD-20 Milling M/C

FREE ACCESSORIES
Drawbar, Arbour, Keyless Chuck, 2" Vice.

£799.50
inc. VAT & Delivery

Swivel Head, Quill Depth DRO, End Milling Capacity 20mm, Table X - 500mm, Y - 180mm 0-2250 rpm variable, Spindle Speed Readout Spindle to table 355mm, Head Movement 300mm MT2 Spindle Taper

BMD-45/80G Milling Machine

800 x 240mm Table Size
585mm Longitudinal Travel
205mm Cross Travel
130mm Spindle travel
80-1250 rpm
MT3/R8 Spindle
Swivel Head

FROM £1229

BMD-25 Mill/Drill

25mm Max Drilling,
25mm Max End
Milling & 50mm Face
Milling

EQUIPPED WITH
Drill Chuck with Arbour,
Milling Vice, Draw Bar,
Taper Drift &
Hand tools.
Stand optional.

FROM £849

*THE first
choice
for the
true
model
engineer!*

All these machine tools
are exclusively supplied
by Engineers Tool Room
and offer superb value
for money and unrivalled
quality & reliability.

BL9/20 & BL10/22B Lathe

FROM ONLY £629.00

FULLY EQUIPPED

Tray, Splash Back, 3 & 4 Jaw Chucks, Face Plate, MT3 & MT2 Dead Centres, Fixed & Traveling Steadies, Drill Chuck with Arbour, Spanner, Allen Key, Oil Can, Tool Box, Chuck Guard and Manual.

BL12/24 Gap Lathe

£1529
DELIVERED

FULLY EQUIPPED

Stand, Splash Guards, Fixed Centres, Revolving Centre, 3 & 4 Jaw Chucks, Face Plate, 4 Way Tool Post, Fixed & Traveling Steadies, Lo Volt Light, Manual, Tools & Tool Box.

BL11/28 VARIO

FULLY EQUIPPED

with Tray & Splash Back
Fixed & traveling steadies,
Spindle bore 26mm
Variable speed.
Fixed & revolving centres.
Swing 11inch, Cts 28 inch. Inch & metric threading. 0.75 kw (1.1HP) motor

VTM Milling Machine

40mm Max Drilling
32mm Max End Milling
80mm Max Face Milling
660 x 155mm Table Size
360mm Longitudinal Travel
150mm Cross Travel
One Shot Lubrication System,
Low volt Lighting, Machine Stand
with Locker as standard.

POWER FEED FITTED FREE

ONLY £1449

The Engineers Tool Room

Contact us for details of complete range or Free Tool Catalogue

Unit 28
Enterprise Centre
Llwynypia Road
Tonypandy
Rhondda
CF40 3ET
Tel: 01443 442651
Fax: 01443 435726
Mobile: 07770 988840
www.engineerstoollroom.co.uk

NORTH AMERICAN ATTENTION! READERS

Do you know that you can now 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, Tel: 760-603-9768
5674 El Camino Real Suite D
Carlsbad, CA 92008-7139 USA Fax: 760-603-9769
E-mail: info@wiseowlmagazines.com

Also available... MODEL ENGINEER

Engineering books:

Model Engineers Handbook - £9.95*

Lathework: A Complete Course - £7.95*

Milling: A Complete Course - £6.95*

Drills, Taps and Dies - £6.95*

Plus many more great titles!

Order Hotline: 01689 899 228/229

*Price does not include p&p



Polly Model Engineering Limited

Incorporating Bruce Engineering

For all your model engineering requirements.

MANUFACTURERS OF THE RENOWNED POLLY 5" GAUGE PASSENGER HAULING, COAL FIRED STEAM LOCO KITS, WHICH ARE EASILY ASSEMBLED WITH HAND TOOLS AND MINIMAL SKILL. POLLY LOCO KITS PROVIDE AN IDEAL INTRODUCTION TO THE MODEL ENGINEERING HOBBY. LATEST POLLY VI ILLUSTRATED KIT PRICE ONLY £5995 inc VAT.

Manufacture is complemented by our Bruce Engineering Model Supplies business, giving a comprehensive range of steam fittings, accessories, materials, books, etc. We specialise in supply of quality injectors (JC, Chiverton), pressure gauges, etc.



Stationary engine kits: we produce a wide range of over 45 different models, including designs by Anthony Mount, our own large R&B gas engine, etc., and supply the full range of Stuart Models.



Practical Scale: Drawings, Castings, lost wax parts, laser cut frames, CNC rods, CNC platework, etc for the range of locos designed by Neville Evans and serialised in Model Engineer.

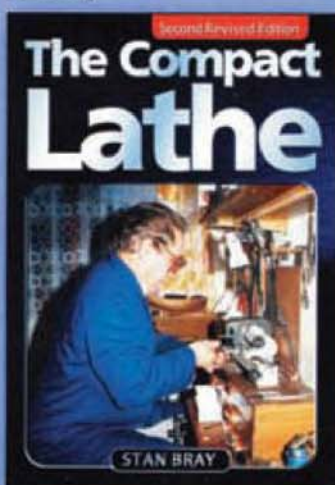
See us at exhibitions or find these & other items in our Supplies Catalogue £1.75 posted UK \$5 worldwide Polly Loco Kit Catalogue £3 Stuart Models Catalogue £5



Polly Model Engineering Ltd (Inc. Bruce Engineering)
Bridge Court, Bridge St., Long Eaton, Nottingham, NG10 4QQ
tel. 0115 9736700 fax 0115 9727251
www.pollymodelengineering.co.uk



Compact Lathe
Second Revised Edition
Stan Bray



The evolution of the compact, or portable, lathe has bought many a model engineer's life-long ambition to reality. This comprehensive introduction to the subject covers the very latest technology, the machine operations and facilities which will enable the novice or experienced operator to achieve the highest standards of lathe work.

2004
978 185486 227 3
210 x 147mm
187 pages
145 b&w photographs
Paperback
£8.95

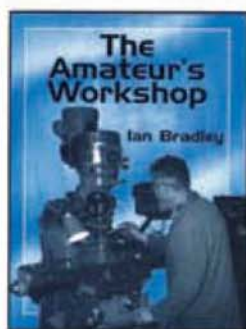
The Amateur's Lathe
L.H. Sparey



1972
978 085242 288 5
216 x 138mm
224 pages
Illustrated paperback
£8.95

First published in 1948, this is the classic, definitive work on the use of the small (3½ inch) lathe which has proved invaluable to generations of light engineers, small garage owners and precision hobbyists, apprentices and engineering professionals alike.

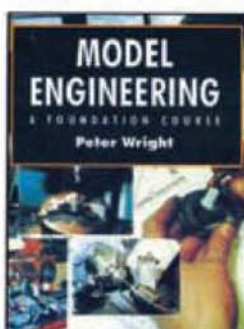
The Amateur's Workshop
Ian Bradley



1995
978 185486 130 6
210 x 148mm
256 pages
Illustrated paperback
£8.95

All model engineers are occasionally faced with an operation outside their usual experience. With more than 430 line and photographic illustrations, this is a comprehensive reference book providing information on setting up a workshop and the use of various machines and tools. Processes such as knurling, reaming, milling etc. are also covered.

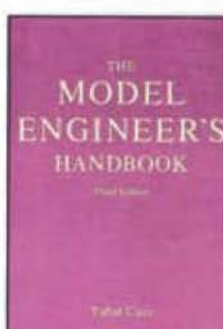
Model Engineering – A Foundation Course
Peter Wright



1997
978 185486 152 8
236 x 189mm
416 pages
Illustrated paperback
£16.95

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

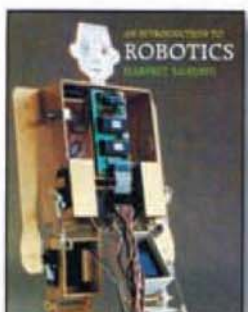
Model Engineer's Handbook
Third Edition
Tubal Cain



Third Edition
1996
978 185486 134 4
210 x 148mm
240 pages
Illustrated paperback
£9.95

This third edition comprises a compilation of tables, facts, procedures and data that the author has found invaluable in his model engineering activities including the use of data and calculations in both Imperial and SI units. The book also contains helpful explanations of the hows and whys of using many of the entries.

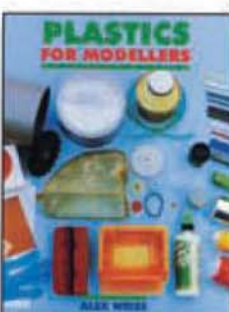
An Introduction to Robotics
Harjit Sandhu



1997
978 185486 153 5
236 x 189mm
208 pages
Illustrated paperback
£9.95

An introduction for the amateur to the ideas and concepts of robotics. The first part explains how and why robots work and are controlled, while the second part shows you how to make a simple two-legged humanoid robot that can be programmed to walk. Everything is presented in clear, concise everyday English. The robot can be built on your kitchen table and can be run from a personal computer.

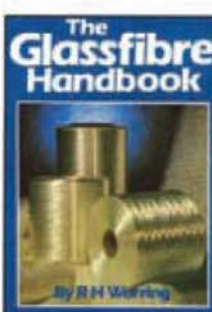
Plastics for Modellers
Alex Weis



1998
978 185486 170 2
236 x 189mm
160 pages
Illustrated paperback
£7.95

This book, for the first time, provides a comprehensive guide to the use of plastics in the many and varied fields of modelling. Various types and forms of plastics are described and their useful characteristics, strengths and weaknesses are detailed. Well illustrated with informative line drawings, instructive photographs and amusing cartoons, it explains why you might choose, plastics over the more commonly used materials such as wood and metal.

The Glassfibre Handbook
R.H. Warring



1989
978 085242 820 7
210 x 148mm
160 pages
Illustrated paperback
£8.95

A prime reference book on glassfibre materials and techniques. Includes information on methods and materials, and covers models, boats, cars and all types of grp work.

ORDER HOTLINE:

Introducing Model Traction Engine Construction

John Haining

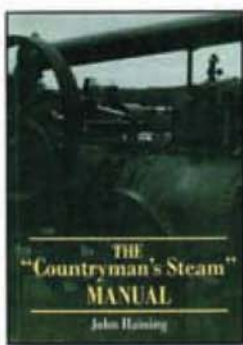


The doyen of traction engine modelling explains and illustrates what is involved in the construction of working steam models (including workshop processes and tools needed) and outlines the history and variety of such engines.

1983
978 085242 805 4
210 x 148mm
112 pages
Illustrated paperback
£6.95

The Countryman's Steam Manual

John Haining

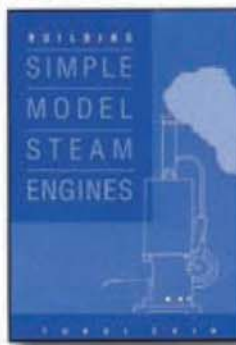


First published in 1962, this new and enlarged edition covers the design, construction and care of steel boilers in general, with formulae and data used by firms of repute. Designs of three vertical boilers are included - the Sentinel, the Caradoc and a 3-inch scale version.

1996
978 185486 136 8
210 x 148mm
96 pages
Illustrated paperback
£5.95

Building Simple Model Steam Engines

Tubal Cain

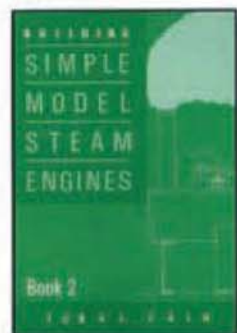


The sheer simplicity of miniature oscillating steam engines has an enduring fascination for all marine and model engineers. This book shows how to build four model steam engines and features designs and plans that even a beginner will be able to follow.

1993
978 185486 104 7
210 x 148mm
112 pages
Illustrated paperback
£5.95

Building Simple Model Steam Engines 2

Tubal Cain



Since the publication of the first book, the author has designed and built several more engines 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
978 185486 147 4
210 x 148mm
112 pages
Illustrated paperback
£5.95

Early British Quick Firing Artillery

Len Trawin



A unique handbook for modellers and historians providing detailed scale plans, exploded drawings and a full description of the gun carriage design of the Boer Wars and World War I including limbers and ammunition wagons, sight development, wheel variations and harness details.

1988, 978 185486 154 2, 189 x 246mm, 416 pages, illustrated paperback, £35.00

Ornamental Turning

T.D. Walshaw



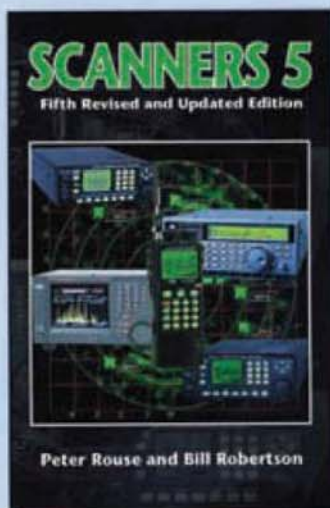
This is the definitive guide to the art, aimed at not only the experienced turner but also at the novice. Tom Walshaw provides comprehensive chapters on purpose-built ornamental lathes, essential accessories, using cutting and decorative tools plus detailed information about screw threads and templates.

1994
978 185486 108 5
234 x 156mm
208 pages
Illustrated paperback
£14.95

ELECTRONICS

Scanners 5

Peter Rouse and Bill Robertson



The 'Scanners' books, originally created by Peter Rouse, have been consistent bestsellers, being the UK's leading guide to the short wave radio equipment employed by enthusiasts to monitor the VHF/UHF wavebands used by airfields, the maritime and emergency services and latterly RT and mobile telephone networks.

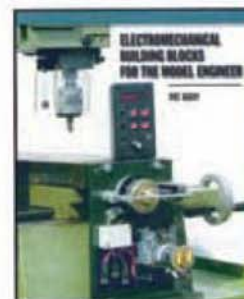
Radio basics and aerial principles do not change much, but the equipment and the frequencies are ever-changing, hence the comprehensive updating of the last edition of this title, Scanners 4 (ISBN 1-85486-180-8).

Fully illustrated with photographs of the latest equipment and accessories, and tables of UK frequencies and call signs.

Fifth Edition, 2006
978 185486 244 0
234 x 150mm
245 pages
Illustrated paperback
£9.95

Electromechanical Building Blocks for the Model Engineer

Pat Addy



Electronic and electromechanical control of machinery and equipment in the factory environment has been commonplace for many years and is steadily finding its place in the model engineer's workshop. This book gives the theoretical and practical details of electronic circuits that can be used to control machinery for the model engineer and 'inventor'.

2006
978 185486 243 3
236 x 189mm
228 pages
Illustrated paperback
£12.95

01689 899 228/229

Prices do not include postage

GLR DISTRIBUTORS 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



NEW



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
£250.00 + £7.00 Carriage to mainland UK
All prices include vat



NEW

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
£150.00 + £7.00 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

Pictures are illustrations of models when machined by our customers

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

Maxitrak
5" Class 66 from £2275

CATALOGUE
£3.50

Maidstone Engineering Supplies
A complete range of materials
B.M.S. Brass, Phos
Bronze, Copper,
Stainless steel,
Nuts & Bolts,
Nylon, St/Tube,
Screws, Studs,
Rivets, Drills,
Reamers, etc.
**PROMPT
MAIL ORDER**
CATALOGUE
£1.00

www.maxitrak.co.uk

MAXITRAK/M.E.S 10 Larkstore Park Lodge Road Staplehurst Kent
TN12 0QY Tel: 01580 893030 Email: info@maxitrak.co.uk

Jade Products 65 Ilmer Close
Rugby Works. CV21 1TY
< Tel 01788 573056 >
Auto Darkening Welding Helmets
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

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

- ❶ The Name to Trust since 1976
- ❷ More designs than ever
- ❸ Industry quality instruction sets
- ❹ 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

www.hemingwaykits.com

SMOKE RINGS

With the Editors

Keep the collection together

Can you help?

We recently heard from Ronald Jarvis about the collection of models he has built, and exhibited with some distinction over the years. The models have a common theme, and together they make a unique composite of steam engineering as it existed in the mid 18th Century.

Ronald is now over 95, and looking to the future, is hoping to secure a future for the collection. The individual items are not to be separated.

Just now, he is having an extension built to his house as his own private museum. Longer term, he would like to secure a home in a museum or other place of safe keeping for the collection.

Please send any ideas, or offers to keep the collection together, to the editor.

Nemett 15S – important safety modification

This issue includes a further installment of the building instructions for the Nemett NE15S in which construction of the crankshaft is covered.

Following an incident in which a backfire caused the propeller to be thrown off in spite of having a securing lock nut, Nemett has modified the crankshaft to include a circlip on the end to prevent the propeller nuts from being able to come off the shaft. Builders are advised not to assemble the crankshaft until this modification is published in issue 4281. All those who have purchased drawings should have received updates by the time this note is published. The propeller driver will also be modified with the provision of securing bolts and will also be covered in issue 4281. The change does not affect those building the marine only version and Nemett apologises for the situation, but safety is not something that can be compromised.

Successful summer rally for 2½in. gauge

In spite of the many crowds of people flocking to Royal Ascot, and Motorway accidents, there was a large attendance of members and friends at the Commercial Road Ground in Staines, home of Staines Model Engineering Society for the summer rally of the National 2½" Gauge Association, on June 24.

John Cook reports that members travelled from as far as Herefordshire, Portishead, Eastbourne, and Essex, as well as visits from the usual locals.

First on the track was *Ayesha II* the revived LBSC Battle of the Boilers 4-4-2 design, driven by Tony Weale, followed closely by *Ursa Maximus* 4-6-2 with Nicholas Taylor in the saddle (later father Graham took over) and John Llewellyn running his 'Brighton Atlantic' 4-4-2. They sped round the track, evenly spaced, making a delightful spectacle and a powerful advert for the gauge.

Peter Gardner showed how well his 0-8-0 'Netta' could perform.

Graham Barker introduced his 2-10-0 *Evening Star*, which after some initial firing problems was soon circumnavigating the track. Andrew Dick had a good run with his *Josie* 4-6-4 this loco was designed by Curly Lawrence for '0' gauge and was doubled up in size for 2½in. rails.

'Uranus' class called *Endeavour* 4-8-4 driven by Des Adeley had a faultless run.

There was great sadness on hearing of the passing away of George Barlow B.E.M., who was a very active member of the association.

The weather was fine, sunny and rather warm, and the hospitality of Staines MES members was great, reports John.

It was really good to hear from John, who has been in and out of hospital lately, but whose enthusiasm remains undiminished.

Bedford beckons

Ted Jolliffe emailed us recently to say that the Bedford Annual Locomotive Rally will be held over the weekend of September 1 – 3. Friday is arrival day, and running on the track if required, followed by a DIY BBQ, bar and film show in the evening.

Saturday is a visitors day with both tracks open. Food is available for most of the day and there is a full cooked dinner in the marquee in the evening.

The bar is open, of course, and Sunday visitors with locomotives are asked to assist with the public passenger service. Caravanning and camping facilities, are available with electric hook-up for caravans if required.

Visiting engines need to produce boiler certificates and proof of insurance, otherwise it is a free and easy weekend.

Further information from Ted on 01234 327791, or email: tednmary.jolliffe@tiscali.co.uk

There are many entries already, but more would be welcome.

New attractions this year include double track all the way to the top loop, and new signalling.

Bargain course for Newport

Starting in September Coleg Gwent, City of Newport Campus will be offering a Friday 10am-1pm slot for model engineers. There is a small group already but more would be welcome. Milling machines, shapers, lathes and surface grinders are available for use.

The course is called 'Model Engineering', and it costs £123 for the year which sounds like a bargain. The only condition is that course members will have to complete a light portfolio to keep the course running. In addition, upon completing the portfolio the members gain a qualification at the end.

Goings on at Gilling

Doug Hewson tells us that the dates for the next Gilling Main Line Rally are, setting up and free running on Friday, August 25, then running to the timetable on the following Saturday, Sunday and Monday. First locomotives are due off shed at 8am Saturday and last locomotives back on shed about 18.30.

Visitors very welcome, free of charge, but donations are encouraged. There are usually about 45 high quality locomotives at this event.

Doug also tells us that the latest GL5 Rally saw at least 250 wagons running.

Also it is the driver training weekend at Gilling on Sept 30/October 1. This is for absolute beginners, or people who can drive but want to come and learn to drive on a double track main line railway and learn all the signals and railway operation.

Visitors also welcome again if they just want to come and see trains running.

Contact Doug on 01652 688408, or at: doug@the-hewsons.co.uk

CHUCK, the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

Belleville washers

SIRS, - I enjoyed Mr. D.A.G. Brown's story of how he got his nickname and was interested to read of his application of Belleville disc spring washers to his driving truck/tender in M.E. 4263, 23 December 2005.

I am familiar with the use of Belleville washers for live loading power plant steam valve packing glands, particularly for inaccessible valves.

Stainless steel disc spring washers are available in the US in sizes down to $\frac{3}{32}$ in. bore and though expensive at around \$2 apiece in these small sizes might be good for live loading hard to reach packing glands in our own models.

The idea is to install the spring washers under the nuts on the packing gland studs to maintain a constant pressure on the packing as the conditions change through wear etc.

Belleville spring washers have been around for a long time as I have seen reference to a study of them written in 1887 by A. C. E. Rateau, the French turbine engineer. Unfortunately I cannot read French and so the paper would be of no help to me even if I had access to it.

Also, the 1889 4th German Edition of F. Reuleaux's wonderful book *The Constructor*, of which I have the 1893 American translation, shows Belleville washers applied to large chain drive sheave used for a chain tramway in the Decido Iron Mines in Spain.

I am very curious to know the history of development of Belleville washers; who or what was Belleville, when were they invented and what was the original purpose? Were they for a specific project or a more general application?

Perhaps if someone knows and could write in to *Post Bag* the facts would be interesting to other readers as well as myself.

Ed Gladowski, Texas.

Useful bolts

SIRS, - Further to your comments on the Gorgon offset in *Smoke Rings* (M.E. 4270, 31 March 2006), I enclose a copy of a flyer recently dug out from my files (from my days as an agricultural engineer) and which may be of interest.

I never actually ordered any of these products, but can remember many an occasion during my service in Nigeria when they would

have been of great value!

With acknowledgments to *The Agricultural*

Engineer (now *Landwards*) the journal of The Institute of Agricultural Engineers (LAGrE). Ken Baxter, Northamptonshire.

We have received many letters with the same series of 'special' bolts that Mr. Baxter shows and thank all those who responded. I will make no comment about what this implies as to the state of our readership!

Global warming

SIRS, - Firstly, I must take issue with Mr. Froom's statement "For every scientist that doubts the dangers of global warming there are a hundred or more who do not, America included" (M.E. 4271, 13 April 2006). This line of propaganda started with the "all scientists (actually the 2000 or so that are working in it) believed in global warming. Well, they would wouldn't they?"

At the IPCC convention 2-3 years ago after a week of presentations the scientists were asked to vote for a motion saying that mankind's use of fossil fuels was changing the climate. The result was that a mere 13% agreed with the motion, the rest not agreeing. After the conference, at a summary for the press, the organisers reversed that verdict saying that 87% agreed with the motion. Guess which figure was quoted worldwide. If the IPCC feels it necessary to lie about figures like this then they have to be on very dodgy ground. In this situation the end definitely does not justify the means.

Mr. Froom gives us a very interesting dissertation upon the attributes of CO₂ but despite its length, misses out salient points. Arrhenius and his successors did their tests upon CO₂ in containers. CO₂ in the atmosphere is not in containers, it is widely distributed. CO₂ as a carrier of heat does so better than air. CO₂ is not fixed and solid like glass. It is a good convector of gas, better than air. Unlike the experiments of Arrhenius and others it does not stay in the same place. It, like air, water vapour and other gases, circulates and carries away heat toward space. The middle and upper levels of the atmosphere are cooled slightly rather than heated.

As far as distribution and density is concerned, perhaps a simple illustration of the proportions concerned would be to liken the

The Acme Patent Fastener Co.
"Bolts to save you time"

We are proud to announce a
New Range of Special Fixings
especially made for the vintage machinery restorer.
Available in various sizes, Whitworth and A/F,
in packs of ten, or box of assorted types.
If you cannot see what you need here, please let us know;
we may be able to produce a type to your exact requirements.

For holes drilled crooked then straight For holes drilled too small then too big For redrilled holes that still don't match For rounded head for work on over-size spanners For rounded head for tightening with vice grips

For holes too near the edge For non-matched holes For holes not drilled straight Oval bolt for out of round holes For threaded bolt holes

Half bolt for tight edge work For holes counter-sunk too deep For tapered holes Neutral thread for left or right hand tappets Pre-stripped for easy over-tightening

STOP PRESS! Now available in Metric sizes!

Some very useful bolts for model engineers, see Ken Baxter's letter.

greenhouse effect of CO₂ to having four goalkeepers in a goalmouth from here to the moon facing a solid line of kicked balls. The save rate would not be very great and neither is the rate of interception by the CO₂ molecules. Water vapour is the only significant 'greenhouse gas', largely because of the latent heat involved in two-phase changes.

Basically the situation is this: for something like 80,000 years glaciations piled up covering a very large part of the earth's surface. A change in the relationship of the sun to the earth caused a warming some ten thousand years ago so why should we expect that the process should stop merely because it is convenient to us?

It was very inconvenient for the people that lived in cities that were drowned off of India, Japan and the Middle East but that didn't stop it so why should we expect to. As the ice was rolled back and the earth warmed then biological activity followed (you don't get a lot of that to produce CO₂ under ice) and produced and is still producing increasing levels of CO₂. In 1800 A.D. the world population was around a billion: it is now 6.7 billion, all putting out massively more than our cars or trains. At the other end of the scale, the aerobic bacterial population has and will

continue to increase and is probably producing more CO₂ than all the fossil fuel burnt. So you would expect CO₂ to increase.

Ice ages are an aberration, lasting generally between 8 and 25 million years. Between ice ages the earth had far longer periods without ice so they could be called more normal.

In this ice age, there have been at least seven previous climbs out of glaciation, some to the level at which we have now arrived. We appear to have two chances historically: we may reach a peak as did the last seven and drop back into another glaciation or this time we may climb back to normal. There was no levelling on the peaks, they just went up and down.

As far as CO₂ being tied to global warming is concerned, perhaps someone would like to explain why ice cores not quoted by Mr. Froom were found by the, I think, 1992 Antarctic expedition, containing 20 times the current amount at a temperature similar to our present one.

Since we all use fossil fuels in our life and particularly in our hobby (think of the enormous coal consumption!) perhaps it is not too out of place here. However, Mr. Froom's snide remarks about America tell us, as they say, where

he is coming from. I think that we definitely do not want to be involved in a political discussion unless it is about the stupidities and cupidities of our present government as they affect our hobbies.

Dave Robinson, by e-mail.

Westbury flat twin 2-stroke engine

SIRS, - First let me say how delighted I am with Nemett's series in *Model Engineer*; it's like a breath of fresh air to the magazine.

I have wanted to build an I/C project for a number of years now and have recently acquired the series from the February 1948 *Model Engineer* covering Edgar Westbury's 10cc flat twin 2-stroke engine.

I was hoping that you knew of any existing producers of castings for this engine who are still in existence.

There is a mention of Craftsmanship Models of Ipswich in the series, who I doubt still exist but I thought if anybody should know then it will be *Model Engineer*.

I hope you can help with any information for the above parts or any other outlets for other engines etc.

Keep up the good work.
Chris Roberts, Lancashire.

Nemett comments:

I must first thank Mr. Roberts for his kind comments; it is nice to know that all the effort is not in vain. Moving on to his query, I assume that he is referring to the 'Craftsman Twin' engine which was a rear disc induction air cooled twin designed by Edgar Westbury and made by Craftsman Models in Ipswich. I believe the engine was available complete and ready to run or as a kit. I have not found a source of castings yet, but am still searching and will put a note in I/C Topics if I am successful.

John Goodall of Barton Model Products (01283-713-715, info@bamopro.co.uk) had some original castings and has copies of the drawings. Certainly there have been several examples built (at least one fairly recently) so some castings may be around.

More on Far Eastern lathes

SIRS, - May I crave space for a reply to Mr. Phillips letter re. *Far Eastern lathes* in M.E. 4273 12 May 2006.

No! I was not 20 years too late, I looked at the Myford 254 lathe as a replacement for my Myford ML7R immediately it became available, however, though it is a lovely well made machine it failed

my criteria as;

- a) It has no clutch, essential as far as I am concerned.
- b) It has a small spindle hole compared to the size of lathe. If we take a 125mm (5in.) chuck as the standard size for this size of lathe, some can pass a 32mm (1 1/4in.) bar through the chuck, I like the spindle to be able to do the same.
- c) To change to back gear requires fiddling around inside the headstock with an Allen key, not very efficient, and...
- d) to change the chuck requires the removal of four bolts, as I change the chucks quite often this would waste a lot of time, a Camlock nose would have solved the problem.

As for price, I am prepared to pay a bit more for a British machine but the price ratio would be about 5 to 1 if it were available now, that is for a complete machine not one with which essentials such as chucks and steadies are regarded as accessories.

We are all living in a global economy but British manufacturing is labouring under high taxes, high rates, quick returns required on loans, lack of investment in tools and training, and excessive legislation on all manner of things. It is very hard to compete in such an environment and it needs a product that offers a lot more than the competition, the economy of scale, and a sympathetic government to manufacturing. Until such a climate arrives I suspect that the majority of customers will go for the easiest option.

As for working conditions in China has Mr. Philips talked to those who have been there? He might be surprised.

Anthony Mount, Devon.

Coincidentally, the following letter from one of our well-known suppliers arrived as this Post Bag was being prepared and seems to demonstrate that the Chinese factories are indeed clean, modern and provide good working conditions. I suspect that there are many UK factories that do not provide anything like the conditions shown. Another point to be made is that, as with British workers during the UK industrial revolution, the Chinese workers are moving from low paid jobs in agriculture to jobs which provide a much higher standard of living and much better working conditions in such factories.

Far Eastern lathes - a trader's view

SIRS - We are prompted to write in response to a letter published from Mr. Phillips in M.E. 4273, 12 May 2006.

The references to sweated labour and unsafe working conditions are totally untrue and written by someone who obviously has no first-hand knowledge of Chinese factories.

We spend a great deal of time in Chinese factories and can therefore categorically state that in our experience "sweated labour and illegal working conditions" do not apply. For instance, the factory producing our 1300, 1400 and 1600 series lathes employs 1,000 people. The plant is immaculate and easily compares with any factory in Europe.

The same can be said for the factory which is producing our drilling machines, belt sanders and small tooling. Each factory has full canteen facilities to provide lunch for their employees. Many of the factories have accommodation for staff that do not live locally. A number of the factories provide protective clothing for their staff.

Without exception, we have visited on several occasions every factory supplying our products; we have never ever felt uncomfortable with the working conditions. If we were not fully satisfied with the manufacturing background, both in terms of quality and employee working conditions we would not support the factory.

Instead of whining Mr. Phillips should appreciate that as a result of competitively priced imported machines thousands of model engineers have had an opportunity to equip their workshop and pursue their hobby which surely must reflect on the whole model engineer market, for instance the demand for castings, boilers and all the other UK made components.

Roger Warren, Warco.

O-rings on Allchins

SIRS, - I am building a 1 1/2in. scale model of the Allchin 'Royal Chester' traction engine to W. J. Hughes instructions published in the M.E. from 1972 to 1976.

There he gives dimensions for the use of O-rings instead of graphite yarn for packing the rods and piston. The dimensions for the diverse rod gland bores and the piston groove depth, are all approximately 0.010in. larger than the O-ring O/D (piston O-ring I/D)

meaning that the O-rings can by no means seal on both inner and outer diameters (no pinch fit). Is there a reason for this, should there be clearance to let them roll; or are the dimensions wrong meaning they should be machined to a pinch fit as indicated in all O-ring fitting tables?

Also, has anyone, after making the mistake of machining to these sizes (if they have been proven to be wrong), been able to find a way of putting things right to save the day on a nearly completed and expensive casting?

Pat Roberts, Germany.

A very old model engineering society

SIRS, - The Cape Town Society of Model and Experimental Engineers is approaching its centenary year. Founded in 1907 as the Cape Town Society of Model Engineers to which the 'Experimental' was added later, we think we may be possibly the second or third oldest such society in the world. The Society was mentioned in *Model Engineer* of that year (12 September, page 264) which stated that the entrance fee was 2/6 and the annual subscription, 7/6. Initially members met in private homes then in the Old Town House in Cape Town. Only in 1980 was the present clubhouse built. We are now compiling a history of our society as one aspect of the centenary celebrations. Possibly some of your readers may have been members at some time or have known members and can assist us by contributing any information, anecdotes or photos from any time since our formation.

Those early days must have been stirring times for the model engineer and the amateur in his home workshop could investigate and experiment with flying machines, automobiles, electricity, wireless, petrol and steam.

It is interesting to reflect on events in those days. In 1909 Louis Blériot was the first man to fly across the English Channel. In South Africa, P. J. Esser, an early aviator, is said to have made a flight of some 200 yards. The automobile was displacing the horse and two intrepid travellers drove an 8hp Rover from Durban to Cape Town via Johannesburg in just 16 days - most of the time probably spent opening and closing farm gates and repairing punctures! In Bloemfontain a local councillor was advocating a speed limit of 8mph. A new model 'T' Ford cost a mere

Views and opinions expressed in letters published in *Post Bag* should not be assumed to be in accordance with those of the Editors, other contributors, or Encanta Media Ltd. Correspondence for *Post Bag* should be sent to: -

The Editor, *Model Engineer*,
Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0EL; fax: 01689-886666
or to david.carpenter@encanta.co.uk

Publication is at the discretion of the Editor.

The content of letters may be edited to suit the magazine style and space available.

Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.

In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.

£180. Electricity was just entering homes and President Kruger awed visitors with the electric light in his home. The snag was that if you wanted it you needed to install a steam engine, generator and switchboard. Without it you treadled your lathe, try it some time!

Though reflecting on the scope of our hobby over the last (almost) 100 years we remain an active society and look forward to yet further years of fulfilment.

Should anyone be able to assist with any information, the club can be contacted by post at PO Box 693, Rondebosch, 7701, South Africa or by e-mail to gtrout@xsinet.co.za G. E. Trout, Capetown.

MEX venue (1)

SIRS, - I am very pleased to note that this year's exhibition is going back to Olympia, London. While Sandown Park is an easier venue for me to visit the atmosphere was not conducive to an exhibition such as the Model Engineer. I have not visited the Model Engineer Exhibition for the last two years simply because it was not as enjoyable as the earlier times at Alexandra Palace and Olympia. Instead I have found myself visiting some of the other exhibitions.

Some of my efforts have been on display in the Loan Section so you can understand that I have been slightly involved. I do miss the original layout arrangement with the benefit of an overall picture of the exhibition that the larger single hall offers.

John Noakes, by e-mail.

MEX venue (2)

SIRS, - Congratulations on moving the Model Engineer Exhibition back to Olympia, much more convenient!

Ian Dawson, Sussex.

Seating ball valves

SIRS, - Until taking out a subscription for *Model Engineer* recently and only reading the occasional copy for some years prior to that I found it pleasant to renew acquaintance, so to speak, with long standing contributors like Peter Spenlove-Spenlove. I remember when, in the last decade of the last century I described the use of a second lathe centre put on the end of the first in the tailstock using this as a centre finder, instead of those expensive-to-buy spring loaded ones, he complimented my idea as a 'neat trick'. Anyway, here is another neat trick for I am surprised that he appears not to

know that there is a better way of seating balls in a valve than striking one with a hammer (and punch). Well here it is:

Obtain a new cast steel ball – the sort used in ball races – of the same diameter that you will be using in the valve. Take a short piece of steel, or brass, rod about 1/16in. diameter less than the ball, put the point of a drill into its end and into this depression soft solder the cast steel ball. The valve body should have its valve face nicely flatted with a D-bit or slot drill, and then the bore should be carefully reamed leaving a sharp corner. Set the valve body vertically in your bench vice.

