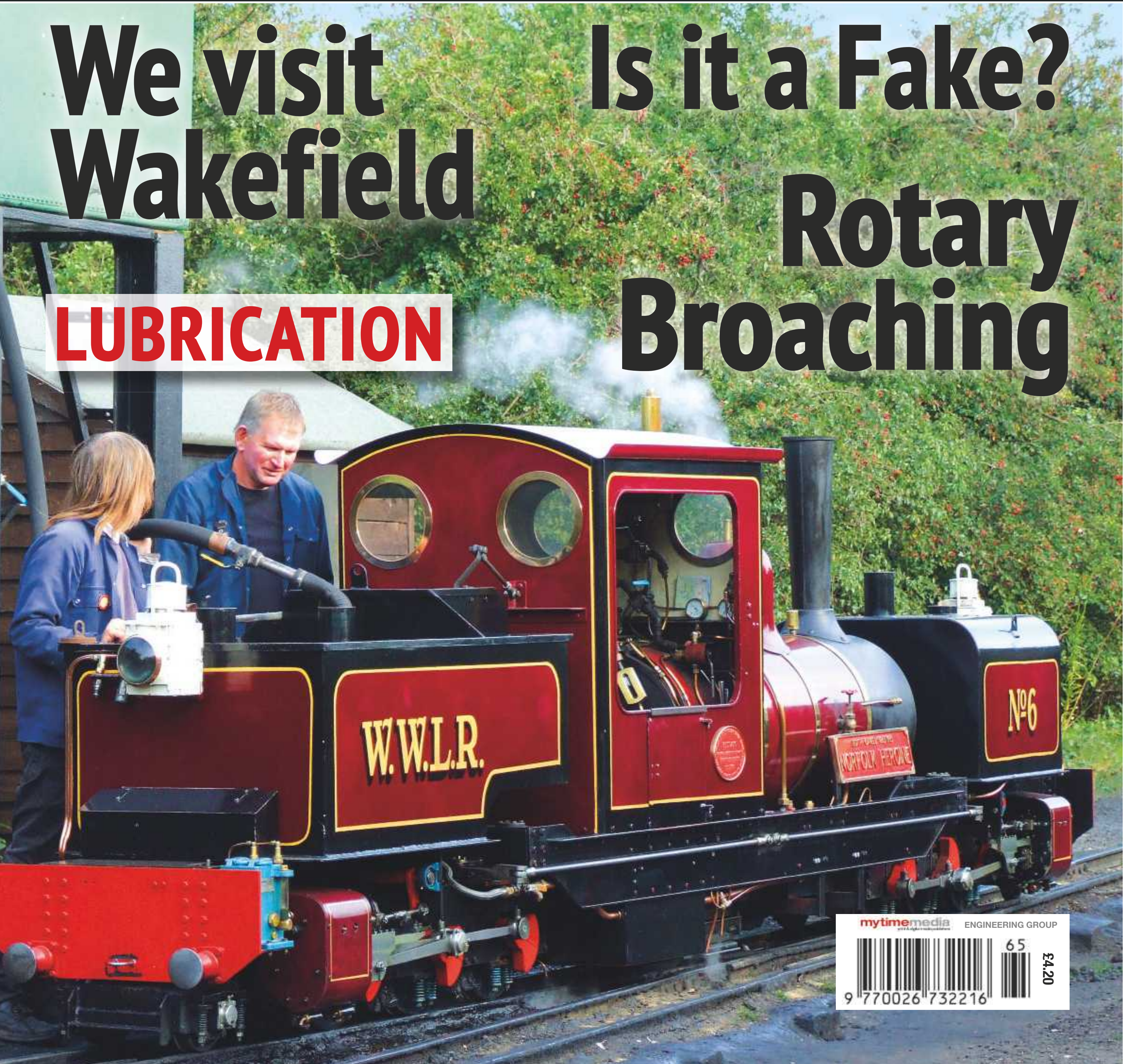
THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 226 No. 4665 • 21 May - 3 June 2021

MODEL ENGINEER

Join our online community **www.model-engineer.co.uk**



We visit Wakefield

Is it a Fake?

Rotary Broaching

LUBRICATION

mytimemedia ENGINEERING GROUP
65
£4.20
9 770026 732216

NEW STORE NORTHAMPTON OPENS IN MAY!

Machine Mart®

65 SUPERSTORES NATIONWIDE

Britain's Tools & Machinery Specialist!

Clarke METAL LATHE

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

£598.00 EXC.VAT £717.60 INC.VAT CL300M

NEW 500 PAGE CATALOGUE

GET YOUR FREE COPY!

IN-STORE

PHONE 0844 880 1265

ONLINE www.machinemart.co.uk

Clarke MILLING DRILLING MACHINE

• Bench mountable, tilts 45° left & right from vertical • Table travel 100x235mm • Table Effective Size LxW: 92 x 400mm

CMD300 £629.00 EXC.VAT £754.80 INC.VAT

CMD10 £419.00 EXC.VAT £502.80 INC.VAT

Clarke MICRO MILLING & DRILLING MACHINE

• Bench mountable • MT2 Spindle Taper • Face mill capacity 20mm, end mill 10mm • Table cross travel 90mm, longitudinal travel 180mm

MODEL	MOTOR	SPINDLE SPEED	EXC.VAT	INC.VAT
CMD10	150W/230V	100-2000rpm	£419.00	£502.80
CMD300	470W/230V	0-2500rpm	£629.00	£754.80

Clarke STATIC PHASE CONVERTERS

• Run big 3 phase woodworking machines from 1 phase supply • Variable output power to match HP of motor to be run

FROM ONLY £249.00 EXC.VAT £298.80 INC.VAT

CONVERT 230V 1PH TO 400V 3PH

PC60

ROTARY PHASE CONVERTERS ALSO IN STOCK

MODEL	MAX. MOTOR HP	FUSE	EXC.VAT	INC.VAT
PC20	2HP	10Amps	£249.00	£298.80
PC40	3.5HP	20Amps	£289.00	£346.80
PC60	5.5HP	32Amps	£339.00	£406.80

Clarke MMA & ARC/TIG INVERTER WELDERS

FROM ONLY £79.98 EXC.VAT £95.98 INC.VAT

AT165

MODEL	MIN/MAX OUTPUT CURRENT	ELECTRODE DIA. (MM)	EXC.VAT	INC.VAT
MMA80	20A-80A	1.6-2.5	£79.98	£95.98
MMA140	20A-140A	1.6-3.2	£99.00	£118.80
AT133	10A-130A	2.5/3.2	£129.98	£155.98
AT162	10A-160A	2.5/3.2/4.0	£149.98	£179.98
MMA200	20A-200A	1.6-4	£139.00	£166.80
AT135	10A-130A	2.5/3.2	£169.98	£203.98
AT165	10A-160A	2.5/3.2/4.0	£209.00	£250.80

Clarke MIG WELDERS

Quality machines from Britain's leading supplier. See online for included accessories

135TE

FROM ONLY £209.98 EX.VAT £251.98 INC.VAT

GAS, TIPS, SHROUDS, WIRE & HEADSHIELDS IN STOCK

MODEL	MIN-MAX AMPS	EXC.VAT	INC.VAT
PRO90	24-90	£209.98	£251.98
110E	30-100	£239.98	£287.98
135TE Turbo	30-130	£259.98	£311.98
151TE Turbo	30-150	£295.00	£354.00
175TECM Turbo	30-170	£469.00	£562.80
205TE Turbo	30-185	£499.00	£598.80

Clarke NO GAS/GAS MIG WELDERS

• Professional type torch with on/off control • Thermal overload protection • Turbo fan cooled • Easy conversion to gas with optional accessories

MIG102NG

FROM ONLY £124.99 EX.VAT £149.99 INC.VAT

BEST SELLER

*no gas only

MODEL	MIN/MAX AMPS	EXC.VAT	INC.VAT
MIG 102NG*	35/90	£124.99	£149.99
MIG 106	40/100	£159.00	£190.80
MIG 145	35/135	£189.98	£227.98
MIG 196	40/180	£229.00	£274.80
MIG 240	50/240	£399.00	£478.80

Clarke ENGINEERS BENCH VICES

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

BEST SELLER

CMV140

FROM ONLY £19.98 EXC.VAT £23.98 INC.VAT

MODEL	JAW WIDTH	BASE	EXC.VAT	INC.VAT
CV75B	75mm	Fixed	£19.98	£23.98
CV100B	100mm	Fixed	£20.99	£25.19
CVR100B	100mm	Swivel	£26.99	£32.39
CV125B	125mm	Fixed	£31.99	£38.39
CVR125B	125mm	Swivel	£38.99	£46.79
CV150B	150mm	Fixed	£49.98	£59.98
CVR150B	150mm	Swivel	£54.99	£65.99
CMV140	140mm	Swivel	£79.98	£95.98

Clarke DRILL PRESSES

• Range of precision bench & floor presses for enthusiast, engineering & industrial applications

FROM ONLY £69.98 EXC.VAT £83.98 INC.VAT

B = Bench mounted
F = Floor standing

CDP102B

MODEL	MOTOR (W) SPEEDS	EXC. VAT	INC. VAT
CDP5EB	350 / 5	£69.98	£83.98
CDP102B	350 / 5	£84.99	£101.99
CDP202B	450 / 16	£199.00	£238.80
CDP352F	550 / 16	£239.00	£286.80
CDP452B	550 / 16	£249.00	£298.80

Clarke HIGH VELOCITY FANS

GIANT SIZES UP TO 30"

FROM ONLY £36.99 EX.VAT £44.39 INC.VAT

MODEL	SIZE	EXC.VAT	INC.VAT
CBF20	20"	£36.99	£44.39
CFF18B100	18"	£39.98	£47.98
CFF18C100	18"	£39.98	£47.98
CPF18B100	18"	£49.98	£59.98
CAMAX24	24"	£169.00	£202.80
CAMAX30	30"	£219.00	£262.80

Clarke ARC ACTIVATED HEADSHIELDS

GWH4

FROM ONLY £37.99 EXC.VAT £45.59 INC.VAT

• Activates instantly when Arc is struck • Protects to EN379 • Suitable for arc, MIG, TIG & gas welding

SEE FULL RANGE IN-STORE/ONLINE

Clarke VENTILATORS

FROM ONLY £159.98 EXC.VAT £191.98 INC.VAT

CAM400 CON500

MODEL	SIZE	AIR FLOW	EXC.VAT	INC.VAT
CON305 (110V)	12"	3900m³/hr	£159.98	£191.98
CON350 (110V)	12"	3900m³/hr	£199.98	£239.98
CAM400 (230V)	16"	7200m³/hr	£299.00	£358.80
CON400 (110V)	16"	7200m³/hr	£329.00	£394.80
CAM500 (230V)	20"	9900m³/hr	£359.00	£430.80
CON500 (110V)	20"	9900m³/hr	£379.00	£454.80

TURBO AIR COMPRESSORS

airmaster

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

8/260

FROM ONLY £99.98 EXC.VAT £119.98 INC.VAT

ALSO HUGE RANGE OF CLARKE AIR TOOLS IN-STORE & ONLINE

MODEL	MOTOR	CFM	TANK	EXC.VAT	INC.VAT
8/260	2HP	7.5	24ltr	£99.98	£119.98
11/260	2.5HP	9.5	24ltr	£119.98	£143.98
8/550	2HP	7.5	50ltr	£129.98	£155.98
11/550	2.5HP	9.5	50ltr	£149.98	£179.98

Clarke WORKBENCH WITH PEGBOARD

BALL BEARING

Easy to assemble, providing valuable working space and plenty of additional storage capacity.

CWB-R1B

Available in Red or Galvanised Finish

£69.00 EXC.VAT £82.80 INC.VAT

• Dimensions (LxWxH) - 1150 x 560 x 1440 mm • Pegboard back wall with 30 hookssupplied

Clarke 3-IN-1 SHEET METAL MACHINES

SBR610

• Bend, Roll & Shear metal up to 1mm thick • Min. Rolling Diameter 39mm • Bending angle 0-90°

FROM ONLY £239.00 EXC.VAT £286.80 INC.VAT

ROLLING, SHEARING & FOLDING

MODEL	BED WIDTH	EXC VAT	INC VAT
SBR305	305mm (12")	£239.00	£286.80
SBR610	610mm (24")	£449.00	£538.80
SBR760	760mm (30")	£529.00	£634.80

Clarke INDUSTRIAL ELECTRIC MOTORS

• Range of single phase motors suited to many applications • All totally enclosed & fan ventilated for reliable long-term service

FROM ONLY £59.98 EXC.VAT £71.98 INC.VAT

HP	SHAFT SPEED	EXC. VAT	INC.VAT
1/3	4 pole	£59.98	£71.98
1/2	2 pole	£69.98	£83.98
3/4	4 pole	£79.98	£95.98
1	2 pole	£79.98	£95.98
2	2 pole	£94.99	£113.99
3	2 pole	£119.98	£143.98
4	2 pole	£149.98	£179.98

Clarke CONTRACTOR 18V BRUSHLESS COMBI DRILLS

• 2 forward and reverse gears

FROM ONLY £99.98 EXC.VAT £119.98 INC.VAT

powered by Li-Ion

CON180LI

MODEL	VOLTS	BATTERIES	EXC. VAT	INC. VAT
CON18LIC	18V	2x 2.0Ah Li-Ion	£99.98	£119.98
CON180LI	18V	2x 4.0Ah Li-Ion	£129.00	£154.80

Clarke BOLTLESS SHELVING/ BENCHES

• Simple fast assembly in minutes using only a hammer

150 KG PER SHELF (evenly distributed) Strong 9mm fibreboard shelves

350 KG PER SHELF (evenly distributed) Strong 12 mm fibreboard shelves

CHOICE OF 5 COLOURS RED, BLUE, GREY, SILVER & GALVANISED STEEL

FROM ONLY £33.99 EX.VAT £40.79 INC.VAT

MODEL	DIMS WxDxH(mm)	EXC.VAT	INC.VAT
150kg	800x300x1500	£33.99	£40.79
350kg	900x400x1800	£52.99	£63.59

Clarke 1 TONNE FOLDING WORKSHOP CRANE

BEST SELLER

ONLY £179.98 EXC.VAT £215.98 INC.VAT

• Folding and fixed frames available • Robust, rugged construction • Overload safety valve

CFC100

Fully tested to proof load

Clarke ANGLE GRINDERS

CON1150

INC. DISC & HANDLE

FROM ONLY £24.99 EX.VAT £29.99 INC.VAT

MODEL	DISC (MM)	MOTOR	EXC.VAT	INC.VAT
CAG800B	115	800W	£24.99	£29.99
CON1150	115	1150W	£27.99	£33.59
CAG2350C	230	2350W	£52.99	£63.59

Clarke HYDRAULIC LIFTING TABLES

• Ideal for lifting & moving models • Foot pedal operated

HTL500

FROM ONLY £319.00 EXC.VAT £382.80 INC.VAT

MODEL	MAX. LOAD	TABLE HEIGHT MIN-MAX	EXC. VAT	INC. VAT
HTL300	300kg	340-900mm	£319.00	£382.80
HTL500	500kg	340-900mm	£349.00	£418.80

Clarke ROTARY TOOL KIT

NEW £29.98 EX.VAT £35.98 INC.VAT

CRT130

Kit includes: • Rotary tool • Height adjustable stand with clamp • 1m flexible drive • 40x accessories/ consumables

Clarke BENCH BUFFERS/ POLISHERS

• For a brilliant shine

FROM ONLY £84.99 EX.VAT £101.99 INC.VAT

MODEL	DIA. (mm)	EXC.VAT	INC.VAT
CBB200	200	£84.99	£101.99
CBB250	250	£169.00	£202.80

PAY Monthly

• Spread the cost over 18, 24, 36 or 48 months
• Any mix of products over £300
• 18.9% APR, 10% Deposit*

5 MIN APPLICATION!

VISIT YOUR LOCAL SUPERSTORE

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

BARNSLEY Pontefract Rd, Barnsley, S71 1EZ	01226 732297
B'HAM GREAT BARR 4 Birmingham Rd.	0121 358 7977
B'HAM HAY MILLS 1152 Coventry Rd, Hay Mills	0121 7713433
BOLTON 1 Thynne St. BL3 6BD	01204 365799
BRADFORD 105-107 Manningham Lane. BD1 3BN	01274 390962
BRIGHTON 123 Lewes Rd, BN2 3QB	01273 915999
BRISTOL 1-3 Church Rd, Lawrence Hill. BS5 9JJ	0117 935 1060
BURTON UPON TRENT 12a Lichfield St. DE14 3QZ	01283 564 708
CAMBRIDGE 181-183 Histon Road, Cambridge. CB4 3HL	01223 322675
CARDIFF 44-46 City Rd. CF24 3DN	029 2046 5424
CARLISLE 85 London Rd. CA1 2LG	01228 591666
CHELTENHAM 84 Fairview Road. GL52 2EH	01242 514 402
CHESTER 43-45 St. James Street. CH1 3EY	01244 311258
COLCHESTER 4 North Station Rd. CO1 1RE	01206 762831
COVENTRY Bishop St. CV1 1HT	024 7622 4227
CROYDON 423-427 Brighton Rd, Sth Croydon	020 8763 0640
DARLINGTON 214 Northgate. DL1 1RB	01325 380 841
DEAL (KENT) 182-186 High St. CT14 6BQ	01304 373 434
DERBY Derwent St. DE1 2ED	01332 290 931
DONCASTER Wheatley Hall Road	01302 245 999
DUNDEE 24-26 Trades Lane. DD1 3ET	01382 225 140
EDINBURGH 163-171 Piersfield Terrace	0131 659 5919
EXETER 16 Trusham Rd. EX2 8QG	01392 256 744
GATESHEAD 50 Lobley Hill Rd. NE8 4YJ	0191 493 2520
GLASGOW 280 Gt Western Rd. G4 9EJ	0141 332 9231
GLOUCESTER 221A Barton St. GL1 4HY	01452 417 948
GRIMSBY ELLIS WAY, DN32 9BD	01472 354435
HULL 8-10 Holderness Rd. HU9 1EG	01482 223161
ILFORD 746-748 Eastern Ave. IG2 7HU	0208 518 4286
IPSWICH Unit 1 Ipswich Trade Centre, Commercial Road	01473 221253
LEEDS 227-229 Kirkstall Rd. LS4 2AS	0113 231 0400
LEICESTER 69 Melton Rd. LE4 6PN	0116 261 0688
LINCOLN Unit 5. The Pelham Centre. LN5 8HG	01522 543 036
LIVERPOOL 80-88 London Rd. L3 5NF	0151 709 4484
LONDON CATFORD 289/291 Southend Lane SE6 3RS	0208 695 5684
LONDON 6 Kendal Parade, Edmonton N18	020 8803 0861
LONDON 503-507 Lea Bridge Rd. Leyton, E10	020 8558 8284
LUTON Unit 1, 326 Dunstable Rd, Luton LU4 8JS	01582 728 063
MAIDSTONE 57 Upper Stone St. ME15 6HE	01622 769 572
MANCHESTER ALTRINCHAM 71 Manchester Rd. Altrincham	0161 9412 666
MANCHESTER CENTRAL 209 Bury New Road M8 8DU	0161 241 1851
MANCHESTER OPENSHAW Unit 5, Tower Mill, Ashton Old Rd	0161 223 8376
MANSFIELD 169 Chesterfield Rd. South	01623 622160
MIDDLESBROUGH Mandale Triangle, Thornaby	01642 677881
NORWICH 282a Heigham St. NR2 4LZ	01603 766402
NORTHAMPTON OPENING SOON	01604 267840
NOTTINGHAM 211 Lower Parliament St.	0115 956 1811
PETERBOROUGH 417 Lincoln Rd. Millfield	01733 311770
PLYMOUTH 58-64 Embankment Rd. PL4 9HY	01752 254050
POOLE 137-139 Bournemouth Rd. Parkstone	01202 717913
PORTSMOUTH 277-283 Copnor Rd. Copnor	023 9265 4777
PRESTON 53 Blackpool Rd. PR2 6BU	01772 703263
SHEFFIELD 453 London Rd. Heeley. S2 4HJ	0114 258 0831
SIDCUP 13 Blackfen Parade, Blackfen Rd	0208 3042069
SOUTHAMPTON 516-518 Portswood Rd.	023 8055 7788
SOUTHEND 1139-1141 London Rd. Leigh on Sea	01702 483 742
STOKE-ON-TRENT 382-396 Waterloo Rd. Hanley	01782 287321
SUNDERLAND 13-15 Ryhope Rd. Grangetown	0191 510 8773
SWANSEA 7 Samlet Rd. Llansamlet. SA7 9AG	01792 792969
SWINDON 21 Victoria Rd. SN1 3AW	01793 491717
TWICKENHAM 83-85 Heath Rd.TW1 4AW	020 8892 9117
WARRINGTON Unit 3, Hawley's Trade Pk.	01925 630 937
WIGAN 2 Harrison Street, WN5 9AU	01942 323 785
WOLVERHAMPTON Parkfield Rd. Bilston	01902 494186
WORCESTER 48a Upper Tything. WR1 1JZ	01905 723451

5 EASY WAYS TO BUY...

SUPERSTORES NATIONWIDE

ONLINE www.machinemart.co.uk

TELESALES 0115 956 5555

CLICK & COLLECT OVER 10,500 LOCATIONS

CALL & COLLECT AT STORES TODAY

30889

MODEL ENGINEER

Published by **MyTimeMedia Ltd**.
Suite 25S, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

EDITORIAL
Editor: Martin R Evans
Tel: +44 (0)7710 192953
Email: mrevans@cantab.net
Assistant Editor: Diane Carney
Club News Editor: Geoff Theasby

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching Manager: Brian Vickers
Ad Production: Andy Tompkins

ADVERTISING
Advertising Sales Executive: Angela Price
Email: angela.price@mytimemedia.com

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Beth Ashby

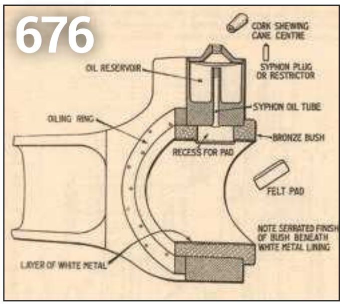
MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

mytimemedia
print & digital media publishers

Model Engineer, ISSN 0026 - 7325 (USPS 24828) is published fortnightly by MyTime Media Ltd, Suite 25S, Eden House, Enterprise Way, Edenbridge, Kent, TN8 6HF, UK. The US annual subscription price is 136USD. Airfreight and mailing in the USA by agent named World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Periodicals postage paid at Brooklyn, NY 11256. US Postmaster: Send address changes to Model Engineer, World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Subscription records are maintained at DSB.net Ltd, 3 Queensbridge, The Lakes, Northampton, NN4 5DT, UK. Air Business Ltd is acting as our mailing agent.

http://www.facebook.com/modelengineersworkshop

http://twitter.com/ modelengineers



ISSUE IN THIS ISSUE IN THIS ISSUE IN THIS ISSUE

IN THIS ISSUE

IN THIS ISSUE IN THIS

Vol. 226 No. 4665 21 May - 3 June 2021

ON THE COVER...

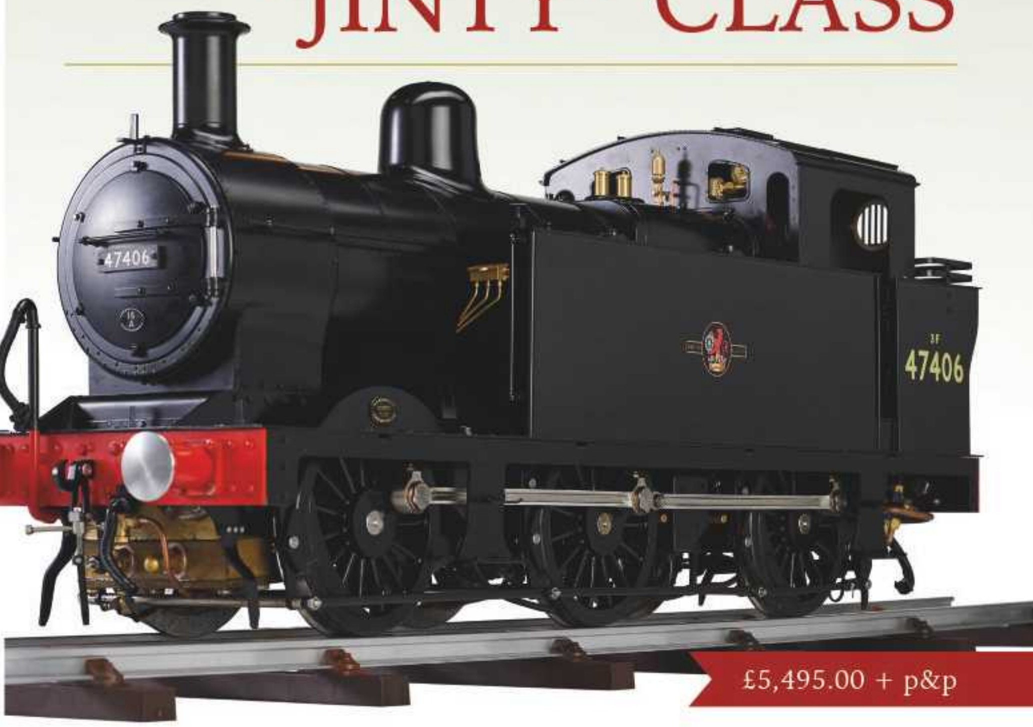
'Baby Garratt' Norfolk Heroine *on the Wells and Walsingham Light Railway in Norfolk (photo: Noel Shelley).*

SILVER CREST models

MARKET LEADER IN LARGE SCALE, READY-TO-RUN, LIVE STEAM

WE ARE PROUD TO OFFER THIS COMPACT YET POWERFUL 0-6-0

5" GAUGE 3F "JINTY" CLASS



£5,495.00 + p&p

The 3F "Jinty" Class

Some 425 of these locomotives were manufactured between 1924 and 1931. Mainly allocated to shunting and station pilot duties they also undertook occasional branch line work. The "Jinties" were frequently used for banking duties with up to three at a time seen assisting express passenger trains up the Lickey Incline on the Bristol-Birmingham line near Bromsgrove. They were frequently seen banking trains out of London Euston up to Camden - a particularly demanding task!

Designed by Sir Henry Fowler for the London, Midland and Scottish Railway they were based on earlier designs by S&W. Johnson.

Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

A majority of locomotives enjoyed long service with the final "Jinty" withdrawn in 1967, right at the end of the steam era. The locomotives were always painted in un-lined black livery. Before nationalisation in 1948 LMS initials were carried on the tank sides. In BR service either lion crest was carried according to period.

Summary Specification

Approx length 33"

- Stainless steel motion
- Boiler feed by cross head pump, injector, hand pump
- Etched brass body with rivet detail
- Two safety valves
- Choice of emblems
- Painted and ready-to-run
- Coal-fired live steam
- 5" gauge
- 2 inside cylinders
- Slide valves
- Stephenson valve gear
- Drain cocks
- Mechanical Lubricator
- Silver soldered copper boiler
- Multi-element Superheater
- Reverser
- Approx Dimensions:
  Length: 33"
  Width: 9.5"
  Height: 14"
  Weight: 44kg

The 5" Gauge Model

We have introduced the "Jinty" to our growing range of models due to requests received from a number of customers who are keen to own one. At just £5,495.00 + shipping this 5" gauge model offers unbeatable value-for-money. The model is coal-fired and its 0-6-0 wheel arrangement provides a powerful locomotive capable of pulling a number of adults. Its ability to negotiate tight curves makes it a perfect candidate for your garden railway. The model is delivered ready-to-run and painted with your choice of LMS lettering, or BR crest.

Each is complete with a silver soldered copper boiler, hydraulically tested to twice working pressure. All boilers comply with the latest regulations and are appropriately marked and certificated. The locomotive's compact size makes this an ideal model to display, transport and drive. As testament to our confidence in the high quality of this model we are pleased to offer a full 2 years warranty. Our customer service is considered to be second-to-none.

The "Jinty" is a powerful locomotive for its size and can negotiate tight curves, making it ideal for a garden railway. It incorporates our latest technical improvements including mechanically operated drain cocks. As an award winning professional model maker I am delighted to have been involved in the development of this first class live steam locomotive"

Mike Pavie

Delivery and Payment

Save £195.00. Free p&p for any order received within 28 days.

The order book is now open and we are happy to accept your order reservation for a deposit of just £995.00.

We will request an interim payment of £2,000.00 in August 2021 as the build of your model progresses, a further stage payment of £2,000.00 in November and a final payment of £500.00 in January 2022 in advance of delivery

VISA MasterCard

FREE BROCHURE REQUEST FORM

Please send, without obligation, my free 5" gauge "Jinty" brochure.

Name: ______________________

Address: ______________________

____

______________ Post Code: ______________

Please send to: Silver Crest Models Limited, 18 Cottesbrooke Park, Heartlands Business Park, Daventry, Northamptonshire NN11 8YL **MEM**

Company registered number 7425348

Request your free brochure today

Request your free brochure today by e-mail, telephone, or by returning the coupon opposite.

Telephone: **01327 705 259**

E-mail: **info@silvercrestmodels.co.uk**

Find more information at

www.silvercrestmodels.co.uk

MODEL ENGINEER SUBSCRIPTION ORDER FORM

DIRECT DEBIT SUBSCRIPTIONS (uk only)

Yes, I would like to subscribe to *Model Engineer*

❑ Print + Digital: £18.25 every quarter
❑ Print Subscription: £15.25 every quarter (saving 41%)

YOUR DETAILS must be completed

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

Address ....

....

Postcode .... Country ....

Tel .... Mobile ....

Email .... D.O.B ....

I WOULD LIKE TO SEND A GIFT TO:

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

Address ....

....

Postcode .... Country ....

INSTRUCTIONS TO YOUR BANK/BUILDING SOCIETY

Originator's reference 422562 DIRECT Debit

Name of bank...

Address of bank ....

....

.... Postcode ....

Account holder ....

Signature .... Date ....

Sort code | | | | | | Account number | | | | | | | |

Instructions to your bank or building society: Please pay MyTimeMedia 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 MyTimeMedia Ltd and if so, details will be passed electronically to my bank/building society.