Now grip the bar shank with its soldered ball in your hand drill, put a drop or two of lubricant on the ball, lower it into contact with the hole and then, with the drill as near upright by eye as you can, give the ball at most three slow turns without putting any pressure on except the weight of the drill. This will burnish the edge of the reamed hole and on pressure test should give complete satisfaction every time. The method has been proved and accepted by a professional model maker of my acquaintance.

David Piddington, by e-mail.

Callipers and brass magnets

SIRS, - May I start by thanking Nick Weston (*M.E.* 4272, 28 April 2006) for an interesting description of the operation of digital callipers. I bought a 6in. calliper at last year's excellent Bristol show. Its measuring system is active even when switched off, displaying the correct reading when switched back on. It even remembers the last reading if the battery is removed and replaced.

In *Club Chat* of *M.E.* 4270, 31 March 2006, Doug Crampton expressed a wish for a brass magnet. In his fascinating book, *The Engineer in Wonderland*, Professor Eric Laithwaite describes a mains AC powered electromagnet which uses pole shading to produce an attractive force on non-ferrous metals.

The core consists of a stack of steel strips laminated (bolted

through) to produce a 1 x 1in. core 36in. long. The coil, carried on an insulating former consists of 875 turns of 18 gauge enamelled copper wire. This coil is securely mounted on the core at one end. There is a strong force trying to move the coil towards the centre of the core in use, so it does need to be well secured.

The most important part is the pole shading which is also fitted at the coil end of the core. This consists of a single turn of copper and is a cut from 3/16in. thick sheet, to produce a square of 3/4in. external and 3/8in. internal dimensions. This is sunk into a square slot in the end face of the core, so that the axis of this single turn is parallel with the axis of the core.

The action of the copper loop pole shading is to produce an inward travelling magnetic field on the end face of the core. Professor Laithwaite says that this electromagnet will pick up a halfpenny, but not a penny (old coin). It therefore ought to satisfy the requirement for a brass swarf magnet.

I have yet to try this out but aim to 'one day'.

Toby Bishop, by e-mail.

Smoky sleeve valves

SIRS, - I noted the letter from M. Hodgson (*M.E.* 4272, 28 April 2006); my advice on first thoughts would be – leave well alone and keep as an exhibit. Sleeve valve engines do tend to be smoky as they have twice the piston clearance which allows oil to reach the combustion space. If, however, it is wanted in good running order, then: -

Take it apart carefully, photographing it stage by stage. Paying particular attention to the sleeve valve gear drive timing and making any notes needed for re-assembly.

Don't de-coke! The exception to this injunction being any build-up of coke actually in the ports which blockage must be removed to clear them.

Carefully remove any steps in both bores – this may actually be impossible with the outer bore as the sleeve may have rings above and below the ports which will have

created four small steps – think about it! The major step will as usual be in the top of the main bore.

Measure both bores accurately.

Check to see if there are locating pins – *à la* two strokes – for the rings.

Get matching rings from a reputable supplier – if 'Wellworthy' still exist they may be able to supply.

De-glaze the bores only – NOT the outside of the sleeve or the piston.

Make or obtain a new set of crankshaft bearings – the increased loading of 'running in' will wear old bearings rapidly.

Re-assemble using the photos as a guide and using lots of oil on everything.

If you are lucky it may start on cranking.

Peter King, New Zealand.

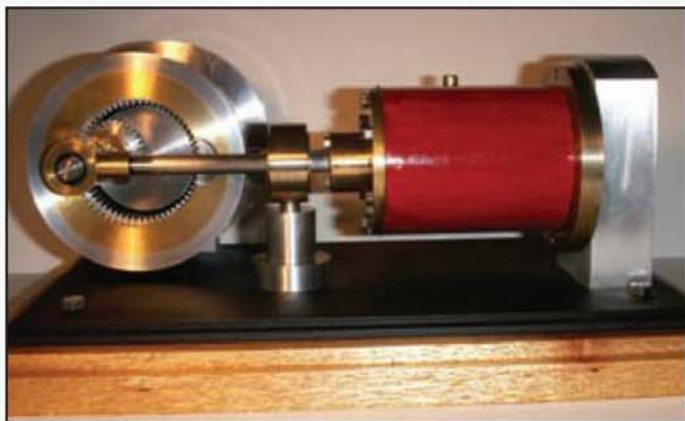
Engineering inheritance

SIRS, - I am so much encouraged by Martin Wallis' first three paragraphs in Savage's *Universal Carrier* (*M.E.* 4274, 26 May 2006), seeing model engineering to embrace a wide range of activity and models engineers represented by a broad variety of abilities, ambitions and dreams.

My Father died when I was nine, leaving the contents of his workshop to me in his will. It was more than 50 years before I began to remove the hibernation fluid from those tools that had not been sold, lost, lent or given away.

One of the items that has come with me down the years is a Stuart & Turner 'Sun type' engine built by my father and half-brother in the 1920s; I have cherished an ambition that I might one day build this into a model boat, and this has lead me on into some of the fascination and skills of the hobby. Looking for advice and encouragement I joined a local Midlands SME and, to get known, became involved in the 'gardening' side (another hobby), until because of a broken wrist followed by increased commitments elsewhere, I suddenly disappeared to become a 'dormant' member. Still I pay my dues and read the club newsletter and am grateful for a potential source of advice and, maybe one day, a boiler certificate.

John Chappell's letter (same issue) struck a sympathetic cord; a boat fits exactly the hole it makes in the water, so please more articles on electronic boiler control, Kitchen rudders, calculating buoyancy etc. David Eve, Cleobury Mortimer.



A side view of the finished engine showing the unusual hypocycloidal crankshaft arrangements.



The two eccentric sides referred to in the text. This design facilitates easy fitting of the eccentric strap.

HYPOCYCLOIDAL DOUBLE ACTING ENGINE

Les Kerr

from Australia describes a fascinating engine with a crankshaft design steeped in history and mathematical mystery.

● Part 1.

Our story starts back in 1674 when a Danish scientist by the name of Olaf Roemer conceived the hypocycloid curve while studying gear teeth. A special case occurs when we look at the path traced out by a point P on the circumference of a circle of diameter 'b' that rotates around the inside of a second circle whose diameter is 'a' where $a=2b$, see fig 1. Believe it or not the path of P is a straight line.

For those of you that are interested in the mathematics, the equation for a hypocycloidal curve with its first point on the boundary circle is:

$$x = (a - b) \cos \phi + b \cos \left(\left(\frac{a}{b} - 1 \right) \phi \right)$$

$$y = (a - b) \sin \phi + b \sin \left(\left(\frac{a}{b} - 1 \right) \phi \right)$$

where:

a is the radius of the large circle.

b is the radius of the small circle that rolls on the inside of the large circle.

ϕ is the angle from the centre of the large circle to the small circle.

A plot of the above curves for $a/b=2$, $a/b=3$ and $a/b=4$ are shown in fig 2. A complete derivation of the formula can be found at the following web address:

<http://mathworld.wolfram.com/Hypocycloid.html>

In 1784 James Watt took out a patent on parallel motion which, by using a series of linkages, converted the linear motion of the piston of a steam engine to rotary motion. Unfortunately for others this patent didn't expire until 1805.

To overcome this patent Matthew Murray in 1802 replaced the circles in fig 1 with an internal and external gear. This gear motion converts the linear force of the piston and rod movement to rotary motion. Murray built several engines using this principle but only two full size examples of his engine exist today. One is in the Henry Ford Museum in the USA and another in the Science museum in Birmingham, UK.

Being fascinated by this action I decided to

build my own model engine from material found in my junk box (see photo). The only problem I had is how to machine the gears. The external tooth gear presented no problems as I have a dividing head and milling machine. However the internal tooth gear is another story. Not having a shaping machine I had to admit defeat and use a commercial product. These I found to be available from Sterling Instruments (usual disclaimer). Their agents in Australia are Small Parts and Bearings and in the UK David Stock Gears. The internal tooth gear is 0.8 module, 60 teeth, part number S1E08ZM08S060. It is made from 303 stainless steel has a face width of 8mm, pitch diameter of 48, bore of 46.4mm and outside diameter of 100mm. The outside diameter is later machined down to 71mm to fit into the engine.

The external tooth gear is 0.8 module, 30 teeth part number S10T08M030S0508. Again it is made from 303 stainless steel has a 5mm face width, pitch diameter of 24, outer diameter of 25.6mm and internal bore of 8mm.

As reasonable accuracy is required to enable the gears to mesh smoothly I decided to run the main shaft in ball races. The ones I had available have a bore of 8mm, width of 7mm and outside diameter of 22 millimetres. Two were used, one in the gearbox and the other in the support.

The engine is double acting and uses a conventional D-valve. It has a stroke of 48mm (pitch diameter of internal tooth gear) and bore of 38 millimetres.

Construction

Over the years I have found that the best way to achieve accuracy between the centre of holes is to use coordinate drilling in the milling machine. To pick up the position of an edge I use a wiggler. If you follow this approach I feel sure that your engine will fit accurately together resulting in smooth operation.

Gear housing (item 1)

I started with the gear

housing which was turned up from a length of 90mm dia. cast iron. To obtain reasonable accuracy all the internal bores and outside surfaces should be machined at the one setting in the lathe. In boring the 22mm hole set the diameter so that the ball race is a press fit in the hole. If you do go oversize then it may be held in place with a drop of Loctite. The mounting holes and slot for the eccentric strap were machined in the mill drill.

Support (item 2)

The support was made from a piece of 50x20mm aluminium alloy. Again the 22mm hole diameter was set so that the ball race was a press fit. Be as accurate as possible with the height of this hole as it sets the level of the centre line of the engine.

Bearing spacer (item 3)

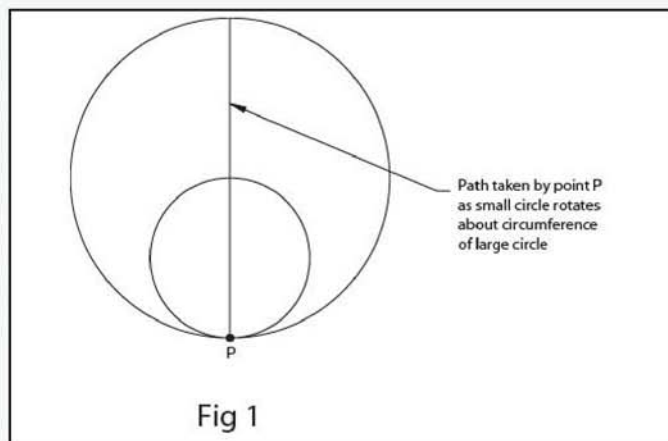
This is a simple turning job from a length of 25mm dia. aluminium alloy round.

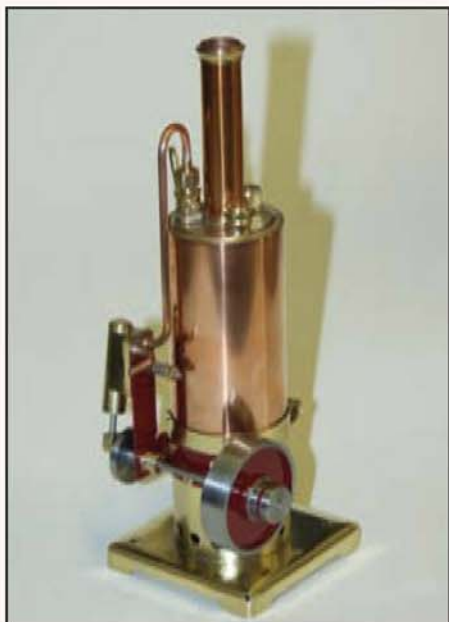
Eccentric

The eccentric is made in two parts so that the strap can be easily fitted. See photograph.

Eccentric body (item 4)

I started with a length of 35mm dia. cast iron. Face the end then turn down the outside to a 27.6mm diameter for a length of 15 millimetres. Next bore out the 19.5mm dia. recess to a depth of 2 millimetres. Finally turn the outside to





Fellow course members voted John Hocking's engine to be the best on display.

Norman Billingham

tells how members of the Society of Model and Experimental Engineers helped him to build a simple single cylinder oscillating steam engine to Tubal Cain's *Polly* design.

Having completed the SMEE basic training course and learned an enormous amount, I was keen to have more practical experience in model engineering. As soon as SMEE announced a second-level training course on building a live steam engine and boiler, I had my cheque in the post to Society Secretary Peter Haycock.

Polly is a simple oscillating single-cylinder steam engine and boiler, originally described by Tubal Cain in his book *Building Simple Model Steam Engines*. The course on building *Polly* ran over six full-day sessions held on Saturdays between September 2005 and March 2006. The Marshall House workshop isn't big enough to cope with a group of sixteen students, so the course was organised as lecture demonstrations, and we were expected to complete the work at home. Everything was detailed in a manual given to each of us at the first session.

Polly has to be built 'backwards', starting with the boiler, around which everything else is supported and fitted. Even starting with copper tubing, building the boiler is challenging to a beginner. It involves cutting, drilling and flanging the copper end-plates, turning and threading the phosphor bronze bushes for the safety valve, steam pipe and filler and silver-brazing the whole thing together. I doubt I would have tried to do this at home by myself, but having watched it all demonstrated by Roger Woollett and George Evans on the first day, I was full of confidence. It all went together first time and was leak tight when tested under air pressure - an amazing feeling of achievement.

Session two, and all the rest of the sessions, began with a discussion during which everyone produced their work and discussed their problems. It was fascinating to see how many different ways people had found to achieve the



Old Glory magazine Editor, Colin Tyson (right), presented John with an engraved crystal tankard.



Course members gather to watch some of the finished engines running under their own steam.

BASIC TRAINING FOR MODEL ENGINEERS

same end, and enormously useful to have the expertise of the SMEE 'elders' to tap into. The whole group very quickly gelled and developed a real camaraderie.

Over the next months we used our newly-acquired skills to make the spirit burner, learned how to mark out, form and soft-solder sheet steel to make the base, firebox and engine stand, turned and milled brass and steel to make the portface, piston, cylinder, crankshaft and flywheel and explored the delights of drilling tiny holes in $\frac{3}{16}$ in. diameter bronze balls and cutting 10BA threads to make a safety valve - those who didn't cheat by buying a ready-made one from Mamod! Of course, we all made lots of mistakes and learned from them, but one beauty of a model like *Polly* is that everything is made from standard materials, with no castings involved. Every time you make a mistake, you just curse, write it off to experience and have another go.

At each meeting everyone produced their work and we learned from each other and from the

experts. Every emerging *Polly* was a slightly different variation of the theme as everyone made their own modifications to the basic design.

Boiler testing and certification were covered in depth, so we are all aware of the requirements when we make bigger boilers. Painting and final finishing was also demonstrated.

A real highlight was having our part-built models on display and being able to help out on the SMEE stand at the model engineering exhibition at Alexandra Palace.

In the end my *Polly* went together just before the final session and the pleasure of watching that little engine whizzing around under steam was quite indescribable.

The final session was judgment day and our *Pollies* were all lined up for peer review. The prize for the best engine (a beautifully engraved tankard) was justly awarded to John Hocking for a complete and beautifully finished model. The tankard was presented by Colin Tyson, Editor of *Old Glory* magazine, who had some very nice things to say, both about the students' work and about the efforts of SMEE in organising the course.

The success of all the *Pollies* is undoubtedly a credit to the students who built them but it wouldn't have happened without the dedication of the guys at SMEE who worked so hard to put something back into the hobby. Mike Chrisp, Peter Haycock, George Evans, Maurice Fagg, Roger Woollett, Michael Hall and Andrew Mawson all gave freely of their time and knowledge - all true gentlemen. Behind the scenes a volunteer 'catering team' worked hard to ensure that we were all fed and watered, while a similar volunteer 'workshop team' ensured that everything was made ready for the demonstration sessions. Sincere thanks to all of them.

All in all, the SMEE training course is one I would commend to anyone starting out in model engineering. It gave me a huge amount of knowledge, a lot of new friends, enormous pleasure and, perhaps most importantly, the confidence to believe that I can go on to much more complex projects.



THE SOCIETY OF MODEL & EXPERIMENTAL ENGINEERS

The next course of seven monthly meeting is scheduled for Saturdays 9 September 2006 to 10 March 2007 inclusive, 9.30am - 6.00pm. Coffee/tea and ploughman's lunch are provided.

All sessions are held at SMEE Headquarters: Marshall House, 28 Wanless Road, SE24 0HW.

Places on the course are available on a first-come, first-served basis at an inclusive cost of £265 for non-members (£215 for members).

Enquiries and applications (with remittance)

should be addressed to

The SMEE Membership Secretary,
28 Wanless Road, London SE24 0HW
or visit the Society's website

at www.sm-ee.co.uk

To ensure a prompt response, your full contact details including name, address, telephone number(s) and e-mail address should be enclosed with all enquiries or applications.

I/C TOPICS

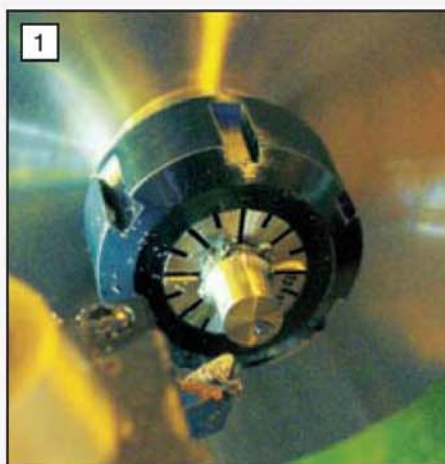
Nemett

continues construction of the NE15S four-stroke engine with the tappets, valves, cam box, camshaft and crankcase.

37 Tappets

Set a piece of EN1 or similar in the collet chuck and turn to 10mm diameter (photo 1) to be a sliding fit in the cylinder head. Aim for a fine finish.

Face the end, again aiming for fine finish and ensure no dimple is left in the centre.



Turning the outside diameter of a tappet.

Part the tappet off to length and reverse in the collet chuck.

Bore 9mm dia. to a depth of 8.5 millimetres. Then use a D bit or slot drill to face the inside to 9mm depth (photo 2) again ensuring that no dimple is left.

Mark the inside to identify the tappets as inlet and exhaust then caseharden the outside and



Boring the inside of the tappet using a slot drill.

polish. When case hardening these items, it is best to completely cover them with case hardening compound in a small container and heat up the whole lot. This avoids distortion of the thin sides.

A point about the marking of such items, I adopted a convention of marking the front end of the engine, so the front tappet, front valve etc are marked with a small scriber mark in a convenient place. This ensures that when all is complete, the engine can be assembled with everything in the correct location.

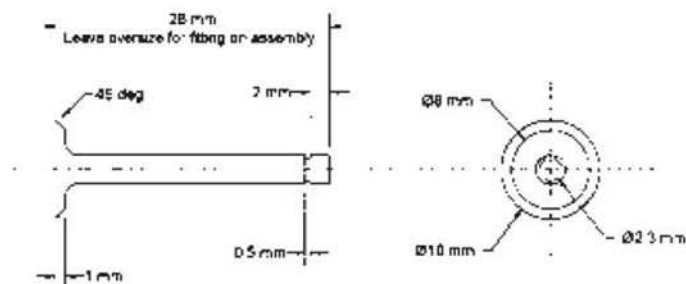
30 Valves

The valves are best machined in a collet chuck from free cutting stainless steel.

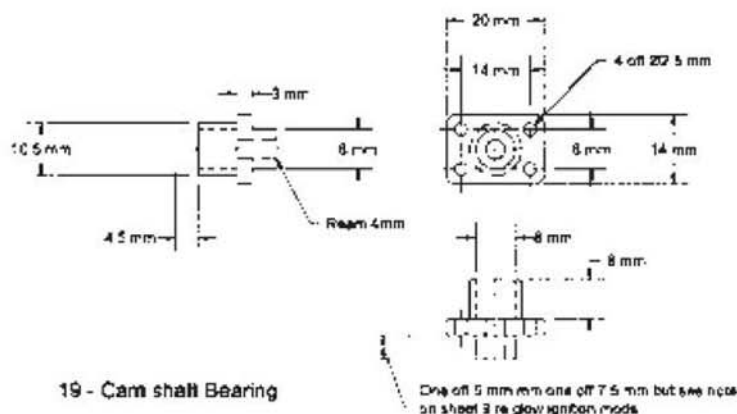
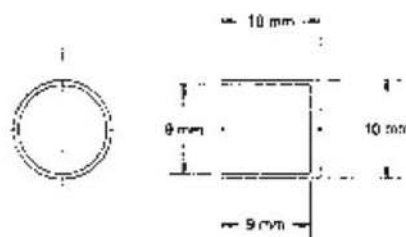
Set a piece of 10mm diameter stainless steel in the chuck and centre with a very small centre drill. Extend from the chuck until about 50mm is protruding and bring a small revolving centre up to the end and ensure that the tool can travel as close as possible to that end of the work.

PURCHASED PARTS

Description	Specification	Code	Source
Small trimming pulley	2.5mm pitch 20 teeth 6mm wide	HPC20T 2.5-10	HPC gears
Large timing pulley	2.5mm pitch 40 teeth 6mm wide	HPC40T 2.5-10	HPC gears
Timing belt	2.5mm pitch 127 teeth 6mm	HPC T2.5/317	HPC gears BSL
Rear crank bearing	Ball race - 12x28x8mm two rubber seals	6001-2RS	BSL
Front crank bearing	Ball race - 10x26x8mm two rubber seals	6000-2RS	BSL
Big end bearing	Drawn cup needle roller 8x10x10.5mm	HK1010	BSL
Big end inner sleeve	Needle roller inner sleeve	IR7X10X10.5	BSL
Tensioner & cam bearings	Drawn cup needle roller 4x8x8mm	HK0408	BSL
Valve Stem E-clips	B.S 023MS RA2 3A	D1500-2.3MM	BSL
Electronic Ignition parts	TIM-3 module kit/Modlectric coil		Woking Precision
Spark Plug	1/4 x 32 tpi		Woking Precision



30 - Valve



19 - Cam shaft Bearing

One off 5 mm hole one off 7.5 mm but see note on sheet 2 re glow ignition mode.



3
Turning the valve stem with the stem end supported with a live centre.

Turn down the stem in easy stages (photo 3) to 3mm dia. (check against the 3mm reamer shank that was used for the valve guides) and take at least three passes at the final setting. Check that the stem is parallel and aim for a near polished finish. Use a round nosed tool to finish the radius between head and stem (photo 4). Repeat for the other valve.

Some constructors use an outside hone on the stems to get the final finish. I have never found this necessary if a sharp round nosed tool is used to turn the stems.

With the valve in the collet chuck, offset the top slide 45deg. before carefully turning the seating face ensuring that minimum diameter is smaller than the valve seat.

Repeat the above steps for the other valve.

Now use a sharp parting tool to part off both valves to leave approximately 0.5mm of parallel edge on the valve head. Hold by the stem in the collet chuck and very carefully skim the surface of the head. Just aim for a good finish rather than exact size.

Part off both valve stems to approximately 2mm greater than the specified length to allow for accurate sizing later and mark the heads to identify them.

The spring clip grooves will be cut once the length is set.

17 and 18 Cam box and cover

I machined these as a pair to ensure a good match. Cut the cover and bar to rough size from HE30 aluminium alloy, clamp together in the milling vice and machine one long edge true. Reverse in the vice ensuring the machined bottom edges are flush and machine to the correct width.

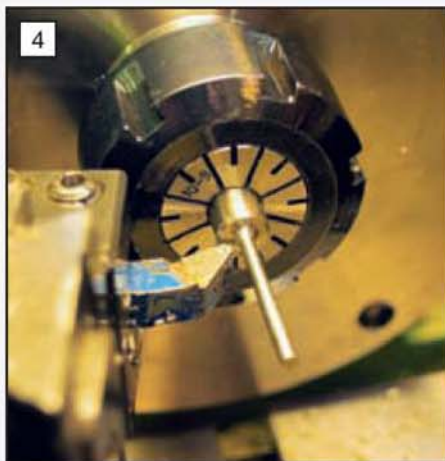
Repeat for the short sides, clamping the items in alignment with a tool maker's clamp.

Now set up the cam box in the vice and machine the bottom face followed by the top face to bring the depth to the correct 15 millimetres.

I then centred the cam box under the quill to mill out the centre aperture. I drilled a row of 10mm holes down the centre before using a 10mm slot drill (photo 5) to remove the waste metal. The box is designed to locate on the cylinder head spigot in the sideways direction so make sure the aperture is central and is a good fit over the cylinder head spigot. This ensures that the cam belt stays in correct alignment.

I then used the machine indexes to position the box for drilling and counter boring the fixing bolts.

The next operation was to mill the top and



4
Finishing the valve head and stem radius with a round nosed tool.

bottom faces of the cover before drilling and tapping for the breather plug.

To bore the holes for the camshaft bearings, I set the cam box on end in the milling vice and found the centre. I then offset the box by one millimetre on the depth to get the correct position for the hole.

Make sure you offset in the correct direction,

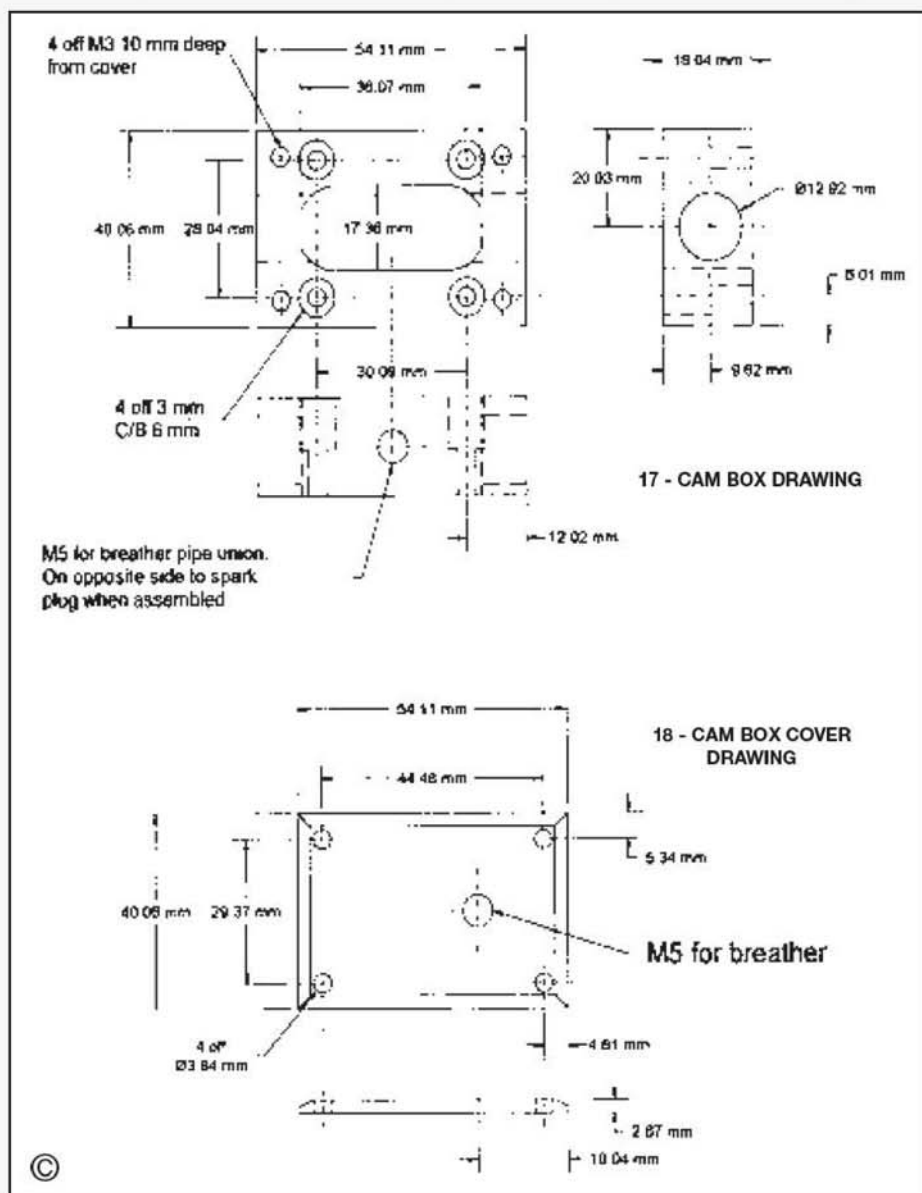


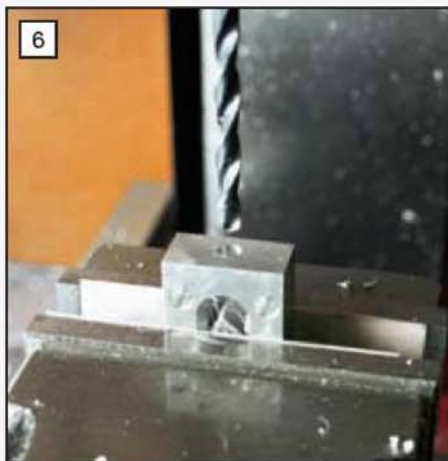
5
Using a 10mm slot drill to remove the waste metal when milling the cam box cavity.

the longer dimension is to the top of the box when assembled.

Centre drill and then gradually enlarge the bore to 10.5 millimetre. The size is not that critical, I used a 'Z' letter drill (photo 6) in the absence of a 10.5mm drill. The bearing housings will be turned to fit later.

I then clamped the cover and box together in





Drilling the cam bearing housing holes in cam box.

the milling vice, using a toolmakers clamp to ensure alignment and drilled the cover fixing bolt holes 2.5 millimetres. These were then tapped M3 and the cover holes enlarged to 3mm to suit.

If you are taking an oil feed into the cam box from the crankcase breather, drill and tap the side of the box for a suitable union (see note re breathers below).

Clamp the cam box to the cylinder head and spot through (photo 7) for the fixing bolts. Drill and tap as per the cylinder head drawing.

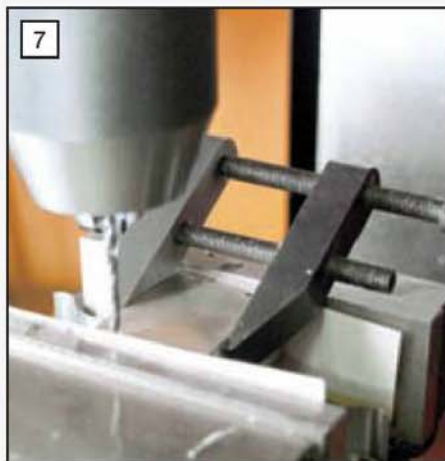
I also cut some shallow 'fins' on the outside long edges of the box to break up the boxy outline a bit, but those are optional, I don't think they add much cooling effect.

A note about crankcase breathers

I have specified a breather pipe from the crankcase to the cam box as a way of getting some oil mist up to the cams. Some constructors using glow ignition prefer to have the crankcase vented directly to the atmosphere so that the corrosive combustion products (from the nitro-methane in the fuel) that blow by the piston can escape. This does mean that oil must always be used in the fuel and that the bottom end lubrication relies on some oil blowing past the piston. In this case the vent pipe is not needed and the bottom crankcase vent can be left open or provided with a nipple to take a flexible discharge pipe.

The other alternative is to have some oil in the bottom of the crankcase and to flush the engine thoroughly after each run, the choice is yours.

Those running on spark ignition do not have the same problems.



Spotting cover fixing holes through into cam box.

19 Cam Shaft Bearing Housings

I started with a piece of 20 x 25mm HE15 bar and mounted this in the 4-jaw chuck to run as truly as possible. Bronze bar could be used if desired.

I turned the bearing spigot to fit the cam box (photo 8) and then drilled 3.9mm dia. 20mm deep.

Drill and bore the bearing housing 8mm diameter and 8mm deep. These can be drilled and machine reamed or bored to size. The needle roller bearings should be a light press fit and are slightly over 8mm dia. to allow for this in a reamed hole.

I then used a parting tool to reduce the outer spigot to rough size before parting off. Note that the housings have different lengths of spigot and if glow ignition only is to be used, the rear spigot and the 4mm hole can be omitted and the camshaft length reduced to suit.

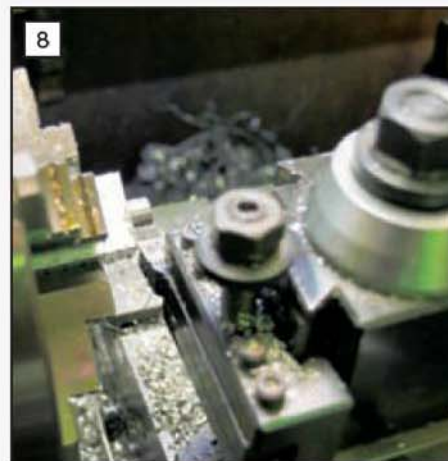
The housings were then mounted in the collet chuck by the bearing end and the outer spigots finished to size before reaming 4mm (photo 9) for the camshaft.

Then both housings were transferred to the mill drill for machining the rectangular section to overall size (photo 10).

The fixing bolt holes are drilled 2.5mm dia.; I used the milling machine indexes to set the positions for these.

The fixing holes can then be spotted through to the cam box and the holes drilled and tapped M2.5.

The timing end spigot has a shallow groove machined in it to locate the ignition timing lock screw. This can be turned later once the timing case is finished and the groove located from the locking screw if desired. This can be omitted for



Turning the camshaft bearing housing to size.

those builders using glow ignition only.

The needle roller bearings are pressed into the housings and I lined mine up using a plain length of 4mm silver steel shaft as a guide with an aluminium drift pushing the bearings (photo 11) using the lathe and tailstock chuck. Note that the curved end of the bearing enters the housing with the push taken on the flat end.

I also found that inserting the bearings enlarged the housing slightly and I had to return them to the collet chuck to machine a small amount off. If you have to do this, ensure that the needle roller bearings are protected from swarf, I put some kitchen towel in the bearings and taped up the outside end.

Check the alignment with everything assembled using a piece of 4mm dia. silver steel.

11 Crankshaft

The crankshaft is built up with the three components Loctited or pressed together and fitted with securing screws.

The big end on the prototype is a needle roller, but for those who prefer a plain bearing, the crank pin could be enlarged to 10mm diameter and the big end machined accordingly.

There are two different lengths of shaft to suit the airscrew and marine versions. If you are intending to use the engine in both guises, make the longer shaft and use a spacer under the flywheel nut.