Reference Number (official use only)

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

CARD PAYMENTS & OVERSEAS

Yes, I would like to subscribe to *Model Engineer, for 1 year* (26 issues) with a one-off payment

UK ONLY:
❑ Print + Digital: £77.99
❑ Print: £65.99

EUROPE & ROW:
❑ EU Print + Digital: £104.99
❑ EU Print: £92.99
❑ ROW Print + Digital: £117.00
❑ ROW Print: £105.00

PAYMENT DETAILS

❑ Postal Order/Cheque ❑ Visa/MasterCard ❑ Maestro

Please make cheques payable to MyTimeMedia Ltd and write code ME2021 on the back

Cardholder's name...

Card no: (Maestro)

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

Signature.. Date............................

TERMS & CONDITIONS: Offer ends 31st December 2021. MyTime Media collects your data so that we can fulfil your subscription. We may also, from time to time, send you details of MyTime Media offers, events and competitions but you always have a choice and can opt out by emailing us at unsubscribe@model-engineer.co.uk. Please select here if you are happy to receive such offers by email ❑ by post ❑ by phone ❑. We do not share or sell your data with/to third parties. Details you share with us will be managed as outlined in our Privacy Policy here http://www.mytimemedia.co.uk/privacy-policy. Please visit www.mytimemedia.co.uk/terms for full terms & conditions.

POST THIS FORM TO:
MODEL ENGINEER SUBSCRIPTIONS, MYTIMEMEDIA LTD, 3 QUEENSBRIDGE, THE LAKES, NORTHAMPTON NN4 7BF

CODE ME2021

HURRY OFFER CLOSES 31st DECEMBER 2021

PRINT + DIGITAL SUBSCRIPTION

- 26 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- ***Download*** each new issue to your device
- A ***75% discount*** on your Digital Subscription
- Access your subscription on ***multiple devices***
- Access to the ***Online Archive*** dating back to August 2001

PRINT SUBSCRIPTION

- 26 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- Never miss an issue

SUBSCRIBE TODAY

MARTIN EVANS
Editor

DIANE CARNEY
Assistant Editor

YVETTE GREEN
Designer

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
mrevans@cantab.net

LittleLEC 2021

Stephen Harrison writes to say: 'This year's LittleLEC competition will be hosted by the Birmingham Society of Model Engineers. The competition is open to locomotives 50lb or under dry weight (no coal or water). It will be held on the 4th and 5th September 2021 at the society's track at Illshaw Heath, Birmingham which can accommodate 3½ and 5 inch gauge locomotives (**photo 1**).

'The Birmingham SME is no stranger to efficiency competitions having run the first ever IMLEC back in 1969, the 50th IMLEC in 2018, SuperLEC in 1998 and previously hosted LittleLEC back in 2010. The track is located on **Illshaw Heath Road, Hockley Heath, Solihull, B94 6DN** which is just off junction 4 of the M42, so easily accessible from the surrounding motorway network. The event will start at 9.30am each day with refreshments available through the day – spectators welcome. There is plenty of onsite parking for competitors and guests.

'Founded in 1936 by a small group of enthusiastic model engineers, the Birmingham SME club has grown to become one of the largest in the country. The club has two tracks; a 3½ and 5 inch raised level track with a total length of 1035ft and a 5 and 7¼ inch ground level track of 1112ft in length. Both are steel section rail. Both tracks are controlled by an extensive automatic signalling system. Footbridges, double arched tunnel, stations and steaming bays service both tracks. The steaming bays have 12V and 24V supplies and mains water supply (but rain water is available if preferred). A large clubhouse with catering facilities is provided for the comfort of its members and guests.

'If you wish to attend the weekend there are numerous places to stay with a few hotels as close as 1.7 miles away. It is recommended you make a booking or reservation as soon as you have decided to compete or spectate to avoid disappointment.

'If you wish to take part in this year's competition the entry form can be downloaded from either the Birmingham SME's or the LittleLEC website (www.littlelec.co.uk). Applications must be submitted before the closing date of 31st July 2021 either by email (littlelec@gmes.org.uk) or post. For those unable to access online you can either phone (07964-622187) or write to the society (address above) and arrangements can be made to post an application form out to you.'

Rob Roy Rally

Rex Hanman also writes with the following good news:

'As things take tentative steps back towards normal I have heard from the Bromsgrove society that the Rob Roy rally, originally intended to take place at their venue last year, has now been planned for Saturday 11th September 2021. This is of course subject to covid conditions pertaining at the time.

'The Bromsgrove Society's website (www.bromsgrovesme.co.uk) gives details of the location of the club. If you are interested in taking part in the rally please contact Ian Horsfield (meadowsend03@btinternet.com or 01386-792628), Peter Maybury (peter.maybury@outlook.com or 0121-453-3691) or Rex Hanman (**hanmanr@yahoo.com** or 01980-846815).'

Sweet Pea Rally

John Arrowsmith tells me that Hereford SME will be hosting this year's Sweet Pea Rally at Broomy Hill on the weekend of the 21st/22nd August. More details and application forms may be obtained from John at johnarrowsmith678@gmail.com. If you don't have access to email, please feel free to contact the editor at the number given below.

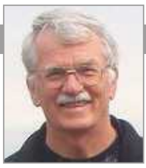
It is very good news that these rallies will be running this year, as well as IMLEC, as none of them were able to run last year. Let us hope that others will follow and that covid has now retreated sufficiently that there is little chance of it interfering with these plans. Judging by the latest expressed scientific opinion we stand a good chance of avoiding any further lockdown.

David Piddington

We are very sorry to bring you the news that David Piddington, well known model engineer and contributor to *Model Engineer*, died on Friday, 30th April, at the age of 81. We remember his life on page 701.

An Experiment in Parametric Design

PART 2



Ian Martin takes a look at how Computer Aided Design can be taken a step further by making use of concepts familiar to software engineers.

Continued from p.642
M.E. 4664, 7 May 2021

Beam engine design example

Figure 26 shows one of the isometric views of the complete beam engine assembly, as generated by my CAD from the script generated by MPM.

Product breakdown atructure

The top-level decomposition of the Beam Engine contains ten major sub-assemblies.

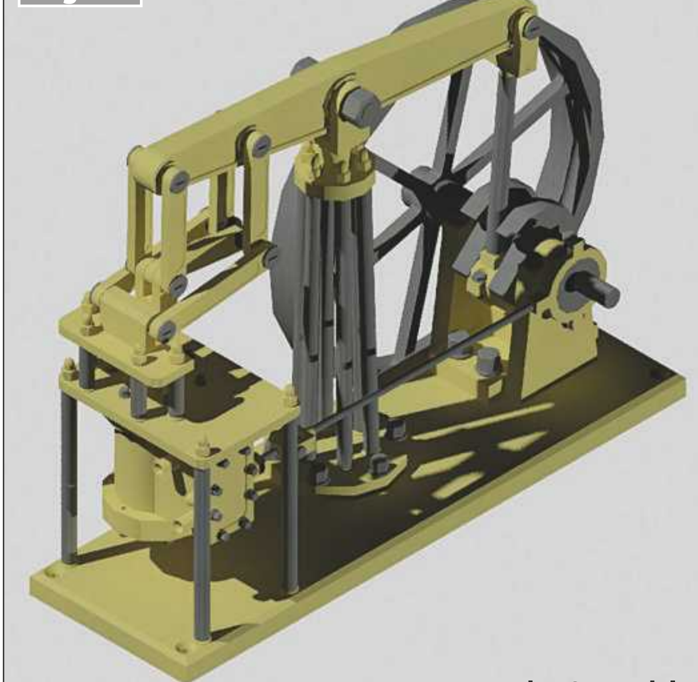
* BeamAssy
* CylnderAssy
* ValveRodAssy
* PistonAssy
* CrankshaftAssy
* EccRodAssy
* CrankBlockAssy
* ConnRodAssy
* PylonAssy
* Base

There is also Shape *BeamEngineAssy* that builds the model of the entire engine from instantiations of the ten major sub-assemblies. *BeamEngineAssy* has a parameter that specifies the rotational angle of the crank shaft, so that different instantiations can show the beam engine with the moving sub-assemblies in different positions. Figure 26 shows *BeamEngineAssy* with the crankshaft at an angle of 135 degrees with respect to the vertical axis.

With one exception, each of these eleven assemblies is modelled as a separate MPM Shape. The exception is *ValveRodAssy*, modelled in distinct Spaces in the Shape *CylinderAssy*.

The model of a complex shape like *CylinderAssy* contains many instantiations of Library Shapes and many Spaces to model the custom component parts necessary to build it. Examples of such spaces are *Cylinder*, *UpperCylCover, LowerCylCover*, *SteamChest* and *SteamChestCover* that, with others, are required to model *CylinderAssy*.

Fig 26

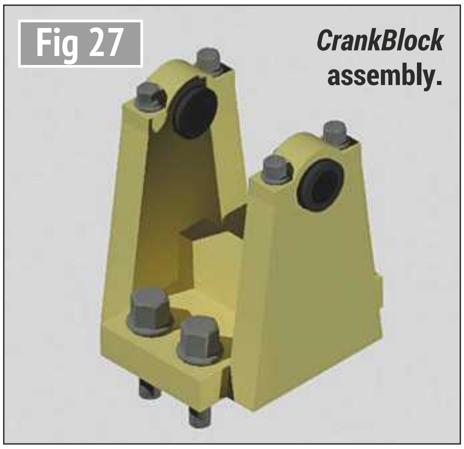


Beam engine 3D model.

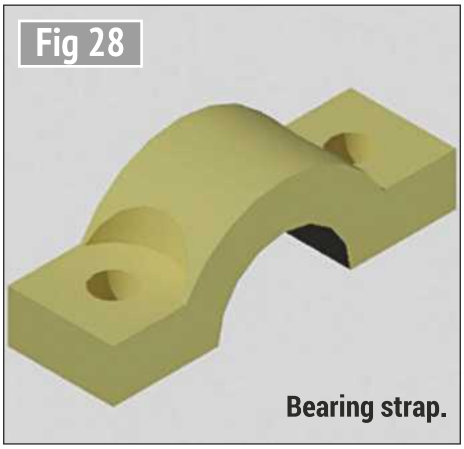
Interfaces

The Interfaces that ensure that all the instantiated parts fit together are organised as follows:

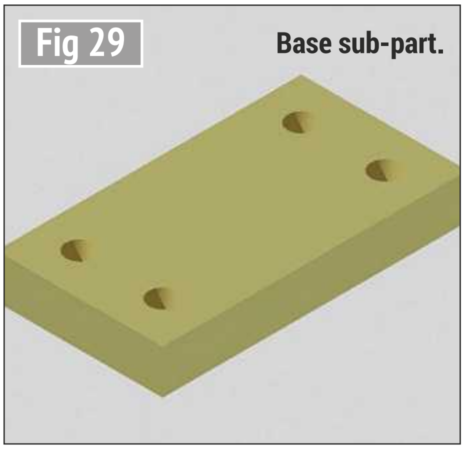
* A single global Interface ***Engine_I*** used by all major shapes. *Engine_I* declares:
* ten parameters for key dimensions of the engine, including the bore, the stroke, the diameter of the crankshaft and the flywheel, the height and semi-length of the beam;
* six parameters needed to make global instantiations of Library Shapes needed by more than one of the ten major sub-assemblies.
* Five Output Interfaces used to pass values from an instance of a major sub-assembly to one or more other major sub-assemblies.
* ***BeamAssy_OI***: Specified by instantiation of *BeamAssy* to make the values of seventeen parameters available to the major sub-assemblies with which it interfaces, namely *CylinderAssy*, *PistonAssy*, *PylonAssy* and *ConnRodAssy*. »



CrankBlock assembly.



Bearing strap.



Base sub-part.

* ***CylinderAssy_OI***: Specified by instantiation of *CylinderAssy* to make the values of seven parameters available to the major sub-assemblies, but excluding *BeamAssy*; with which it interfaces, namely *EccRodAssy*, *CrankshaftAssy* and *Base*.
* ***CrankshaftAssy_OI***: Specified by instantiation of *CrankshaftAssy* to make the values of six parameters available to the major sub-assemblies but excluding *BeamAssy* and *CylinderAssy*, with which it interfaces, namely *CrankBlockAssy*, *ConnRodAssy* and *EccRodAssy*.
* ***CrankBlockAssy_OI***: Specified by instantiation of *CrankBlockAssy* to make the values of five parameters available to the major sub-assemblies but excluding *BeamAssy*, *CylinderAssy* and *CrankshaftAssy*, with which it interfaces, namely *Base*.
* ***PylonAssy_OI***: Specified by instantiation of *PylonAssy* to make the values of three parameters available to the major sub-assemblies but excluding *BeamAssy*, *CylinderAssy*, *CrankshaftAssy* and *CrankblockAssy*, with which it interfaces, namely *Base*.

This propagation of shared values works because:

* *Engine_I* is specified before the first instantiation of any major sub-assembly,
* the order of instantiation of the major sub-assemblies is that shown in the list in the section Product Breakdown Structure. This order is such that each Output Interface is specified before instantiation of any major sub-assembly that uses it.

Example: The three parameters in Output Interface *PylonAssy_OI* relate to the threaded holes for the ring of bolts that fix the *PylonAssy* to the *Base*:

* Diameter of the ring of bolt axes.
* Diameter of each bolt.
* Number of bolts.

The *CrankBlockAssy*

This example takes a closer look at Shape *CrankBlockAssy* of the beam engine.

Figure 27 shows an isometric view of the instantiation of this Shape. Bolted to the rectangular base plate, its role is to support, in two bronze bearings, the rotating *CrankshaftAssy*. In MPM terminology, the Shape modelling *CrankBlockAssy* has an Interface with Shape *Base* and an Interface with Shape *CrankshaftAssy*. As explained in the previous section, the first of these interfaces is specified by the instantiation of *CrankshaftAssy*, while the second is specified by the instantiation of *CrankBlockAssy* itself.

The first step to create a parametric shape definition is to decide the set of parameters. Usually, the parameters fall into two classes: *key parameters* for which the instantiation must specify explicit values, and *subordinate parameters* for which values computed from the values of the key parameters will probably be satisfactory. In the case of *CrankBlockAssy*, five key parameters are probably sufficient:

* Diameter of crankshaft [shaftD]
* Height of crankshaft axis above engine base [crankAxisH]
* Distance between inner rims of the two bushes [crankW]
* Width of the bushes [bushW]
* Thickness of engine base [baseH]

The subordinate parameters, with their default values, could then be

* Outer diameter of central part of bush [bushD = r ound_up(1.2*shaftD, 0.5)]
* Outer diameter of bush rims [bushRimD = round_up(1.2*bushD, 1)]
* Thickness of crank block sub-parts [plateT = round_up(0.6*bushW, 1)]
* Diameter of strap bolts [strapBoltD = round_up(0.4*plateT, 1)]
* Etc.

Some (or all) of the subordinate parameters could be defined as constants. The result is a somewhat simpler model but the instantiator cannot specify a different value.

Once the parameters, constants and appropriate validations have been defined, attention can be turned to the model itself. As shown in fig 27, *CrankBlockAssy* is an assembly of the following parts:

* A crank block in brass,
* Two identical bearing straps in brass,
* Two identical bearings in bronze,
* Four identical small bolts in steel to fix the bearing straps to the crank block,
* Four identical bigger bolts in steel to fix the assembly to the base of the beam engine..