Main shaft

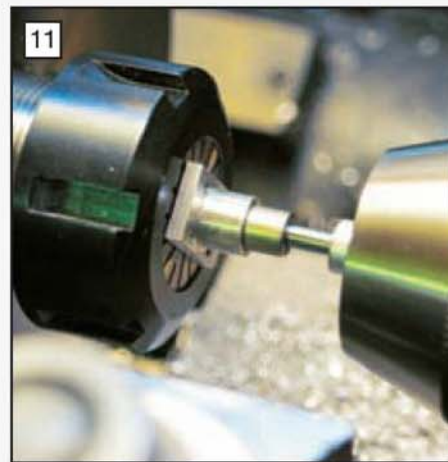
This is turned from a piece of EN8 and the first operation is to turn the 8mm section to size. I used the collet chuck and first centred the end in



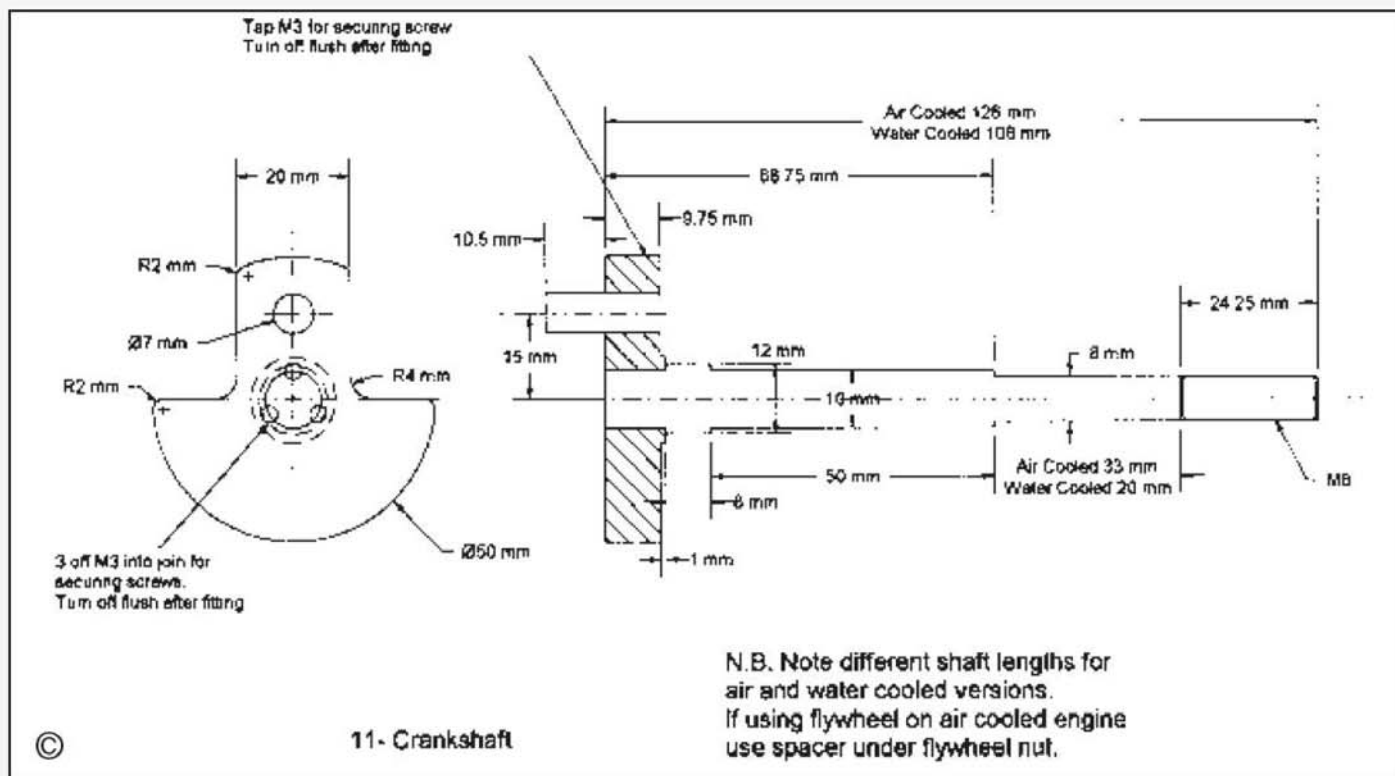
Reaming the 4mm camshaft hole in the housing.



Milling the bearing housing flanges to size.



Pressing in camshaft bearing using lathe tailstock.



order to be able to support the shaft with a live centre in the tailstock.

Turn the required length down to 8mm dia. and then bring the bar further out of the chuck in order to turn the 10mm diameter length (photo 12) in the same manner. This diameter is critical and should be a good close fit in the front bearing with no slack.

The rear bearing seating is then turned to the correct diameter and length.

I cut the front thread by first screw cutting it in the lathe to about 1/3rd depth and then running a die down it to finish off. I find this method keeps the die straight but avoids having to grind and set thread-cutting tools accurately (pause for much squawking from the purists here!)

Crankpin

This is a piece of silver steel turned to length and to be a press fit in the needle roller bearing inner race. I pressed it into the needle roller inner bearing with a smear of Loctite. Those using a plain big end bearing can use a piece of 10mm silver steel just faced to length.



Turning the main part of the crankshaft.

Crank web

The web is turned from a suitable piece of EN1 bar. The first operation is to turn the overall 50mm diameter and then face off the front leaving the centre part 1mm proud.

Drill the crankshaft centre hole undersize at this stage.

Part off at slightly over final thickness and reverse in the chuck, setting the front face to run true with a dial gauge (photo 13).

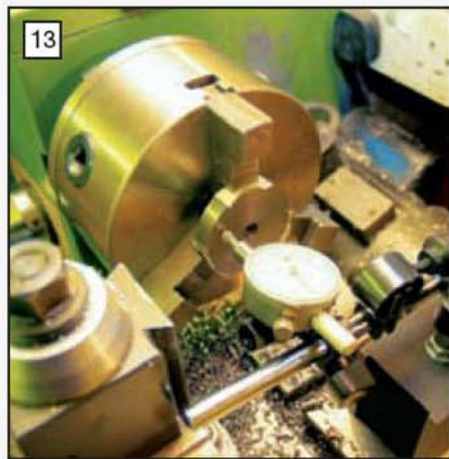
Bore the centre hole to 11.95mm (photo 14) and then ream or finish bore to size. I used Loctite to assemble my shaft but those who prefer press fits can use this method.

Face off the front to give the correct 9.75mm web thickness.

I then moved the chuck to the rotary table on the mill. If you cannot do this then set the web up on the rotary table and ensure the centre bore and upper face run truly.

Centre the bore under the quill and zero the dials or digital readouts.

Increment the table 15mm in the X-axis and drill and ream (or bore) the crank pin hole (photo 15) to be a press fit for the pin.



Setting the crankshaft web blank to run truly.

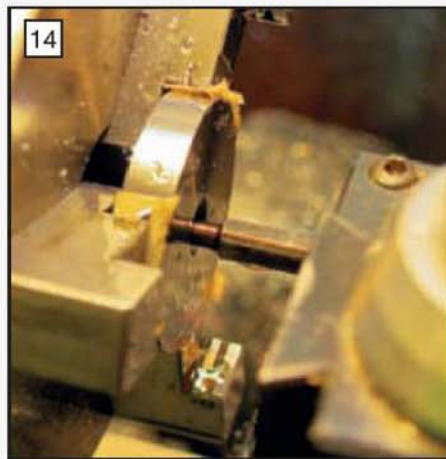
I then remounted the web in the chuck with the crank pin and shaft holes aligned with the X axis so that I could mill the cut outs away without hitting the chuck jaws.

I drilled two 8mm holes in the corners (14mm and 4mm off the X and Y centre lines) and also two others towards the edge of the web to remove some of the surplus metal before milling to final shape. I used a roughing mill to remove the majority of the surplus metal (photo 16) because they will cut the metal away very quickly. I then finished with a slot drill (photo 17) to bring the web to size.

I then rotated the rotary table 45deg. to allow the sharp corner to be removed with the mill and then rotated back 90deg. for the other corner to leave a nice clean web.

Assembling the crankshaft

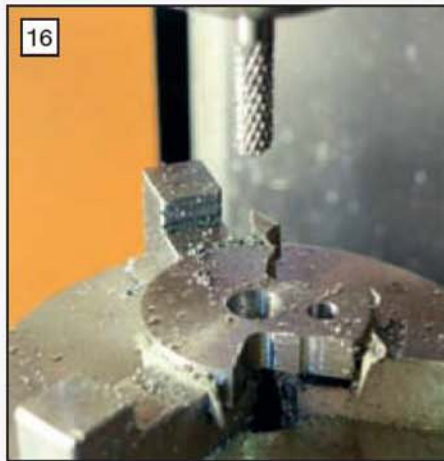
After degreasing the shaft and web thoroughly they were assembled using Loctite and left to harden fully. I always do this in the lathe to ensure correct alignment. For those using a press fit, the pressing will need to be done in a suitable press to maintain correct alignment.



Boring the crankshaft web.



Drilling the crank pin hole in the web.



Roughing out the web outline in the mill.



Finish milling the web.



Drilling holes for the securing screws in crankshaft.

The shaft was then mounted in the lathe and checked for true running.

Three M3 holes were then drilled and tapped approximately 8mm deep into the joint (photo 18) at 120deg. intervals and M3 socket screws inserted tightly (photo 19) with a smear of Loctite before cleaning off the surplus material in the lathe.

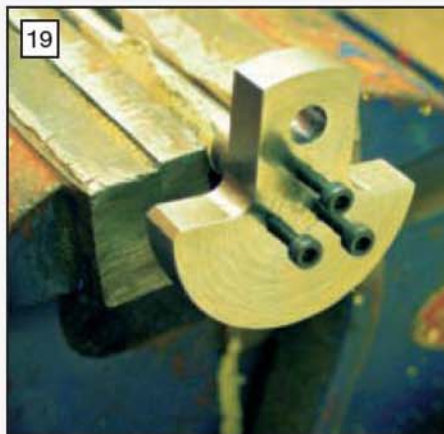
The crank pin should then be pressed into the web with a smear of Loctite and allowed to cure.

Once cured drill and tap an M3 hole 2.5mm from the rear edge (photo 20) down into the crank pin. Insert an M3 socket screw, trim off the surplus and then with the crankshaft in the lathe take a final skim over the outside diameter to clean up.

I then milled a small flat for the timing pulley screw at the top dead centre position.

12 and 13 Crankshaft spacers

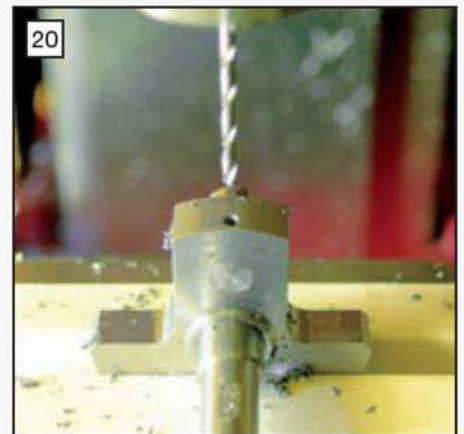
These are a simple turning job from mild steel and should be a slide fit on the shaft. Leave both spacers slightly long until final assembly when they will be fitted.



Securing screws before cutting off.

The small timing pulley can also be bored out now and should be mounted in the collet chuck or a split collet in the 3-jaw chuck to run absolutely truly before being bored out to fit the shaft.

The finished items are shown in photos 21 to 23 but note that the cam box cover fixing holes have been moved since the prototype was built to avoid



Drilling the crank pin securing pin hole.

getting too close to the bearing housing fixing bolts.

That is all for this time, next time I will move onto the cams and will discuss the various methods of cutting cams without cam cutting machines before describing the operations for this engine.

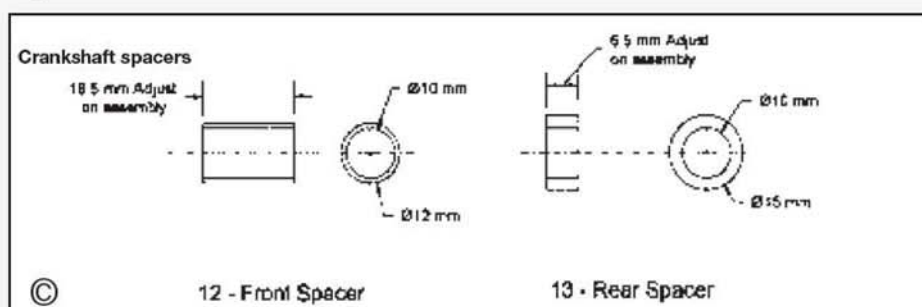
●To be continued.



Pair of tappets.



Cam box.



Finished crankshaft.

CHANGING HINDSIGHT INTO FORESIGHT

Mick Appleyard

completes his valve manufacturing sequence before bringing this popular series to a conclusion.

● *Part XII continued from page 36 (M.E. 4277, 7 July 2006)*

I will now detail the complete valve manufacturing sequence to avoid any risk of confusion.

1: Start off by making the shaped body as per the drawing shown last time using a gauge plate forming tool and then part off.

2: Make the upper body section (gland housing) drilling the spindle hole with a pilot drill only. Counter bore and tap $\frac{1}{4}$ in. x 40tpi for the gland and part off. Make a D-bit with a radius the same as the valve body and place the upper body section in the chuck with the square end showing. Now machine the body radius in the end using the D-bit.

3: Set up the valve body with the upper body section sitting on top, put a little flux paste in the spindle pilot hole together with a little piece of silver solder. Heat up the body until the silver solder runs.

4: Drill the inlet and outlet steam holes and flange bolt holes in the valve body.

5: Set up the body in the 3-jaw chuck holding it by the upper body. Now drill the 2BA spindle hole right through the body and tap. (Not as shown on the drawing). Drill and tap the $\frac{1}{4}$ in. x 40tpi seat plug hole.

6: Make a drilling guide. This is a piece of 2BA screwed rod with a 0.110in. dia. hole down the centre. Its length is such that when screwed into the valve body up to the seat two 2BA half nuts can be fitted to the protruding piece. The fit into the body should be as tight as possible without exerting undue force to screw it in. Remember the wall thickness will be very thin so it will easily shear off. A point on the seat diameter; the drawing shows the steam hole as $\frac{1}{8}$ in. diameter. This means that the effective seat

The author is available, at reasonable times, at 17 Aintree Road, Lords Wood, Chatham, Kent ME5 8PY; tel: 01634 669875; e-mail: mickapple@aol.com

The articles can be obtained in book form from the author together with a CD-Rom containing the photographs.

width for sealing is 2BA core diameter: $(0.157 - 0.125)/2 = 0.016$ inch. From my experience I think this is a little narrow so I have opted for a steam hole of 0.110 inch.

7: Now for the seat thread a piece of brass rod $\frac{1}{4}$ in. x 40tpi ensuring that it is a good fit in the valve body. Remember that when installed it must be a steam tight. Face off the end and machine a very small chamfer. Do not cut it off. Apply a little jointing compound and screw into the valve body and tighten it up.

8: Drill the steam inlet hole into the plug for a distance of 0.125 inch.

9: Fit the drilling guide into the valve spindle hole and screw down to touch the seat. Now place the valve body into the 3-jaw chuck holding it using the excess $\frac{1}{4}$ in. seat plug material. You will almost certainly see the valve body run out of true. Now since we have fitted a drilling guide, the drilling of the seat hole will run true with the spindle threads. Just a point here, do not hold the drill with too much shank in the chuck, as we need it to be flexible to cater for the run out. Drill the seat hole being careful when the drill breaks through into the steam hole. Remove from the chuck and cut off the plug to length.

10: Make a dummy shaft 0.157in. dia. with a 45deg. taper on the end (the same as the spindle face). Place this in the spindle hole and give it a sharp tap with a hammer to form the seat.

11: Make the spindle as per the drawing and fit.

12: Make a brass washer 0.221in. outside diameter ($\frac{1}{4}$ in. x 40tpi core) and 0.128in. (No. 30) spindle clearance, and part off 0.015in. thick. Place this in the gland stuffing box to hold the gland packing. Pack the stuffing box and fit the hand wheel.

13: Test the valve. Should it leak, then the spindle can be removed and the seat lapped with the dummy spindle and the valve re-tested.

14: A point on the safety side, the valve as drawn will not allow the spindle to pass through the stuffing box so there is no risk of steam escaping. With the modified type if the gland became unscrewed and the spindle continually opened until it came out then live steam could be emitted. It is therefore imperative that the gland nut is kept tight at all times and that the spindle is not opened excessively.

Valve test gear

For those people who are building live steam models, it is imperative for safety reasons that any steam valve fitted is fully tested for tight shut off before it is put in service. Let us just consider what would happen if they could not work properly on the first steaming of the boiler (photos 1 and 2).

Blowdown valve

As pressure starts to build up it will blow the water out of the boiler, this will leave us in the situation where the need to get more water into the boiler is not possible by the use of the injector or pump as there may not be enough steam to drive them. This could leave a fire in the boiler with no means of filling it with water. The alternative will be to dump the fire - a hazardous job if not done under control.

Blower valve

As pressure starts to rise it will cause the blower to draw air through the fire greatly increasing the fire rate. At this point the grate will be full of fresh coal, so increasing the firing rate, and this will release a lot of heat in the boiler. Without control the only thing which can be done is to dump the fire.

Injector valve

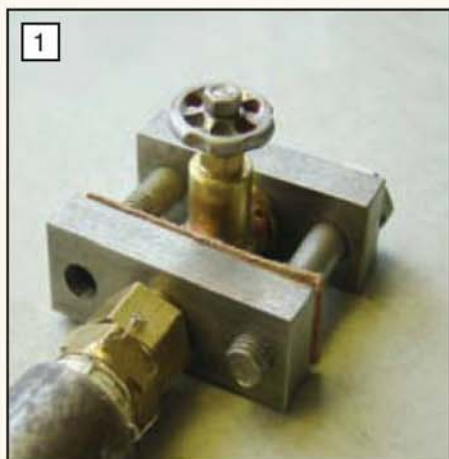
As pressure starts to rise it will cause water to feed into the boiler. In the short term this can be controlled by opening the blowdown valve, but is not a good situation to be in. Once again the fire will have to be dumped.

Regulator valve

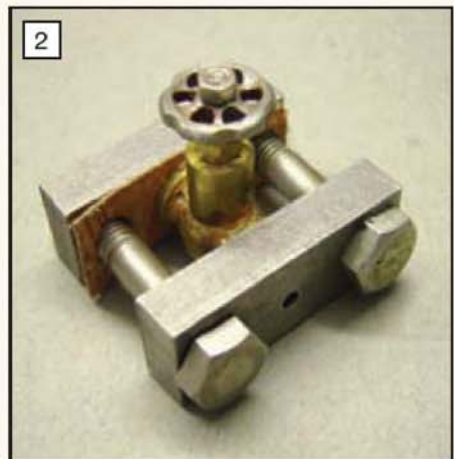
As pressure starts to rise it will cause the motion to start to rotate, not too much of a problem providing the engine is in mid-gear and has been set up correctly, but once again not a good situation to be in. Once again the fire will have to be dumped.

One can see that all the above situations should be avoided at all costs. In addition we will have to remove the offending valves to replace them - all additional work.

To overcome this each valve should be tested. This can be done on a simple hydraulic test pump or on a compressor. To aid this we need to make up some simple testing adaptors. We will have two types of valve to test, those with a screwed connection and those with flanges.



The author's valve test rig with a valve undergoing examination.



A view of the other side of the valve test rig. Note the vent hole.

For the screwed valves this will be a suitable connector with one end fitting the pump/compressor and other to fit the valve. For the flanged valves I have made up a simple clamp to fit the valve between while the pressure is applied. This consists of two plates with long set bolts and a joint. The two plates are 1 5/8in. long x 5/8in. wide x 1/2in. thick. Clamp them together and mark a centre line along the length and width. Mark off the two set bolt holes - each side of the centre on the length and centre pop, also centre pop the centre hole. Drill the two set bolt holes with a No. 4 drill for 1/4in. BSF. Drill the centre hole 1/8in. diameter. Separate the plates and tap the two set bolt holes 1/4in. BSF in one plate only. Open out the 1/8in. hole in the centre of the plate to 0.339 (letter R) but do not drill right through. Tap 3/8in. x 32tpi. This will be the plate that connects to the pump or the compressor.

Drill out the two set bolt holes on the other plate with a 1/4in. clearance drill. Make a 1/32in. joint with the two set bolt holes and the 1/8in. hole. Make an adaptor screwed 3/8in. x 32tpi on one end and the other to fit the pump/ compressor. Screw this to the plate and fit to the pump/ compressor. Fit the other flange to this with the two set bolts making sure that the joint is fitted between them. The valve can now be quickly fitted between the flanges with the joint on the inlet side and then nipped with the set bolts ensuring that the valve sits central in the plates. We can now turn on the air/water and test the valve. Should it leak then this will be emitted through the centre 1/8in. dia. hole in the clamping plate.

Condensation in the workshop

Many builders of fine models carry out their work in garden shed or garage type workshops. This will mean that projects of long duration will require some additional thought as to what we do to protect components manufactured early in the project. Remember all components will at some time require protection/ finishing. It is better to do this early, rather than later.

The main cause of rust forming is condensation from heating sources. If workshop heating is required then use a fan type heater. Do not use gas as this produces large amounts of water vapour during heating. If gas/ propane is used for brazing/ silver soldering keep the workshop well ventilated. Keeping machines covered, an old blanket/ curtain is the best form of cover. Do not use polythene sheeting, as this will cause sweating.

Workshop bench space

In the latter stages of building a model whilst assembly takes place you may find that bench space is at a premium. Since the model could be very heavy it may not be possible to keep removing it from the bench. You will also need to get to both sides of the model. Some consideration needs to be given to this matter. In my case I have a Workmate bench, which comes in very handy here. Shown above is also some guidance on steel heat treatment colours.

Safety in the workshop

To complete your model you will need all your senses and body parts. Statistics have shown that

Steel colours and temperatures			
Tint of oxide on steel surface	Temp deg. C	Temp deg F.	Uses
Pale Yellow	221	430	Small Lathe and edge tools requiring a keen cutting edge
Straw Yellow	230	446	Razors and surgical instruments
Golden Yellow	243	470	Cutting dies, reamers, drills, slotting tools, hammers, pen-knives.
Brown	254	490	Scissors, shears, cold chisels, punches and wood cutting tools.
Brown to purple	266	510	Axes, plane irons and woodworking tools.
Purple	277	530	Table knives, wood turning tools.
Bright blue	288	550	Small springs.
Full blue	293	560	Smith's tools, augers, fine saw blades, chisels.
Dark blue	316	600	Hand saws

more accidents occur in the home than in industry. This means that you are at higher risk in your workshop than at work. Stop and think of those incidents and near misses that you have had in the past and ask yourself: What if? A good start to reduce the risk is to work in a clean environment. Once a week I have a good clean up, put all my tools back in their place, sweep down the machines and clean the floor. This usually only takes about 10 minutes. Try to get into the habit of keeping your bench free from clutter and tools. If your bench is a mess tools will also be hard to find, causing time wasting. Give your tools a home and you will quickly find them. Do not take short cuts when machining, doing it correctly usually only take a few minutes longer and you will live to tell the tale.

Shed type workshops

If you are about to build a workshop, which is a shed type wooden building, there are a few things that you should consider.

1: Place the shed on a solid concrete base because when assembled and in use there will be a lot of weight inside. Make sure that there is a slight fall in both directions on the base this will ensure that it will stay dry. Also, fit some damp proofing between the concrete and the shed this will stop the damp from rising and rotting the timber.

2: Raise the floor on the inside and place some insulation underneath it. In the winter it is the feet that suffer. I lifted my floor by about 2in. and made the it out of scaffold boards. Your local builders can supply the insulation. On top of the floor I nailed down hardboard and painted it with floor paint to protect it. The hardboard will prevent you loosing things down the gaps.

3: The walls and ceiling were also lined with insulation and hardboard. Keep a sketch of distances of all the main standards so at a later date when you want to erect a shelf or something similar you know where to screw it too. I have painted my wall white for maximum light reflection. As a result of the insulation, in winter I need very little heat while working.

4: Make sure that the power cable is adequate for your needs and is of the armoured type. If you run it underground then make sure that it meets with the correct regulations. You do not want to be digging the garden and suddenly sever it and possibly cause a fatal injury. While running the power cable consider running another cable for a security alarm. You may not have one at present however one day you might fit one and the cable

Temperature of heated steel	Temp deg. C	Temp deg. F
Dull red	550	1022
Dark red	650	1262
Red	750	1382
Light Red	800	1472
Bright Salmon	900	1652
Salmon	950	1742
Pale Salmon	1000	1832
Straw	1100	2012
White	1400	2550

COLORS	°C	°F
DULL RED	550	1022
DARK RED	650	1262
RED	750	1382
LIGHT RED	800	1472
BRIGHT SALMON	900	1652
SALMON	950	1742
PALE SALMON	1000	1832
STRAW	1100	2012
WHITE	1400	2550

will already be there. It only cost a few pounds.

5: Security, I have an alarm fitted to my house and shed with the contacts wired into the 24hr circuit so, even if the alarm on the house is not set at night, the shed is protected. My shed was broken into one night when the thieves unscrewed the hinges and removed the door. I was very lucky as they were disturbed and left without taking a thing. Make sure that if you have external door hinges that all the screw head slots are burred over to make it hard to unscrew them. In addition I have fitted a 3/4in. bar across the centre of the door with a security padlock. Take the view that the shed will be broken into so make it as difficult as possible, this way you will not be a victim.

Workshop lighting

When setting out your workshop lighting make sure that specific lighting for working areas like the work bench, lathe etc. are fitted such that illumination is from the front of the work area and not from behind you, as this will cause shadows and restrict your viewing.

Joints, jointing and fittings

In all my years of building models I have never come across a drawing that states what type of gaskets to use. This has prompted me to include a few paragraphs on the subject.

To obtain good steam/ water tight joints it is imperative that the correct type of joints and jointing compounds are used. There is a wide variety of jointing compounds available to us and I have no intention of listing them all. The products that I have listed are the ones, which I regularly use. You will find that manufacturers are very willing to send you all the technical information you require and many of them have a good technical help desk where you can obtain advice. As with all the materials listed below it is important that the correct type of jointing and jointing compounds are used for the specific application in hand to ensure trouble free operation and personal safety. Do not cut corners here especially when dealing with live steam. If in doubt then get advice from the supplier.

Jointing materials

The most commonly used jointing materials for our hobby are:

Rubber

This should only be used for flanges carrying liquids. It is okay for water but for other specialist liquids advice should be sought. Care should be taken when tightening, as it tends to continually compress. The sizes most suitable for our hobby are 1/64in. and 1/32in. thick. No jointing compound should be used with this material.

Klingerite

This is a good all round jointing and can be used for steam, water, gases and oil. The sizes most suitable for our hobby are 1/64in. and 1/32in. thick. This material has a limited compressibility. As a point of safety ask for the asbestos free variety.

Klingerite (Statile paper jointing)

This jointing paper can be used for oil and water. Its thickness is usually about 0.010 inch. With jointing of this thickness it is important that the flanges are flat.

Cork

This material can be used for joints involving low-pressure oil. Care should be taken when tightening, as it tends to continually compress.

O-rings

These come in a variety of sizes, thickness and materials and are mainly used for sealing joints carrying liquids and gasses. It is very important that the O-ring recess has been correctly designed so that on assembly the O-ring has been properly compressed. In addition the O-ring material must be of the correct grade for the liquid or gas.

Copper washers

These can be used with steam, water, gases and oil. It is very important that the washer has been properly annealed before assembly.

Jointing compounds

As a general rule be very careful with the amount of jointing compound used. The surplus jointing compound, which is not used in the joint face's imperfections, will have to be expelled from the

joint. Some of this will work its way to the outside and some into the middle. This will mean that there is a risk of blocking the small pipes generally used on models.

For those jointing compounds used with steam we need to know the operating temperature to ensure that the correct compound is used. Adjacent is a selection of data for typical model operating pressures.

PTFE

This normally comes in tape form and is wrapped around pipe threads before assembly. It can be purchased from any plumber's shop. Normally used for water, air, some gasses and low temperature / pressure steam.

Loctite hydraulic (there are several types within the range depending on its use)

This is a liquid type, jointing compound, which is applied to pipe threads before assembly. Normally used for water, oils, air and gasses.

Loctite instant gasket (there are several types within the range depending on its use)

This is a compound type, jointing compound, which is applied to joint faces before assembly. Normally used on face-to-face joints for water, oils, air and some gasses.

Rocol Foliac jointing compound

This is a paste type, jointing compound, which is applied to pipe threads or gaskets before assembly. It can be used for water, oil, air, some gasses and steam. A point to remember here is that this product tends to separate in the tin (oil from compound) and should be thoroughly stirred before use.

Femox Hawk white jointing compound

This is a paste type, jointing compound, which is applied to pipe threads or gaskets before assembly. Normally used for water, steam, air and some gasses. It complies with BS6956: part 5 1992 to 7 bar pressure and 200 deg. Celsius. It can be purchased from any plumber's shop. A point to remember here is that this product tends to separate in the tin (oil from compound) and should be thoroughly stirred before use.

Types of joint

The type of joint chosen for a given task will vary from model to model according to the design, however many of the fundamentals are common to all. The types detailed below are those most commonly used and is by no means exhaustive.

Flange joints

Flange joints should have a gasket jointing material between them and they rely on the tightness of the flange joint to make the seal. It is therefore important that the correct size and grade of bolt is used. They can be used with water, air, steam, gas, and oil.

Face-to-face joint

Steam temperatures at pressure			
Pressure lb/in ²	Pressure bar	Saturated steam temperature deg. C	Saturated steam temperature deg. F
50	3.40	281.0	138.3
60	4.08	292.7	144.8
70	4.76	302.9	150.5
80	5.44	312.0	155.6
90	6.12	320.3	160.2
100	6.80	327.8	164.3
110	7.49	334.8	168.2
120	7.17	341.3	171.8

This type of joint relies on the flatness of the flanges and the tightness of the bolts to make the seal. A jointing compound is usually applied to the faces before assembly.

Screwed joints

There are two types of screwed joint:

Parallel thread

These would not normally seal without a back nut tightened against a square face. It should have one of the jointing compounds listed above applied to the threads before assembly. They can be used on water, steam, gas, and oil.

Tapered thread

These joints normally have a parallel threaded hole with a taper threaded pipe or union screwed into it. They rely on the tight taper to make the joint. Conversely, one could use a parallel pipe thread with a tapered hole formed by the tap when the thread is cut in the hole. The pipe would be screwed up to the taper. A point to remember here is not to use a plug tap when tapping the hole, the second tap will do. These can be used on water, steam, gas, and oil.

Unions

These joints rely on the conical tapers of the union being tightened together by the nut to make the seal. They should be free from any dirt when assembled and will not normally require any jointing compounds. They can be used on water, steam, gas, and oil.

Compression joints

These joints rely on the conical tapers in the union nut and main body of the fitting being tightened together to compress an olive inserted over the pipe on assembly to make the seal. They should be free from any dirt when assembled and will not normally require any jointing compound. They can be used on water, steam, gas, and oil.

Soldered joints

These joints rely on the adhesion of the solder to hold the items together and make the seal. They can be used on water, gas, and oil.

O-ring joints

They can be either be a flange or union type joint containing an O-ring. These joints rely on the O-ring being compressed on assembly. They normally fit into a recess, which is designed to give the required compression when assembled.

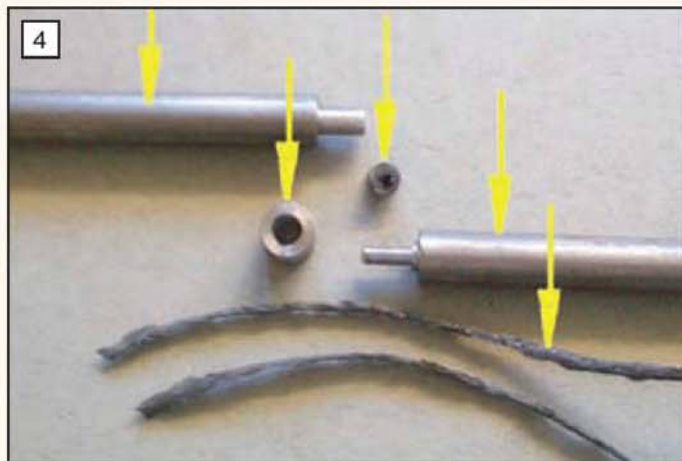
Gland packing

A couple of points here are:

1: Make sure that the gap between the valve spindle and body is not excessive since, when



The gland packing tool, the making and use of which is described in detail in the text.



The gland packing tool component parts. The bottom anvil needs to be long enough to be supported comfortably in the vice.

one tightens the gland nut, the packing will be forced into the valve body.

2: When fitting gland packing make sure that the joints in the packing are 180 degrees apart.

3: The gland box should be deep enough to take the minimum of two turns of packing.

Gland packing forming tool

With the very small valves in use on our models it becomes difficult to pack the glands. I have made a tool to enable me to make a preform in the gland-packing ring. It consists of four parts (see photos 3 and 4):

- 1: The bottom anvil
- 2: The dummy spindle
- 3: The stuffing box
- 4: The drift

The tool is used as follows. Place the bottom anvil in the vice with the bottom touching the base of the vice and about 1in. protruding above the jaws. Now slot the dummy spindle into the anvil and place the stuffing box over the spindle and locate on the spigot. Cut off a thin length of gland packing and wind around the dummy spindle to fill the stuffing box. Now place the drift over the spindle and tap the packing down with a hammer to compress it. Lift off the stuffing box and withdraw the dummy spindle. Using the drift, push out the preformed packing ring from the stuffing box. Now place over the valve spindle and push into position using the drift. Fit the gland nut and tighten.

Detailed below are the typical dimensions for a valve with a 1/4in. x 40tpi gland nut and a 1/8in. diameter spindle.

1: Bottom anvil 3/8in. diameter, its length should have the bottom touching the base of the vice and about 1in. protruding above the jaws. An 1/8in. dia. hole is drilled in the end, say 1/4in. deep to take the dummy spindle. A 1/32in. spigot is machined on the end to locate the stuffing box.

2: The dummy spindle is 1/8in. dia. with a length protruding about 1/8in. above the stuffing box when assembled.

3: The stuffing box is 3/8in. dia. with its length 5/16in. long. A No. 3 hole is drilled up the centre, this being slightly smaller than the 1/4in. x 40tpi tapping drill.

4: The drift is 3/8in. diameter with its length about 3in. long. One end is machined down to fit into the stuffing box for a length of 1/8in. longer than the stuffing box. An 1/8in. hole is drilled up the centre, say 1in. deep to take the dummy spindle.

Model operation

I have detailed below the methods that I use when operating my steam models, however these procedures will be different for each model and should be used as a guide only. It is very important that when operating live steam models that the operator is fully conversant with the model and knows what action to take for every emergency. If one is inexperienced and only operates the model infrequently then I suggest that you write out your own operating procedures so that they can be referred to.

The generating of live steam is a dangerous process if not carried out under controlled conditions. It can, at the very least, cause severe burns and, in the worst case, death. Do not underestimate the dangers and do not take chances.

Safety precautions

Remember the safety valve is the main protection device on the boiler. It must work reliably and efficiently to protect personnel and the boiler. I make sure that the following tests are carried out with every care. When firing the boiler for the first time I set the spring tension on the safety valve light such that the valve will lift well below its running pressure. I now fire the boiler until the valve lifts and note the lift and shut off pressures. A range of 10-15lb/in² between lift and re-seat at normal working pressure will be ideal (this could be different at the lower pressures).

If the lift range is too small then you will get repeat valve lifts and boiler pressure will not reduce to safe levels. In this case the valve spring will have to be changed. It is far better to have a wider range, as this will err on the safe side. You should also note that once the valve opens that there is no further rise in boiler pressure. If this is not the case then the valve inlet is too small. When the valve re-seats add tension to the spring as appropriate and raise pressure until the valve lifts and note the lift and shut off pressures again. Repeat until the set pressure is correct. Note: never set the valve to lift above the design operating pressure of the boiler.

Blowdown valve

From my experience of power station operation and maintenance it is essential to have some means by which water can be removed from the boiler. In the event of an overfilling of the boiler, the water level can be lowered under controlled conditions using this valve, however extreme caution must be taken to ensure that the water

level does not fall below the firebox crown (minimum working level) as this will lead to the boiler overheating. Ensure that when the valve is installed the access to the hand wheel is not restricted and that any pipe emitting water from the outlet is well clear of the hand wheel. Also ensure that when the valve is fitted that the pressure side of the valve is fed from under the seat. During the first couple of pressure raising tests check the operation of the valve to ensure that there are no blockages to the valve from within the boiler from stray silver solder or swarf, etc. Take care when using this valve, as the water emitted will instantly turn to steam.