Appropriate instantiations of Library Shapes Bearing (one instantiation) and HexBolt (2 instantiations) will yield designs for the bearings and the two kinds of bolt.

The parametric design for the Bearing Straps, shown in **fig 28**, is expressed as a sequence of ten Build Steps in a dedicated Space.

The parametric design of the Crank Block is expressed as sequences of Build Steps in four dedicated Spaces:

* Base sub-part (4 steps), shown in **fig 29**,
* End subpart (7 steps), shown in **fig 30**,
* Web sub-part (1 step) shown in **fig 31**,
* Crank Block part (5 steps), shown in **fig 32**. The steps are:
  • place copy of Base sub-part,
  • place copy of End sub-part at near end,
  • place copy of End sub-part at far end,
  • place copy of Web sub-part
  • unify above four objects into a single object (represents silver-soldering).

Finally, the entire *CrankBlockAssy* is modelled (12 build steps) in a dedicated

Space by appropriately placing of one or more copies of the instantiated library parts and of the two custom parts.

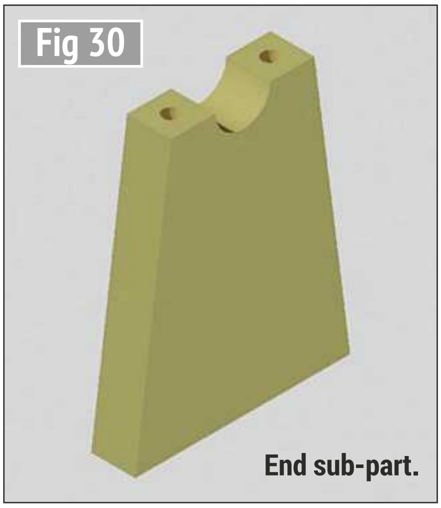
The *BeamAssy*

BeamAssy (**figs 33** and **34**) is the only major beam engine sub-assembly that is not rigid. *BeamAssy* comprises the Beam itself (that rocks on an axial pin at the top of *PylonAssy*) and all the links and their pin joints that make up the famous Watt parallel motion linkage. As can be seen from the figures, the relative positions and orientations of these links depends on the rocking angle of the Beam.

Among the parameters of the Shape that models *BeamAssy* is the rocking angle of the Beam with respect to horizontal. A set of constant definitions computes the position and angle of each link, and the position of each axial pin and all the washers and spacers in the assembly, as a function of the instantiation dimensions of the parts and the value of the rocking angle parameter.

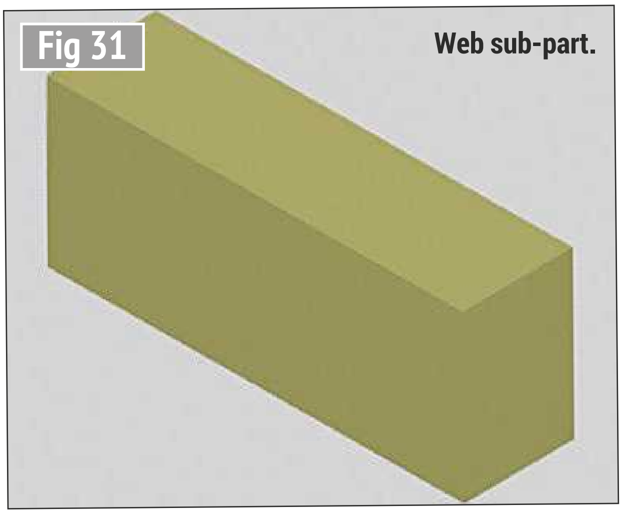
The Model part of shape *BeamAssy* starts by instantiating all the required parts and then defines a Space in which one or more copies of these parts are placed with these calculated positions and orientations. Shape *BeamAssy* is destined to be instantiated several times to show the configuration at different rocking angles. Since the individual parts of the assembly do not depend on the rocking angle, the part instantiations in *BeamAssy* specify that their instantiation must be *SHARED*. In this manner, the parts will be instantiated once only at the first instantiation of *BeamAssy* and will be reused by all the subsequent *BeamAssy* instantiations.

Fig 30



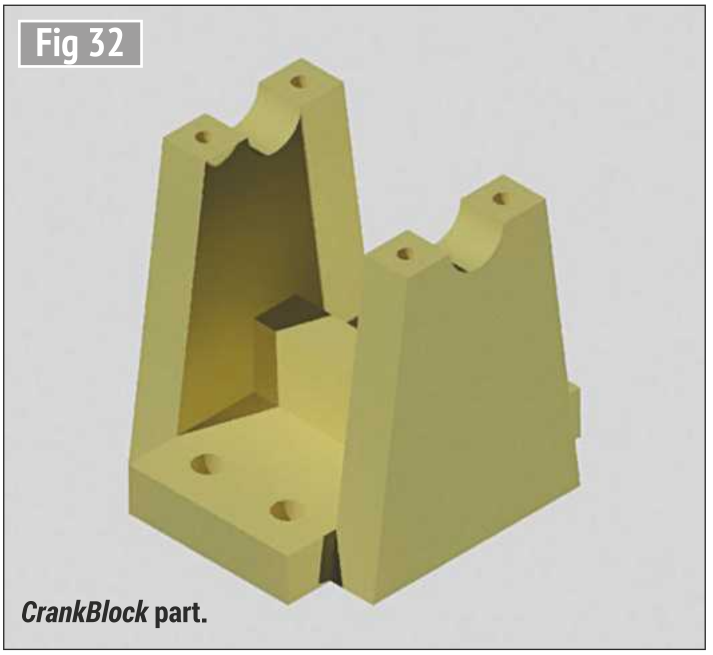
End sub-part.

Fig 31



Web sub-part.

Fig 32



***CrankBlock* part.**

Conclusion

My experience to date in using my MPM prototype to develop the beam engine design has demonstrated three things to my satisfaction.

* The basic idea of a parametric front-end to a non-parametric CAD tool works.
* Parametric design does enable fruitful regular use and enrichment of a Shape Library.
* Parametric design does greatly facilitate design modifications.

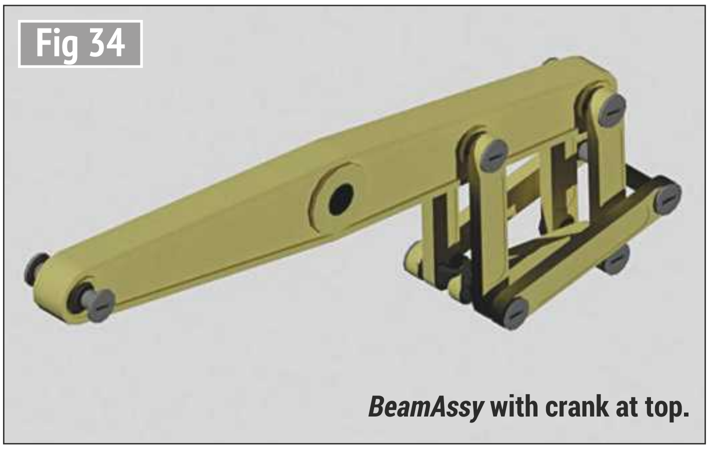
Nevertheless, the proof of the pudding is in the eating. My experimental scene must now move from desk top to workshop for an attempt to build, from real metal stock, a real model beam engine as described by the information in the Build Document produced by MPM.

Then too, how nice it would be if MPM were integrated into a Development Environment with a syntax aware editor and a graphics interface with windows and buttons for managing the Shape Library, the components of the current design, the MPM tool and the CAD tool. But this is the stuff of which dreams are made.... **ME**

Fig 33

***BeamAssy* with crank at bottom.**

Fig 34



***BeamAssy* with crank at top.**

The raised track acquired from the Barnsley SMEE.

Ian Stewart takes his 0-4-2 'Tich' for a run on the raised track. Another of Ian's engines is on the traverser.

We Visit the Wakefield SMEE

John Arrowsmith goes up north to visit Wakefield.

My next visit was to Yorkshire, to the Thornes Park Railway of the Wakefield Society of Model & Experimental Engineers. Like many clubs that were formed in the 1950's the Wakefield SMEE started with a portable track which was used at various galas and events to generate some funding in order to hopefully build a permanent site for the club. Negotiations with the City of Wakefield authority resulted in a site being made available in Thornes Park in the city. Members then proceeded to build a raised 3½ and 5 inch gauge raised track on the site.

Ian Stewart's old style 0-4-0 tender locomotive is pictured on the raised track traverser.

These gauges were the popular ones for that period but by the 1970s there was a requirement to consider building a 7¼ inch gauge ground level track to cater for the increased interest in large scale models. The club decided that a 7¼ inch track could be built around the outside of the existing raised track. Permission was obtained from the council and building began with a circuit which has some testing gradients for both locomotives and drivers. At the same time the club decided that the raised track needed refurbishment so the whole track was re-laid on concrete beams. Now the club had two good tracks catering for all the popular gauges to provide lots of interest for their members.

After a few years of operating both tracks it became apparent that the concrete support beams for the raised track were in serious need of repair so it was decided that the whole track should be removed with a 5 inch gauge line added to the ground level circuit. This had the effect of the 5 inch gauge line doubling in length so drivers of the smaller gauge now had a really good test of their skills. It remains like this today and is how I found it when I went in October.

However, the club became aware in 2018 that the Barnsley SMEE had been given notice to vacate their track site at the Kirklees Light Railway. The complete raised track from Barnsley was offered to the Wakefield SMEE and the committee took advantage of this offer to rebuild a raised track in Thornes Park (**photo 1**). With the help from some Barnsley members who have now joined the Wakefield club this has been installed and, in the process, has been increased in length by about 220ft. This was achieved by adding the redundant steel from the anti-tipping rail, about 90ft to 120ft of new material, to the track. Ian Stewart an ex-Barnsley member (**photos 2** and **3**) carried out this work and has made a good job of it as well. There is still quite a

The good-sized clubhouse at Wakefield.

The 7¼ inch gauge 'Deltic' stored in the shed.

lot of work to be done on the support base but at least they have a good long 3½ and 5 inch gauge raised track to use again.

The existing ground level track is about half a mile in length with some good gradients to test both locomotives and drivers. They do hope in the future to perhaps increase the length of the ground level track as well and a route has been looked at but it is no more than an idea at the moment. When they operate for the public all the profits, less the operating costs, are donated to the Mayor of Wakefield charities over the year and this amounts to a good sum of money for the town.

To support these operations the club have a well-equipped club house where members can enjoy the refreshment facilities and toilets and where they can hold their winter meetings. The club house (**photo 4**) is raised off the surrounding land because, at rare occasions in the year, rain water runoff from the surrounding park land finds its way to the lowest part of the park causing the railway to be flooded but the clubhouse remains dry.

Useful storage and workshop buildings provide a strong working base for the club and the range of locomotives available is impressive. One track in the shed has a pit which is a useful feature to have. There is also a hydraulic lift platform available to assist with maintenance work on locomotives. A scratch-built scale model of a Deltic locomotive (**photo 5**) catches your attention when you enter the shed. This engine was built by Tony Bickerstaffe, who was able to measure up all the dimensions he needed from a full-size engine at the Barrow Hill depot in Chesterfield, where it was kept.

Tony tells an amusing story about how he arrived at the overall dimensions of the model that provides an outline that might appear to be a 10¼ inch gauge model - he measured up the backsides of some of his fellow members in order to provide a decent space for the driver. The delivery of this story was

Another large petrol-engined locomotive built by Geoff Stubbs.

The driver's cab on the Union Pacific.

A Morris Minor 1000cc engine for the Pacific.

>>

A petrol/hydraulic 'Hymec' on shed at Wakefield.

An all-electric 'Crocodile' part of the fleet of locomotives.

Linda*, the Ffestiniog Railway engine in 7¼ inch gauge.*

In contrast to the large locomotives was this smart looking 0-4-0 battery locomotive and driver's truck.

hilarious but he got there in the end and it is a very impressive model. The model itself has a petrol/hydraulic water-cooled Honda 360 engine with an electric starter and balancing shaft to provide a good smooth drive, which is very quiet. The hydraulic drive has a hydraulic motor on each bogie driving a toothed belt to each axle, which gives a 12 wheel drive. A steel box section chassis and steel casing result in a very strong and powerful locomotive which weighs in at about 600/700kg. Each bogie weighs in at 108kg.

Another large-scale petrol powered locomotive was a version of a Union Pacific locomotive built by club member Geoff Stubs (**photos 6** and **7**). This fine model is powered by a Morris Minor engine (**photo 8**) and was built a few years ago by being started in November and finished ready for operations at Easter of the following year. A petrol/ hydraulic Hymec (**photo 9**) and an all electric 'Crocodile' locomotive (**photo 10**) also stood out in the shed together with a fine example of one of the Ffestiniog Railway engines *Linda* (**photo 11**). This was built by Geoff Stubs 40 years ago and was the first model of this locomotive built from works drawings supplied by the railway. It has been modified to suit an operational model and is very powerful. It has been recorded at pulling 8 tons round the track. There was also a nice little 0-4-0 battery engine on shed along with a smart looking driving truck (**photo 12**) on the same track as the Union Pacific.

Simon Mayor has built this fine looking slate wagon.

Lancashire Witch *making plenty of smoke.*

In contrast to all the locomotives in the shed there was a brand new very well made 7¼ inch gauge slate wagon built by Simon Mayor (**photo 13**). Simon, who is also a driver on the Welshpool & Llanfair Railway, was busy getting a 7¼ inch gauge Hunslet in steam for a run on the track (**photos 14** and **15**). I was privileged to be able to drive this locomotive and also chairman Phil Owen's 7¼ inch gauge 'Sweet Pea' (**photo 16**). Both locomotives (**photo 17**) were a pleasure to drive and showed me what an interesting track this is, with gradients which can cause problems for the unwary.

A smiling Simon Mayor leaves the station with the Hunslet.

All in all, this was a very pleasant day spent with knowledgeable model engineers and all the humour and banter that goes along with it. My sincere thanks to all the people I met, including chairman Phil Owen, Simon Mayor, Tony Bickerstaffe and Ian Stewart for all their help and information during the day. Wakefield is a fine club which, although not large in terms of membership numbers, is thriving and looking forward to the future.

ME

I just had to try my hand at the regulator but with spectacles it can be difficult in damp weather.

Two locomotives raising steam, Phil Owen's 'Sweet Pea' and the Hunslet Lancashire Witch.

Rhys Owen discusses friction and lubrication and how to get the oil where we want it.

Lubrication

PART 1

Friction can be both desirable and undesirable. Without friction nails would not stay in their holes, shoelaces and other knots would come undone, locomotives could not grip the rails to exert tractive force and brakes would not stop vehicles. Friction also allows the wind to create waves in water.

No surface is perfectly flat or perfectly round and, even at molecular level, there are irregularities. Through a variety of mechanisms these irregularities give rise to frictional forces that resist the relative motion of two substances in contact.

Friction converts mechanical energy into heat (as in the case of making fire by rubbing sticks together). It is friction that causes a 'hot box', when an axle box bearing overheats and, eventually, melts the surface of the bearing.

The study of friction and lubrication is called *tribology*, a word derived from the Ancient Greek words for 'I rub' and 'study', one definition being 'the science and engineering of interacting surfaces in relative motion'.

The primary purpose of a lubricant is to reduce friction but it can also carry away impurities and heat. Examples occur in nature – our lacrimal glands lubricate the movements of the eyes and eye lids, when necessary also carrying away dirt from the surface of the eye.

Lubricants must be chosen appropriately – lubricating the eye with motor oil would not be wise! Among the criteria that are considered when choosing a lubricant are its cohesion and its adhesion. Cohesion is the attraction of like particles to each other, in other words, the force that holds a substance or body together. By holding the lubricant together cohesion resists the lubricant's breakdown under pressure. On the other hand, adhesion is the attraction between bodies that are in contact with each other - the force that causes materials of different types to stick together. It is this adhesive force that allows the movement of a journal to draw oil into the contact area of a bearing - a lubricant must get to where it is needed to be effective.

Manufacturers of lubricant may add 'tackifiers' to improve one, or both, of these properties. Lubricant blenders also need to take account of the temperature and other conditions at which lubricants will operate. For example, steam engines that use high-pressure superheated steam require a higher grade of lubricant than engines fed with low pressure saturated steam.

Other properties that need to be considered are viscosity and relative density (specific gravity). This latter property is relevant as lubricating oils are generally displaced by water.

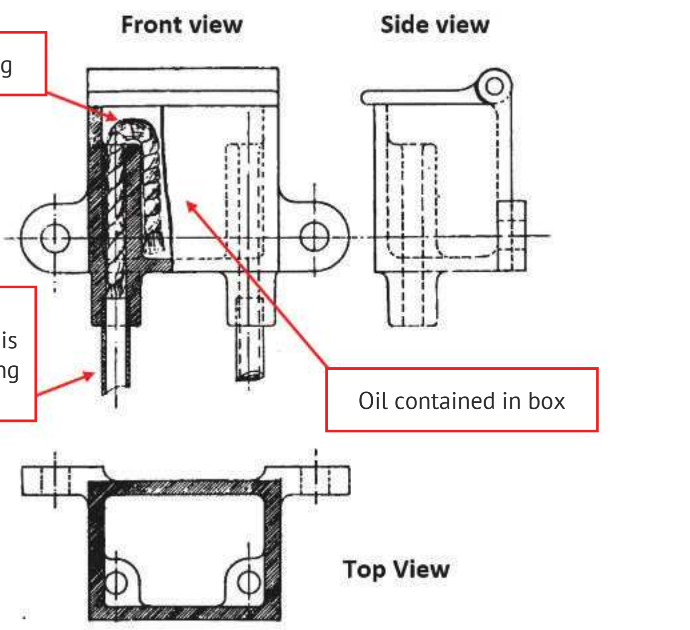
Water and oil do not mix (in the sense of forming a homogeneous solution of the one in the other) but form an emulsion in which the particles of one are dispersed in the other.

Without delving too deeply into the theory of how lubricants function at a molecular level, adequate lubrication occurs when the layers of molecules that make up the lubricant ensure that the asperities (i.e. irregularities) of two surfaces do not touch. Incidentally, friction between these layers of lubricant molecules as they pass over each other will create a certain amount of heat.

Research into friction in bearings was undertaken in the late 19th century by the Americans, M. Hersey and R. Thurston as well as the Germans, A. Martens and R. Stribeck, the Stribeck curve being named after this last gentleman. Essentially, the Stribeck curve shows that:

* Initially, friction is high because the asperities of the sliding surfaces interfere with each other;
* At a certain point, the friction falls considerably because the lubricant tends to keep the asperities apart;
* As the relative velocity of the surfaces increases then friction increases because of internal friction within the lubricant.

Thanks to the cohesive and adhesive properties of a lubricant, the motion of the bearing surfaces tends to create a wedge (a curled wedge in the case of a circular bearing) of lubricant by drawing it into the area of maximum pressure between those surfaces. However, an adequate film of lubricant may not be created immediately and a high proportion of wear occurs during the first movement of a bearing surface (this is one reason why a car with a low mileage made up of short trips may have an engine that is in worse condition than a car that has amassed a high mileage on long journeys). On the Chemin de Fer du Vermandois (CFTV) lard was smeared over the crank and gudgeon pins when re-assembling the motion of locomotive 140-C-314 to minimise this initial wear. (Another sensible idea adopted by the CFTV is to prevent distortion of a stored locomotive's bearings over time by changing the position of their motion periodically so that the mass of the locomotive



Drawing showing oil box (base drawing from *A Manual of Locomotive Engineering* - ref 1).

Oil box open to show tail trimmings in place (on CFTV 030-T-3).

does not always rest on the same part of the bearing.)

Supplying the lubricant

Ideally, lubricant should be fed to a part of the bearing assembly where the pressure is not great so that it can be drawn into the area of greatest pressure by the motion of the bearing, thus forming the wedge of lubricant.

The simplest way of feeding lubricant consists simply of putting a few drops of oil into a plain oil hole such as can be found on bearings that have little movement (e.g. a steam locomotive's coupling rod knuckle joints). For bearings that require continuous lubrication tail trimmings may be used (**photo 1**). A tail trimming consists of strands of worsted held together by wire and it works by a combination of capillary action and the siphon effect. Capillary action draws the lubricant – usually oil - into the fibres of the worsted and, provided the ends of the fibres in the oil pipe are lower than the ends in the oil pot (**fig 1**), oil will slowly feed into the bearing. (To start the siphon effect the trimming is normally soaked in oil before being inserted into the oil hole.) When lubrication is not required then the trimming can be withdrawn from the tube to save oil.

A small tube (inverted 'J' shape) can be used instead of a tail trimming although a restrictor may be necessary to control the flow of oil. Again, to ensure that the siphon effect starts, the tube should be filled with oil before the long leg of the 'J' is put into the oil tube.

TRIMMINGS AND PADS

Trimmings are made of wire and worsted, a type of woollen yarn and various types are shown in **fig 2**.

Another (arguably better) way of preparing a plug trimming than that shown in fig 2 is to trap one end of the worsted thread in the wire at stage B above and then loop the thread several times over the forked end and through the loop until the required thickness is obtained.

Copper wire is best for making trimmings because, should the wire touch the bearing surface, the soft copper will be unlikely to damage it.

A plug trimming is used where the rotation of the bearing throws the oil around the oil reservoir so that some will feed into the tube leading from the oil reservoir to the bearing. The plug trimming should fit comfortably in the oil tube - neither too tight so that it prevents adequate flow nor so slack that the oil is immediately used up.

A tail trimming is used where a continuous flow of oil into a bearing is required. The oil rises into the worsted fibres by capillary action and the fibres must reach far enough down the oil tube for the trimming to act as a siphon.

The plug-tail trimming performs both functions.

A worsted pad may be soaked in oil and placed in a reservoir of oil under a bearing so that the bearing will rub oil off it as it rotates. Such pads are placed in the bottom of axleboxes such as those in **fig 3** (an alternative is simply to stuff the underkeep with oil-soaked material such as cotton waste).

A more sophisticated device used in plain bearing axleboxes is the Armstrong oiler. This consists of a sprung metal frame which holds a wool and cotton pad against the underside of the journal. Strands of material reach down into the oil reservoir to ensure that oil feeds into the pad by capillary action.

These devices are currently manufactured by Armstrong Oilers who are based at the North Yorkshire Moors Railway depot in Whitby. In addition to their use within the UK, Armstrong oilers have been exported to a number of countries (including to the CFTV in France!).

According to the 'Directions for use' document:

* An Armstrong oiler should be perfectly clean and dry before use.
* The oiler should be soaked in lubricating oil for at least 24 hours and then allowed to drain off for three hours.
* The oiler should be inserted carefully into the axlebox so that it fits snugly under the journal (specific techniques are shown for this).
* When an oiler needs to be cleaned it should be rinsed in warm lubricating oil only and no other liquid should be used.
* Grease should not be used on a pad as this substance will clog the capillaries of the material and will cause the pad to 'glaze'.
* Finally, no foreign matter or waste should be allowed to collect in the axlebox.

Although now somewhat out of date, the company's website (www.armstrongoilers.co.uk) includes illustrations of these oilers.

With thanks to Armstrong Oilers' production supervisor, Mr Martin Ashburner, for sending me material on these devices.

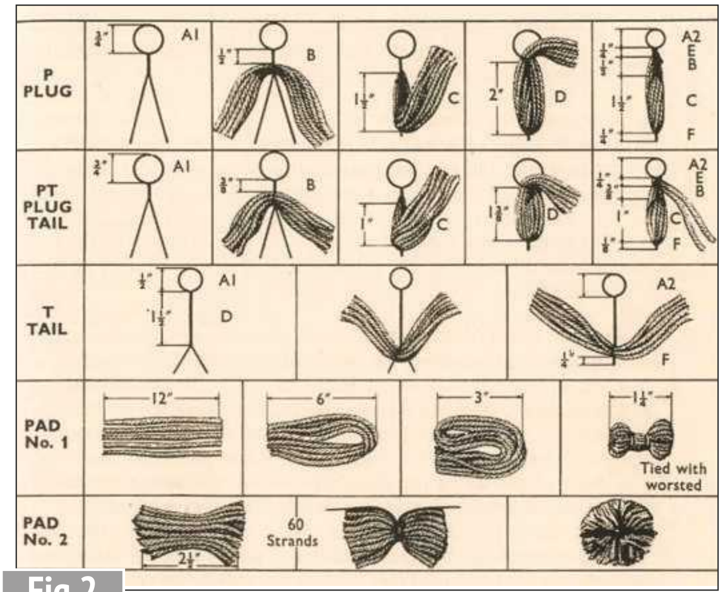
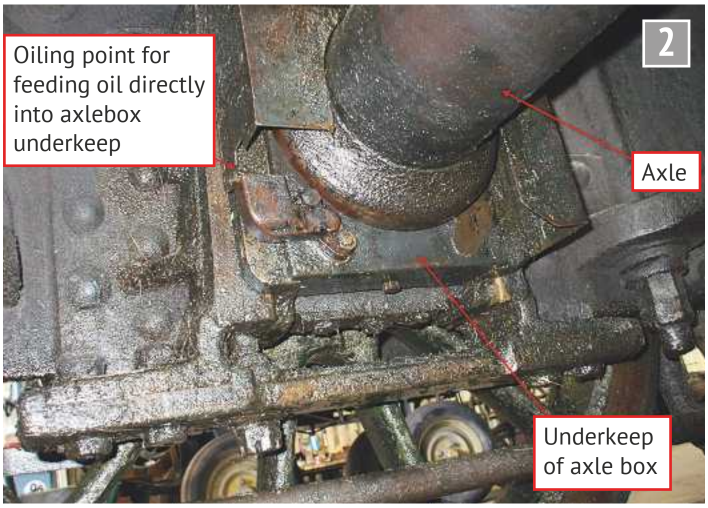


Fig 2 **Preparation of worsted trimmings (from 'Handbook for Steam Locomotive Enginemen' – ref 2).**

Care should be taken to ensure that the oil does not get contaminated by water or dirt. Scrupulous cleanliness is always desirable as a breakdown in lubrication can do a lot of damage. Water should be extracted from the oil reservoir using a syringe or siphon. Since oil normally floats on water it is necessary to dip the end of the syringe deep into the reservoir. Owing to its low viscosity the water is easily drawn into the syringe so that the entry of oil can be sensed by the greater resistance of the viscous oil. Too much water in an oil reservoir or bearing will displace all the oil and, in the case of a steam locomotive, priming (the carrying over of boiler water into the main steam pipe and hence into the valve chests and cylinders) can wash away lubricating oil so that much wear will take place over a short distance.

Where the bearing structure rotates (e.g. the big end bearing of a steam locomotive connecting rod) then the oil in the reservoir will be flung around and some will find its way into the tube leading to the bearing surface. This flow is controlled by a restrictor, in British practice usually a plug trimming but elsewhere a needle or other type of restrictor may be used. The degree of flow can be changed by changing the trimming for one with more or fewer strands or the needle for one of a different diameter (see box).

Incidentally, in British practice the oiling hole is threaded but is closed by means of a cork screwed into it. This cork traditionally had a porous cane centre to allow a flow of air (so that the flow of oil would not be curtailed by a partial vacuum forming as the oil was consumed) but where such a cork is not available a slit may be made in the side of the cork. Screwed or sprung plugs are also used as shown in **figs 4** and **5**.



Axlebox of CFTV 030-T-3 viewed from inside the frames.

A French technical document (**ref 5**) states that filling coupling and connecting rod oil reservoirs completely full should be avoided as this can cause a hot bearing. The document states that, for a satisfactory supply of oil to the bearing, especially in winter, it is necessary that a mousse form on the surface of the oil and that this mousse can only form in the presence of a certain quantity of air. This theory may or may not be true, but it would certainly not be incompatible with an air supply through a cane insert in a cork (or a slit in the cork's side).

Axleboxes

These (**photo 2**) are subject to forces that derive not only from the mass of the vehicle but, in the case of locomotives, also from propulsion. For example, a steam locomotive axle box has to withstand not only the force exerted by the vehicle mass but also the force of the piston thrust transmitted by the connecting or coupling rods and the forces derived from the locomotive's interaction with the rails. The methods used to get oil to the bearing surface need to be effective because re-metalling a hot box is not a trivial undertaking.