External filling of the boiler

Caution, only carry out external filling of the boiler with distilled water when in the cold condition. This can be done through the boiler filling point using a funnel. At first, fill the boiler to the half working level point in the gauge glass. This is because as steam is generated the steam bubbles in the water will cause the water to rise to the top of the glass. As a safety precaution the height of the firebox crown should be clearly marked on the gauge glass (this being the level which the water must not fall below) together with the maximum working height. This should be, say, 1/4in. below the highest visible point in the glass (this being the level above which the water must not rise).

Filling

When filling the tender or other water storage device, take care not to allow any foreign matter to enter the tanks and only used distilled water.

Starting the fire

Caution, before lighting the fire confirm that the following conditions are met.

- 1: The boiler has the correct amount of water.
- 2: The engine is in neutral gear.
- 3: The cylinder steam cocks are open.
- 4: The crankshaft has been rotated a couple of times and all is free.
- 5: The blower valve is shut.
- 6: The injector steam feed is closed.
- 7: The regulator is closed.
- 8: The forward and reverse lever is in mid-gear.
- 9: The engine brake is on.

Method 1

Cut small pieces of softwood and soak them in paraffin, drain off the excess and place into the firebox. Open the ash pan damper and fight the

wood with a long taper and start the auxiliary chimney fan. Once the wood is alight add coal spreading evenly along the grate. Slowly build up the coal bed thickness. Never use this method on a hot boiler as the paraffin could form a gas cloud and, when ignited, can cause a flamethrower effect. Once rising pressure has reached about 15lb/in² then the auxiliary chimney fan can be turned off and removed.

Method 2

Cut small pieces of firelighter and place into the firebox and add wood. Open the ash pan damper and light the firelighters with a long taper and start the auxiliary chimney fan. Once the wood is alight, add coal spreading evenly along the grate and slowly build up the coal bed thickness.

Remember it will take a lot of heat to warm through the boiler and bring the water up to boiling point and then only a small amount to raise the boiler up to pressure. Do not get caught out by leaving the fire unattended.

Operating the boiler (traction engine models)

Once steam pressure has been raised to say 15lb/in² then crack open the blower valve to assist with the pressure raising whilst keeping an eye on the water level. Should the pressure start to decay then the valve must be shut until the pressure rises.

Once pressure rises to say 75lb/in² then the injector can be opened, if required, to top up the water level. Check that the engine is still in neutral gear and the brake is on. Move the forward and reverse lever to, say, forward position and crack open the regulator to allow steam to enter the cylinders (at this point the blower valve should be closed). This will cause water droplets to be emitted from the cylinder steam cocks and the flywheel to commence rotating. Once clear of water droplets the steam cocks can be closed and the engine allowed to continue to run to warm through.

The exhaust steam from the cylinders will cause air to be drawn through the fire grate thus increasing the boiler firing-rate. The ash pan damper can be adjusted to regulate this. In addition the pump will now be available to fill the boiler and the bypass valve will have to be adjusted to balance the water delivery to the boiler to maintain a level gauge glass. Should the boiler pressure start to rise towards maximum pressure then the firebox door can be opened and the ash pan damper closed and possible bypass valve adjusted to allow more water flow into the boiler. This should cause the pressure to fall.

A careful eye should be kept on the water level since we do not want the boiler to fill to capacity (maximum working level) and prime/ pressure lock the cylinder, which could cause extensive damage. At the end of the warming through period one should aim to have the water level at the ³/₄ gauge glass working level.

What to do if:

The safety valve lifts

This will be caused because the firing rate (coal burning) is making more steam than is being used. The things that can be done here depend upon the conditions at the time. The main thing here is to reduce the boiler firing rate or use

steam. Closing the ash pan damper and opening the firebox door and opening the steam valve to the blower can achieve these. This will cause cool air to be drawn through the boiler above the coal fire bed, which will reduce the pressure. Normally the safety valve, once lifted, will reseal once the pressure has returned to normal. The above measures will only be required if the pressure starts to rise immediately the safety valve has re-seated.

The high water level in the gauge glass is reached

This will be caused because water is entering the boiler faster than steam being drawn off. If the engine crankshaft is not in motion then we should close the steam feed to the injector. If the water level is not visible at the top of the glass then the blowdown valve can be cracked opened to reduce the level to normal. Take great care since the water being emitted here will turn to steam. If the engine crankshaft is in motion then we should open the pump bypass fully, which will stop the water feed into the boiler. The use of steam to rotate the crankshaft will also help to lower the water level, however before using this ensure that the boiler has not overfilled to the point where it has entered the cylinder. Keep a watchful eye on the water level and balance the bypass valve setting when the level has reached normal.

The low water level in the gauge glass is reached

This will be caused because steam is being drawn off faster than water is being fed into the boiler. If the engine crankshaft is not in motion then we should open up the steam feed to the injector. This will commence to feed water into the boiler. The use of steam for this purpose will cause the boiler pressure to fall, which will also be compounded by the fact that cool water is being fed in, which will further reduce the pressure. If the engine crankshaft is in motion then we should close the pump bypass valve. This will increase the water feed into the boiler, which will cause the boiler pressure to fall. At the same time we must reduce the boiler-firing rate until the water level has recovered. We can do this by closing the ash pan damper and opening the firebox door. Keep a watchful eye on the water level and balance the bypass valve setting when the level has reached normal.

Operating the engine

Once the boiler and cylinders have warmed through the engine will be ready to run. Close the regulator and allow the crankshaft to come to a halt and select the gear required. Check boiler water level and release the engine brake. Set the forward and reverse lever to the forward position and crack open the regulator, the engine should now commence to move.

Shutting down the boiler

Close the ash pan damper, steam feed to the injector; the pump bypass valve and steam to the blower valve. Allow the boiler pressure to fall and the fire to die down. Place a suitable steel ash pan under the engine and lower the ash pan and then the grate and rake out the embers. When the firebox is empty open the blower valve to reduce

boiler pressure to about 5lb/in² and then shut off. Ensure that the ash pan containing the embers has been removed from under the boiler.

Open the blowdown valve to release the last of the boiler pressure. This will also help to blow out any build up of solids in the water and drain down the boiler. Allow the boiler to cool down and close all valves. This method should be used if the boiler is only fired infrequently.

If it is planned to fire the boiler again in the short term then the following method should be used. Close the ash pan damper. Close the pump bypass valve and top up the boiler to the ³/₄ gauge glass working level using either the pump or injector. Allow boiler pressure to fall and the fire to die down. Place a suitable steel ash pan under the engine and lower the ash pan and the grate and rake out the embers. When the firebox is empty open the blower valve to reduce the boiler pressure to zero and leave open. When the boiler is cold close the valve. The boiler is now topped up ready for re-firing.

Lubricating the model

The following points are some of those requiring lubricating with good quality machine oil. I suggest that you make up your own list for your specific model:

- Main bearing oil reservoirs.
- Connecting rod oilers.
- Slide bar oilers.
- Motion links.
- Pump and eccentric cam oilers.
- Pump connecting rod.
- 3 and 4 shaft oilers.
- Front and rear wheel oilers.
- Axle boxes.
- Fill main cylinder lubricator with steam oil.

Gear changing (traction engine)

Never attempt to change gear with the engine in motion. Ensure that the crankshaft has stopped, then unlock the fork heads, select the gear required and re-tighten the fork heads.

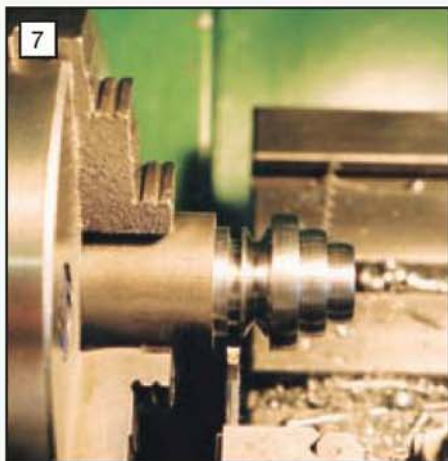
Closing statement

May I take this opportunity to thank you for putting your trust in me by reading this series. It has taken about a year to write which I have found most enjoyable. However, like most hobbies, it started off as a set of notes and expanded into its present form. Remember model making is a personal thing and its main purpose is to give you pleasure. The methods and views given in this book are my way of doing things and are by no means the only way. Work in the way that you feel comfortable with and that gives you the most pleasure.

I trust that you have found the material of use and hope that it will help you to build your model without some of the frustrations that could arise. I have tried to give you an insight into some of the methods and techniques that I use, however I do stress that all of the above information is applicable to my way of working. It will be the responsibility of the builder to assess if he/ she wishes to use them when building their model.

I would appreciate feedback on your views of the series together with any suggestions as to where it could be improved or additional information added.





Turning the main drive pulley from continuously cast iron bar.



The second operation on the pulley involves the use of an expanding arbor.



The finished pulley. Note the crowned peripheries of the pulley steps.

BUILDING A STUART MODELS PILLAR DRILL

Anthony Mount

continues the construction of this model machine tool starting with part 5, the drive pulley.

●Part II continued from page 25
(M.E. 4277, 7 July 2006)

Though not a casting as such the drive pulley is supplied as a piece of continuous cast iron. This is quite a nice material to machine but still a dirty one. As supplied it is $1\frac{3}{16}$ in. long, which is a problem in that it is not long enough to hold in the chuck for machining.

Continuous cast iron is supplied over size as it has a rough skin on the outside, so it needs to be held in the 4-jaw independent chuck, set it to run true and face off the end, centre and drill through and ream $\frac{5}{16}$ inch. Change to a self-centring chuck and mount the embryo pulley on a $\frac{5}{16}$ in. arbor. Use a solid arbor and turn it down so that the pulley is a tight fit on the arbor with about 1 in. passing right through the pulley. Centre the end of the arbor and give tailstock support.

The stepped flanges can be turned down, square at first and then lightly rounded. They are rounded so that the flat belt takes up the shape

and does not come off when running. A little freehand turning can form the rounding and the surface formed into a smooth curve with the use of a fine file.

I suppose I should mention that the file must be fitted with a good handle so that there is no danger of you jabbing the tang of the file into your hand, which would be painful to say the least. Turn down the rebate behind the steps with a short parting type tool and the V-groove can be put in with a screw-cutting tool. Reverse the pulley on the arbor and face off to length.

There is a shallow groove in the face of the pulley but this is decorative only, and will require a cranked tool with the pulley on an arbor.

You will see from the next photo (photo 7) that I did not use the material supplied but used a longer piece I had in stock that allowed the work to be done without the use of an arbor; apart that is for an expanding arbor (photo 7a) to face off the parted off end. A completed pulley can be seen in photograph 7b.

Table bracket (part 11)

The second iron casting to be tackled is the table bracket. Clean up as for the base and mount in the 4-jaw independent chuck with the top face outwards. Set the larger diameter end to run true. Again this may take a little time as, once again, only three sides are available for checking. Also check that the front face is square, checking against the front face of the tailstock chuck can achieve this.

Take a shallow cut across the face, as the cut is intermittent, continue in shallow steps until the start of the edge of the bead is reached. Centre deeply and drill right through. Open out to $\frac{1}{2}$ in. diameter by drilling and finish by boring to $\frac{9}{16}$ in. diameter. Again a reamer can be used to size the hole should one be available.

Reverse the bracket by

mounting it on the expanding arbor and clean up the base of the bracket, this operation is shown in photograph 8.

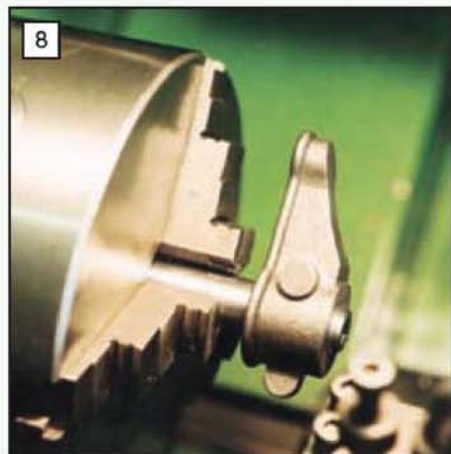
When the head is completed both head and bracket can be mounted on the column and the head used as a drill guide to spot the hole in the bracket for the table spigot. Remove the bracket from the column, place under the drilling machine, firmly clamp the bracket down and open out the hole to $\frac{1}{4}$ in. diameter.

There are two bosses at the sides just forward of the column hole, these are for the spindle that carries the pinion gear for the rise and fall of the bracket via the rack, before drilling the spindle hole, mill off the tops of both bosses to give a finished dimension overall of the bosses of 1 inch.

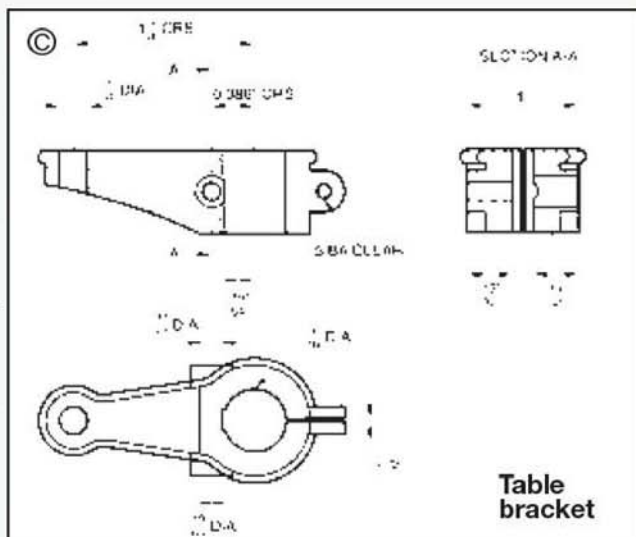
Photograph 9 shows the bracket set up for milling the boss, notice the drills in the bores for bringing the bracket level. That in the small hole is of course $\frac{1}{4}$ in. that in the column hole is $\frac{13}{32}$ inch.

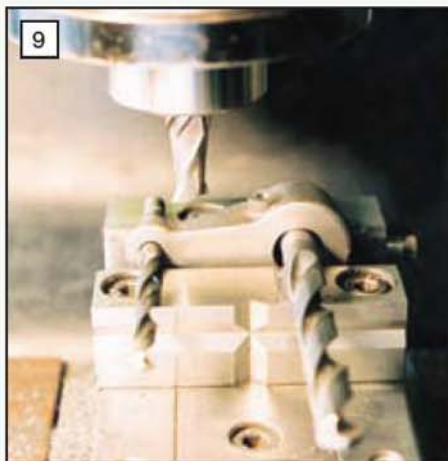
Photograph 10 shows the bracket gripped in the machine vice on the vertical milling machine, ready for drilling the spindle hole. As can be seen it overhangs the side of the vice and there is packing under one end to resist the downward pressure of the drill.

The hole for the spindle needs careful location

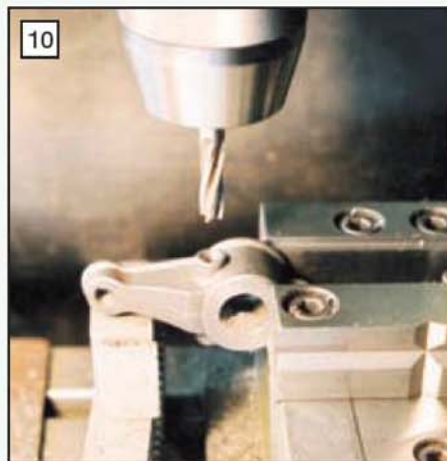


Using an expanding mandrel to perform the second turning operation on the table bracket.





9
Milling the table bracket bosses. Note the drills used to support the part.



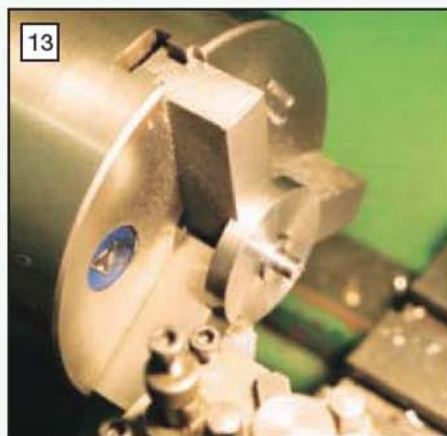
10
Drilling the table bracket spindle hole with the part supported using the vice and packing.



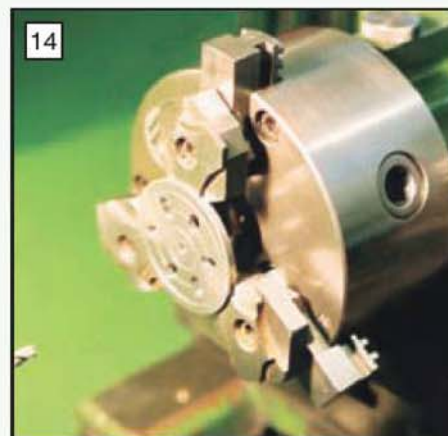
11
Slitting the table bracket main column hole using a slitting saw.



12
The finish painted table bracket ready to take its place on the machine.



13
Turning the underside of the drill table. note the spigot to fit the table bracket.



14
The set up used to machine the radial slots. The cutter was driven by the lathe mandrel.

as the gear centres need to be close to that given for the gear to engage properly with the rack. Place the column in its hole in the bracket and with an edge finder locate the side of the column. Zero the dial and use co-ordinates to position the chuck on the centre line of the column, re-zero the dial and remove the column. Now you can turn the dial through 0.386in. and, hopefully, it will be over the centre of the boss. Drill through $\frac{1}{8}$ in. and counter bore for the gear spindle. The size given on the drawing for the counter bore is $\frac{19}{64}$ inch.

I have a drill this size but the bottom of the hole should ideally be flat bottomed. You have a choice of options, you can regrind the drill to give a flat-bottomed hole, or make up a D-bit of this size.



15
The finished drill table. No painting of this item is required.

While the bracket is set up like this you can also drill the 3.3mm dia. hole for the clamp screw at the back through the lug. Reposition the bracket in the vice so that the rear of the bracket now over sails the side of the machine vice. Change to a $\frac{1}{32}$ in. slitting saw and cut a slot through to the bore of the column. Run the saw at a slow speed and it will cut through the cast iron like a knife through butter, this detail can be seen in photograph 11. The completed bracket painted ready for assembly is shown in photograph 12.

Drill table (part 15)

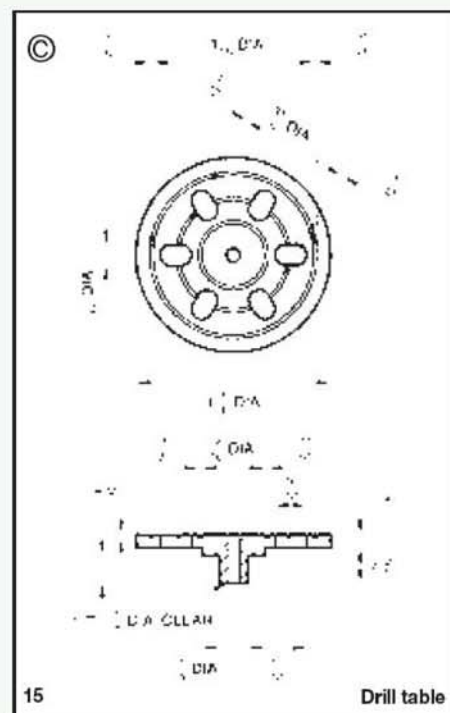
The drill table is another piece of cast iron to work on; it is supplied as a slice off a bar. For holding shallow discs like this I usually use soft jaws in the chuck. As the name denotes these jaws are left unhardened and can be machined with internal rebates to grip around the work and to support the back of the job, as can be seen in photograph 13.

Face off, and turn down the spigot to $\frac{1}{4}$ in. diameter to fit in the bracket hole. Centre and drill through $\frac{1}{8}$ inch. Reverse in the chuck and face off the other side and put in the shallow V-grooves.

Set up the table in a chuck on the dividing head and mount the dividing head on the lathe cross-slide, presuming your dividing head comes on the centre line of the lathe. You can now index around to drill holes at the end of the slots and then change to a slot drill to extend the holes into a slot, see photograph 14. The drawing calls for a $\frac{3}{16}$ in. wide slots but I made mine $\frac{5}{32}$ inch. My first intention was to hedge my bets and to try the

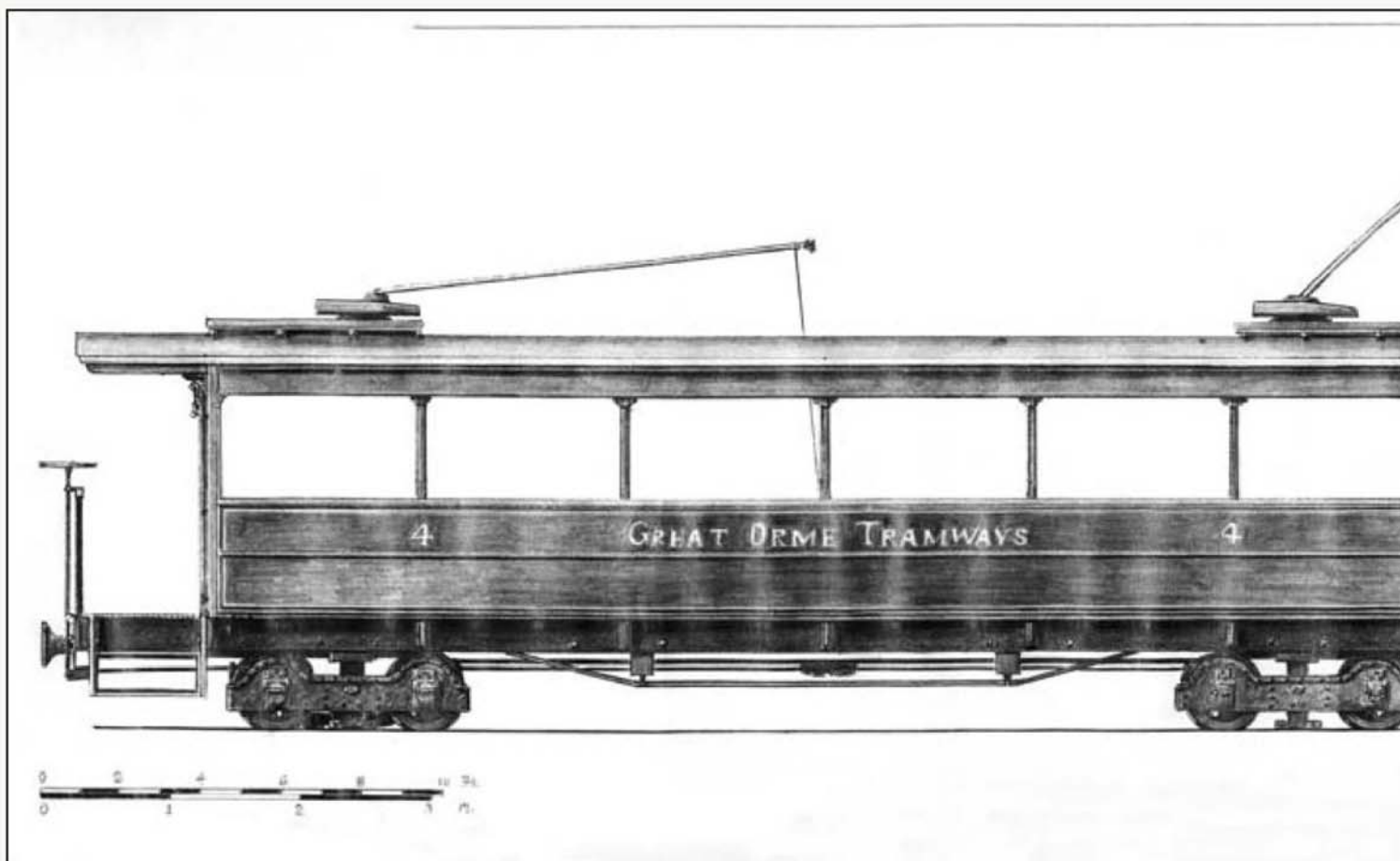
$\frac{5}{32}$ in. size and if the cut turned out ragged I would be able to open it out to $\frac{3}{16}$ in., however the slots turned out alright so I left well alone at $\frac{5}{32}$ inch. The completed drill table is seen in photograph 15.

●To be continued.



15

Drill table



EDWARDIAN ELEGANCE: THE GREAT ORME TRAMWAY

Ron Isted
describes a little-known national
treasure, built over one hundred
years ago but still operating today.
●Part I

The British are in many ways an odd race. I sometimes get the feeling that we consider it slightly vulgar, or at least not quite the done thing, to publicise our historical assets, especially those associated with engineering or what our Victorian forebears rather snootily referred to as 'trade'. The cable cars of San Francisco have made guest appearances in major Hollywood films and even received honourable mention in the world of popular music: the Tony Bennett hit song *I Left My Heart in San Francisco*, for example, contains the fanciful but poetic lines "Where the cable cars, Climb halfway to the stars." The Americans rightly consider these colourful vehicles just as much part of their heritage as the Statue of Liberty or the Grand Canyon. In contrast, the other surviving cable operated street tramways have received so little publicity that one web site (American, of course!) claims the 'Frisco cars to be the only ones in the world still operational.

To put the record straight, two other systems are still very much alive: the *Elevador da Bica*, is situated in the Portuguese capital, Lisbon, while the other is the subject of this article, the Great Orme Tramway in Llandudno, North Wales. All three surviving systems are powered by a moving cable laid in conduit between the running rails, but while both European lines stop the cable itself to bring the cars to a halt, the American network keeps the cable permanently in motion, a gripper on each car being released or engaged to stop or start the vehicle. Incidentally, Lisbon also possesses two examples of a third species of street tramway incorporating a cable, but in both cases unpowered and merely linking together a pair of electrically driven vehicles. For the record, they are the *Elevador da Gloria* and the *Elevador da Lavra*, but they are not true cable tramways because the cable does not provide the motive power.

About a mile in length, the Welsh Great Orme line is a funicular system divided into two separate sections, of which only the lower is strictly speaking a tramway, since it runs along the public highway. The upper section is legally a tramroad, running on its own reservation, unpaved apart from a level crossing. Please note, I have quoted the overall distance as about a mile, because over the last century, both Great Orme lines have exhibited a disconcerting habit of

varying their length, which, had it been publicised American style, might very easily have alarmed prospective passengers of a nervous disposition. At this point, I would suggest that you metric types, nervous or otherwise, skip the next paragraph unless you are also connoisseurs of Ascot or Aintree - as it includes such peculiar terms as furlongs.

On 23 May 1898, "An Act for incorporating the Great Orme Tramways Company and for authorising the Company to make and maintain a Tramway and Tramroad from Llandudno to or near the summit of the Great Ormeshead in the county of Carnarvon" received the Royal Assent and quoted the projected lengths as three furlongs, six chains (720 yards) for the lower section tramway, and four furlongs, 0.8 chains (888 yards) for the upper section tramroad, total length 1,608 yards. By the time the first section opened four years later, the magazine *The Tramway and Railway World* already reported a growth of 98 yards in overall length to a total of 1,706 yards, but failed to quote figures for individual sections. The first half of the twentieth century must have been particularly propitious for the cultivation of the plant *Tramwaya Greatormiensis*, because a 1960s book (see references), informs us that the combined total was now as much as 1.11 miles, the lower



tramway having sprouted to 872 yards, though on the other hand, the upper tramroad had wilted slightly to 827 yards. Now if these two figures are correct, they add up to a mere 1,699 yards, and in my day, there were 1,760 yards in a mile, but maybe Welsh miles are like the tramway itself, elastic. By the time the line's very attractive 90th birthday booklet was published in 1992, the combined lengths had been pruned back to "a little under a mile". I can only imagine that either the vagaries of the North Wales climate had something to do with these variations, or that the proprietors employed rubber rails, with a view to massaging the passengers per mile statistics in their annual returns to the Board of Trade. Whatever the reason, such tinkering with basic dimensions seems rather reprehensible and brings to mind the standard wording in the small print of today's financial investment documents: *"these figures may go down as well as up.....and you may not get back what you put in"*. A more physical form of tinkering involving technical equipment, and definitely *not* notified to the Board of Trade, was to lead to far more serious consequences - not just to the only fatal accident in the line's entire history that would close it down for 1³/₄ years, but to an amazing drama culminating in a Sheriff's Officer taking possession of the line and the liquidation of the original company.

This crisis, however, was still 30 years in the future when the lower section of the line finally opened on 31 July 1902, just over four years after the passing of the Act of Parliament. Well over half of that rather abnormal length of time had been spent trying to raise the £20,000 required to cover parliamentary expenses and constructional costs. At one stage, the company had hoped that HRH The Prince of Wales would open the line, but so urgent was the need to start earning money

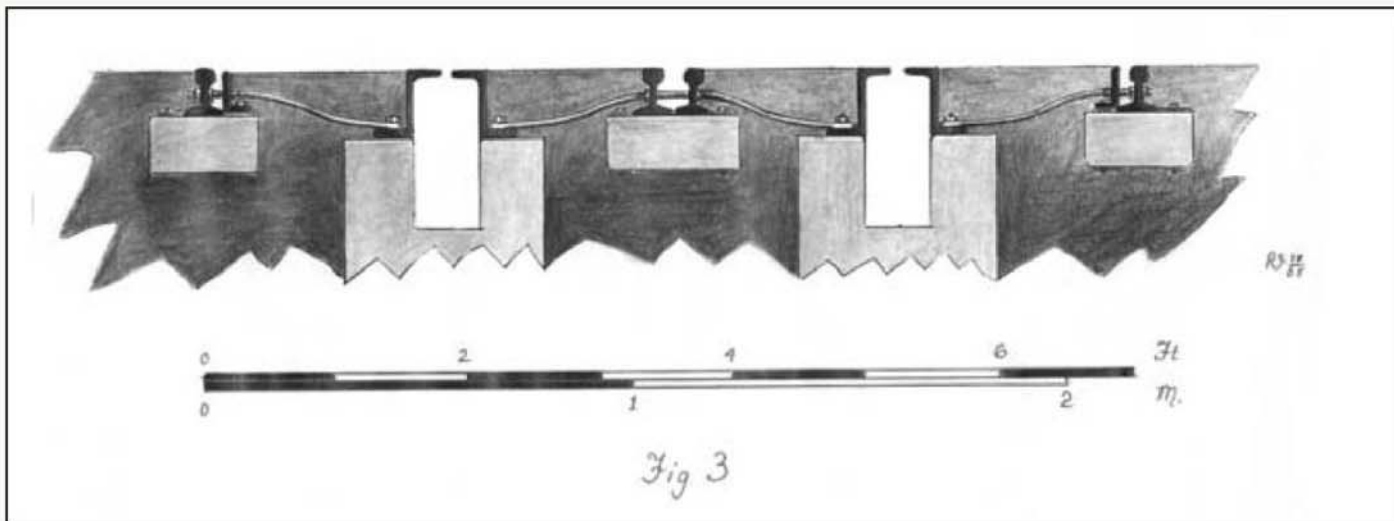
and pay off some of the outstanding bills, that the first tramload of fare-paying passengers set off the very next day after the statutory Board of Trade inspection. They departed to the strains of the National Anthem performed by Llandudno Town Band, a hurriedly organised (and probably cheaper) substitute for the physical presence of HRH. The cash flow problem had already seriously delayed construction of the upper section, but the directors still had hopes of opening it in time for the beginning of the following season. They therefore invited their friendly BoT Inspector, Colonel von Donop to revisit the line in May 1903, with a view to starting public services over both sections at Whitsun. This time, he was not so impressed and insisted on several modifications before the upper section finally opened on 8 July, again without any formal ceremony.

Gradient 1:8

The gauge of both sections is 3ft. 6in. and the lower, the true cable tramway, runs along a steep and very twisty public street, with an average gradient of 1 in 6, but as fierce as 1 in 3.8 for a brief stretch. The minimum radius curve is just 75ft. - equivalent to 6ft. 3in. on a 3¹/₂in. gauge version, a more practical figure from a model engineer's point of view than the gentle curves of most main line railways. From the lower terminus, Victoria, not opened on its final site until 1904 (which may account for some, but not all, of the discrepancies in distance), the track is single as far as the passing loop, but from there to the winding house, about 400ft above the lower terminus, it is interlaced as shown in fig. 3, the right hand running rail of the ascending track acting as a check rail for the descending track and vice versa. The 30ft. long running rails were of the Vignoles type, 4in. high, with a 2in. wide

head and 3¹/₂in. base, officially weighing 50lb to the yard, - though I presume the precise figure varied, depending on the current length of the line! The cable conduit, laid midway between them, was 14in. deep by 6in. wide, the bottom half consisting of a concrete trough, while the upper half comprised two opposed 1¹/₂in. thick Z-shaped girders weighing 60lb to the yard, with a 1¹/₄in. wide slot between them at road surface level, according to a contemporary account. However, I was suspicious of the latter figure since, if correct, it would be difficult to insert or withdraw the haulage cable. In fact, Neil Jones, the Great Orme Tramway Operations Officer, has confirmed that the width of the slot these days is between 35 and 40mm, (approximately 1³/₈ to 1⁹/₁₆ inch). The top arm of each 'Z' was 3in. wide and the bottom arm 3¹/₂in., the 6in. high vertical section of the 'Z' intended to act as a bearing surface for the emergency brake described below. The cable for the lower section was 1¹/₄in. diameter, later increased to 1⁵/₁₆in., (hence my distrust of the official figure of 1¹/₄in. quoted for the slot width), with a breaking strain of 60 tons, and supported in the conduit on 12in. diameter grooved steel sheaves, while vertically mounted steel pulleys at 6ft. intervals guided it round the many sharp curves. Obviously, lubrication of the moving parts was, and is, of crucial importance and each pulley was provided with its own inspection cover. In the days of oil lubrication, this had to be carried out every day, no small task when you think how many pulleys there are in each section. With the use of grease and modern materials including nylon bushes, the interval is now as much as three months, although regular inspections are still made on a daily basis.

The upper section rises a further 160ft., on its own right of way, with a maximum gradient of 1 in 10.3 according to early documentation and 1 in 8 according to the tramway's 90th birthday booklet - obviously the Welsh are also partial to rubber hills. The running rails were identical to those on the lower section, but laid on ordinary wooden cross-sleepers, railway style, and there is no central conduit, the 7/8in. cable, breaking strain 40 tons, running above ground on 12in. grooved sheaves, and guided by vertical pulleys nicknamed 'top-hats' from their appearance. Unlike the lower section cars, the cable drawbars are offset from the centre line of the vehicle, to avoid the ascending and descending cables fouling each other. Because the winding house is below the upper section, a third unpowered cable connects cars Nos. 6 and 7, via a free running pulley at the highest point of the line, to enable the car descending to the Halfway Station to haul the ascending vehicle up to Summit Station. This is situated approximately 650ft. above sea level, about 30ft. below the actual summit of the Great Orme and I can personally vouch for the magnificent views from here, including Snowdonia of course, but also stretching as far as the Isle of Man, the peaks of the Lake District and even the Irish Wicklow Hills. It is even beautiful when it pours with rain as only Wales knows how, or in a Welsh mist when you can scarcely see anything in front of your nose, as was the case on my most recent visit in September 2005 (photo 1).



Environmental sensitivity

The 1898 Act of Parliament, possibly in an early gesture of environmental sensitivity, but more likely I fear as a result of pressure from local influential big-wigs, prohibited the building of any furnace, chimney or similar edifice within the residential area of the genteel town of Llandudno, at the lower end of the line, so the winding house had to be sited at the top of the lower section, 489ft. above sea level and 400ft. higher than the lower terminus. Originally known as 'First Station', it was re-named 'Halfway Station' soon after the opening of the upper section. While the requirements of the Act enabled the powerhouse, together with the associated haulage equipment for both sections, to be concentrated in a single location, it presented the company with major problems in transporting fuel, not to mention the half-mile long replacement haulage cables, each of which weighed about three tons. Before the advent of reliable motorised transport, the services of a dozen horses were required to lug these bulky items up the steep and winding road to the powerhouse. The boilers themselves, however, were hauled up by a traction engine, which on the steepest sections, advanced a short distance, then locked and chocked the wheels in order to winch the wagon carrying the boiler up the hill towards the engine. This slow and laborious method was probably used with other heavy equipment, including the winding drums.