Outside the world of steam locomotives a ring oiler may sometimes be used to carry oil to a bearing. In this case the ring is of greater diameter than the journal

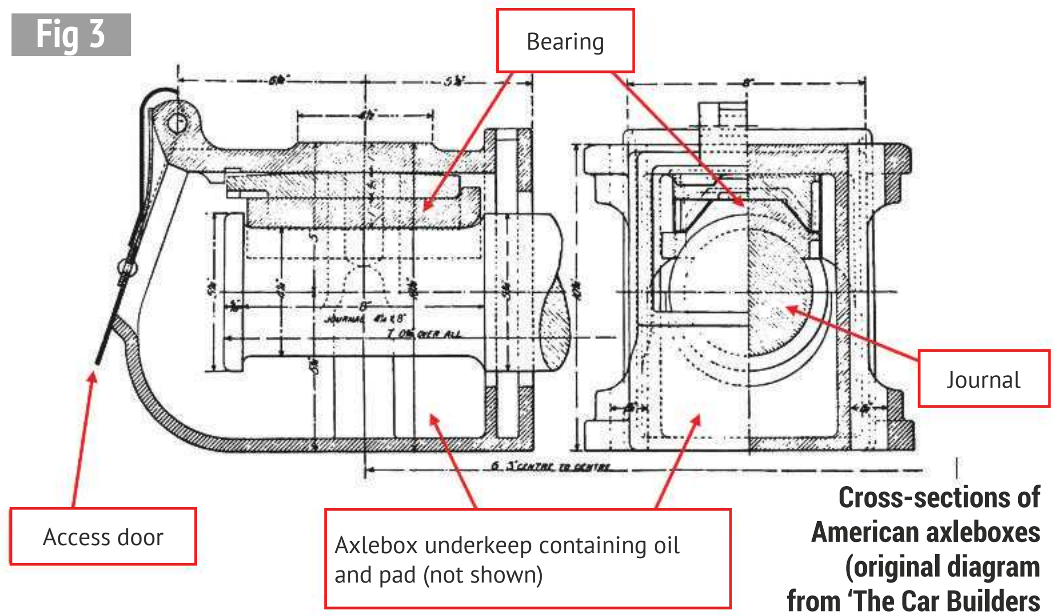
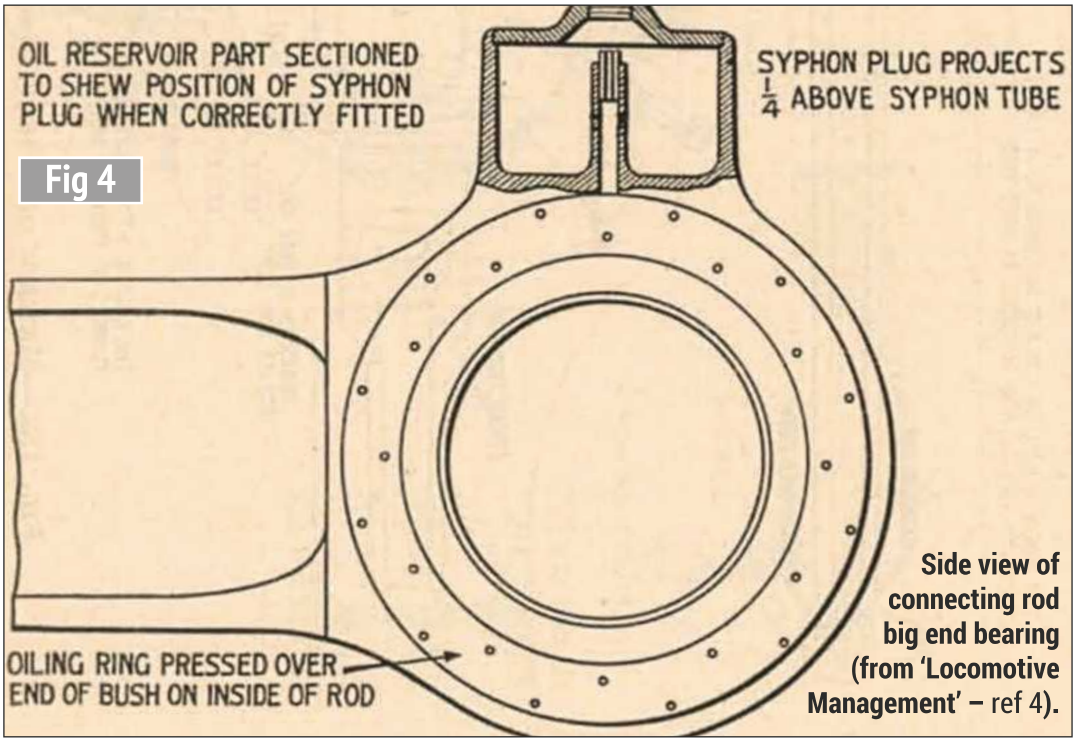


Fig 3 **Cross-sections of American axleboxes (original diagram from 'The Car Builders Dictionary 1903' – ref 3).**

and dips into an oil reservoir, the oil adhering to it and being carried up to where is needed. However, if the speed of rotation is too high the oil will fly off the ring before it reaches its destination. In his autobiography, Roland Bond tells of difficulties encountered with the jack-shaft bearings of the electric locomotives that had been supplied to the Great Indian Peninsula Railway by the Vulcan Foundry and also by SLM Winterthur, who had undertaken the design. Inspection of these jack/shaft bearings showed damage arising from ineffective lubrication, notwithstanding the fact that these bearings were fitted with ring oilers. Locomotives of similar design were understood to be performing with no such troubles on the St. Gotthard route. A visit to the Bellinzona Shops where the St. Gotthard locomotives were maintained revealed that their jackshafts did not use ring oilers but were lubricated by spring-supported pads.

Fig 4

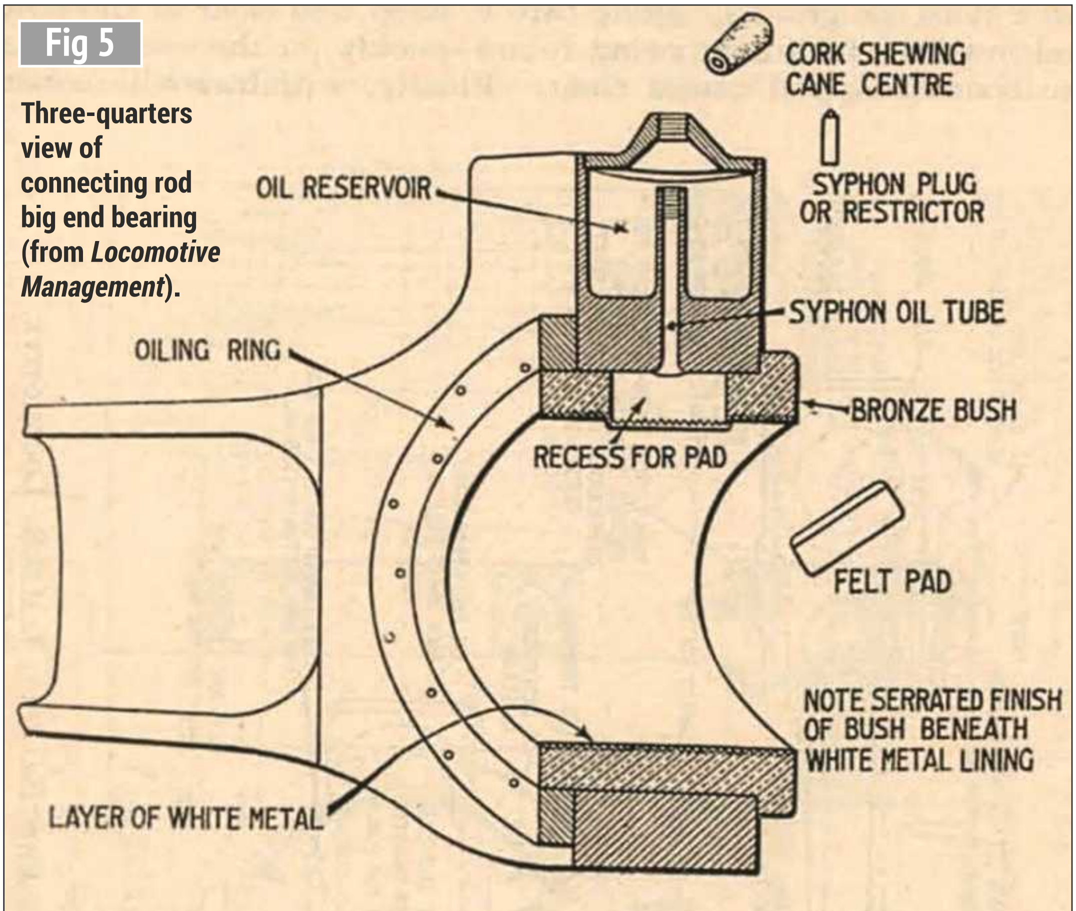


Side view of connecting rod big end bearing (from 'Locomotive Management' – ref 4).

Where the wheelset journals are on stub shafts of the axle (i.e. on projections outside the wheels) the 'Isothermos' type axlebox may be used. This type of axlebox has a lower bearing as well as an upper bearing and, at the end of the stub shaft, a dipper or finger that throws oil upwards each time the axle revolves. The trajectory of the oil thrown up varies with the rotational velocity of the axle but the basic idea seems to be that the oil projected either finds its way directly to the journal, or to the bottom bearing, or onto the top of the upper bearing or the body of the axlebox. If the oil is thrown onto the upper bearing it drips down through passages in that bearing either directly to the journal or to the lower bearing. The lower bearing appears simply to act as a reservoir holding oil under the journal whence the journal carries it to the upper bearing.

●To be continued.

Fig 5



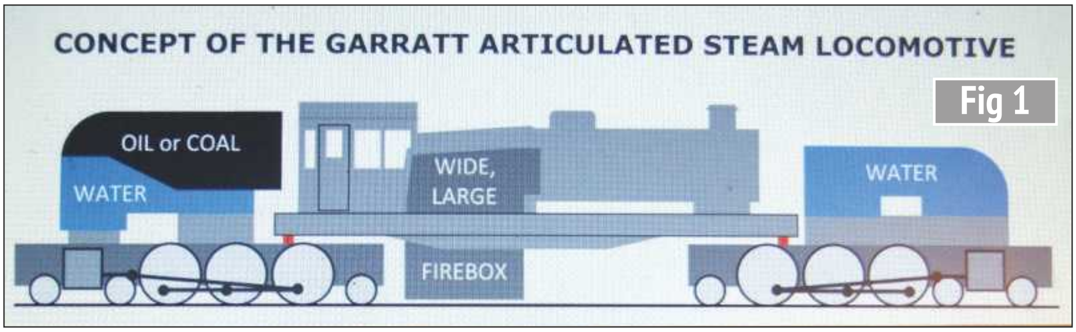
Three-quarters view of connecting rod big end bearing (from *Locomotive Management*).

REFERENCES

1. *A Manual of Locomotive Engineering*, W.F. Pettigrew, 1899.
2. *Handbook for Railway Steam Locomotive Enginemen*, British Transport Commission, 1957.
3. *The Car Builders Dictionary*, R. Hitt et al., 1903.
4. *Locomotive Management* (10th edition), J.T. Hodgson & C.S. Lake, revised W.R. Oaten, 1954.
5. *Cours de Locomotive à Vapeur à l'usage de personnel de conduite*, SNCF Région du Sud-Est Matériel et Traction (via SNCF/SARDO/Association 141R420), 1956.

Is it a Fake?

Noel Shelley reckons there's a thin dividing line between a replica and a fake.



The Beyer-Garratt locomotive.

Since the following tale involves the last Beyer-Garratt locomotives produced, a brief description of this type of machine may prove useful.

With ever increasing loads to haul as the 1800s moved into the 1900s, the designers of steam locomotives were faced with several major stumbling blocks in their attempts to make ever more powerful and efficient machines. The standard gauge, at 4 feet, 8½ inches (or any other) was something of a handicap to *really* big machines; only Hitler's dream of a 3 metre gauge and the projected Breitspur Fernbahn tried to address the issue, although it was to go no further than the drawing board. One could ponder what Brunel's 7 feet ¼ inch broad gauge *might* have become. In Britain our track was mostly laid to a high standard but many countries used lightly laid lines that could not take high axle loadings. More axles will reduce the loading, but with more than eight coupled wheels, rounding curves is a problem. A ten coupled engine, e.g. the 9F, had a flangeless centre wheel set to help the problem.

By this time (late 1800s) the loading gauge was set almost literally in stone; tunnels, platforms etc. limited the width and height of the engine and therefore the size of firebox and boiler and, if these had to fit between the wheels, it was a serious restriction. Observe an early locomotive with its tall chimney and small boiler and compare it to a 9F and it's almost non existent chimney!

Numerous designs were used to try and solve some of the above problems, Mallet and Meyer types amongst them. Whilst the Union Pacific Big Boy 4-8-8-4 was an impressive sight, let me suggest there was another, every bit its equal … the Garratt Locomotive!

Herbert W. Garratt did not come up with any new principles, in fact he was to comment that he was surprised that the other makers of articulated locomotives had not spotted what, to him, had become obvious.

By using two powered bogies and suspending a boiler between them you have it (**fig 1**)! You can now use the full height and width of the loading gauge to build a large, low slung boiler, unencumbered by wheels. Using two powerful engine bogies with a wheel plan to suit the axle loading of the track and a boiler big enough to give ample steam you have a locomotive capable of the work of two but only needing one crew. You can use large wheels now to give speed, a large water tank on the fore bogie and an equally large coal bunker (or oil tank) on the aft bogie affording long distances between stops. This last matter made Garratts very popular in many parts of the world including on the continents of

A 'baby Garratt' on the Wells & Walsingham Light Railway.

Africa and Australia. For even greater economy of fuel and water compounding could be used. The Garratt design had another trick! On a curve the boiler unit moved to the inside of the radius, forming a chord between the two pivot points, thereby counteracting the centrifugal force, aiding stability.

An association between Mr. Garratt and Beyer Peacock was to see this company produce some of the largest and most powerful steam locomotives ever made, on many track gauges down to 2 feet.

The main motive power on the world's longest 10.25 inch gauge railway, the Wells & Walsingham Light Railway, is a pair of 'Baby' Garratt locomotives (**photo 1**).

Is it a fake?

This all starts with the well known author of books on steam machines, Ronald H. Clarke who was not only an author but also a prolific draughtsman, doing most of the drawings for his books himself. A lot of his knowledge was gathered from visiting many manufacturers of steam engines of all sorts and talking to their staff. When making these visits he would always have an old army knapsack with him to carry his lunch etc., which was also useful for containing any 'little gifts' he might acquire during his visit.

He reached a grand age but his flywheel turned its last in 1999. During his long and interesting life he had gathered up a large collection of steam related items, books, models - all manner of things, in fact. The majority of the collection was offered for sale by auction at the annual steam rally at Weeting in 2000.

I attended this auction with the intention of buying a few items, though my budget was limited. As is so often the case at an auction, one gets carried away; whilst I did manage to maintain some self control, I still spent six or eight hundred pounds!

There were several nice brass makers plates from Beyer Peacock for their Garratt locomotives dated 1958. This date is significant. The odd thing was that they bore no serial number. These items were making £110, which was more than I could justify, but there was one that appeared to be cast iron which I won for £35. As the day passed - it being a long auction and I was almost spent out - I was sitting reading the illustrated catalogue when, to my dismay, I saw that my lot was described as a wooden plate! *What had I bought?* Had I bid on the wrong lot? I thought not, as the auctioneer was holding up the lot as the bidding took place. So what had I got?

The auction was very well attended. It was a long day and as it drew to an end a very long queue built up to pay at the auctioneer's caravan. I was in the queue that by now stretched back into the tented auction hall as some of the final lots were coming under the hammer. It was the turn of large bundles of Ronald's drawings. The auctioneer lifted a corner of a bundle that was on an easel and allowed them to fall back and in that split second I thought I saw a general arrangement drawing for a traction engine so my hand went up. £22 and it was mine! If I had known what I had bought I would have bid for all the bundles, but that's another tale.

I had reached the front of the queue so handed over the money and was presented with my lots. I picked up my 'wooden' plate and realised I had got one of the bargains of the day, a very interesting piece! It was the factory pattern for the maker's plate (**photo 2**)!

Makers plate pattern.

I started to do some research on Beyer Peacock and its Beyer Garratt locomotives of 1958. It was the last year that this type of locomotive was built and orders for 19 engines were placed. This was to be the end of steam locomotive production. Then … *Oh dear!* … another order for seven NG/G16s came in from the Tsumeb Corporation. These locomotives were required to haul minerals to the coast but, due to regauging of the line, they were delivered to the South African Railways (SAR). Of this last batch, three are now working on the Welsh Highland Railway and in 2008 they held a 50th Anniversary event which I attended. On looking at the last of the batch, No. 7868, I found that it had a very simple makers plate, as opposed to the detailed pattern I had (**photo 3**). Why?

Through a string of unconnected events I was to meet a gentleman who had known Ronald H. Clarke very well and I asked if he could throw any light on how Ronald might have come by the makers plate. It was at this point that I was told of the significance of the knapsack!

It would seem that with production of the penultimate batch of 19 engines complete, and the end of steam at Gorton foundry well within sight, Ronald visited and acquired the maker's plate pattern as it was of no further use in the foundry! Knowing how time consuming making this pattern would have been, when the order for the *very last* seven engines came in and the pattern was found to be missing, a very simple pattern was made which bore none of the very small lettering.