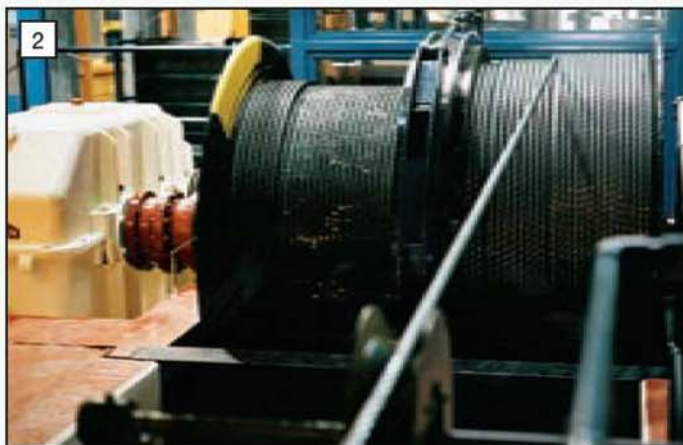
These were 5ft. 4in. diameter, and the 6ft. wide winding length on each was divided into two sections, one cable being over-wound and the



No. 6 St. Seiriol approaches the passing loop on the upper section 15 Sept. 2005 (photo: Ron Isted).

other under-wound, (photo 2), so that the cars were "equipoised", to quote the October 1902 issue of *The Tramway & Railway World* - in other words, the weight of the descending vehicle assisted the ascent of its twin. Power was initially provided by a pair of colliery-type two cylinder

simple horizontal steam engines built by C. & A. Musker of Liverpool, the one for the steeper lower section rated at 80hp with cylinders 12in. diameter by 14in. stroke, while the upper section machine was 60hp, with 8in. by 12in cylinders. Both engines were geared down 4 to 1 to drive the winding drums and both were originally non-condensing, but I have been unable to discover whether condensers were added later. The original engines and locomotive type boiler, built by Roby of Lincoln, proved inadequate for their daily duties and their shortcomings were not exactly helped by the company's insistence on buying the cheapest fuel available. Shortly before the first world war, therefore, a 120hp engine, built in Chester by the Sandicroft Foundry, was installed to work the lower section, and the 80hp Musker transferred its efforts to the less arduous duties of the upper section. The smaller Musker engine was disposed of. In the 1920s, another Roby boiler was acquired secondhand and gave good service for over a quarter of a century, until a combination of the ravages of *anno domini* and annual inspections reduced its safe working pressure to the point where it too was barely able to cope with demands. In addition, it munched its way through about 250 tons of coke each season, the cost of which escalated alarmingly after World War II to around £7 per ton. As a result, the steam plant ceased operation at the end of the 1957 season and the following Easter, a shiny new pair of electric motors from English Electric hummed into action. Nearly 50 years later, they are still performing their allotted tasks, (photo 3). They are 415V, 3-phase 50-cycle A.C. slip



The winding drums for the upper section photographed on 15 Sept. 2005 (photo: Ron Isted).



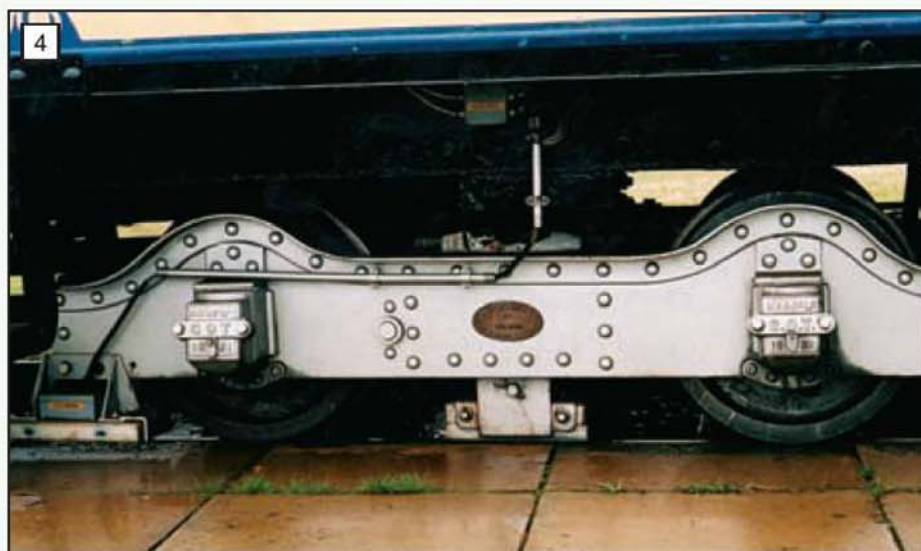
Electric motor for the lower section (English Electric 1957-58) on 15 Sept. 2005 (photo: Ron Isted).

ring induction machines, the one for the lower section rated at 125hp, that for the upper at 75hp. They run at about 730rpm and are geared down to the winding drum speeds of 25rpm for the lower section (around 5mph) and 35rpm for the upper (about 7mph).

Line for all seasons?

When the line first opened, the company stated its intention of providing a year round facility for both passengers and goods, but apart from the first season, when the passenger cars on the lower section ran until 3 January 1903, the line has never run a winter service. Nothing is known about any regular goods service, if there ever was one, although apparently the promoters initially had hopes of 'mineral traffic' from the possible re-opening of the ancient Bronze Age copper mines situated not far from Halfway Station. To cater for this flight of optimistic fancy, three four-wheeled vehicles were built by Hurst Nelson of Motherwell and delivered in May 1902. Numbered 1 to 3, they had an overall length of 16ft. 7in., and incorporated a central enclosed area, which implies they may have been intended to double as passenger cars when traffic was light. They also probably carried coke to the boiler house and sundry supplies to the partially completed hotel at the summit, while their double side-opening doors enabled them to carry out (or should I say undertake?) a rather more gruesome task, namely the transportation of the remains of the departed from the town up to St. Tudno's cemetery, for which service the company charged 2/6 (12½p). This compared to 6d (2½p) for a living passenger and it is greatly to its credit that in spite of such a substantial financial inducement, enshrined - if you'll excuse the expression - in its original Act of Parliament, the company resisted the temptation to earn a quick buck by killing off its clientele. The fate of the 'jockey cars' as they were known, is not recorded, but the goods traffic failed to materialise and all three disappeared some time between the two world wars.

The only legacy from the above rather shadowy vehicles is the centre coupler, together with the safety chains still carried by three of the four passenger cars, and the numbering from 4 to 7. These too were built by the Motherwell firm of Hurst Nelson in 1902, although the second pair, intended for the upper section, were not delivered until the following year. All four were delivered by rail, which conjures up interesting visions of possible out-of-gauge loads on the Caley and the North Western, but no-one seems to have made any photographic record of their journey south from the Land of Haggis to the Land of Leeks. How they made the short journey from Llandudno railway station to the tramway is also a matter for speculation. Perhaps the twelve faithful horses, having recovered from their efforts with the cable, set to again to drag the 6½ ton trains up the half mile or so to the lower section terminus, or more probably the traction engine mentioned above may have been called upon. The four vehicles were originally identical, apart from the braking and drawbar arrangements, and were designed by one H. Enfield Taylor, M.I.C.E., of Chester, the company's engineer. This gentleman departed



Bogie of No. 6 St. Serial at the Halfway Station 15 Sept. 2005. Note that one axle is dated 1901 and the other 1932 (photo: Ron Isted).

somewhat abruptly following the referral to an 'impartial umpire' of various arguments with the contractors about the quality of the constructional work on the line's infrastructure. That Mr. Taylor may have had a point is shown by the fact that parts of the track did in fact have to be re-laid at an early stage, while his vehicles are still happily fulfilling their daily duties over a century later.

Before describing the four passenger vehicles, I would like to record my gratitude to Glyn Wilton and John Shawcross of the National Tramway Museum at Crich, Derbyshire, for their help in ensuring that figs. 1 and 2 are a great deal more accurate than they might otherwise have been. John has taken several measurements off the vehicles themselves, some of which are at variance with details published over the last century. These include such basic dimensions as the bogie wheelbase, which has surely not changed - or perhaps the Welsh climate has induced some shrinkage? Hurst Nelson went out of business around 1960, and their works drawings appear not to have survived, although, unlike the Tramway Museum, the Museum and Heritage section of the Motherwell Library did not deign even to acknowledge my letter of enquiry despite the enclosure of an SAE. My drawings are intended to show car No. 4 in its original condition, though in the royal blue colour scheme that succeeded the short-lived original yellow. Most of the drawing has been scaled off various early photographs, but I have had to refer to some of my own shots taken in 1955 for certain details, so I just hope I have not accidentally included later modifications.

Attractive finish

Considering the vehicles are over a hundred years old, they have been subject to surprisingly few alterations and I must say I find the current colour scheme the most attractive in their long history. They measure 38ft. 10in. over the now redundant couplers, with a maximum width over footsteps of 7ft. 9in., while the actual body is 37ft. by 7ft. 6 inches. The 3ft. 6in. gauge Hurst Nelson bogies (photo 4) are equipped with 1ft. 9in. diameter single flange wheels, 3¾in. wide, on 3¾in. diameter axles, with a 3ft. 9in. wheelbase, set at 23ft. 4in. centres. I repeat, where dimensions differ from those previously

published please note these figures have been taken directly off the vehicles themselves. Lateral movement of the bogie is controlled by means of horizontal springs housed in the bolster. Incidentally, it was only when I looked at my recent photograph of the bogie on car No. 6, that I realised that one axlebox carries the date 1901, while its otherwise identical partner is branded 1932, which doesn't say much for my powers of observation on the day! My only excuse is that when I took the shot, good Welsh rain was falling in abundance, and I had no desire to get wetter than necessary. The internal measurements of the main saloon are 30ft. long by 7ft. wide by 6ft. 6in. from floor to roof, with five pairs of fixed, transverse, wooden-slatted seats placed back to back, each seating two passengers, plus a single two-seater at each end, either side of the central gangway. This gives a total of 48 seats and until relatively recently, up to 12 additional people were also allowed to stand along the gangway. As the said gangway measures just 1ft. 8in. wide, it is evident that these vehicles date from an era before our current national problems with obesity.

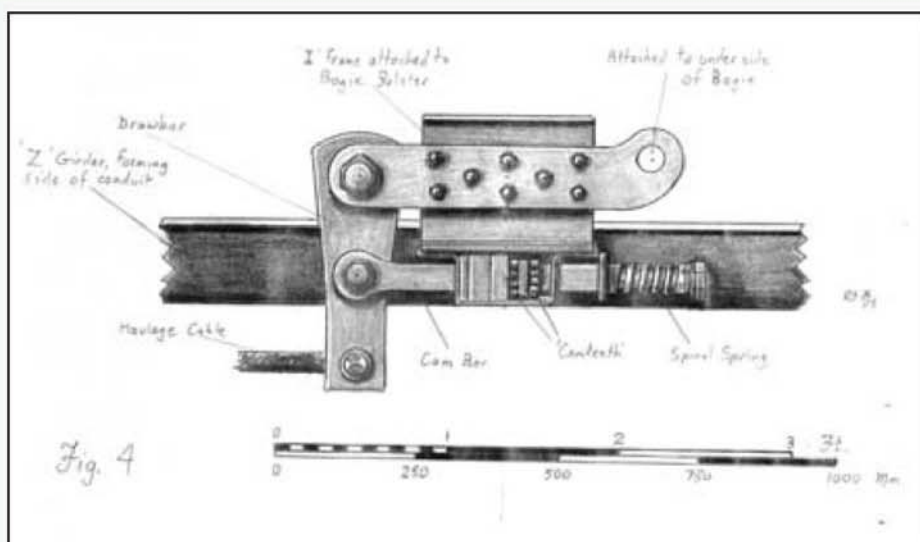
Although the six 'windows' on each side have always been unglazed, those on Nos. 4 and 5 (the lower section cars) were at some time in the early days fitted with 'sun and rain-proof curtains', to quote a contemporary publication, but they appear to have been removed within a couple of years. There is, however, conflicting visual evidence about these curtains; two of the earliest photographs, one of No. 5 on pre-opening trials and the other of No. 4 on the first day of public service, 31st July 1902, show both vehicles devoid of them, but a couple of picture post-cards published the following year show them with curtains. One thing that is certain is that their career was extremely short. In any case, it would surely have been more logical to install them on Nos. 6 and 7, the cars employed on the exposed upper section. I have very vivid memories of the first time I visited the line some 50 years ago and travelled through a typically Welsh combination of mist and driving drizzle, when some protection from the elements would have been very welcome! It is only fair to state that my second trip was made two days later under a cloudless blue sky, and was quite breathtaking.

Another puzzling variation in the photograph of No. 4 on opening day in 1902 is the single, centrally mounted trolley pole, similar to that

used on the jockey cars already described, instead of the normal two shown in my drawing and in every other illustration I have ever seen, including the earlier pre-opening trial picture of No. 5. The single pole had been replaced on No. 4 by the standard front and rear mounted pair by May 1903 at the latest, although I believe the jockey cars retained the single trolley throughout their existence. The rear trolley pole was always the one in contact with the overhead wire, the front one originally being swung round 180deg. by hand and held clear of the overhead by means of a rope wound round a cleat fitted to the side of the vehicle just below the central window pillar. In later years, a simple fixed hook at each end of the roof avoided the need for this rather cumbersome time and space consuming procedure. Until the late 1940s, the passing loop on the upper section was equipped with only a single overhead wire, which demanded some manual dexterity by the second man on the descending car, as he had to lower the trolley arm and swing it outwards while passing the ascending vehicle, and then re-wire it as his car negotiated the reverse curve out of the passing loop.

Modus operandi

Now those trolley poles must have deceived a good many people over the years into thinking they were current collectors, supplying electric power from the overhead wire to drive the vehicle, as with a conventional electric train. In fact, they are, or more accurately were, part of a communications system between the driver and the staff in the winding house, employing a simple hand-generated telephone and bell mounted on the driving platform at each end of the car, described in a 1902 publication as a 'Hunningscont transmitter and receiver'. Has anybody any further information? The *modus operandi* belonged to a more leisurely age and will no doubt seem unbelievably long-winded to the present generation accustomed to instant global communication via the internet. The first operation was for the driver of the car at the lower terminus to hand-crank his phone in order to contact his colleague on the car up at Halfway Station and ask him if he was ready to proceed. If so, the lower driver then gave two rings in the winding house, by means of the bell push mounted in the roof of his cab, at which signal the engineer in charge at the winding house set the cables in motion and off went the two trains. The bell codes in use on the lower section were as follows: two short rings meant no passengers for the request stops, one long followed by one short meant that the car needed to stop at Black Gate, the first request stop, while one short and one long required a stop at the second request, Tyn-y-Coed Road. I am *not* offering prizes for guessing the meaning of two long rings. To stop the cars in an emergency, the driver of either car pressed the bell once, but otherwise the driver of the ascending car gave all the signals required, and neither driver on the lower section normally used his hand brakes, relying entirely on the winding house operation. The system on the upper section was similar, except that there were no request stops, while the drivers did operate the car hand brake simply in order to keep the surface mounted



cable taut enough to avoid any possibility of it dropping beneath the 'top-hat' pulleys.

It is obvious that the above system was, to put it kindly, basic, and while more than adequate in the less frenetic era of horse-drawn transport, in later years it was fighting a losing battle with both ageing equipment and, on the lower section, with the ever-increasing levels of late 20th century road traffic. In 1990, as part of an ambitious investment programme, a local Llandudno firm, 'Airlink', installed an ingenious dual-use radio system, adding both a further safety check to the actual operation of the line and at the same time vastly improving the speech communication. All four trains were equipped at each end with a foot pedal, linked by radio signal to the braking system in the winding house. Depression of the pedal on both trains in the section was necessary before the cable could be set in motion, while if either driver took his foot off the pedal during the journey, a warning bell rang in the winding house and both vehicles were immediately brought to a halt. The principle is similar to that of the 'dead man's handle' used on multiple unit electric trains. The speech contact was now two-way between all four cars and the winding house, and each driver was required to make regular calls at specific points en route. Ten years later, an even more sophisticated control system of Swiss design was installed, incorporating a track side inductive loop cable, which gives a continuous indication to the winding engineer of the exact location of each vehicle.

Apart from the obvious improvements in safety checks and communication, the 1990 system facilitated the introduction of single man working, as the second man was no longer required to make sure the trolley pole did not suddenly take it into its head to part company with the overhead when traversing the more violent curves. Passengers have never been officially allowed to travel on the end platforms, but with the introduction of one-man crews, the Railway Inspectorate required side doors to be fitted as an extra safety measure. In my opinion, these modern additions, which have been very sympathetically designed and fitted, have actually improved the appearance of the cars, and combined with the modern colour scheme, have given them an elegance they did not possess a century ago.

All four vehicles as built were equipped with mechanical wheel and 'slipper' track brakes, while Nos. 4 and 5 on the steeper lower section were in addition provided with an extremely

powerful emergency brake. The wheel brakes consisted of cast iron blocks mounted each side of every bogie wheel, while the slipper brakes, each having a contact face measuring 12in. by 4in., were mounted between each pair of wheels, both types of brake being operated by separate vertically mounted hand wheels on each end platform. The emergency brake on Nos. 4 and 5, (fig. 4), designed like the rest of the car by the unfortunate Mr. Taylor, comprised two sets of eccentric cam-teeth mounted beneath the vehicle, together with a strong 5/8in. diameter spiral spring, which in its natural position retained the teeth hard against the vertical faces of the Z girders forming the central cable conduit channel described earlier. However, the teeth were also connected to the vehicle's drawbar and haulage lever in such a way that when the main cable was set in motion, the drawbar was pulled forward, overcame the force of the spring and drew the teeth clear of the conduit plates. Any slackening of the cable would immediately release the spring, pressing the cam-teeth back against the plates to bring the car to a halt. As an added precaution, the cam-teeth, as the name implies, were eccentrically shaped, so that any vehicle attempting to run away downhill would by its own weight force the teeth still harder against the sides of the cable conduit. All in all, a pretty simple, very effective, fail-safe brake and Colonel von Donop was highly satisfied when he tested it on behalf of the Board of Trade on 30 July 1902.

There was, however, (to borrow one of LBSC's favourite expressions) a fairly large wasp in the jam-pot: the slightest slackening of the haulage cable brought the brake into action and virtually locked the car to the rails, bringing the lower section of the tramway to a complete halt for a long period, as releasing the teeth was a protracted business. On Harvest Thanksgiving Day, 8 October 1902, little more than two months after the opening of the line, an inexperienced member of staff in the winding house (was he still learning the ropes? - this installment's *awful joke*) caused a slight jerk in the cable and brought the line to an abrupt halt for no less than four hours. The problem recurred at intervals for the next three seasons, until a new manager was appointed in 1906, by the name of Henry Sutcliffe. This gentleman immediately resolved these difficulties by a very simple expedient, the thought of which, even a hundred years on, still causes a shudder of horror and sheer disbelief.

●To be continued.

LETTERS TO A GRANDSON

M. J. H. Ellis

concludes his discourse on the history of measurement and also adds a story about Einstein's humility.

● Number 91

Dear Adrian, I will begin by concluding my remarks about the Vernier. When you reflect that the graduations on both scales are open enough to be easy to read, and that the alternative would be trying to read a scale graduated in 1/100ths to a tenth of a division, you should appreciate the benefit conferred on mankind by Pierre Vernier.

In practice, of course, the Vernier scales would form part of a measuring instrument, for example, Vernier calipers. I dare say you have seen this instrument in use in metal warehouses. In shape, it resembles the 'girder' type of adjustable spanner. Perhaps I have not made this clear enough already, but the thing to remember is, that you read the measurement from the main scale to the last whole division, beyond which the Vernier tells you how much more to add on.

I trust that you have now grasped the Vernier principle. The example I chose is probably as much as you are likely to want to use. There are also Vernier protractors and Metric Verniers, but I don't expect that you will have the need to use either of them. By the way, the Vernier principle is valid using any pair of whole numbers which differ by one, but only a few are suitable for practical use. For example, suppose that you chose 10 and 11. The difference between 1/10 and 1/11 is $0.1 - 0.0909 = 0.00909$; and what use is that? I regret to say that it took me some little time to work this out, so I have learnt something too. The same kind of serendipity is also to be found in musical scales, and that is something which, I might say something about later, if it is of any interest to you.

Before we leave the Vernier, you will (I hope) remember that I mentioned in No. 89 (*M.E.* 4275, 9 June 2006) that by using a Vernier in conjunction with John Bird's quadrant it was possible to measure the angle of right ascension of a heavenly body to an accuracy of one second. I now return for a little while to the efforts which were made by the French Academy of Sciences to define the metre as a ten-millionth of the length of the quadrant through Paris between the North Pole and the Equator (No. 84, *M.E.* 4267, 17 February 2006). Assuming that I was correct in supposing that the difference in latitude between Dunkirk and Barcelona was determined by astronomical observation, (and I can think of no other way of doing it), let us see what the error might have been if both observations had been in error by one second. At worst, one would have been positive, and the other negative, so making the total error 2 seconds.

In my original example, the length of the metre was $1175838/34836 \times 0.0524$ yards = 1.0936143

yards, = 39.370114 inches. If we reduce the number of seconds (34836) by two the expression becomes $1175838/34834 \times 0.0324$, = 1.0936771 yards, = 39.372375 inches.

The difference is 0.002261in., a little over 2 thous. No doubt, the best which could be achieved at the time, but a margin of error which is far greater than present day metrologists would accept. It amounts to 0.0057%, and a comparable error in the length of the arc over the ground would be 3.6 inches in the mile. This all goes to illustrate the inevitable imperfection of a standard derived from measuring the earth itself.

Before I conclude my discourse about measurement, I can now add a few words about developments in the micrometer. You will recall that as long ago as 1895 J. Ciceri Smith devised a digital micrometer, the rights to which were acquired by Brown & Sharpe. I also mentioned that in 1970 James Keill absorbed the micrometer business of Ambrose Shardlow, and that of Moore & Wright in 1971. In 1975 a concern named Patscentre International approached the James Neill Group with the suggestion that they had the expertise to develop an electronic micrometer in which the Group might be interested. They evidently were, for other specialist concerns contributed to the development work. Diffraction gratings having pitches of 0.0004in. and 0.004mm were at the heart of the instruments which resulted, and which read to 0.0001in. and 0.001mm respectively in Imperial and Metric versions. They are said to have been very successful, but in a catalogue in my possession electronic micrometers are priced at more than twice as much as the traditional type, and I hardly think that the extra cost is justified in the case of customers such as you and me.

I really did think that I was drawing near the end of what I had to say about metrology, but something has just happened to make me change my mind. The public library has just procured for me a copy of a specialised work, which will enable me to fill at least some of the gaps which I had to leave in the story of how it became possible to define standards of length in terms of something truly changeless and reproducible, that is, the wavelength of light of a particular colour.

The book was published in 1929, so obviously, it does not deal with developments that took place after that date. Nevertheless, I think that it will serve our purpose well enough, since all I hope to do is to give you an outline of the principles which were used. The philosophical revolution which led to the suppression of physical artefacts as standards by abstract-numbers was brought about largely, if not entirely, by the pioneer work of one illustrious American physicist, Albert Abraham Michelson (1852-1951). His contribution was so important that I am going to give you a short account of his career.

Actually, he was born in Strelno in Prussia on 19 December 1852, but as his parents emigrated

to the US two years later, I think that you can fairly claim him as American. The family settled in San Francisco, where his father became a prosperous merchant. When 17 years-old he entered the Naval Academy in Annapolis, Maryland. He did well in science, and graduated in 1875. From 1875 until 1879 he was employed there as an instructor.

Michelson was deeply interested in the accurate determination of the velocity of light. To further this end, he went to Europe, in order to study optics, which he did for two years in Berlin, Heidelberg and Paris. Meanwhile, he had resigned from the US Navy in 1881. While in Europe, he worked on the interferometer which is named after him, and which I shall describe in detail later. It will suffice for the present to say that on his return to the US he used it, in collaboration with an American chemist, Edward Mosley, to carry out the famous Michelson-Morley experiment. The idea was to find out how rapidly the Earth was moving through the 'ether', the mythical all-pervading medium through which physicists imagined that the electromagnetic waves, newly discovered by the German scientist Heinrich Hertz, were propagated. It would be difficult to exaggerate the significance of this experiment, for it demonstrated conclusively that in reality there was no ether for the Earth to move through at all. The demolition of the 'ether' theory left a perplexing vacuum, which was eventually filled by Albert Einstein with the Theory of Relativity. The ingenious arrangement devised by Michelson was adapted with minor modifications, for evaluating the standard metre in wavelength terms. But I will defer

"I travelled third-class"

dealing with that until my next letter, because I want to recount a story which illustrates Einstein's true humility.

It seems that he was friendly with the King of the Belgians, who invited him to come to stay in the palace. The King sent his chauffeur to meet Einstein's train. He returned without him, and reported to the King that he had carried out his orders, but had been unable to locate the visitor among the passengers. He feared that he must have missed the train. Some time later, Einstein was seen plodding along the drive to the palace. Having greeted him, the King sent for the chauffeur and demanded to know why he had failed to identify the distinguished visitor. "*Your Majesty*," protested the man, "*I went straight to the first-class carriages, and I assure you, Monsieur was not there!*" "*He is quite right*" interjected Einstein, "*I travelled third-class*".

I can't say I blame him. I have never seen a train, of which the first-class carriages arrived any sooner than (in Britain) the second-class.

Your affectionate Grandpa.

THE OMC-3 FROMENT ENGINE

Malcolm Stride

reviews the third engine kit in this interesting series of models.

The subject of this review is the third in the series of interesting models from the Old Model Company of pioneering attempts at electric motors.

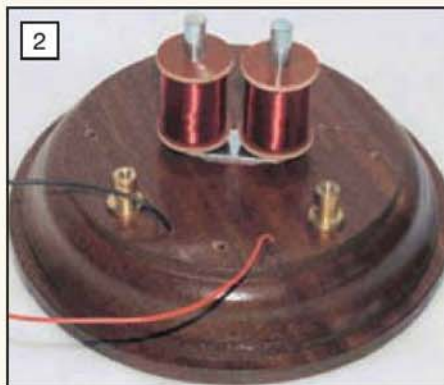
This engine is a model of one of the first engines which moved development away from reciprocating 'steam engine' technology towards the type of rotary electric motor we are all familiar with today. This particular model is based on designs by Paul Gustav Froment (and others) from 1844 and the type is known as the Froment Engine for this reason.

This motor is a direct current motor using a rotating armature with iron pole pieces. This is driven by a pair of fixed coils (the stator) energised via a contact system driven by a cam on the shaft. This is different to the typical DC motor of today which uses an armature with coils energised via a commutator and rotating between magnetic poles.

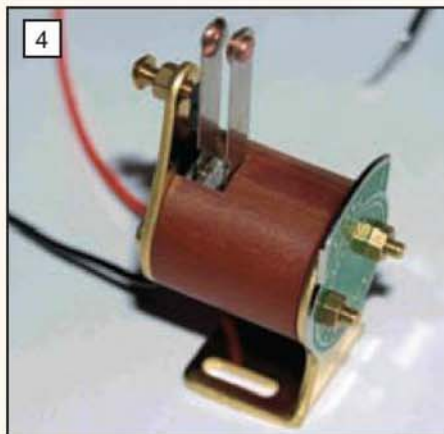
Unlike such modern electric motors the mechanism for this engine is completely exposed and provides a superb means of educating youngsters (or the not so youngsters) into the principles of operation of direct current electric motors.



The engine assembled prior to final setting up.



One of the two main sub-assemblies, the wooden base with the coils mounted.



The contact housing showing the fine-tuning adjusting screw.

The kit

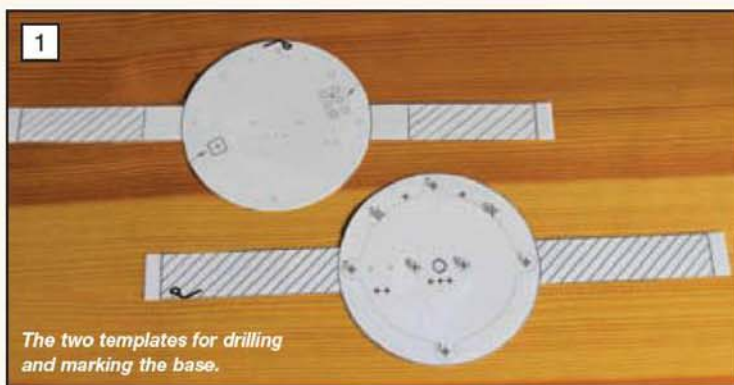
As readers who have followed this series of reviews will expect, the kit of parts (80) comes securely packed in a strong card box which doubles up as an assembly aid when everything is unpacked.

The now familiar well-finished parts are all packed into numbered bags to link to the relevant numbered sections in the detailed instructions. I have found from the previous kits that if the instructions are followed to the letter, the kits go together without problems and the model will work as expected which is how kits should be.

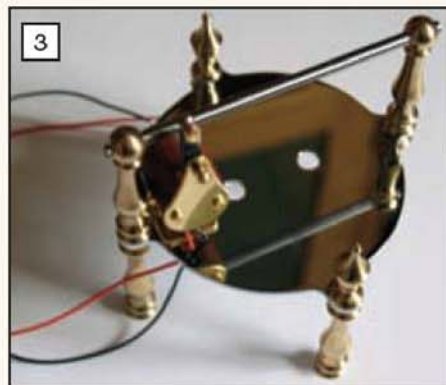
I do not intend to repeat the instructions in this review but have photographed the basic assembly stages to show the sequence.

Assembly

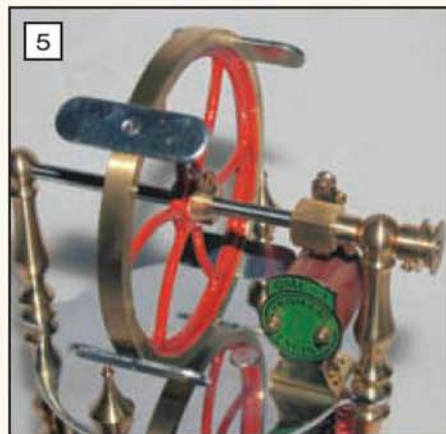
As with the previous kits, the first thing that needs doing is to drill the base to the templates provided and then to varnish or stain to choice.



The two templates for drilling and marking the base.



The platform assembly with contact housing and cam on the shaft.



The main shaft showing the flywheel pole pieces and the contact cam.

Having discovered that the elderly tin of varnish I used for the previous kits had 'gone thick' I decided to use a can of spray gloss varnish from the local DIY store. This did avoid the "two minutes painting followed by ten minutes cleaning the brush" syndrome which tends to be the case when dealing with small parts like this.

I kept things simple with the varnished base and just the flywheel spokes painted red as a contrast.

I decided to drill the base after varnishing this time and as with the previous kits, cut out templates (photo 1) are provided for the top and underside. It is important that the underside template is lined up correctly so that the jack socket and terminal block are in the correct positions relative to the drilled holes.

There are two main sub-assemblies with this kit, the wooden base with the coils (photo 2) and the main wiring and the platform assembly (photo 3) which consists of the main mechanical components.

Whilst the varnish was drying I assembled the platform assembly ready to be mounted on the base.

One clever point illustrates the attention to detail in these kits. An extra shaft is provided for lining up the bearing pillars on the platform assembly. This shaft is a fraction larger in diameter than the actual working shaft thus ensuring that the working shaft will rotate freely when assembled. I suggest that builders keep this extra shaft in case anything moves and needs to be re-aligned later.

The contact assembly (photo 4) on this engine is slightly different from the previous two and has an adjusting screw for fine-tuning of the engine when running. It still pays to set up the contact assembly accurately first for best running.

The flywheel was bolted on pole pieces (photo 5) which locate into milled slots and I assembled these with a touch of thread lock on the screws to ensure they stayed put.

The wiring is similar to that on the OMC-1 engine and is easy provided the instructions are followed.



Set up and spinning merrily.

Setting up and running

Once everything is assembled (photo 6) it is time to set the flywheel position relative to the

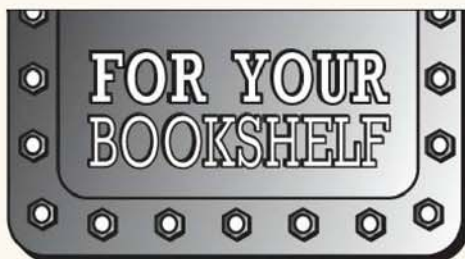
contact cam and to fine tune the engine for running. I found that the best position for the cam was with the contact points just opening as the leading edge of the flywheel pole piece was level with the leading edge of the coil poles.

Once everything was running, the adjusting screw can be used to get the best performance.

This engine runs faster than the others (photo 7) and has a heavier flywheel so make sure small fingers do not get in the way of things when it is running!

This kit maintains the high standard that I have come to expect from this company and yet again is an interesting model of an early experiment in electric power which provides an instructional kit that assembles into something to grace the mantelshef.

The OMC-3 is the third in the series from the Old Model Company who can be contacted at PO Box 455, Chichester, West Sussex PO18 9ZH, tel: 01243-575403 or via the website at www.oldmodels.co.uk



Bicycle: the history

For me the bicycle is the most significant machine ever invented. It is simple, efficient, healthy, magnifies human power, makes long journeys possible, gives minimal pollution and is a delightful urban transport.

David Herlihy is an American who has written an excellent international history of the bicycle. He starts with the first 'hobbyhorses' and 'velocipedes' powered by feet on the ground, then covers the early treadle powered efforts.

The bicycle proper took a surprisingly long time to evolve. The simple idea of putting pedals on the front wheel was a French innovation by Pierre Michaux of Paris around 1867. It was a rich man's plaything but its popularity swept across France, England and the USA. This evolved into the 'ordinary', better known as the Penny Farthing, from around 1870. The huge front wheel allowed a measure of gearing up which was popular with young athletes who enjoyed racing and weren't put off by risks of falls from a height of up to 7 feet.

In cycling the racing fraternity have often been against innovation. They certainly didn't like the next idea, the safety bicycle. It depended on the idea of a Swiss engineer living in Manchester, one Hans Renold, who invented the first reliable roller chain with anti-friction bushing and rollers. A Coventry man, James Starley, saw the potential and used it first in one of his tricycles in 1877. Though expensive, at the time trikes were popular as they were stable, safe and also allowed women to ride comfortably in the long skirts of the day.

Henry Lawson was the first to try a chain drive

to the rear wheel but his machine did not catch on. However, James Starley introduced the 'Rover' safety bicycle in 1885. It was heavier than an 'ordinary' but was lower and offered less wind resistance so was faster. The Rover led to a cycling boom across the world from the 1890s. It was still a bumpy ride but James Boyd Dunlop of Belfast introduced the pneumatic tyre in 1888 which not only cushioned the ride but made it faster.

The basic frame of the safety bicycle has remained little changed since then though new materials have made it lighter. Reynolds celebrated butted tubes were introduced from 1934 making the frame lighter but just as strong as conventional tubes. Tulio Campagnolo invented the derailleur gear in the 1930s though this marvellous invention was also resisted by the racing fraternity just as they had disliked the safety bike. These developments mostly took place in Europe. American bikes remained an overweight disgrace for years. The big US innovation was the mountain bike and this now influences most bikes now sold in Britain. Recumbent designs are fast but remain a specialist market.

This is an excellent history marred by some odd mistakes. For example, I wonder where the 'London Borough of Hore' is to be found? It is definitely a book for the cyclists in the family and even if you haven't ridden a bike for years the author's enthusiasm might even tempt you on two wheels.