The pattern I have has a small window that allows a little wooden block bearing the serial number to be placed in it and thus many plates can be cast, bearing different serial numbers, with one pattern.

I placed the serial number 7868 in the window and had it cast (**photo 4**).

Cast from the maker's factory pattern, as they all were, the question is … is it a fake??

ME

Simple makers plate.

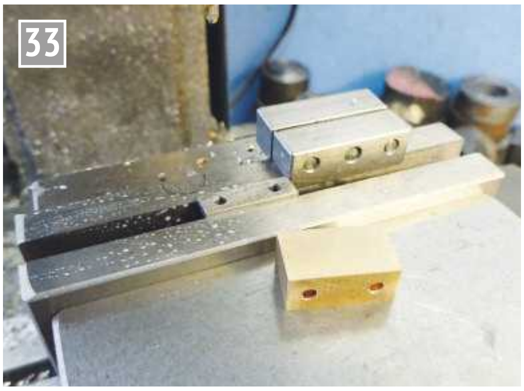
The 'fake' plate.

Thompstone Engine

PART 4

Jason Ballamy builds a mill engine first described in *Model Engineer* 120 years ago.

Continued from p.621
M.E. 4664, 7 May 2021



Drilling the big end bearing and cap plate.

Boring and facing bearing.

Turning radius edges of assembled big end.

Reaming the crosshead.

Big end bearing and end plate

These two can be worked on at the same time as they share several dimensions. Start by soft soldering two pieces of 6mm thick bronze together and then machine to overall size. Doing it in this order is a lot easier than trying to get two pieces of hot metal perfectly lined up. Machine the cap to the same overall length and width. They can now both be drilled for the clearance holes using a vice stop to repeat their positions; also add a small centre drill hole to the cap (**photo 33**).

Slip a couple of nuts and bolts through the holes to help keep the solder joint together while you drill and, ream the bearing's hole and with a small round nosed tool, form the rounded ends on each side (**photo 34**). The rod, bearing and cap can now be assembled and the three parts turned to the final 19mm diameter followed by reducing the 'waste' of the bearing to 18mm diameter with the small round nosed tool (**photo 35**). Mark all the parts with a punch mark so they can be reassembled the same way before taking apart by melting the solder and gently cleaning off the faces back to bare metal. You can now round over the small end and turn up its bush which can be retained with a drop of Loctite.

Crosshead

This is best worked on the end of a short length of bar that will need to be at least 17mm diameter. I used ¾ inch but 18 or 20mm metric stock will do just fine. After facing off one end transfer over to the mill and machine the four sides to produce a 10 x 13mm rectangular end (**photo 36**). I used a collet block for this as it also makes it easy to maintain alignment for the next operation which is to stand the part on end and mill the 6mm wide slot (**photo 37**). Then back into the lathe to drill and ream

Slotting the crosshead.

the 4mm hole after which the spigot can be turned down to 7mm before final parting off (**photo 38**). The final job is to hold the crosshead on a simple arbor and using the trusty radius noosed tool turn the sides to leave the bosses 1mm proud of the sides (**photo 39**).

Crosshead slippers

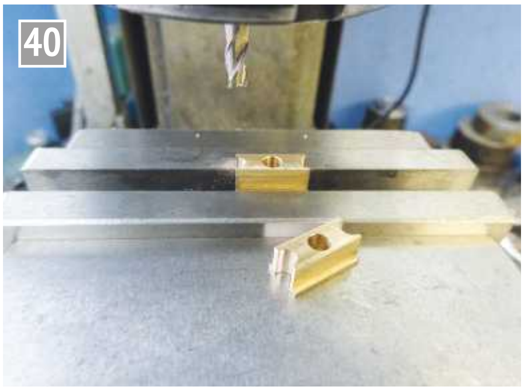
Machine a couple of bits of bronze to overall size then mill the rebate down each side before drilling and reaming the central hole. The decorative half moon on each end is easiest done by plunging downwards with a 4mm diameter cutter, moving sideways 0.5mm after each cut, and taking a second spring cut on the final setting (**photo 40**).

Crosshead pin

The crosshead pin is placed into the crosshead and the two drilled and then reamed for a 1.5mm taper pin that

Forming the crosshead's spigot before parting off.

Facing the side of the crosshead.



Plunge cutting half round detail on slippers.

Completed crosshead, pin and taper pin.

Fig 10

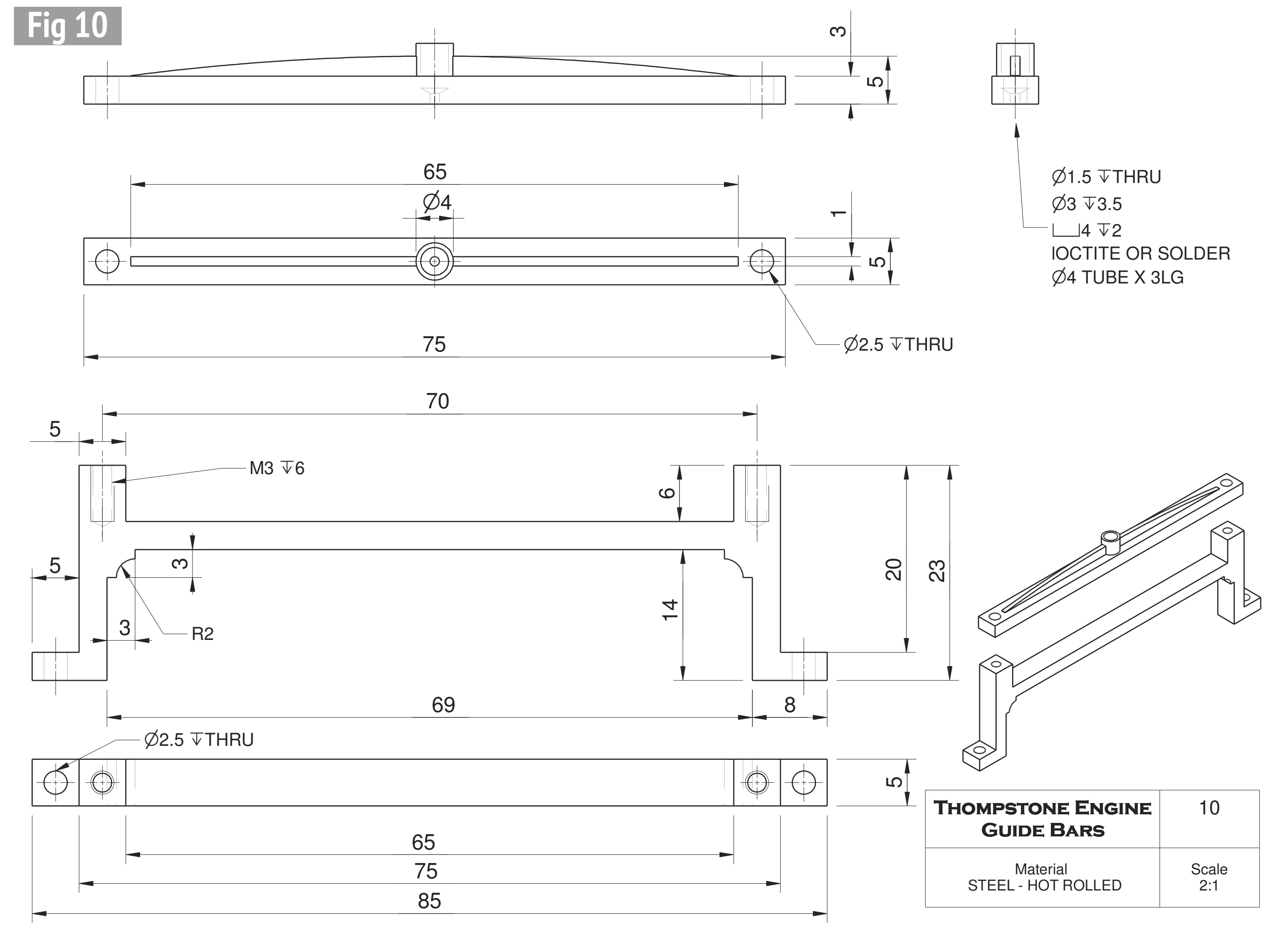
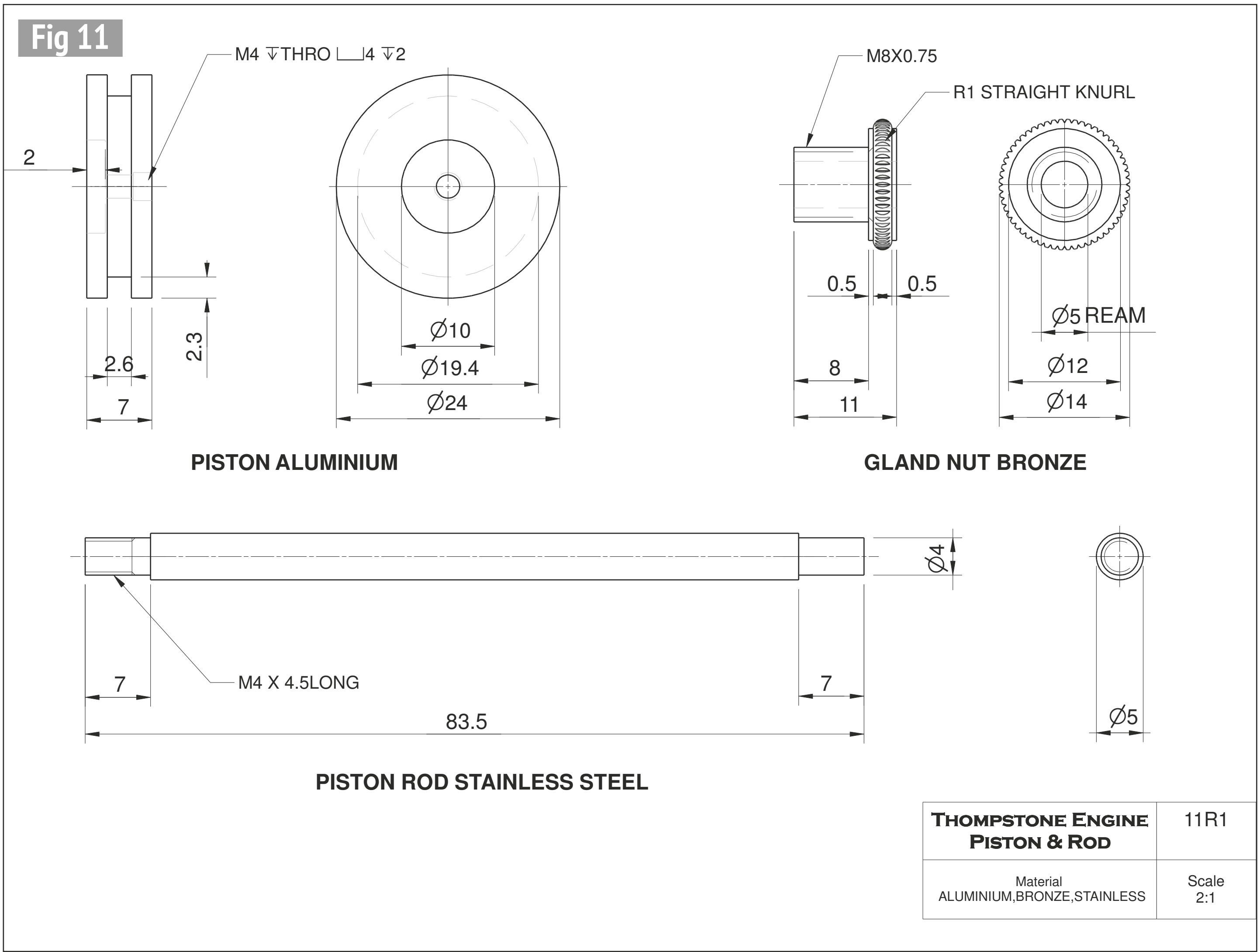
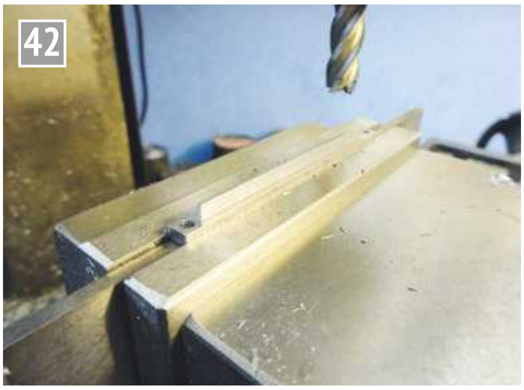


Fig 11



Start by machining some hot rolled (black) mild steel down to overall size, this is less likely to distort as the unequal amounts of material are removed from top and bottom.



Forming a web on the top guide bar.

Holes and slot defining underside of lower guide bar.

just nicks the edge of the crosshead pin so that it can't rotate or move sideways (**photo 41**). If you measure the small end of the pin about 2mm up from the end, that will give you the size of hole to drill before reaming. If you don't want to use a taper pin, then a parallel one could be used and held in place with a thread locking compound (not a more permanent retainer).

Crosshead guides

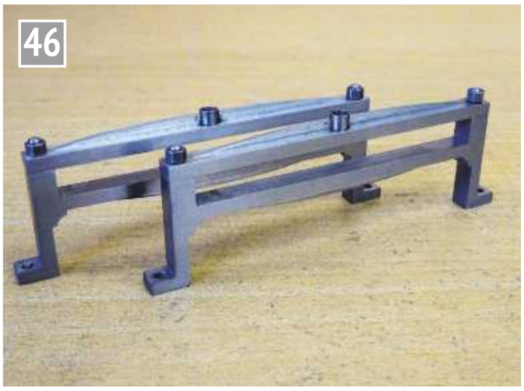
A lot of model engines have quite simple bars raised up off the bed with spacers and another set of spacers between the two pairs of bars but the Thompstone has what may have been cast lower guides with integral legs and feet so I have tried to emulate that feature here. If you want to take the simple route, then make four of the upper bars and some spacers. The holes in the bed plate will need to be drilled at 70mm centres, rather than 80mm, or the bars could be made longer if you have already made the bed.

Start by machining some hot rolled (black) mild steel down to overall size; this is less likely to distort as the unequal amounts of material are removed from top and bottom. Starting with the upper bars mill all round to leave the 1mm thick stiffening web standing proud; drill the 2.5mm holes either end (**photo 42**) and make a 4mm diameter plunge cut in the centre to form a pocket for the oil reservoir and finally drill the oil hole through. The lower bar blank can have the holes for the feet drilled, M2.5 ones tapped, and also drill two holes that will form the concave quarter circle

The curved profile of the stiffening webs is easiest filed to shape by eye but for those that want to have a go at machining, the radius is 250mm.

Forming web to underside of lower guide bar.

Milling sides to form the feet.



Completed guide bars.

Finished piston on its rod.

in the inside corners. After this, mill between these two holes at a height level with the lowest point of the curved web (**photo 43**). Make two saw cuts to remove the waste from the bottom cut-out and then mill the inside of the legs and the small flat area either end of the web (**photo 44**).