Bicycle: the history by David Herlihy. Published by Yale UP 2005. price £20. ISBN 0-300-10418-9.

RB

2-10-0 Austerity Engine and Tender

This is a photocopy reproduction of what is really a user's manual for the wartime Austerity 2-10-0 locomotives, ordered by the Ministry of Supply.

The book has an index of 61 items, ranging from major components, such as the boiler, motion and wheels to the smaller items, for example injectors, brakes and piston valves. In

many cases there are drawings illustrating the component, with a description of it, the form construction, its operation and hints on the method of use, covering virtually all the components of the locomotive.

Although specifically intended for the Austerity 2-10-0, it is equally applicable to steam locomotives in general. It is a valuable reference book recommended to all of those readers interested in the design, construction and operation of the steam locomotive, both full-size and miniature.

In the copy reviewed, some of the drawings were over-inked, leading to a loss of detail; nonetheless this is a very useful work.

2-10-0 Austerity Engine and Tender. Brief Description with Hints on Maintenance and Repair. Originally published by the Ministry of Supply, March 1945. This edition published by Camden Miniature Steam Services, Barrow Farm, Rode, Somerset BA11 6PS. Price £15.60 inc. postage. ISBN 0-9547131-3-3. 92 pages, 11⁵/₈ x 8¹/₄in. Softback.

DGM

LMS Locomotive Profiles. No. 8 The Class 8F 2-8-0s

As we have come to expect, the eighth book in this series is another definitive work on a specific class of LMS locomotive. Following the 1923 Grouping, a number of existing designs were considered for development into a standard heavy freight locomotive for the LMS. These included the LNWR 0-8-0 G2 and the Derby S&D 2-8-0s. In the event the Beyer-Peacock 2-6-0 - 0-6-2 Garratts were ordered and the ill-fated Fowler Class 7 0-8-0s were produced.

On 1 January 1932, W. A. Stanier was appointed CME of the LMS Railway and he initiated the production of a number of standard locomotive designs, including the 4-6-0 Class 5s and the 2-8-0 Class 8Fs.

The first 2-8-0s were ordered in 1932 as experimental machines, to be built in 1933, but the design work was not completed in time and a further 10 engines were ordered in 1934 for the

1935 building programme. Thus, the very first engine, No. 8000 was delivered in June 1935, the remaining 11 being completed by October that year. A total of 226 engines were completed by November 1939.

From then on the story becomes very complex. With the onset of hostilities, the design was selected by the War Department as the preferred type for the European Theatre of War and orders were placed on private contractors for more locomotives.

The Government Railway Executive Committee controlled locomotive production during the war, with the result that substantial orders were placed for LMS 2-8-0s with the LNER, GWR and Southern Railways, so that orders were placed on Eastleigh, Ashford and Brighton as well as Darlington, Doncaster and Swindon, all in addition to Crewe Works. This entailed minor design changes to suit different production methods and operating conditions of the different railways.

Subsequent to the war, the LMS built further engines of the class and took on stock engines returned from the War Department and other railways.

A pullout Frame Arrangement, Pipe and Rod and a General Arrangement (drawn by Fred James) as well as detailed drawings are included. There are six appendices, detailing Engine diagrams, Design variations as built, Tender particulars, Building, Numbering and re-numbering, AWS and withdrawal dates, Shed allocations and particulars of War Department engines. From these it can be gleaned that a total of 852 Class 8Fs were built; a number were lost at sea during hostilities and over 600 went to the Middle East after the war, others were repatriated and a total of 666 eventually worked on British Railways.

This book is a very useful reference work that is confidently recommended to railway historians. It makes fascinating reading for all interested in railway locomotives and model engineers in particular. However, as the authors warn, because of detail variations anyone wishing to build an authentic model are well advised to choose a particular locomotive and glean as much information as possible from drawings and photographs of that engine.

The authors are to be congratulated on an extremely well researched book.

LMS Locomotive Profiles. No. 8 The Class 8F 2-8-0s by David Hunt, John Jennison, Fred James and Bob Essery. Published by Wild Swan Publications, 1-3 Hagbourne Road, Didcot, Oxon OX11 8DP. Obtainable from Camden Miniature Steam Services, Barrow Farm, Rode, Somerset BA11 6PS. Price £19.35 inc. postage. ISBN 1-905184-08-5. 136 pages, 10³/₄ x 8³/₈in. Softback.

DGM

LMS Locomotive Profiles. No. 9 Mainline Diesel Electrics Nos. 10000 and 10001

The book commences by explaining the origins of the diesel locomotive. Whereas a steam locomotive requires coal all the time it is in steam, a diesel locomotive can have the power turned off when not in use. The saving in fuel costs can be as much as 50% and when the saving

in coaling, ash disposal plants and other ancillary equipment is considered, this makes the diesel an attractive proposition to the railway company, even with the increase of capital cost.

Thus in the 1930s, the LMS Railway began experimenting with diesel shunting locomotives, samples of 10 different types being purchased. From these emerged the English Electric diesel electric shunting locomotive.

Following WW2 the LMS decided to extend its experience to mainline diesel locomotives and the twins 10000 and 10001 were designed and produced.

The book describes the events leading up to the locomotives' design and production in co-operation with the English Electric Company who supplied the diesel engines and electrical equipment, while the LMS designed and built the mechanical equipment.

The diesel engine is described, together with the electrical and associated control equipment. The LMS designed mechanical equipment, including the mainframes, bogies and bodywork is covered with a pullout General Arrangement and other detail drawings of the bodywork. There are numerous photographs of the locomotives in service on various duties, both as single and multiple units.

Problems, which inevitably occurred in a development project, are discussed. The most notable of these was the inability of the locomotives running in multiple to supply steam heat to long trains because the boiler in the trailing locomotive continually blew out. This had a serious effect on diagramming during the winter months.

There are three appendices; Visible Alterations, Service Details and an explanation of 'field weakening', utilised in the locomotive's electrical control system.

This book is welcomed as an authentic record by one who was involved with these locomotives throughout their relatively short life. It is both an important contribution to LMS locomotive history and a record of pioneering project that led the way to the introduction of diesel power on British Railways.

It is recommended to all railway historians, to those interested in railway locomotives as well as to model engineers.

LMS Locomotive Profiles. No. 9 Mainline Diesel Electrics Nos. 10000 and 10001 by David Hunt. Published by Wild Swan Publications, 1-3 Hagbourne Road, Didcot, Oxon OX11 8DP. Obtainable from Camden Miniature Steam Services, Barrow Farm, Rode, Somerset BA11 6PS; website: www.camdenmin.co.uk Price £16.60 inc. postage. ISBN 1-905184-04-2. 81 pages, 10³/₄ x 8³/₈in. Softback.

DGM

Making Mechanical Toys

There are many model engineers who take great pleasure in making toys for their grandchildren or others and this book may well appeal to those of you who do engage in making toys as part of your model engineering activities.

The book, a good quality hardback, is basically a construction manual for 17 wooden mechanical toys designed by the author and is described in the



preface as "a book for anyone wishing to make a special toy for a special person".

The toys in the book are simpler versions of the automata of the late 19th century and will not only appeal for their entertainment value but also as educational toys illustrating various mechanical movements such as gears, cams and even the Geneva wheel. The difference between automata and mechanical toys is defined in the preface.

The book includes a chapter describing the basic processes used during the construction of the toys and also the tools required for those with no previous experience.

Each of the toys described in the book has a dedicated chapter with the relevant drawings, material list and full instructions for making the toy. The drawings are designed to be traced and the result used as templates for cutting the wooden parts. In some cases drawings are also provided for making stencils to assist with the painting of the models.

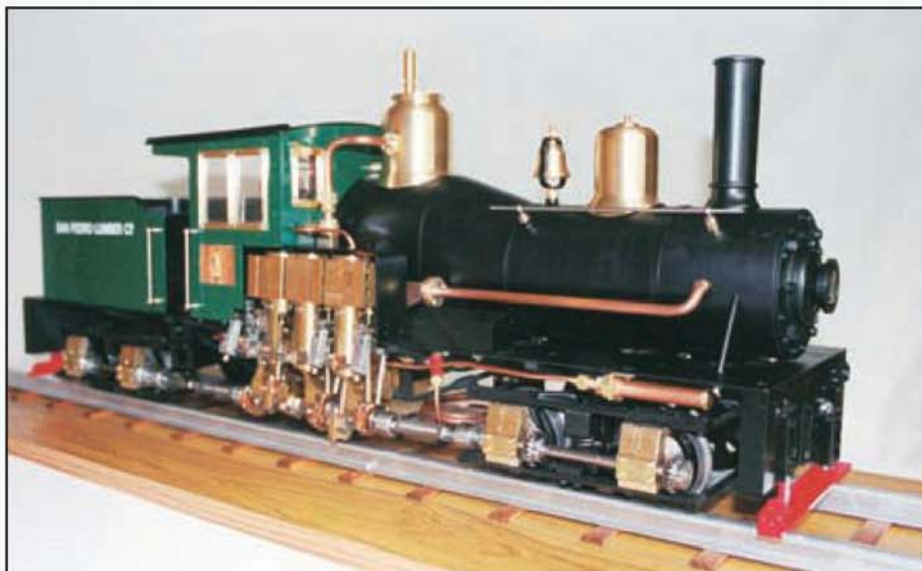
For three of the toys the full coloured print is designed to be colour photocopied (or possibly scanned) and the result spray glued permanently to the plywood sheet to provide fully detailed figures. In this case the book suggests the use of a light box or in the absence of that a well lit window as a means of lining up both sides of the cut-outs correctly. In one chapter the book uses the term 'off-cuts' to describe the cut out parts in this process which I found slightly confusing because to model engineers and woodworkers 'off-cut' usually means the waste piece left over after cutting out the required part. Other than this slight confusion the instructions are generally well written and easy to follow and I am sure none of our readers will have any difficulty with them.

The toys described range from the very simple up to a complex moving jungle scene so those with no experience of such things can learn the techniques on the simpler designs before progressing to 'greater things'.

In conclusion, for those interested in mechanical toys, or wishing to develop an interest in such things this is an excellent book which provides a good selection of toy designs and will inspire those interested into producing their own designs based on the principles described.

Making Mechanical Toys (ISBN 1 86126 723 1) is written by Rodney Peppé and is published in hardback by The Crowood Press Price Ltd., Ramsbury, Marlborough, Wiltshire SN8 2HR; website: www.crowood.com. It is priced at £19.95.

MLS



THE 'SHAY' LOCOMOTIVE

John Brooker
concludes the construction of his
American 3¹/₂in. gauge locomotive.
●Part III continued from page 43
(M.E. 4277, 7 July 2006)

The boiler was built by Western Steam Model Engineers of Bridgwater, Somerset. I elected to do this in view of the unusual shape of the boiler which will clearly be seen from the photographs. I was delighted with the finished product - an excellent example of model boiler making. Again the metric dimensions for the threads were disregarded and suitable alternative sizes were employed to suit my taps and dies in readiness for making the boiler fittings. The fitting of the smokebox has already been described and my next task was to construct the sandbox dome and water filler, (fig 27). This item is in fact simply a cover for the main water filling point. It was turned from solid brass bar.

Next came the throttle block, (fig 28). A rather complicated job to say the least. This unit consists of a circular brass block bolted to the flange on the boiler barrel, using four 2BA stainless steel machine screws. Steam from the boiler is throttle controlled to the propulsion engine via various ports and passages within the block. Mounted on the top of the throttle block are the twin safety valves and the whistle. In my version of the Shay this whistle is a dummy a separate whistle being accommodated under the right-hand running board. The control linkage support arm was first silver-soldered into a slot milled in the outer end of the throttle block extension tube. The centre section was then removed with a slot drill then rethreaded for the gland nut. The 'areas' were then filed to shape and drilled for the linkage.

Work was then started on the throttle block dome and this was again turned from

a very large brass bar end, the maximum that could be held in my lathe chuck with the added support from a fixed steady. After much drilling, boring, turning and filing the result is as shown in fig 29. In this type of dome the top is open to allow room for the safety valves and whistle which project above the top of the dome. In order to secure the dome to the throttle block a spider ring insert was constructed from a brass disc. A retaining bolt passes through this ring and screws into the throttle block, (fig 30).

Next came the task of cutting a hole in the right-hand side of the dome to allow the main steam inlet pipe flange to connect to the throttle block. The hole position was very carefully marked off on the dome then centre drilled, opened out to 3/8in. dia. and further enlarged with a coarse Abrafile and finally

finished to size with a smooth half round file; the work being held in the bench vice. The main steam inlet pipe was then shaped from 1/4in. O/D copper tube. (After annealing bending springs were inserted into the bore before bending to shape - the springs then being pulled out of the pipe by stretching and unwinding them). The pipe was then silver-soldered into the flange which had previously been drilled for four bolts that secure it to the throttle block, (fig 31). A union was then silver-soldered to the other end of the pipe to connect with the propulsion engine.

Boiler fittings

The next job was, the making of the numerous boiler fittings, namely: manifold/turret; water feed clack; injector steam valve and injector water valve (note: as no hand pump fitted in order to allow for increased water space in the tank) blowdown valve; blower valve; whistle valve; water gauge.

No details are given of these fittings as these items are familiar to most model engineers, other than to state that in the case of the water gauge an expansion tube is first connected to the boiler from which the normal gauge glass mountings are taken. As the drawings are to metric dimensions this has again necessitated a good deal of conversion to suit my taps and dies. The laying out of the pipework has also not been easy in view of the small size of the locomotive and the rather complex machinery installation.

Firehole door, grate and ashpan

The rectangular firehole door was made in mild steel complete with a baffle plate. The grate is also of mild steel strip 1/2 x 1/8in. section with the customary cross rods and spacers. The ashpan is made up from brass sheet. The official drawings for these items were only used as a guide, the actual measurements being taken from the job. ▶

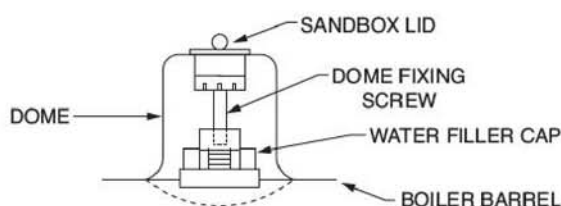


FIG. 27 SANDBOX DOME & WATER FILLER

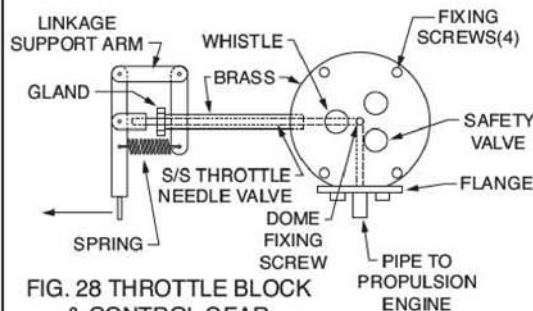


FIG. 28 THROTTLE BLOCK & CONTROL GEAR

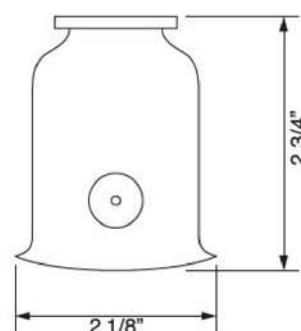


FIG. 29 DOME

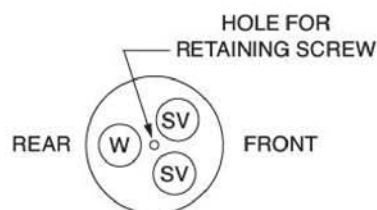
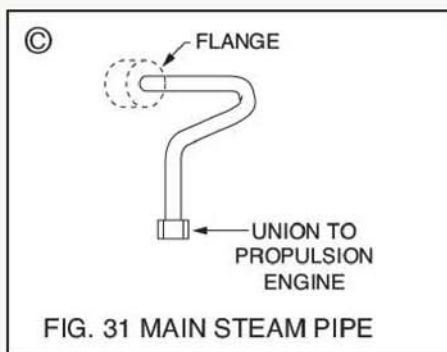


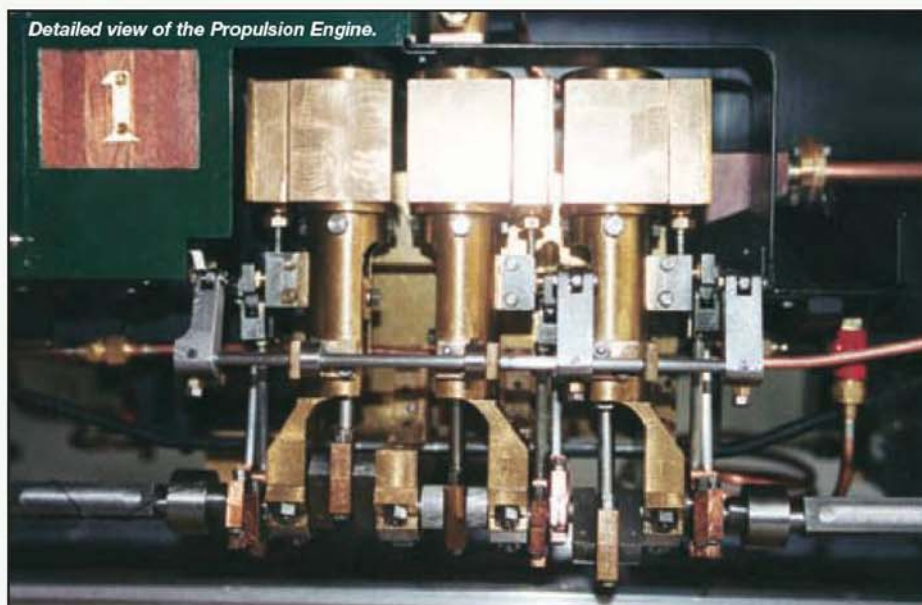
FIG. 30 SPIDER RING



Painting

Not my favourite job, but one which is worth taking time over. It is a great pity to spoil good workmanship with a poor paint job. Following the necessary strip down, all steelwork and brass was roughened with emery cloth, the lightly scored surface providing a key for the priming paint. Following the rubbing down all surfaces were thoroughly cleaned with lighter fluid which leaves no deposit when it evaporates. (This task is best carried out in the open in view of the strong fumes). The steelwork was then primed with Humbrol Matt Grey whilst the brass surfaces were treated with a special etching primer obtained from 'Precision Paints'. This dries in a matter of minutes but the chemical etching process continues for several hours. The finishing coats were then applied mainly using Humbrol paints and a good quality sable brush. The colour scheme is as follows:

Frames - matt black
Buffer beams - gloss black.
Guard irons - gloss red.
Trucks, wheels, running boards, sand boxes and firehole door - dull black.
Cab side sheets, spectacle plate and water tank



(except top plate) - gloss Brunswick green.
Cab steps - dull black.
Water tank top - matt black.
Cab interior - matt grey.
Footplate - dull black with overlay of planking.
Propulsion engine casing - dull black.
Tool box - dull black.
Bell frame - dull black.
Boiler, smokebox including door and chimney - dull black.
Main dome, sandbox dome, and bell - polished brass.
Cab exterior window frames - polished brass varnished over.

After a reasonable drying out period the locomotive was reassembled with great care to

avoid damage then the handrails were fitted to the boiler, cab sides and water tank and the lumber company's name transfer placed on the sides of the water tank. 'San Pedro Lumber Co.' A final run was then carried out on compressed air. A joy to see.

Construction has taken approximately six years - the result an unusual model of which I am justly proud and which now looks even more realistic set on a length of presentation track.

I hope that my 'humble efforts' will spur a few experienced model engineers to try something really different. Drawings are available from: Camden Miniature Steam Services, FREEPOST, (BA 1502) Rode, Frome BA11 6UB. Tel: 01373-830151.



A SIMPLE INDEXING TABLE



Starting point for the project - two pieces of 1in. thick armour plate. This design was intended to be bullet proof!



Machining the table. The finished base is resting on the headstock. The relatively high bottom speed of the lathe meant frequent tool sharpening.

John Wilson

describes how he made this useful accessory for his new milling machine.

With the purchase of a new milling machine, I decided I would like a indexing table and, having looked

at the price of a decent sized table, decided to make my own. The starting point was to find some suitable (free) material. I do voluntary work for the Royal Gunpowder Mills at Waltham Abbey and in one of their disused buildings was a pallet load of 6in. square by 1in. thick steel plates, which I was told were used for ballistic testing. They kindly said I could have a couple of them (photo 1).

The next problem was how to make a scale for the table without a dividing head. I decided to make the scale from a length of metric steel tape using the 0 to 360mm divisions to give the readings in degrees. Now 360mm using $\pi \times d = 114.58\text{mm}$ or approximately $4\frac{1}{2}\text{in.}$ so I now had the diameter of the scale. I decided that the table would be $5\frac{3}{4}\text{in.}$ dia. with the base remaining at 6in. on one side but $4\frac{3}{4}\text{in.}$ on the



View of the under sides of the circular table and the square base. The 2in. dia. pivot pin is resting on the table.



Top surfaces of the main components. The section of steel measuring tape used for the scale is resting across the parts.



The method used to fit the pivot to the table. It was a nice press fit.

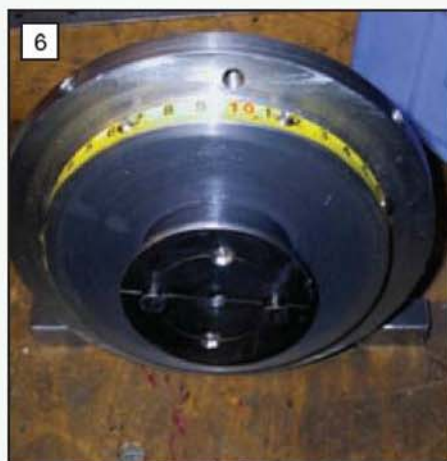


Table with the scale fitted into position and held in place with blind rivets.



The indexing table fitted to the milling machine in the author's workshop.

other. So now I was ready to start machining.

With the first plate set up in the 4-jaw chuck I hit a problem. The plates were of some sort of high tensile (armour) steel. I can only get the lathe speed down to 160rpm, which was too high a surface speed for such tough material, particularly when machining a piece that was square. However, with light cuts and a lot of re-sharpening of tools I finally got both plates machined (photo 2).

Unlike the base, the table was to be completely round. So, to achieve this, I used a thin, tipped parting blade as a fly cutter to rough out the 5³/₄in. dia., so that I would not have to spend hours turning off the corners of the plate (photos 3 and 4).

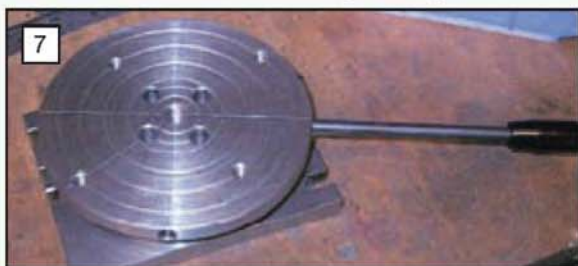
The base was bored to 2in. dia. for the pivot with a 1/2in. deep recess, 2³/₄in. dia for the retaining plate. The table was also bored to 2in. x 3/16in. deep to take the pivot pin. The pivot pin was made from a piece of 2¹/₄in. dia. steel that had been part of a draw hammer and this material also turned out to be high tensile steel and if anything harder than the two plates. This was turned down to 2in. dia. by 1in. long.

As I said previously, the scale was to be made out of a metric tape measure, so a visit to the local '£ Shop' gave me a suitable donor. Unfortunately, I could not get a metric only tape so had to cut off the imperial scale, grind off the two rivets holding the datum edge and cut to 360mm long. This was duly rivetted (using small blind rivets also from the '£ Shop') when all the machining was complete (photo 6).

I felt that the table was too hard to T-slot, so I drilled and tapped the face with 4 off, 5/16in. BSW holes, making sure not to drill through into the bearing face of the table. The centre had already been drilled and tapped for 1/2in. BSW screws.

The base had six slots 3/8in. wide, diagonally cut so that the table can be bolted down in any one of three positions on the table, i.e. overhang to rear, dead centre, overhang to front (photo 8). The base was also drilled and tapped 1/4in. BSW as a locking point for the table (photo 8) and a piece of brass was turned to slide in the hole to prevent the locking bolt from scoring the pivot. The tommy bar, to turn the table, is the locking bar for the milling machine head and is used when changing cutters. It is 8mm dia., so 4 off 8 mm holes were drilled at 90deg. around the 5³/₄in. circumference of the table to form a capstan when indexing the table (photos 7 and 8).

The whole project took approximately three weeks from inception to completion. Although it will not win any prizes for finish or looks, the table should prove a useful addition to my machine shop.



The completed indexing table. The capstan handle is borrowed from the milling machine when required.

General Notes

The concentric rings on the table face were cut with a 60deg. thread cutting tool to about 0.030in. deep. They are cut at 1in., 1¹/₂in., 2in., 3in., 4in. and 5in. diameters respectively.

The cross lines I got by turning the tool through 90deg., re-setting the centre height, then taking a series of light cuts by winding the cross-slide across the face of the table as fast as I could until I had got to a depth of 0.020 inches. I then turned the work through 90deg. and repeated the operation.

The second pair of cross lines are at 45deg to the first and were scribed in after the table top was removed from the lathe. Why didn't I cut them in on the lathe? It was an after thought.

Although the spindle was a tight push fit into the table, it was obvious that I could not rely on just that to locate it, so I drilled and tapped four holes for 3/16in. BSW cap head screws at 1¹/₂in. pitch circle diameter (more '£ Shop' saver items), hence the four holes at the centre of the table.

The keep plate (photo 6) is held by 4 x 3/16in. BSW cap head screws, which were pinched up until the table was stiff to turn on its base. The screws were Loctited in. The table rubbing face and spindle were treated with anti-scuffing paste prior to assembly.

You will have noted that I purchased various items from '£ Shops'. They often have bags of assorted screws for wood and metal work (self-tapping and machine), which come in handy. Their large roasting tins make good parts washing receptacles and there are always plastic and metal containers for storing odds and ends in. A very useful shop for anybody, like me, on a tight budget.



Keith Wilson

concludes his 'notes' on whistles, comments on some readers letters and adds a few reminiscences.

●Part XXIII continued from page 47
(M.E. 4277, 7 July 2006)

For reasons of time, I have only showed the modified 'top in' type of whistle. If you want to make the more usual type, then leave out the central pipe and, of course, the hole in the top cap. The bottom cap needs only to have its lower end made with a union fitting for the pipe and, of course, not to be drilled right through.

The little bit of the labial (the floor of the pipe) marked as 100 degrees is tricky to file, but quite easy to mill, especially if you have a rotary table. It can be done 'vertically' leaving sharp ends, or 'horizontally' leaving rounded ends to the cut-out, which should be 0.025in. deep. This end fitting can be inserted directly into the lower end of the tube after cutting out the 'mouth', which need not be nicely curved at the top; flat works just as well. Just a 'wee dab' of soft solder (plumber's variety) will ensure its retention; make sure that the solder does not fill up the gap. If it does, then the easy way out is to cook up the end again with a certain amount of air pressure on the input end. When the temperature reaches the melting point of the solder, it will blow out (mind your eyes!!) and leave the perfect gap. The top cap needs sealing with soft solder, for leaks are best avoided.

In view of the cramped conditions, methought of possible ways of improving matters, and a certain amount of development work resulted in what I have named the 'top feed whistle'.

Basically it is obvious - once it has been pointed out! The top cap is drilled right through $\frac{3}{16}$ in. dia. and has a length of copper tube silver-brazed into the end remote from the threaded portion. The bottom cap is drilled $\frac{3}{16}$ in. but not right through. It otherwise matches the bottom cap on the 'normal' whistle. I have just knocked out four of these whistles, result deafening on air, will have to wait awhile for performance on steam to be assessed, but I have no doubts on the matter.

It may look tricky to assemble this flute, but if you set in the lower cap first, soldering it in, then the top cap c/w inner tube can be shoved in the top, a tiny bit of juggling will set in the lower end of the inner tube into its socket. Seal in the top, and then it is easy to put a 'wee dollop' of solder onto the lower joint working through the mouth of the whistle.

After cleaning up, mere lung pressure should be enough to

LILLIAN A NARROW GAUGE LOCOMOTIVE for 7 $\frac{1}{4}$ in. gauge

sound the beast: if nothing doing try the compressor. It is possible that some of the solder 'may have done gotten itself' into the wrong place; if you suspect this then to keep air pressure on whilst cooking up the whole shebang (actually the bottom is probably best to start with) will enable surplus solder to blow itself out and the hooter will pick up and ring out loud.

With whistles of this type hanging direct on the ends of their supply pipes I see no reason for any other form of support. They are likely to be well tucked in anyway.

No one knows why!

There is not, so far as I am aware, any accepted scientific theory as to precisely how a steam whistle works, but for the time being we shall just have to understand and accept that it does. After all, it took a large number of years to understand how an organ pipe (of the flue variety as distinct from reeds) actually worked; it took fast photography plus smoke-loaded air-blown pipes to solve this one. There is a book on whistles (*The Engine's Moans* published by Astragal Press in America) dealing with histories of whistles; said book confirms my first sentence in this paragraph. However, it is worth reading.

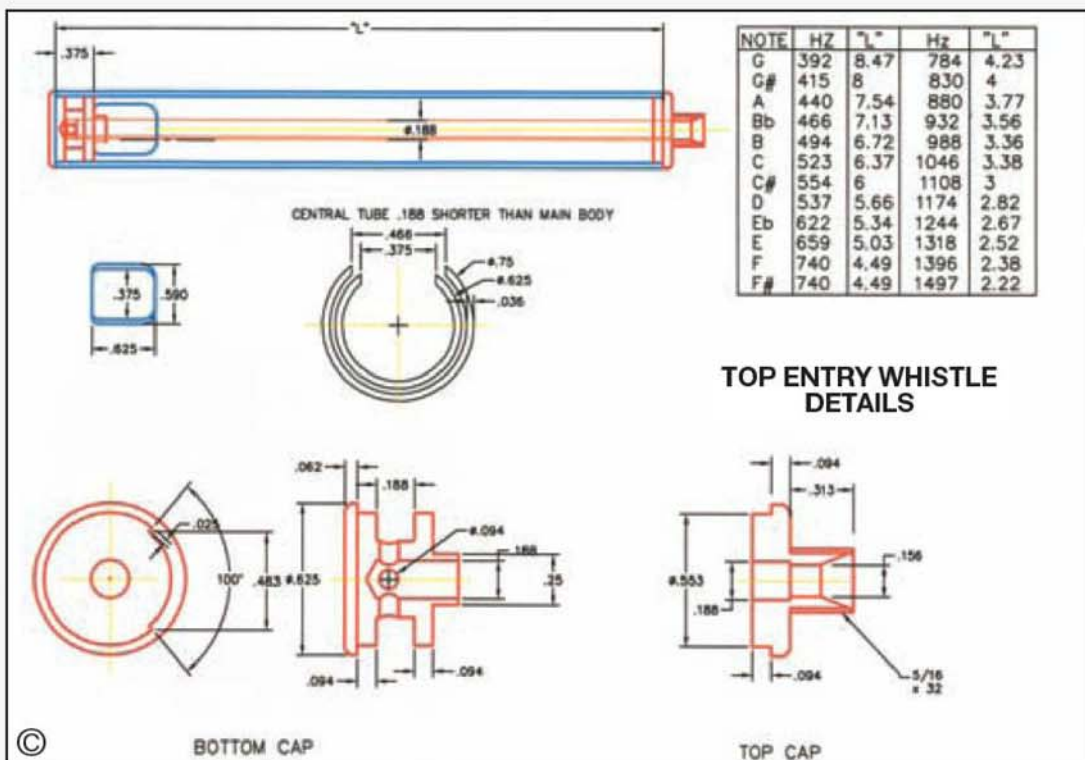
Another crafty whistle-wangle is to purchase an 'Acme' referee's whistle, but get the metal one rather than the plastic variety. Dig the pea out (it is, or was, just a piece of cork). A little bit of

fiddling about will enable a steam supply pipe to be fitted - and there you are.

I did this 50 years ago on my first ever steam locomotive (*Mary Ann*, a Darlington J39 by LBSC in 2 $\frac{1}{2}$ in. gauge) and discovered that the frequency of the note depended largely on pressure of steam; hence by careful manipulation a nice loud wolf-whistle can be produced.

A few years ago, a builder approached me with a genuine Stanier whistle off a Black Five, asking me what size pipe would be needed. I could only make a guess, and recommended nothing smaller than $\frac{1}{4}$ in. diameter. I was not very hopeful, but I was wrong. He mounted it between the frames of his Simplex, fed it with a generous valve and pipes, and behold! It worked. I understand that on its first run, he did not blow it at first, but trundled on round the track gloating a bit - I'll bet! Coming near to the club hut, he hoicked heftily on the chain and blew a mighty blast. It seems that the club door had never known so many people to pass through it at one go. But I'll bet it knocked his pressure back a bit - no moan without groan!

Reminds me of being in the NASA set up at Cape Canaveral when the broadcast system informed everyone that the big Jumbo was just landing with *Challenger* mounted thereon. A door just in front of me burst open, and I would not be believed if I guessed just how many people passed through it in about 5 seconds! I got my camera up but was just too late to catch the



Jumbo, but no-one else managed it anyway.

It brings home the sheer size of the Saturn 5 rocket to note the time it takes to walk from one end to t'other. The actual rocket engines at 14 feet diameter take some thought, and I believe that on take-off some 80,000 horsepower goes into the pumps alone.

How had we got to Florida? Well, we purchased a Hoover washing machine a couple of years previously and were lucky enough to win. Oddly enough, and as unlikely as it seems, the Cape is one of America's larger nature reserves. Eagles' nests are not rare sights, and one has to keep an eye open for alligators, especially at night. The largest nature reserve in Britain is the combined area of motorway grassed sides.

A few years ago I built a couple of Hunslets, and from sheer cussedness decided to put a multiple-piped chime whistle on them. As I recall, I fitted them into a straight horizontal pipe with a hefty valve. I deliberately chose notes that made a wild sound, C, Eb, F#, A, making a diminished 7th chord. I am playing about with designing a single-pipe chime whistle for my next batch of locomotives.

Reader's letters

I include a couple of letters from friends with reference to water troughs and locomotive speeds.

Keith,

The drawings you show for the *Logger/Slogger* tender trucks are of a type known as Arch-Bar trucks in the US. These were in general use by about 1870 and continued to be made well into the 1920s. They were used on freight cars (fitted with coil springs) and cabooses (caboose?) and tenders (fitted with elliptical leaf springs). It was inexpensive and gave good service when speeds were low.

A few American railroads had water troughs, although they were known as 'track pans' in the U.S. The New York Central was one of the few with track pans and this allowed them to build tenders with larger coal capacity. The NYC 'Niagara' S1 class 4-8-4 locomotives, which were used on the 928 mile New York to Chicago route, had 14 wheel 'centipede' tenders that had a water capacity of only 15,000 imperial gallons! This allowed them to carry 42 long tons of coal! This enabled them to run through from New York to Chicago with only one stop for coal. The coaling docks straddled the main lines so that the locomotive did not have to be uncoupled from its train. The ash pan would be emptied at the same time. These locomotive were averaging 26,000 miles a month, I wonder if any Swindon, Doncaster or Crewe built engines could have managed this sort of performance?

Is anyone supplying the castings for *Logger/Slogger*?

Keith

I have just read your latest article in the latest *Model Engineer* and the final paragraph set me thinking of locomotive speeds. Up until about 1930 there was a rule of thumb in the USA that said that a locomotive's normal maximum speed was the same in mph as its wheel diameter in inches i.e. a locomotive with 60in. diameter driving wheels was good for a maximum speed of 60 miles per hour. After this date about 20%

could be added to the speed because of better cross balancing.

All locomotives have a wheel diameter speed of 336rpm so that at this rotational speed, the locomotive speed is the same in mph as its wheel diameter in inches. I can't remember the diameter of the Highlander driving wheels, but I think it was about 10in. so to be going at 31mph. the wheels must have been revolving at something near 1,000 revs. per minute! This must have been a well-balanced engine.

Before WW2 in the USA there were many reports that, due to heavy counterbalance weight being added to the wheels for the cross balancing of the reciprocating and revolving weights, the driving wheels were lifting off the rails at high speed. To ascertain just what did happen under these conditions, special slip tests were run over greased rails on the New York Central in 1938 with one of the latest 4-6-4 'Hudson' type locomotives equipped with roller bearings on all axles and lightweight moving parts. The tests showed that only a very slight wheel lift off the rail actually occurred at the top slipping speed of about 700rpm. These locomotives had 79in. diameter drivers so that at 700rpm the equivalent speed would be about 170mph! There was no damage to the locomotive or the track during these tests, indicating a well balanced and well proportioned piece of machinery. After the tests there were no more complaints and the condition was recognised as an inherent balancing characteristic of the two cylinder locomotive engine, as is the condition of maximum torque position of the crank pins with resultant 'quarter slip', or uneven tyre wear, on the driving wheels.

I have never heard of these problems affecting British two cylinder locomotives, maybe this is because the maximum piston thrust is so much lower in this country than the US.

Have you heard of any of these problems with locomotives in this country?

Malcolm Young.

Arising from the above, if a GWR 2-cylinder locomotive did pull away hard from a stop (rush-hour suburban services) this surging could be clearly felt. The average 5-coach suburban stock on these trips had a 61xx Prairie on the front, bunker first if Paddington bound, and I have noticed this surging more than once.

I heard a few days ago (time of writing) that there is in existence a photograph taken inside the cab of a Princess Coronation with the speed recorder showing 125. Does anybody 'out there' know of this photograph? It would certainly alter history a bit! I see no reason to doubt the possibility of this feat, but I can see a big reason for keeping it quiet! I wonder what the maximum recorded speed on a passenger train (as distinct from a test train or 'mail special') is? I have notes of 112.5m.p.h on *Dryslwyn Castle* from the locomotive inspector (Jack Hancock) who was on the footplate, and there is a note from the late O. S. Nock in similar position on a King at 105+. Both were passenger trains in regular service. Also, as I have mentioned before, every King, Castle or Star, and probably Saint as well was tested at a steady 100 on coming out of shops. If on arrival back at Swindon the bearings were still cold, it was passed as okay. Any questions?

Reminiscences

In days of yore (late 40s) when steam still was the thing, one of the 9700-9710 (condenser-fitted) was (regularly) on the 8.31 (formerly 8.32) at Hanwell, (7¹/₄ miles from Paddington) to run the regular stopping train thereto. I am fairly certain that the train started at Southall, for it would be quite a trip from Slough in view of the tank capacity. A slightly slacker schedule from the 61xx class, thus Hanwell to West Ealing was 3 minutes, on to Ealing Broadway (another 3 minutes) 4 to Acton, 7 to Westbourne Park, final 3 minutes to Paddington.

The return run (about 5 o'clock) was the same schedule, but a Castle left the terminus about the same time with, of course, a heavier train. The result was that whilst we stopped at Westbourne Park, the Castle rolled effortlessly through on the Down Main. Drivers were seldom worried about acceleration this early in the trip knowing well that the high speeds of Castles would take care of this minor 'lateness'.

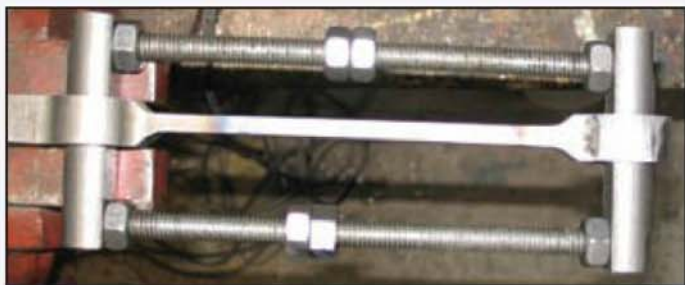
The 97xx invariably caught up with and passed the Castle by about Ladbrooke Grove, but although this afforded a nice picture of a Castle sneering at mere miles and tons, however at Acton the situation was reversed and we did not see the Castle again.

The speed of the 97 between Westbourne Park and Acton was just over the 70, and the Prairies invariably touched 75 or so here. Their schedule was 1 minute tighter between Westbourne Park and Acton.

This brief reminiscence was triggered (of course) by Pete Rich's splendid drawing in *M.E.* 4267, 17 February 2006. There is not as much difference between 57xx and Dean Goods as might be expected. Incidentally anyone building *Pansy*, would do well to get the drawings thereof from GLR Distributors, for there are more details (I know, because I drew 'em) shewn on these than dear old Curly bothered with. Of course, they do not affect the working, as he always claimed; but 'tis much nicer to look at (and drive) summat not too far from the prototype.

My thanks to Victor Croasdale (*Postbag, M.E.* 4275 9 June 2006) for his remarks on transcendental numbers, etc. but it is not necessary for both of a pair of meshing gears to be prime numbers, one is sufficient. For that matter, that the two numbers (of teeth) should be mutually prime; that is, having no common factors is just as good. Consider 41 and 43 teeth (both primes). Meshing the same tooth will only come round 41 x 43 times, 1,763. Now look at 39 and 41 (one composite, other one prime). The same tooth-meshing will only occur every 1,599, and the ratios are similar. For mutually prime numbers, such as 49, 55 (neither is prime). Clearly they will 'repeat' every 2,695 times.

A formula for primes was once thought to be $(n^2 + n + 41)$, which works quite well up to $n=41$, after which I don't know that it works at all! One good system was, if I recall correctly, 'the Sieve of Eratosthenes' (error-toss-the-nees) or something like that. Write down a large number of consecutive numbers from 1 upwards, then go through it and delete every even number, then ditto and delete those divisible by 3, then 5, 7 and so on. Obviously, every prime can only end in 1, 3, 7, or 9 (apart from the first 3). Another



Above: The author's stretcher in use.

Right: The coupling rod jig in position on the wheels.

interesting number is the number made up of a prime number of ones - 11, 111, 11111 etc.

Discovering factors of these is not an easy task without a computer, in fact 11 is the only prime one as far as I know. 11,111 is 271×41 ; 1,111,111 is $239 \times 4,649$. A final comment on this topic is that there is no such thing as the largest possible prime. Consider the composite number made up from $p \times (p-1) \times (p-2)$ etc. Then add 1. Clearly, not divisible by any number less than p . So either it is a product of two prime numbers each greater than p , or it is a new prime larger than p . Either way, we win!

Numbers are fascinating indeed!

The tender behind

We need a driving truck of some sort, and one that can be sat in rather than sat on is useful for us old codgers.

Once again, low-friction bearings are recommended. No point in wasting tractive effort even though there is enough and to spare. Likewise, although we have enough water capacity in the side-tanks, another few gallons in the tender are no handicap. It is easier to use steel for the tender than for the tanks, for at least the size and shape makes for easy treatment of the inside - car underseal is excellent; however the extra cost of brass is not a terrible handicap.

The main frames can be steel channel; $4 \times 2 \frac{1}{2}$ in. is okay, but of course angle is equally good.

Axleboxes are available 'off the shelf' in the form of ball bearings in a housing more or less square, they have grooves on each side - just right for hornblocks. Springing is of course essential, easy to arrange. Powerful substantial brake gear is plain and simple, fully compensated of course, and powered by a vacuum cylinder identical to that on the engine.

There is no need for water valves (on the tender) for the injectors, for they are fed from the side tanks. There is only need for a plain connection betwixt engine and tender, although simple shut-off valves or cocks are needed for when engine and tender are parted. This pipe from boiler-feeding point of view needs to be only about $\frac{3}{8}$ in. diameter, but from filling locomotive's tanks and tenders point of view as large as you can get. One inch is probably ideal. Some folk have had one injector connected to side tanks, t'other to the tender or driving trolley, but there is a snag. Even when using them alternately, forgetfulness is likely to raise its head, for it is on the cards that one could run out before the other, so you would have another thing to worry about - even though it is minor. Also, if low on water, it takes longer to fill up two tanks than one, albeit of twice the capacity.

Some folk with tank locomotives believe in having a completely separate supply for injectors, for the old belief that a hot injector won't pick up and feed. However, as mentioned recently in my article on injectors, if the overflow

is large enough ($4\frac{1}{2}$ times the steam cone in diameter) water will be sucked in and t'squirt will work. I understand that the ultimate upper temperature for water to work in an injector is about 57deg. C (135deg. F) and I know from my own experience in Los Angeles during a heat-wave that a squirt will put water in at just over 50deg. Celsius. Just too hot to bear on the back of your hand. Admittedly, they put more on the ground than into the boiler, but the important thing is - they worked.

You might well recall (from a recent *Lillian* article) how the bracket connecting motion bracket to guide bar was not too obvious to me at the stage when these bits were only on the drawing board; not surprisingly the part required was (censored) obvious when I got to the point where I could see it in 3D. A simple piece of mild steel, $2 \times \frac{3}{4} \times \frac{3}{16}$ in. bent at right angles about $\frac{5}{8}$ in. from one end meets the case perfectly. Welded to the motion bracket just front of the forward-facing flat surface on the bracket; a $\frac{1}{4}$ in. nut and bolt will take care of the attaching to the guide bar, and Bob's your aunt's brother!

If your arc-welding is as bad as mine, some useful disguise is that afforded by the standard Car Body Repairer e.g. paste, Isopon. If the area is clean (de-greasing by washing with white spirit for example) the stuff can be mixed and spread on and when set, smoothed off and painted. Photos of before and after will appear later.

It is a moot point whether you paint each steel item as it is made - at least with a good primer - and watch it becoming 'orribly scratched; or leave everything until all are made and mostly assembled. If, on finishing a steel object, a gentle spray of WD40 is used, it will take care of things should you have a moistish atmosphere in your workhouse. Contrary to some old tales, if properly degreased even brass will take good etch primer and it will last well. I believe that stainless (rustless) iron (usually called stainless steel) is unhappy where paint is concerned; but then it can usually be polished anyway. I always have a rustless set of buffer heads in my engines, albeit full-size ones were rusty except for a patch in the middle where other buffers rubbed. Hand rails are normally painted, but stainless polished looks nice on a model. And on said model, hand rails get a lot of rubbing so if you like a part-bright part-painted handrail then the choice is yours.

Shot blasting before painting, if available, is very good indeed, provided you don't get it in the bearings or cylinders. This happened to me once, shewing up on my first professional locomotive steam test (1366, last heard of near Glasgow and still going strong. Built in 1966, that's not too bad) and it took me two whole days to re-bore cylinders, fit new pistons and rods, clean up valves and port-faces, etc. It then went like the proverbial bat out of hell. A bit of good luck here, for one of the dealers who witnessed its

performance promptly ordered two, at better prices to boot. Ill winds etc.

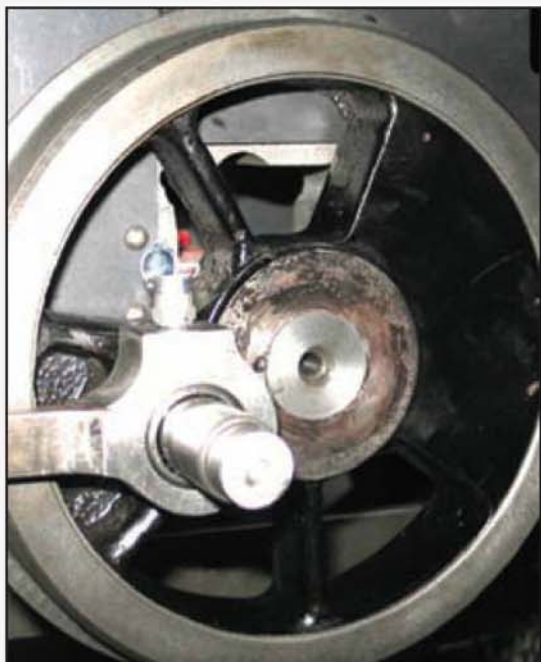
D. A. G. Brown and Mark Smithers have come up with an excellent design for a tender of narrow-gauge type (see *Anna* series) and I will be using the same basic idea for *Lillian*, with acknowledgement and approval. Oddly enough, my brain does not seem to 'invent' new ideas, although it is not too bad at utilising them and sometimes drawing them up for easier manufacture, or putting several new ideas together and coming up with new processes (or should it be processi?). Pre-keying for driving wheels comes to mind, steam-on-first and self restart injectors not far behind. In similar vein, my work can be copied, preferably with acknowledgement but not too worried about that. To know that it has been used on someone's engine and made life a little brighter for them is reward enough, for me at least and probably for others too.

The tank portion of the tender - if you use one - is best from brass; but steel is not impossible if a couple of coats of car underseal are applied to the inside - alas not always as easy as it might seem. It also caulks small leaks. I recall once seeing a Castle in Paddington with a leak in the tank - for some reason it was neglected and there was actually a load of grass growing round the leak!

Give me quarter, Cap'n

Quartering of driving wheels is a very important process and is certainly not to be taken lightly. There are so many tolerances to add up, not only because we do not have the same machines as they had at Swindon; whether any other (nearly wrote 'lesser') railways had the same type of machine. Basically, t'was a machine rather like a two-ended lathe, with a boring head-set at each end set at right angles to each other, these heads would be set at the correct distance from the centre to give the required throw. Boring of each hole to suite the crank pin then would take place simultaneously - unless I have got it all wrong - resulting in accurate quartering. I believe that the heads could also be set to turn the outside of each crank pin in case of wear. I do know they had a device to check on the roundness of each crank pin and its quartering accuracy. Useful, because you can't really measure both sides of the engine simultaneously.

For us, super accuracy in throw and quartering is not utterly vital, as long as it is constant for all of the driving wheel pairs on any given locomotive. About the best method for us is to drill the crank pin holes from a jig, and use an assembly jig to ensure absolute quartering; the wheels being bonded onto their axles on this jig, and a couple of elastic bands clamping the wheel-set to the jig whilst the bonding material sets, be it Araldite or Locite. Trouble is, it is not then possible (at least I can't see how to do it) getting a proper square key into the joint. Round ones -



View of the left-hand rear end wheel and coupling rod showing the bearing and oil box.



The lifting lever and weigh shaft. Note the L-shaped guide bar bracket at the bottom.

Wilson's Words of Wisdom:

*I keep six honest
serving men,
(They taught me
all I knew),
Their names are
What, and Why, and
When, And How and
Where, and Who.*

Kipling

clearly easy. I have dealt with pre-quartering axles some time ago, likewise keyway cutting in wheel hubs. It seems to work quite well, and a good clue to accuracy is hefty jigs and hardened bushes to accurately locate drills and broaches.

The other nasty problem is coupling rod length. A photograph herewith shews my own jig on the actual engine. Note that the keys are clearly seen; square and on the line passing through axle centre and crank pin centre. The hole just above the middle of the picture is for the brake lever hanger. Although it doesn't shew in the picture, the completed rear coupling rod is in place on the other side, to my (sshhh!) surprise verifies just about perfect quartering, for it was possible with ordinary hand-pressure to spin the two wheel-sets up to about 250rpm and, on letting go, the wheels carried on spinning for a time. This was with temporary steel bushes, with needle roller bearings on the axles. Plan is to have similar bearings on coupling and connecting rods.

However, after machining the left-hand coupling rod (drilled from the jig as shewn) all the tolerances lined up one way instead of evening out and the result was a rod too short by about 0.01 inch. The adjacent photograph shews the rod mounted in its extension jig. For a guide to sizes, the screwed rods are 1/2in. Whitworth at 3in. centres.

The device was mounted in the vice and the nuts turned by spanner until the tension in the rod was high (I don't know precise figure). Oxy-acetylene torch played on the middle portion of the rod cooked it up to dull red heat, whereupon the nuts were further tightened. After allowing it to cool, removing the rod and testing it in place proved that the method worked and the rod was nearly long enough. After three goes, length was very close and the wheel set could be spun as above.

In theory, it should be possible to calculate the effects due to thermal expansion, in practice it would be a waste of time; for the rod would not be at the same temperature all the way along, also the stresses on the jig itself would need careful consideration and there is the difficulty of measuring the rod accurately enough.

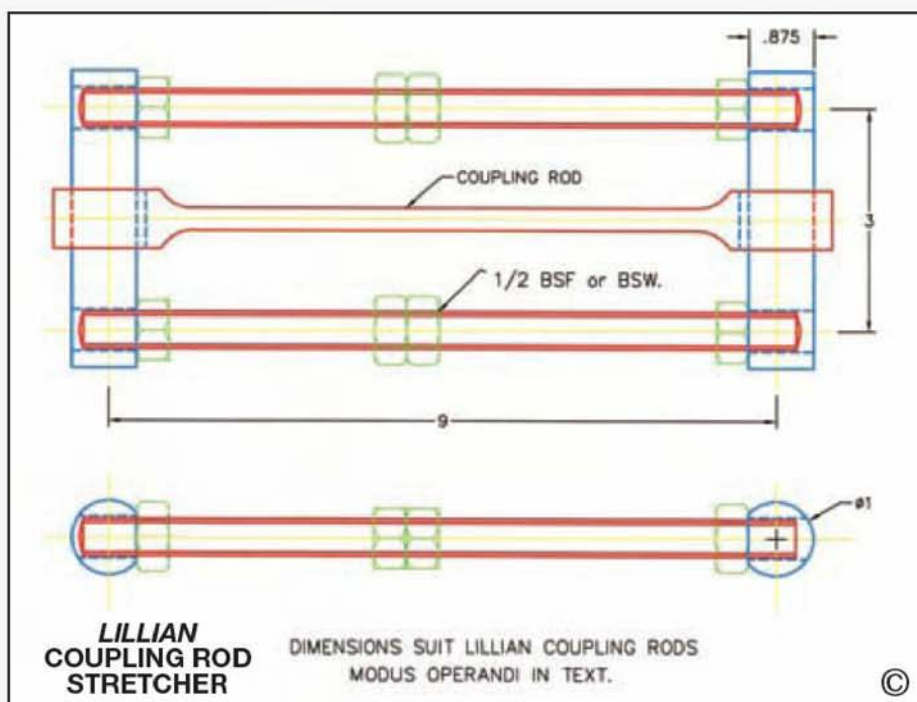
Diagnosis

There are a few useful ways of diagnosing trouble, for it does not seem very useful to spend time making something right it ain't wrong to start with. Coupling rod length can be checked by using one side of the engine only, for if things jam up at front or back dead centre, then either the throw is wrong or the rod is 'out', if you start with the adjustable jig, then it is instantly clear 'wot's wot'. Once the two wheel sets turn freely with no locking at either dead centre, then rod length and throw must be 'spot-on', so remove the rod on the tested side and do the same test on the opposite side. Then, to check quartering, put both rods on; if all turns freely then quartering is all well and good. If the whole lot turns stiffly but without tight spots, then quartering, rod length, and throw are all okay but the bearings are tight or a bit out of line.

The same process may now be repeated with the 'free' part of each rod in place, the same experimentation is applicable. If you are then happy with the spin of the wheels, then you will be even happier when the needle roller races are installed.

A friend of mine making a six-coupled engine using needle roller bearings throughout noticed that his workbench apparently sloped both ways at once. Watching carefully however, shewed that the bench was dead level and smooth; it was the weights of the coupling rods settling to the stable position. I am happy to note that mine has turned out much the same. A similar sort of thing happened many years ago on the Tal-y-llyn railway when a couple of roller-bearing carriages were slowly rolling up and down due to a tiny dip in the otherwise level track.

●To be continued.



CLUB CHAT

With Malcolm Stride

Firstly a change of contact details, following the resignation of Secretary Les Morgan, the new contact for the Isle of Wight MES is Mr. Malcolm Hollyman who can be reached at 01983-564568 or via e-mail at MJHollyman@aol.com

UK News

The Annual locomotive rally at Bedford MES will be held over the weekend of 1-3 September this year. Friday will be arrivals day and running on the track if required, followed by a DIY barbecue, bar and film show in the evening.

Saturday will be a visitor's day with both tracks open, food most of the day and a full cooked dinner in the marquee in the evening with a bar. On Sunday visitors with locomotives will be able to assist in the society public passenger hauling service. Caravanning and camping facilities are available. Visiting engines need to produce boiler certificates, if needed, and proof of insurance, otherwise it will be "a free and easy weekend". New attractions this year include double track all the way to the top loop, all

new lever frame operated signalling system, and a new bridge. The society can cater for 2 1/2, 3 1/2, 5 and 7 1/4 in. gauges, and can lay on a transfer wagon to take the smaller gauge engines to and from the main station to the elevated track. Further information can be obtained from Ted Jolliffe Tel: 01234-327791 or via e-mail at tednmary.jolliffe@tiscali.co.uk

Members of Bradford MES are preparing for the centenary celebrations in 2008 and are already looking into suitable souvenirs and the possibility of building a model boating pond at the track site. Work continues at the site and one of the new carriage sheds is now in use with the second available as required.

I will spare the blushes of those involved by not identifying them, but several members of Crawley Model Engineers spent some time pulling the starting cord on the Hunslett locomotive before checking the fuel tank and finding it empty! Put your hands up all those who have done something similar. The club has had to deal with rodents in the club hut and recently caught two mice in traps. The mice were given a decent

burial in the infield and the reporter wondered, "Will we see some mouse trees growing there in a few years time?" I would not dream of commenting. Bob Hill has completed his GWR Collett tank, built from a Winsor kit, and after much modification and testing has got it running and has now hauled the occasional passenger.

Mike Bannister of the Erewash Valley MES describes the fitting of tyres to his Sweet Pea locomotive following wear on the wheels due to the heavy use since it was built in 1995. Roger used some steel steam pipe material fixed to the turned down wheels with Loctite 603. Although he profiled the tyres in situ with no problems, after some use the tyres moved. This was probably, as Roger says, due to "the cast iron having absorbed oil which prevented the Loctite from properly binding". The tyres have been replaced with securing pins.

The above mention of Loctite prompted me to include a tip from Len Steel of the Guildford MES which is that Loctite structural glue can be used for attaching tool tips to tool holders. The newsletter also contains details of the latest I/C engine being built by John Day which is an Anzani Brevette 3-cylinder rotary engine. Perhaps I

shall have to try one of those before attacking the 9-cylinder radial which has been waiting for some time? Clive Lawrence is standing down as Editor of the newsletter and I would like to thank him for his contributions to this column over the last four years.

For those with broken taps in castings which have had lots of hours work carried out on them, the "Professor of Engineering, University of Life's Experience" from the Melton Mowbray DMES has an answer. When presented with this problem, he replaced the writing stylus on an electric etching pen with a 0.03 in. dia. copper wire and used this to erode the tap from the hole. The set up reached a depth of 1/4 in. in about half an hour with breaks for cooling down. Those in a similar position may well find this a useful avenue to explore. Perhaps there is a market here?

In spite of the many crowds of people flocking to Royal Ascot, John Cooke reports that there was a large attendance of members and friends of the National 2 1/2" Gauge Association at the Commercial Road Ground in Staines - home of Staines MES. Members had travelled from as far as Herefordshire, Portishead, Eastbourne, and Essex, as well as the

CLUB DIARY

A minimum of 6 weeks notice is required for diary entries. Clubs and Societies are asked to include a telephone number for the assistance of would-be visitors.

AUGUST

- 4 Aylesbury (Vale of) MES. Track Night. Contact Andy Rapley: 01296-420750.
- 4 Canvey R&MEC. Meeting. Contact Brian Baker: 01702-512752.
- 4 Maidstone MES (UK). Evening Run & Barbecue. Contact Martin Parham: 01622-630298.
- 4 North London SME. Meeting & Barbecue. Contact David Harris: 01707-326518.
- 4 North Norfolk MEC. At Sheringham Pool. Contact Gordon Ford: 01263-512350.
- 4 Portsmouth MES. Meeting. Contact John Warren: 023-9259-5354.
- 4 Rochdale SME. Meeting. Contact Mike Foster: 01706-360849.
- 4 Romford MEC. Competition Night. Contact Colin Hunt: 01708-709302.
- 5 Canvey R&MEC. Members' Running Day. Contact Brian Baker: 01702-512752.
- 5/6 Dockland & E. London MES. Public Running. Contact P. M. Jonas: 01708-228510.
- 5 Ickenham DSME. Public Running. Contact David Sexton: 01895-630125.
- 5 Isle of Wight MES. Track & Pond. Contact Malcolm Hollyman: 01983-564568.
- 5 Maxtrak Owners Club. Maxtrak Rally, Leatherhead. Contact Eric Penn 0208-979-4335.
- 5 New Jersey Live Steamers, Inc. Work Day. Contact Karl Pickles: 718-494-7263.
- 5 Romford MEC. Trackside Afternoon. Contact Colin Hunt: 01708-709302.
- 5 York City & DSME. Summer Meeting. Contact Pat Martindale: 01262-676291.
- 6 Bristol SME. Public Running. Contact Trevor Chambers: 0145-441-5085.
- 6 Cardiff MES. Steam-Up and Family Day. Contact Don Norman: 01656-784530.
- 6 Frimley & Ascot LC. Public Running. Contact Bob Dowman: 01252-835042.
- 6 Guildford MES. Driver Training. Contact Dave Longhurst: 01428-605424.
- 6 Leighton Buzzard NG Rly. Family Fun Day. Enquiries: 01525-373888.
- 6 Malden DSME. Public Running. Contact John Mottram: 01483-473786.
- 6 Northampton SME. Public Running. Contact Pete Jamman: 01234-708501 (eve).
- 6 Nottingham SME. Public Running. Contact Gerry Chester: 0115-9259096.
- 6 Peterborough SME. Visit by Erewash Valley MES. Contact Ted Smith: 01775-640719.
- 6 South Durham SME. Running Day. Contact B. Owens: 01325-721503.
- 6 Guild of Model Wheelwrights. Bewdley Horse Event, Holbeache Farm, Trimley, Nr. Kidderminster. Contact Biddy Hepper: 01492-623274.
- 7 Peterborough SME. Bits & Pieces. Contact Ted Smith: 01775-640719.
- 8 Dockland & E. London MES. Meeting. Contact P. M. Jonas: 01708-228510.
- 9 High Wycombe MEC. Evening at Track. Contact Eric Stevens: 01494-438761.

- 9 Norwich DSME. Barbecue. Contact Paul Reed: 01603-462925.
- 9 St. Albans DMES. Ron Dean: Preparation of model boat kits. Contact Roy Verden: 01923-220590.
- 10/11 Ascot LS (2003). Frimley & Ascot LC Open Days. Contact Derek Alford: 01344-482485.
- 10 Bedford MES. School Holiday Running. Contact Ted Jolliffe: 01234-327791.
- 10 Sutton MEC. Chat Night. Contact Bob Wood: 0208-641-6258.
- 10 Worthing DSME. Bits & Pieces. Contact Bob Phillips: 01903-243018.
- 11-13 British Columbia SME. Train Fest Meet. Contact Sean Laurence: (604) 931-1547.
- 11/12 Frimley & Ascot LC. Open Days. Contact Bob Dowman: 01252-835042.
- 11 Hereford SME. Meeting. Contact Nigel Linwood: 01432-270867.
- 12 Brighton & Hove SMLE. Fun Run. Contact Mick Funnell: 01323-892042.
- 12/13 Guildford MES. OMLEC. Contact Dave Longhurst: 01428-605424.
- 12 Maxtrak Owners Club. Seventh Ipswich Maxtrak Meet. Contact Eric Penn 0208-979-4335.
- 12 Portsmouth MES. Efficiency Comp. and Concours d'Ellegance. Contact John Warren: 023-9259-5354.
- 12/13 Guild of Model Wheelwrights. Sandringham Show. Contact Biddy Hepper: 01492-623274.
- 12/13 Leeds SME. LSME August Rally. Contact Colin Abrey: 01132-649630.
- 13 Cambridge MES. Public Running. Fulbrooke Road. Contact Rex Mountfield: 01284-386128.
- 13 Canterbury DMES (UK). Public Running. Contact Mrs P. Barker: 01227-273357.
- 13 Edinburgh SME. Track Running Day Steam & Diesel. Contact Robert McLucke: 01506-655270.
- 13 Harrington LS. Public Running. Contact Peter Tarrant: 01895-851168.
- 13 Hereford SME. Public Running. Contact Nigel Linwood: 01432-270867.
- 13 High Wycombe MEC. Club Running afternoon. Contact Eric Stevens: 01494-438761.
- 13 Hornsby ME. Running Day. Contact Ted Gray: 9484-7583.
- 13 Leyland SME. Scale Running Open Day. Contact A. P. Bibby: 01254-812049.
- 13 New Jersey Live Steamers, Inc. Historical Society Run. Contact Karl Pickles: 718-494-7263.
- 13 Nottingham SME. Public Running. Contact Gerry Chester: 0115-9259096.
- 13 Plymouth MSLs. Members' Running Day. Contact John Brooker: 01752-671722.

usual locals.

First on the track was Ayesha II (4-4-2) driven by Tony Weale, followed closely by *Ursa Maximus* (reduced), (4-6-2) with Nicholas Taylor in the saddle and John Llewellyn running his Brighton Atlantic (4-4-2). Peter Gardner showed how well his *Netta* (0-8-0) could perform and Graham Barker introduced his *Evening Star* (2-10-0) which after firing problems was soon circumnavigating the track. Andrew Dick had a good run with his *Josie* (4-6-4) doubled up from the Curly Lawrence design for '0' gauge. The Uranus class 4-8-4 locomotive *Endeavour* driven by Des Adeley had a faultless run.

John finished by commenting that "The weather was fine, sunny and rather warm, and the hospitality of Staines MES members was great. Our thanks go to Staines for a most enjoyable time".

Members of Reading SME were surprised by the appearance of a large 5in. gauge locomotive at the track recently in the form of the ex-Ron Etter *Shay*, now owned by Mike Jones. This magnificent locomotive had a boiler test and then completed several laps of the track with no effort. Although 5in. gauge, it is built to a scale of 2 1/2in. to the foot making it a very large



Ron Etter's fine 5in. gauge Shay locomotive at the Reading SME track.

locomotive. Some maintenance work has been carried out on the raised track. This was needed because a stream runs under part of the track and the support beams had sunk in that area, giving a switchback ride.

Another event taking place on 3 September is the LBSC Memorial Bowl Competition which is being held at the City of Sunderland MES track site on that day. This year is the society's 75th anniversary so the event should be a special one. New axles and wheels have been fitted to the five 7 1/4in. gauge passenger bogies and the 5in. gauge bogies have also been refurbished. Ken Buckingham's Stanley Steam Car has been successfully hydraulic and steam

tested. This vehicle apparently has an Oldsmobile body.

The newsletter of the Sutton MEC contains some "workshop definitions" which readers may well appreciate. I include a selection this time;

Drill Press – A tall upright machine useful for suddenly snatching flat metal bars out of your hands so that they smack you in the chest and fling your beer across the room, splattering it against that freshly painted part you were drying.

Wire wheel – Cleans the paint off bolts and then throws them somewhere under the workbench at the speed of light.

Hydraulic jack – Used for lowering a car to the ground after you have installed your new brake

shoes, trapping the jack handle firmly under the bumper.

Eight foot long 4x2 timber – used for levering the car up off the hydraulic jack handle.

More soon!

Worthing DSME has gained six new members in recent months, which is a good sign that model engineering is alive and very well. The biennial exhibition this year was opened by Anthony Bullied, the eldest son of the late Oliver Bulleid of the Southern Railway.

World News

New Zealand

Some 23 members of the Hutt Valley MES attended a general meeting at the Mainline Trust's depot at Plimmerton in March. Members had a chance to look at the 7 1/4in. gauge model of *Gloria J1211* which was stripped down for work on the piping in the Briggs firebox. The group also then saw the full size *Gloria* in the main engine shed before moving out into the yard to look at the facilities there including a pit that allows wheel sets to be dropped and moved sideways before being lifted with a mobile crane. Trust member Ian Welch guided the group and answered the questions during their visit.

- 13 St. Albans DMES. Puffing Field Morning. Contact Roy Verden: 01923-220590.
- 13 Surrey SME. Public Running. Contact John Cook: 020-8397-3932.
- 13 Sutton MEC. Track Day. Contact Bob Wood: 0208-641-6258.
- 13 Worthing DSME. Public Running. Contact Bob Phillips: 01903-243018.
- 13 York City & DSME. Running Day. Contact Pat Martindale: 01262-676291.
- 14 Bedford MES. Centring. Contact Ted Jolliffe: 01234-327791.
- 14 Erewash Valley MES. Meeting. Contact Jim Matthews: 01332-705259.
- 14 Melton Mowbray DMES. Summer Evening Steam-Up. Contact Phil Tansley: 0116-2673646.
- 14 Saffron Walden DSME. Club Night. Contact Jack Setterfield: 01843-596822.
- 15 Basingstoke DMES. Bring & Buy Evening. Contact Guy Harding: 01256-844861.
- 15 Chesterfield MES. Howard Turner: Great Central – Chesterfield to Sheffield. Contact Mike Rhodes: 01623-648676.
- 15 Northampton SME. Running Night. Contact Pete Jarman: 01234-708501 (eve).
- 15 South Durham SME. Afternoon Steam-Up. Contact B. Owens: 01325-721503.
- 16 Bournemouth DSME. Barbecue. Contact Dave Fynn: 01202-474599.
- 16 Bristol SMEE. Meeting. Contact Trevor Chambers: 0145-441-5085.
- 16 Hull DSME. Auction. Contact Tony Finn: 01482-898434.
- 16 Maidstone MES (UK). Members' Playtime Run. Contact Martin Parham: 01622-630298.
- 16 Stockholes Farm MR. Members' Evening Running. Contact Ivan Smith: 01427-872723.
- 16 West Wiltshire SME. Steam-Up. Contact R. Nev. Boulton: 01380-828101.
- 17 Bedford MES. School Holiday Running. Contact Ted Jolliffe: 01234-327791.
- 17 Cardiff MES. Forum. Contact Don Norman: 01656-784530.
- 17 Harlington LS. Public Running. Contact Peter Tarrant: 01895-851168.
- 17 Leyland SME. What is it Night? Contact A. P. Bibby: 01254-812049.
- 17 Sutton MEC. Evening Steam-Up. Contact Bob Wood: 0208-641-6258.
- 18 Canvey R&MEC. Meeting. Contact Brian Baker: 01702-512752.
- 18 North London SME. Loco Section Barbecue. Contact David Harris: 01707-326518.
- 18 Rochdale SMEE. Video Night. Contact Mike Foster: 01706-360849.
- 18 Romford MEC. Track Maintenance. Contact Colin Hunt: 01708-709302.
- 18-20 Guild of Model Wheelwrights. Bristol MES Show, Thornbury, Nr. Bristol. Contact Biddy Hepper: 01492-623274.
- 19/20 Basingstoke DMES. Gala Weekend. Contact Guy Harding: 01256-844861.
- 19 Canvey R&MEC. Members' Running Day. Contact Brian Baker: 01702-512752.
- 19 Chesterfield MES. Public Running Day. Contact Mike Rhodes: 01623-648676.
- 19 National 2 1/2in. Gauge Ass'n. Northern Area Autumn Rally. Contact Clive Young: 01233-626455.
- 19/20 Nottingham SMEE. Miniature/Model Rail Event. Contact Graham Davenport: 0115-8496703.
- 19 Romford MEC. Trackside Afternoon. Contact Colin Hunt: 01708-709302.
- 20 Birmingham SME. Simply Trains Day. Contact John Walker: 01789-266065.
- 20 Bournemouth DSME. Charity Day. Contact Dave Fynn: 01202-474599.

- 20 Frimley & Ascot LC. Club Running. Contact Bob Dowman: 01252-835042.
- 20 Guildford MES. Public Running. Contact Dave Longhurst: 01428-605424.
- 20 Leicester SME. Club Competition Day. Contact Raymond Wallis: 0116-285-8824.
- 20 Plymouth MSLS. Public Running. Contact John Brooker: 01752-671722.
- 20 Rugby MES. Public Running. Contact David Eadon: 01788-576956.
- 20 Saffron Walden DSME. Running Day (public running after 2pm). Contact Jack Setterfield: 01843-596822.
- 20 Guild of Model Wheelwrights. Mid-Somerset Show, Shepton Mallett. Contact Biddy Hepper: 01492-623274.
- 21 Model Steam Road Vehicle Soc. Vintage Motorcycles. Contact Geoff Miles: 01869-247602.
- 21 Peterborough SME. Barbecue & Drive-a-LoCo Evening. Contact Ted Smith: 01775-640719.
- 22 Hornsby ME. Social Night. Contact Ted Gray: 9484-7583.
- 24 Sutton MEC. Busy Night. Contact Bob Wood: 0208-641-6258.
- 24 Worthing DSME. John Rea: Workshop Ideas. Contact Bob Phillips: 01903-243018.
- 25 Hereford SME. Meeting. Contact Nigel Linwood: 01432-270867.
- 26 Bedford MES. Club Running Day. Contact Ted Jolliffe: 01234-327791.
- 26-28 Harrow & Wembley SME. Open Weekend. Contact Roy Goddard: e-mail RSGwattford@aol.com
- 26 Hornsby ME. Family Day & Boiler Inspection. Contact Ted Gray: 9484-7583.
- 27 Amnerfield Miniature Railway. Public Running. Contact David Jerome: 0118-9700274.
- 27/28 Bedford MES. Bank Holiday Running. Contact Ted Jolliffe: 01234-327791.
- 27/28 Bristol SMEE. Public Running. Contact Trevor Chambers: 0145-441-5085.
- 27 Cambridge MES. Members' Steam-Up. Fulbrook Road. Contact Rex Mountfield: 01284-386128.
- 27/28 Cardiff MES. Summer Bank Holiday Open Days. Contact Don Norman: 01656-784530.
- 27/28 Claymills Pumping Engines. Open Days. Contact B. Eastough: 01283-812501.
- 27 Edinbrough SME. Track Running Day Steam & Diesel. Contact Robert McLucke: 01506-655270.
- 27 Guildford MES. Members' Running Day. Contact Dave Longhurst: 01428-605424.
- 27 Hereford SME. Public Running. Contact Nigel Linwood: 01432-270867.
- 27 High Wycombe MEC. Public Running. Contact Eric Stevens: 01494-438761.
- 27/28 Malden DSME. Public Running. Contact John Mottram: 01483-473786.
- 27/28 Northern Mill Engine Society. Open Days. Contact John Phillip: 01257-265003.
- 27/28 Nottingham SMEE. Public Running. Contact Gerry Chester: 0115-9259096.
- 27/28 Papplewick Pumping Station. Steaming Days. Enquiries: 0115-963-2938.
- 27/28 Romney, Hythe & Dymchurch Railway. Day of Syn Festival. Information: 01797-362353.
- 27 Staines SME. Public Running. Contact Stan Bishop: 01784-241891.

**THE MODEL
ENGINEER
EXHIBITION**

29-31
december
2006

In association with Model Engineer, Model Engineers' Workshop and Model Boats



*Traction
Engine.*



Loco.

BACK ISSUES

CLUBS AND SOCIETIES

COMPETITION DISPLAYS

SUBSCRIPTION OFFERS

FREE DAILY LECTURES

TRADE STANDS

**NEW
VENUE!**

olympia 2

LONDON

Getting to the venue is easy with trains, tubes and buses. For further travel information please visit: www.eco.co.uk or call +44 (0)20 7385 1200



Kensington Olympia (Mainline trains)

Silverlink and Southern Trains run direct services to both these stations from Clapham Junction, Gatwick Airport, Brighton, Watford Junction and Willesden Junction.



Kensington Olympia (District Line)



Olympia is served by the following bus routes

Hammersmith Road 9, 10, 27, 28, Holland Road 49, North End Road 391

**FOR FURTHER
INFORMATION AND
TICKET PRICES
CALL: 01689 899 228/9**

HURRY!
Offer ends
17 August

FREE
delivery
straight to
your door

Never miss
an issue

 BY PHONE: **01689 899200** quote ref. E081

ONLINE: www.subscription.co.uk/mde/E081

 BY POST: Complete the form below



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

UK (SAVE £18%)	Europe (incl Eire)	US Airmail	ROW Airmail
☐ £53.50	☐ £78.00	☐ \$136.00	☐ £85.00

☐ **Postal Order/Cheque** ☐ **Visa/Mastercard** ☐ **Switch** ☐ **AmEx**
Please make cheques payable to Encanta Media Ltd and write code E081 on the back

Cardholder's name

Card no. _____

[illegible]

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 £12.99 every 3 months by Direct Debit

Name of bank

Address of bank

Postcode

Account holder

Signature _____ Date _____

[illegible]

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.

[illegible]

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

TERMS & CONDITIONS: Offer ends 17 August 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 at the Publisher's sole discretion. Encarta Media Ltd, publishers of *Model Engineer*, may contact you or share information with other reputable companies to let you know about products and services that may be of interest. Tick if you do not want to receive information about offers from us ☐ or from third parties ☐

Photocopies of this page are acceptable

Code E081

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

MODEL ENGINEER

CLASSIFIED

Tel: 01689 899 215

Fax: 01689 899 266

Email: jenni.collins@encanta.co.uk

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

MODELS & MATERIALS

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

COMPLETE HOME WORKSHOPS

AND MODELS PURCHASED.
DISTANCE NO OBJECT

Tel: Mike Bidwell on
01245 222743

MODEL MAKING METALS

1/8in. to 12in. 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. ME,
Ridge Hill Farm, Little Horwood Road, Nash, Milton Keynes,
MK17 0EH Tel: (01296) 713631 Fax: (01296) 713032
Web: mkmetals.sageweb.co.uk Email: sales@mkmetals.co.uk

SOCKET SCREWS

Cap. Csk. Button. Set (Grub). Shoulder
METRIC. BA. BSF. BSW. UNF. UNC
Hexagonal & Slotted Screws Nuts & Washers.
Dowel & Spring Pins. Dormer HSS Taps & Drills. Draper Tools.

NO MINIMUM ORDER PROMPT SERVICE

Send 4 x 1st class stamps for our latest catalogue

Special offer ***** Workshop Discount Pack *****

30 different packets of socket, hex. and slotted screws

Pack 1. BA 8BA to 2BA.

Pack 2. Metric M2 to M6.

Catalogue value of pack is over £35.00 + p/p

Either pack on offer to you

for only £24.95 + £2.95 p/p

Send for this offer and benefit from a very

useful stock of screws in your workshop.

You will not be disappointed. Refund guaranteed.

Emkay Screw Supplies (ME)

74 Poppy Way Strood Rochester Kent ME2 3LL

Email: emkaysupplies@onetel.net

Tel: 01634 717256 www.emkaysupplies.co.uk Mail Order Only



BOOST PHASE CONVERTERS

- PRICE GUARANTEE
- PERFORMANCE GUARANTEE
- 3 YEAR WARRANTY
- WORLDWIDE DELIVERY
- OUTSTANDING DESIGN
- COMPREHENSIVE SUPPORT

Boost Energy Systems
Park Farm, West End Lane,
Warfield, Berkshire RG42 5RH
Tel: 01344 303 311
Fax: 01344 303 312
Mob. 07952 717960
www.boost-energy.com
info@boost-energy.com

HIGH QUALITY UK PHASE CONVERTERS SINCE 1957

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 26 Page List (Overseas £2.50) 'Quote Me'

"ITEMS" MAIL ORDER LTD,
46, ST. MARTINS ROAD, NORTH LEVERTON,
RETFORD NOTTINGHAMSHIRE DN22 0AU
Telephone 01427 884319 Fax 01427 884319

MARSHALL 7 NHP TRACTION ENGINE

3" scale MARSHALL 7 NHP single cylinder
general purpose Traction Engine of 1910
'PRIDE OF THE ROAD'



BRUNELL MODELS

SEND NOW for our fully illustrated
A4 catalogue with 54 models, some in full colour
Stationary, Marine, Traction Engines and Locomotives
UK £5.50 • Europe £7.50 • Rest of world £9.50

Starting cheque/credit card only. All incl. p&p.

Order on line at: www.brunell.com

Brunell Models, Unit 31, Heysham Business Park,
Middleton Road, Heysham, Lancs. LA3 3PP

email: sales@brunell.com • Fax/Ans 01524 855887

DRAWINGS AND CASTINGS



4" scale Tasker "Little Giant" Steam Tractor
3" & 5" x 4" Marine Compound Engine
3" scale Rider-Ericsson Hot Air Pumping Engine



For full details send a large SAE - or see our website.

Camden Miniature Steam Services

Barrow Farm, Rode, Frome, Somerset. BA11 6PS

www.camdenmin.co.uk Tel: 01373 - 830151

www.modelsteamenginesuk.com



COWELLS SMALL MACHINE TOOLS LTD

Tendring Road, Little Bentley, Colchester, Essex, CO7 8SH

Tel/Fax +44 (0) 1206 251792 E-mail sales@cowells.com

MANUFACTURERS OF PRECISION SCREW CUTTING LATHES,

ANALOGICAL COLLET LATHES AND MILLING MACHINES.

www.cowells.com

MODELS & MATERIALS



Carr's Solders



Cadbury Camp Lane,
Clapton in Gordano, Bristol. BS20 7SD
Tel: 01 275 852 027 Fax: 01 275 810 555
Email: sales@finescale.org.uk
www.finescale.org.uk

GB BOILER SERVICES

COPPER BOILERS FOR LOCOMOTIVES AND TRACTION ENGINES etc

MADE TO ORDER

Constructed to latest European Standards
71/4" gauge and P.E.D. category 2 Specialist

NO VAT

Enquiries, Prices and Delivery to:

Tel: **Coventry 02476 733461**

Mobile **07817 269164**

Amazing New Guide to Metal Plating! "Yes!
You Can Do Your Own Professional
Grade Metal Plating, **QUICLY AND EASILY** and for a **FRACTION**
of the Cost, With This Top-Notch Metal Plating Information."

FREE REPORT at www.metalplatingbook.com

All large steam engines wanted

Anything considered from 4" to 15" traction
engines, locos, boats, stationary engines. Any
condition. Finished or unfinished projects.
Distance no object. Will call and pay cash.

Tel: 01507 606772

(Kevin)

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 build included,
OR JUST PLAIN WORN OUT!!

Will collect anywhere and **PAY CASH.**

For an informal chat telephone **01507 606772**

KITTLE HOBBY

Sharp milled (not rolled) brass sections
from 1mm to 10mm.

Sold in metres.

Send sae for list to:

PO BOX 5, YSTALYFERA,
SWANSEA, SA9 1YE

TEL: 01639 731005

www.kittlehobby.com

Paul Gammon Technical Services



STAINLESS STEEL
SUPERHEATERS
WATERPIPE CONNECTOR KITS
PAINT LINING PEN 1-4

'Trevi', Whitby Road, Pickering, North Yorkshire YO18 7HQ

Tel/Fax: 01751 473472

Email: pgtecser@yahoo.co.uk

SAE all enquiries please

Little Samson Models

SCALE MODEL
TRACTION ENGINE
DESIGN AND CONSTRUCTION



Edward Gosnell

Best
Seller



38 Wheatsheaf Way, Linton,
Cambridge CB1 6XD
www.littlesamson.co.uk
email:
edward@littlesamson.co.uk

Little Samson Steam Tractor

Available in 3", 4" and 6" scale

Universal Carrier Steam Lorry

Available in 3" scale

Both Models serialised in the Model Engineer
Machine cut gears including differential
Fully tested and certified boilers (Bell Boilers)
Comprehensive sets of laser cut components
Lost wax castings, name plates, spun brass chimney caps
Book £35 inc p&g (UK), signed on request
All normally in stock and posted by return
Cast wheels option saves weeks of work
Catalogue £2.50 post free (UK) Sorry cheques only

Oliver

Aciera 1.3 complete with operation manual.
Boost 240v converter fully tested, January 2006.
H&V attachment, Rotary Table, Rotary Vice, Fixed Vice.
Dividing Head and Tail stock, 2 collet shanks, 4 Arbors & collets.
Cupboard 30x28x18 with 46x18 Bench top.
Quorn tool cutter grinder complete with operation
manual & some attachments.
Selection of milling cutters & H.D. Bolt Set.
Price:- £5,000... O.N.O Delivery Negotiable.
Tel: 0191 496 0561

(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.

MODELS & MATERIALS

PENNYFARTHING TOOLS Ltd. The Specialist Tool shop

Quality Secondhand
Machine Tools
at Sensible Prices

We purchase complete Workshops,
Machines, Models and Hand Tools.
Agreed settlement on inspection -
Distance no object

Tel: Salisbury 01722 410090
Web Site: www.pennyfarningtools.co.uk

Practical Scale - Drawings, castings,
laser cut frames, etc for designs by
Neville Evans (including the Highland
Locos - Loch & Jones Goods, Penrhos
Grange and the forthcoming Schools
Class) are now available from
Polly Model Engineering Limited.
Tel: 0115 9736700
or see web page
www.pollymodelengineering.co.uk
for further details

Model Engineering Products (Bexhill)

www.model-engineering.co.uk
Email: diesel@17bexhill.fsnet.co.uk
Manufacturers of 5" and 7 1/4" diesel outline
battery electric locomotives and rolling stock.
Visit our shop to see the stock.
Colour brochure inc. p&p £1.75
PHONE/FAX. 01424 223702
MOBILE 07743 337243
17, SEA ROAD, BEXHILL ON SEA,
EAST SUSSEX. TN40 1EE.

**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

RRb Machining Services Ltd

General Turning and Milling
Screw cutting, Gear Cutting, Broaching
General fabrication work
One off or small batch work undertaken
Please contact us for a no obligation quotation.
Call 07725 806100 or
Email rrbmachining@yahoo.co.uk

Model Engineering Odds and Sods

Opening now at
Unit 0 Wallowes Industry
Estate, Brierley Hill DY5 1QA
For materials, fasteners,
taps & dies.
For catalogue please send
SAE (A4) to above address
Tel/fax: 01384 70455



Ortec

Ortec are manufacturers of low cost, high quality, precision digital
readout - DRO for machine tools such as milling machines for the
hobbyist and model engineering user. We offer a complete range of
readouts from 1 to 3 axis in a variety of encoder lengths.

Phone +44 (0)1481-235708
www.ortec.freemove.co.uk

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

EVENSON ENGINEERING

Quality Machines
and Tooling

Machine Sales

NEW MACHINERY IN STOCK

Harrison M300 Lathe, excellent condition	£3000
Colchester Student Mark 2 - K2 fully tooling with clutch pauper turning	£1650
Alexandra Toolmaker dividing head, NEW	£900
Schaubling Vertical Head	£600
Tom Senior milling machine, horizontal, excellent condition	£600
Alexandra Toolmaker Milling Machine complete with both table in outstanding condition	£1850
Boxford VSL Lathe Q.C.T. 4 jaw, 3 jaw phase plate	£1200
Chester 626 Milling Machine as new with power feed	£900
Union Jubilee wood turning lathe	£475
Union Graduate bowl turning lathe with accessories - mint condition	£575
Grimstone Tapping Machine with pitch control	£500
Elliot Shaper	£195

NEW TOOLING IN STOCK

Harrison M300 copy turning attachment complete	£475
Kennedy power hacksaw	£175
Tom Senior slotting head	£300
Duplex 226 tool post grinder as new (small)	£300
Myford compound vertical slide	£125

MISCELLANEOUS

Wadking knife/blade sharpener with tooling	£800
Odd size Thill collets	£900
Alexandra high speed head as new	£700
Alexandra spiral milling attachment as new	£700
Bridgeport slotting head	£800
Horizontal pedestal sander	£350

Denford Viceroy Lathe with gear box and tooling	£950
Myford mini cop lathe	£250
Edwards 3ft Treadle Glatton	£300
Viceroy Milling Machine vertical 30int good condition, excellent daylight	£1400
Tom Senior vrt/horis 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 grinder as new	£275
Elliot 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
HMylford Minicop copy turning lathe on cabinet	P.O.A.
Wadkin Universal Cutter Grinder Type N.H. with lots of tooling	£1,500
3 x Harrison LS lathe with Tooling	£900
3 x Harrison LS lathe with Tooling	£700 each
Grimstone 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
Versa tool, tool cabinet	£150
3 Point steady for Boxford 5" lathe	£100
3 Point steady for Dean Smith and Grace lathe	£200
3 Point steady for Colchester Master model 2500/student 1800	£200
Colchester student collett chuck	£120
Colchester student capstan hardly used	£300

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

WE ALSO PURCHASE QUALITY MACHINES & TOOLING * DELIVERY SERVICE AVAILABLE PLEASE TELEPHONE BEFORE TRAVELLING - WEEKEND & EVENING VIEWING AND DELIVERY SERVICE

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

MODELS & MATERIALS



**ALL YOU NEED
FOR YOUR
WORKSHOP**

www.warco.co.uk



LYNX MODEL WORKS LTD.

Dovecot House, Maltby le Marsh, Alford, Lincs LN13 0UP
Tel: 01507-451565 Mobile: 07899-806689
Website: www.lynxmodelworks.co.uk
Email: info@lynxmodelworks.co.uk

WORKING SCALE MODELS AND SPECIALIST SERVICES

Lynx Model Works - 5 Specialist Engineers working together to not only build beautiful Working Live Steam Locomotives from gauge 0 to 10 1/4, Traction Engines from 1/4 to 6" Scale, and Stationary Steam Plant Engines. We will also complete your unfinished project for you or renovate the one you've just bought, inherited or simply wish to rejuvenate in our Restorations Division.

We have expertise in building, completing and renovating the very beautiful and elegant Clarksons of York range of Working Steam Models and currently have 4 of these highly respected locomotive designs being built as specialist commissions for clients.

Lynx Model Painting and Machining Services will give your cherished model that professional, lined finish and also help you by manufacturing Specialist parts to assist you complete your current or planned project.

Lynx Model Boilers sells a range of Fully Certificated and EC-Compliant Copper and Steel Boilers, some ex-stock.

We are also Agents for Stuart Models and build the ones that Stuart don't!

Visit our Website (www.lynxmodelworks.co.uk) or contact us today with your requirements for a no-obligation quote or discussion. A full colour A4 Brochure shortly available - telephone or email for further details.

Renowned Quality & Service Together at the Right Price

ALL MAJOR CREDIT AND DEBIT CARDS ACCEPTED

Call John Clarke on 01507-451565

NEW! - Lower cost, compact, high performance speed controller and motor combination.

The new CL range features start, stop and emergency stop buttons and speed control with forward, reverse and jog. It comes complete with high quality motor and is ready to mount, plug in and go!



Call us now for more information and friendly advice on
01925 444773
or visit www.newton-tesla.com

**From only
£390 inc VAT**

Unit G18, Warrington Business Park, Long Lane, Warrington, Cheshire WA2 8TX, UK



Nemett 155 I/C Engine

- 15cc SOHC Four Stroke
- Machined from solid, no castings
- Easy toothed belt camshaft drive
- Spark or Glow ignition
- Aero or marine versions
- Cams cut on mill or lathe
- Fully detailed drawings
- Designed for those new to I/C engines

Drawings (15 A3 size sheets CAD produced) £45 (payable to M.L.Stride please)

Post free world wide.

Nemett, Box 001, Encanta Media Ltd, Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL

INTERNAL COMBUSTION ENGINES

DRAWINGS, CASTINGS, MATERIALS, SPARKPLUGS, TIMING GEARS, ETC AVAILABLE FOR A RANGE OF DESIGNS INCLUDING:



15cc Chenery Aero Twin

- 0.8CC & 5CC DIESEL
- 6CC TWO STROKE
- 10CC GLOW PLUG
- 2 CYL 30CC O.H.V.
- 4 CYL 30CC O.H.V.

WORKSHOP EQUIPMENT

DRAWINGS AND CASTINGS FOR MILLING ATTACHMENTS, BORING HEADS VERTICAL MILLING MACHINE ETC.

RADIAL & STATIONARY STEAM ENGINES

ILLUSTRATED CATALOGUE AND PRICE LIST £1.50

WORKING PRECISION MODELS

27 Petts Crescent, Littleborough, Lancashire, OL15 8ED

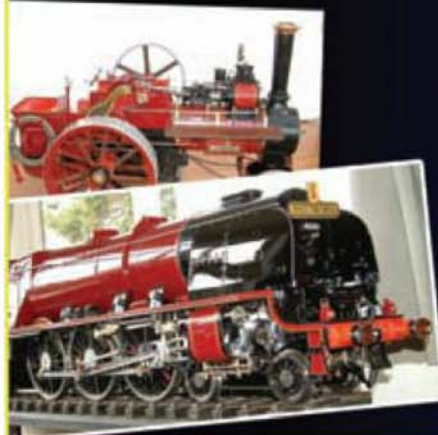
Tel: 0780 8446915 (day) 01706 377508 (evening)

e-mail: graham@workingprecisionmodels.co.uk

www.workingprecisionmodels.co.uk

ALL 3 1/2" GAUGE LOCO's WANTED

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



ALL 5" GAUGE LOCO's WANTED

Hunslett, jinty, Simplex, Speedy, BR Class 2, Horwich Crab, BR 8400 tank, Maid of Kent, Black Five, Jubilee, Royal Engineer, BI Springbok, Torquay Manor, Castle, A3/A4

ALL TRACTION ENGINES WANTED

Minnie, Burrell, Royal Chester, Showmans, etc

ALL PARTBUILT MODELS WANTED

We also purchase WORKSHOP EQUIPMENT

Regular collections made throughout:

SCOTLAND, ENGLAND AND WALES

For a professional friendly service, please tel:

GRAHAM JONES M.Sc. 0121 358 4320

visit our website: www.antiquesteam.com

ALL 7 1/4" GAUGE LOCO's WANTED

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



MODELS & MATERIALS

NEIL GRIFFIN

- St. Albans, Hertfordshire
Engineering Services

Machining for Model Engineers
From drawing, sketch, pattern etc.

Friendly personal service.

Telephone / Fax: 01727 752865

WESTERN STEAM

Model Engineers

Founder Member Assn of Copper Boiler Manufacturers (ME)

COPPER BOILERS

For Locomotive, Traction, Marine & Stationary engines, to PER cat 2. All copper construction, silver soldered throughout using quality materials to the standards required by the APCBM/ME, PER, & relevant Model Engineering Associations. CE marked and certificates of proof test and conformity supplied.

Write or phone to Helen Verrall:
Unit 4A, Love Lane, Burnham-on-Sea
Somerset, TA8 1EY
Tel: 01278 786 007
Visit our website: www.westernsteam.co.uk

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

PART BUILT MODELS

All locomotives, at any stage of construction. Completed models also bought. Traction engines and all Stuart stationary engines wanted - beam, vertical, horizontal etc, part built or complete. Will travel any distance.

Please telephone Graham. 0121 358 4320. m

PUBLICATIONS

CLOCK CONSTRUCTION & REPAIR

Books by John Wilding and others

Free Catalogue
01420 487 747

www.ritetimepublishing.com

THE TOOL BOX

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

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

Open Monday - Saturday throughout the year

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

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

STATION ROAD STEAM

Good prices paid for live steam models in any condition, broken or part-built through to exhibition quality. Collections purchased. Locomotives, traction and stationary engines, bought, sold and part-exchanged.



- Locomotives from gauge 1 to 10 1/4 inch •
- Miniature railway equipment, rolling stock etc •
- Traction engines from 1/4 inch to half full-size •
- Stationary engines from table-top models to full size, including designs by Stuart Turner, Westbury •
- Spirit, gas and coal-fired boilers in all sizes •
- All types of restoration projects & part-built models •

Fully serviced and tested locomotives and traction engines supplied with our renowned "no quibble" written warranty

Large range of items in stock, available for inspection and trial at our premises at any time, by appointment. Comprehensive workshop facilities on site. Advice, valuations and driving tuition freely given. World-wide mail-order service, goods supplied on 7 days approval, competitive shipping rates.

Fully illustrated and priced catalogue online at
www.stationroadsteam.com
Telephone Lincoln 01526 320012

Non-Ferrous material supplied in all forms, tailored to your need by size & quantity. Aluminium, Brass, Copper & Stainless steel, Silver steel, Gauge plate, B.M.S. steels.

Catalogue free.

P.L.Hill (Sales) Ltd

Unit 3 Crownworks, Bradford, BD4 8TJ

Tel/Fax: 01274 733300

Email: plhillsales@aol.com www.plhillsales.com

R. A. ATKINS

MODEL ENGINEERING
MACHINES & TOOLS

100's of Engineers Tools In Stock

WE URGENTLY REQUIRE TO BUY
COMPLETE WORKSHOPS OR
SINGLE MACHINES

Immediate Inspection & Settlement

Tel: (01483) 811146 Fax: (01483) 811243

Hunts Hill House, Hunts Hill, Normandy,
Guildford, Surrey GU3 2AH

MODEL ENGINEER

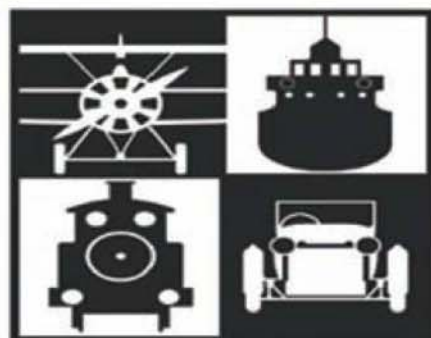
RCM ENGINEERING LTD.

Machine Tools.	Taps & Dies.
Hand Tools.	Materials.
B.A. Nuts & Bolts.	Machining Service

23 Egerton Road, Dronfield,
Sheffield S18 2LG
Tel: 01246 292344
Fax: 01246 292355

Mon-Fri 8.30-5.30
Sat 10-3
Sun CLOSED

(Out of hours appointments also available)



THE MODEL ENGINEER EXHIBITION

FOR MORE INFORMATION CALL: 01689 899 228/9

MODELS & MATERIALS



QUALITY MACHINES AT UNBEATABLE PRICES

A range of measuring equipment, surface plates, marking out tables, boring heads, chucks & tooling always available!

Colchester Chipmaster [2 machines]	£950/£1450	Meddings MF4 Pillar Drill	£675
Colchester 'Bantam-1600' DRO, collets	£1750	Elliott 2G Pillar	£450
Colchester 'Master' MKII	£1650	Startrite 250/10 Bench	£375
Boxford A' collets, chuck	£750	Meddings & Startrite Drills	from £225
Harrison 12" [Ex research]k	£1200	Inger Surface hydraulic table, chuck	£1200
Harrison M300	£1450	Jones & Shipman 540 Surface	from £950
Gate 'Sturditurn' [1994]	£1750	March T&C Grinder. With equipment	£750
Smart & Brown 1024-VSL, 5C collets	£1850	Clarkson MK1 T&C Grinder	from £350
Colchester 'Triumph-2000' from	£2500	Double ended & pedestal grinders from	£25
Elliott '0-0' Onmimil [Ex medical school]	£1450	Dronsfeld 'Eagle' Surface Grinder, chuck	£750
Bridgeport BRJ DRO, tooling [2 machines]	£1250	Alexander 2GC Cutter grinder, collets	£450
Condor 1050KV Turret .vari speed. DRO	£1650	Wadkin BAO Planer /Thickneser [as new]	£1200
Wickstead 'Econicut' 6" Power Hacksaw	£350	Wadkin LTA Disc/Bobbin Sander	£1000
Qualters & Smith 6" Power Hacksaw	£475	Multico Planer/Thickneser 9" 1 phase	£250
Startrite H175 Horizontal Bandsaw	£495	Phillipson vertical belt sander 1.5" wide belt	£500
Bridgeport Slotting Attachments [2 units]	£450	Machine Vices	from £25
Abwood Universal Vice	£120	Rotary Tables	from £50
Hydravane PUM 23 Compressor	£350	Gyrwheel Jig Grinding att [cost new £3K]	£300
Taylor Hobson Type 'D' Engraver	£200	Walton 305 Projectorscope bench	£400

All Prices
INCLUSIVE
of VAT!

TEL/FAX: 01892 836628 MOBILE: 07702-124466/07787-768398 EMAIL: MBMACHINES@BTINTERNET.COM
MASCALLS POUND FARM, MAIDSTONE ROAD, PADDOCK WOOD, KENT TN12 6LT

FOR SALE

SERVICES:

Laser cut parts for locomotives, traction engines etc.
Frames, tenders, cabs, spokes horn plates etc.
01302 721 611 [Doncaster]

BOOKS AND PUBLICATIONS:

Wanted copy of F J Camms dictionary of metals and
allows fair price paid for clean copy. 01837 52859

MODEL AND MATERIALS:

Steel boiler some castings UN – machined full
drawings for 2" Durham north Yorkshire traction engine
£550 Tel: 01507 354983

Ruston 5" gauge electric shunter by maxitrac £480 +
carriage. Atkinson steam lorry 1" scale £1100 + car-
riage. Both models well made with little use.
Tel Tony 01482 703140[hull]

5" gauge super simplex as 2-6-4 southern river class
chedder boiler just completed and RUH fully certificated
£4950 OVNO. Tel: 01689 880368

5" gauge GWR grange locomotive. Built to works draw-
ings 2003 current boiler certificate £4500
Tel: 01633 864994

5" gauge metro. Partbuilt rolling chassis
professional boiler, castings, drawings £1050
Tel: 01274 881803[west Yorkshire]

Workshop Equipment:

Collet lathe for sale 3" centre height 14" centres many
collets 4" jaw chuck. Phone Ian on 01553 760503

Britannia gap bed bench lathe probably pre-war 4" chuck
14x change wheels ideal restoration project, £165, 01794
517321

Colchester capstan attachment for Colchester
bantam, £150

No 2 fly press with out rigger, old but good £25,
Tel: 02476 411 660[Coventry]

32 imperial, cylinder bore gauges. All in their
original "tool room" box, £36 01775 640 112

Boxford training lathe 4 _ x 20" T.U.D non-screw
cutting good condition 3 saw chuck single phase cabinet
stand £200 Tel: 0161 366 7190

Boxford T.U.D 4" _ x 18" good condition £350. Myford 3"
x 12" 240v good condition £250, Clark hoist 250h.g lift
240v £70 Tel: 01452 728384

Warco BH-600 Gap-bed lathe, fully tooled. Excellent con-
dition, light use only, dual dials, imperial
lead- screw, £975.o.n.o, Tel: 01789 841 223.

Vertical miller 2MT with Myford collects single phase
motor and starter, VGC £425 Tel:01953 884 727 [Norfolk]

HITACHI GIANT EXCAVATOR EX1800 1/60TH
MINT IN BOX 10"x6"x5" ONE OF TWO IN UK
PICTURE AVAILABLE
01278741627

GENUINE MACHINES AND TOOLING HOME AND WORKSHOP MACHINERY

QUALITY USED MACHINE TOOLS

144 Maidstone Road, Fooks Cray, Sidecup, Kent DA14 5HS

Telephone 0208 300 9070 - Evenings 01959 532199 - Facsimile 0208 309 6311

www.homeandworkshop.co.uk stevehwm@btopenworld.com

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

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

**FREE DELIVERY/UK
MAINLAND ON ANY
ITEM IN THIS ADVERT
ONLY PURCHASED IN
AUGUST 2006**



Eliot 14S 14" stroke shaper in excellent condition



Boxford AUD 4 1/2"x20" gearbox, power cross-feed + Jaguar Cub inverter fitted



Harrison 140 5 1/2"x24" lathe

BCS jig borer on stand + collets and tador made Transwave converter £1125
Tom Senior M1 vertical/horizontal milling machine £1250
Bridgeport turret milling machine Coming In
Myford MA99E chuck type
Imp./Met. collets each £20
Raglan/Littlejohn accessories just in

Clarkson radius attachment £425
Denford Viceroy pedestal 3MT drill £245
Granite surface plates £120/£145/Pink £425
Myford vertical slides (Not copies) from £140
Boxford collets (Not copies) each £12
To clear/As is: Myford ML7 £495
Boxford TUD £300
Viceroy £495



Keetona 1 metre 16g guillotine + stops



Calchester Student 1800 lathe complete with inverter on single phase



Jones & Shipman/Eliot dividing heads



Harrison vertical milling machine, 30 INT head + 30"x8" powered table and coolant



Startrite 20 RWH (hydraulic) vertical metal cutting bandsaw



Tom Senior slotting head for M1/Major models



Startrite metal cutting bandsaw (8 speed)

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



Myford Super 78 lathe 3 1/2"x19" lathe



Q&S 6" hacksaw



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



Gabro AC450 knotther



Viceroy buffing machine complete with built in extractor



Boxford 1130, 5 1/2"x30"

Milling/Drilling ground X-Y table



Smaller items; also keyway broaches individually!



Boxford pedestal 1/2" 2MT drill



Eliot U1 horizontal milling machine 40"x11" table



Boxford 240 TCL CNC slant bed lathe



Eliot U1 horizontal milling machine 40"x11" table



RJH 4" finisher complete on dust extraction cabinet stand



Harrison M300 lathe complete with gap and tooling



One of many different size sets of keyway broaches



Harrison Jubilee polisher



Crompton Parkinson Motors NEW 3/4HP ideal for Myford & Boxfords etc



Henry Milnes vertical milling machine



Boxford 260VMC 3 axis vertical milling machine



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



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



Norton No.6 flypress complete with Hunton bolster



PLEASE PHONE 0208 300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST

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

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 LTD

Ciwyd Close, Hawarden Industrial Park, Nr. Chester, CH5 3PZ
Tel: +44(0)1244 531631 Fax: +44(0)1244 531331
Email: sales@chesteruk.net Web: www.chesteruk.net



Table Size 90x404mm

Motor Size 350W

Dimensions

490x445x860mm

Weight 55Kg



Conquest Mill £450

Swing Over Bed 180mm

Distance Between Centres 325mm

Motor Size 400W

Dimensions 770x254x300mm

Weight 38Kg



Conquest Lathe £365

Swing Over Bed 420mm

Distance Between Centres 520mm

Motor Size 0.55Kw

Dimensions

930x690x1090mm

Weight 155Kg



Model B 3-in-1 £725

Swing Over Bed 420mm

Distance Between Centres 520mm

Motor Size 0.55Kw

Dimensions 930x690x1090mm

Weight 155Kg



Centurion 3-in-1 £1,250

Now Open
New Midlands Showroom
For Details Contact

Rotagrip Ltd
16-20 Lodge Road
Hockley
Birmingham
B18 5PN
Tel: +44(0)121 5511566
Fax: +44(0)121 523 9188
Email: rotagrip@blueyonder.co.uk

Midlands Showroom

Swing Over Bed 300mm

Distance Between Centres 570mm

Motor Size 1.1Kw

Weight 390Kg



Craftsman Lathe £1,525

Table Size

156 x 745 mm

Motor Size 1.1KW

Dimensions

1085x990x1710

Weight 410Kg



*Shown With
Optional P/Feed

626 Mill £1,395

Max. Cutting Capacity @ 90° 90mm

Max. Cutting Capacity @ 45° 65mm

Dimensions 760x295x465mm



Motor 420W

Weight 70Kg

H80 Bandsaw £125

Shearing Thickness(Steel) 0.6mm

Bending Thickness 1mm

Rolling Thickness 1mm

Weight 45Kg



12" Multifformer £145

All prices include VAT & Delivery UK mainland only