The guide bar can then be held the right way up to firstly mill out the top recess before moving it along to the side of the vice and cutting away the ends of the bar to leave just the feet (**photo 45**). The curved profile of the stiffening webs is easiest filed to shape by eye but for those that want to have a go at machining, the radius is 250mm. After a quick draw file to remove all the machining marks two short 'tubes' can be turned up and Loctited or soft soldered into place to act as oil containers which complete these parts (**photo 46**).

Piston rod

Face off one end and turn the plain spigot down to a firm push fit into the crosshead before facing the other and reducing to 4mm diameter and partly threading M4.

Piston

Starting with a piece of 25mm or 1 inch stock face off and reduce sufficient length to something like 24.3mm for now, then using a parting tool cut the O-ring groove to the specified diameter of 19.4mm. Follow this by drilling 3.3mm tapping size and opening out the counter bore to 4mm before tapping the M4 thread. The piston can be sawn or parted off from the stock and then held the other way round to face it back to length and form the recess for a locknut using a small boring bar.

Set the piston rod to run as true as possible with the threaded end sticking out of the collet or chuck and then screw the piston firmly into place followed by a locknut. These items should not be taken apart again so that they remain concentric. Using light cuts and a sharp tool take a couple of light cuts off the piston's diameter until the cylinder can be slipped over it then remove any burrs (**photo 47**).

The groove could be packed with traditional graphite yarn packing but I now tend to use O-rings, a metric 19.6mm I/D x 2.4mm cross section Viton 75 ring will do the job. If you only want to run the engine for display any form of packing or ring can be left out as the engine should run quite happily without and the reduced friction allows for very low pressure of 0.1-0.2bar (2-3psi). I can even blow into mine and it will run (though I can't keep that up for long!).

Gland nut

Make as described for the valve nut. A small amount of graphite yarn packing in the cavity can be used here and on the valve nut too.

●To be continued.

NEXT TIME

We make the eccentric and the slide valve.

Follow the discussion thread on this build:
www.model-engineer.co.uk/forums/postings.asp?th=170608

The Stationary Steam Engine

PART 21 - THE YORKSHIRE TEXTILE MILL ENGINE

Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.580
M.E. 4663, 23 April 2021

At the time that the first Boulton and Watt engines were supplied to the Lancashire cotton masters the greatness of the industry still lay in the future. In the eighteenth century cotton textiles ranked below the woollen and the linen industries in industrial importance. Where cotton manufacture was confined to central Lancashire, woollen cloth was produced throughout the country with the strongest concentrations of the industry in the West Riding of Yorkshire. Arkwright's patents recognised that cotton was only part of the potential use for his inventions and the specifications invariably encompassed woollen and linen fibres. Within months of the success of Arkwright's machines becoming common knowledge, the wool men were seizing the opportunity to adapt the machines to their business.

The generic term woollen conceals a structural division which splits the industry into two quite separate trades. The first, and older, is the woollen industry proper which uses short, heavily crimped wool fibres, carded to produce a fleecy blanket in which the fibres interlock randomly. After carding the blanket is divided into strips which are loosely twisted into slubbings, before passing to spinning where the yarn is drawn and given a hard twist. The yarn is then woven and the resulting cloth is immersed in a bath of alkaline fluid - fuller's earth and male urine - where it is pounded by water-powered hammers, the fulling process, carried out in the fulling mill. In contrast, worsted cloth uses long, staple fibres with virtually no crimp. These are combed to parallelism in the preliminary process and twisted into slubbings which depend for their strength upon the long strands forming a rope like helix. The spinning process attenuates and adds further twist to the yarn. After weaving, the worsted cloth is not fulled but passes to other finishing processes.

The woollen side of the industry lent itself most readily to Arkwright's machines but it was the carding engine rather than the water frame that made the impact. Carding machines permeated down the Colne and Calder valleys from Lancashire in the late seventeen-seventies along with scribbling machines which performed a prior carding stage that mixed and leveled the raw fibres. The new machines tended to be placed in fulling mills where the power source was already available. The Arkwright water frame followed but the older spinning jenny invented by Hargreaves and adapted to woollen spinning with a further variant, the slubbing billy, became the most widespread spinning machines. Both types of machine remained hand powered and for that reason there was no argument for moving out of domestic premises.

At the same time that the woollen industry was absorbing the new technology, mills spinning cotton advanced into Yorkshire by way of the Calder and Aire valleys. The first cotton mill in Yorkshire was Low Mill, Keighley, built in 1780 under an Arkwright partnership. It was to be the sole Yorkshire instance of such a partnership. Prior to 1785 a few mills were built which simply ignored Arkwright's patents but after the patents collapsed a rash of cotton mills pressed down the Aire valley and by the seventeen-nineties the fashion for building cotton mills had reached Leeds.

Again, throughout the period 1780 to 1835 the mills that housed the new industrial technology were largely water powered. The fulling mill had an historic hold on many of the best water powered sites in Yorkshire and in the earliest days of industrialization the modest power demands of the scribbling and carding machines were usually well within the capacity of the existing wheels. This situation did not last and from 1790 steam engines begin to figure in the insurance records for wool textile mills (**ref 123**). David Jenkins in his history of the wool textile industry in Yorkshire catalogues 251 mills built up until the end of 1800, 79 of which had steam engines. It is not possible to say how many of these engines were used for pumping water back over a waterwheel and how many were rotative Newcomen engines. Some of the known sites were definitely inaccessible to any viable water supply such as the Morley Crank Mill where a rotative Newcomen engine was in built in 1790 to the design of

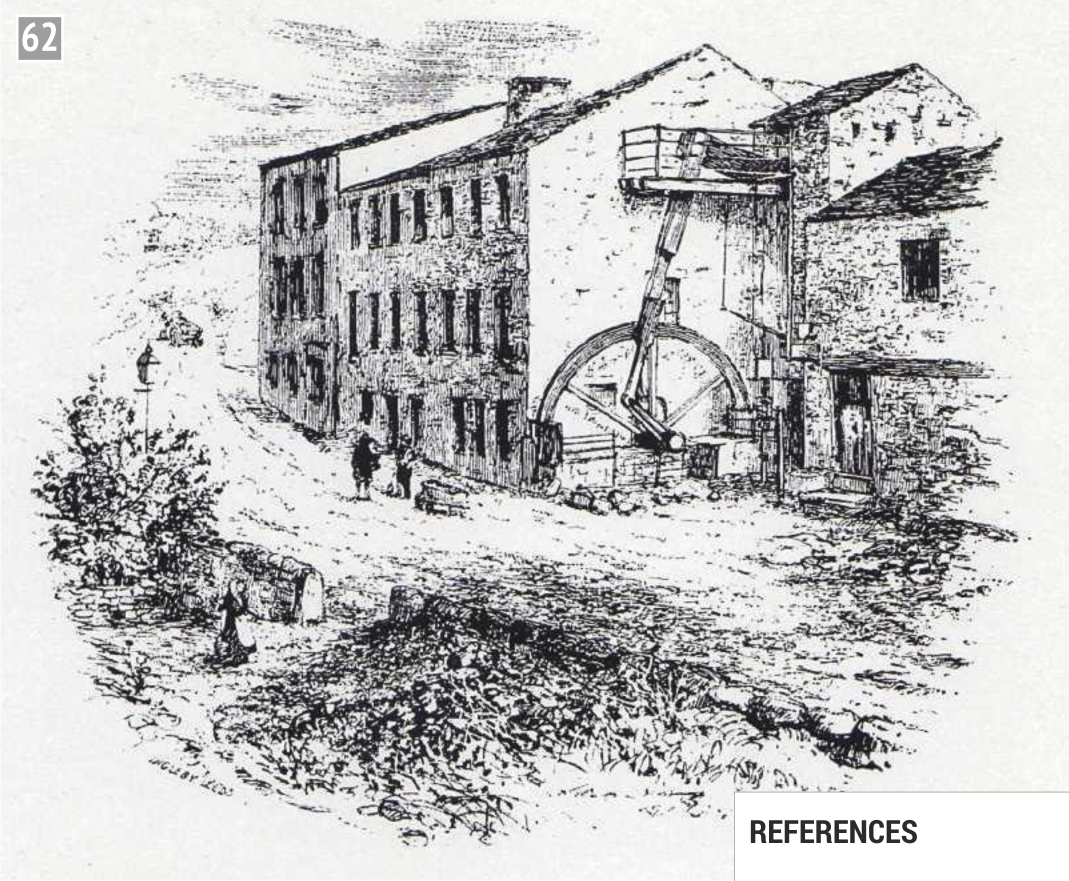
Edward Smalley working with the Birkenshaw Ironworks.

The Morley Crank Mill engine (**photo 62**) was possibly the first rotative steam engine in the Yorkshire industry but an engine powered mill at Birkenshaw at work in the same year may have been built by the same builders as the Birkinshaw Ironworks must have been close to its site.

If woollen mills often occupied old mill sites, cotton mills more frequently favored new sites but prospective mill owners still sought water power. Often substantial hydraulic engineering was needed to provide this power especially as the full range of powered textile machines developed. George Ingle (**ref 124**) has identified about 50 cotton mills built by the turn of the century. About half were making use of steam power (**ref 125**) and of these engines all bar one was described as a pumping engine. Whether the engines were of the Wrigley type or whether they were atmospheric beam engines is at present unknown.

When the total number of Boulton and Watt engines delivered to the Yorkshire textile industry by 1800 is placed against the combined total of 129 engines known to have been operating, the very limited impact that the Boulton and Watt engine made in the county is apparent. Before 1800 cotton spinners ordered two engines in 1792, one in 1795 and one in 1796. All were for Leeds manufacturers and all were sun-and-planet engines. Two crank type engines were ordered in 1796, again both for Leeds. The record of the much larger woollen industry is equally uninspiring, a mere five engines being delivered between 1792 and 1800.

62



Rotative atmospheric engine at Morley near Leeds, 1790. The weighted connecting rod is clearly shown

●To be continued.

REFERENCES

123. *The West Riding Wool Textile Industry 1770-1835*. D.T. Jenkins. Pub. Pasold research Fund. 1975. p. 84 and Appendix I.

124. *Yorkshire Cotton. The Yorkshire Cotton Industry 1780-1835*. George Ingle 1997. Pages 14 and 16.

125. Ibid. p. 42.

NEXT ISSUE

Regulator Valve
David Fulton makes a regulator valve that offers fine control of the flow of steam.

Flying Scotsman
Having completed the tender, Peter Seymour-Howell begins the construction of the locomotive.

Thompstone Engine
Jason Ballamy makes the eccentric and slide valve.

Content may be subject to change.

ON SALE 4 JUNE 2021

FREE PRIVATE ADVERTS

MODEL ENGINEER MODEL ENGINEERS' WORKSHOP

Did You Know? You can now place your classified ads by email. Just send the text of your ad, maximum 35 words, to neil.wyatt@mytimemedia.com, together with your full name and address, a landline telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses to protect your security.

Coronavirus advice is changing!
Please follow local government advice in Wales, Ireland, Scotland or England as appropriate, especially if you are considering buying or selling items for collection. Please respect the needs of delivery drivers to protect their own safety and, if receiving a parcel take sensible precautions when handling anything packaged by someone else.

Machines and Tools Offered

■ Harrison lathe, L5, 9" swing, 24 B.C. Norton gear box. With DRO. £1,100.
T. 01775 820469. Spalding.

■ Myford capstan lathe on wheeled trolley with collets and cut off slide. £200. **T. 01298 687448. Buxton.**

■ Myford Super 7B on Myford stand, gearbox, fully tooled, metric conversion set, inverter drive, excellent condition £2,750. Myford Speed 10, Myford stand, one owner, tooling, pristine, books and manuals, for both £950.
T. 07724857140. Colwyn Bay.

■ Little used. Warco wm180 lathe + d.r.o. F+t steadies. faceplate,4x chucks, tailstock chuck, live centre boxed set, q-change toolpost + tools, Keats block. £1000. O.v.n.o buyer to collect.
T. 07948 515105. Worthing, Sussex.

■ Elliott UO Horizontal Mill, single phase, with dividing head, vice, and Bridgeport vertical head on 'swing-over' mounting, fitted inverter drive for variable and reversible speed - £650-
T. 01494 864978. Great Missenden.

■ Myford Super 7, stand, raising blocks, screw cutting gearbox, MDRO, chucks, faceplates, Dickson toolpost, capstan type tailstock, other accessories, will deliver 150 miles of Reading.
T. 01189 842512. Reading.

Models

■ 3 ½" and 5" gauge Portable Elevated Steel Track for sale. 165 feet long, 17" high. Complete with two Bogie Passenger cars. £600.
T. 07958 250533. South London.

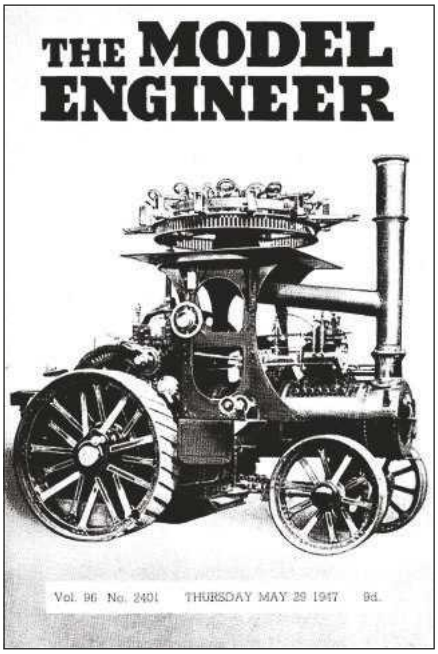
Parts and Materials

■ Virginia 3.5" chassis. Wheels, cylinders, bogie machined. Plans. Tube for boiler. Tender bolster castings. £50.
T. 01444 451175. Haywards Heath.

Magazines, Books and Plans

■ Model Engineer Vol. 138-140, 158-174, 186-188, 193-204, 211-225, not all complete. Also some Model Engineers' Workshop and Locomotives Large and Small. Offers.
T 01582 883260. Luton/Bedford.

■ A quantity (ca.6 Kg/ 13 lb) of mint condition ex-dealer illustrated sale leaflets/distributor information/ accessories data etc for a wide range of machine tools mainly 1980 - 1990. Includes 600 group, Q&S, Binns and Berry, Boxford, Ajax, Denbigh, FANUC, Alzmetal, Abwood, Danobat, Aerogrip, Warrior etc.
T. 01205 290312. Near Boston, Lincs.



Wanted

■ Bench mounted milling machine, anything considered.
T. 01530 460573. Coalville.

■ Cowells ME lathe, must be reasonably new. Also accessories, chuck etc. Delivery by taxi if required. P.S. too old to buy a new one.
T. 01986 835776. Norwich/Ipswich.

Old girl all dressed up posing for the camera.

PART 14 - TENDER TANK AND WATER VALVES

WAHYA A 5 Inch American Type Locomotive

Luker builds an American 4-4-0.

Continued from p.571
M.E. 4663, 23 April 2021

Water valves

The water valves for the injectors (**fig 2** and **photo 86**) need to be made before the tank can be assembled. The standard model engineering 'injector type' valves were used with the top handle fashioned to fit the large scale type handle used. Most of the valve is simple turning operations and I wouldn't be too pedantic with fits and tolerances - as long as the valve turns freely in the seat it's fine. A little leakage is not the end of the world; besides you'll never leave the tank full of water.

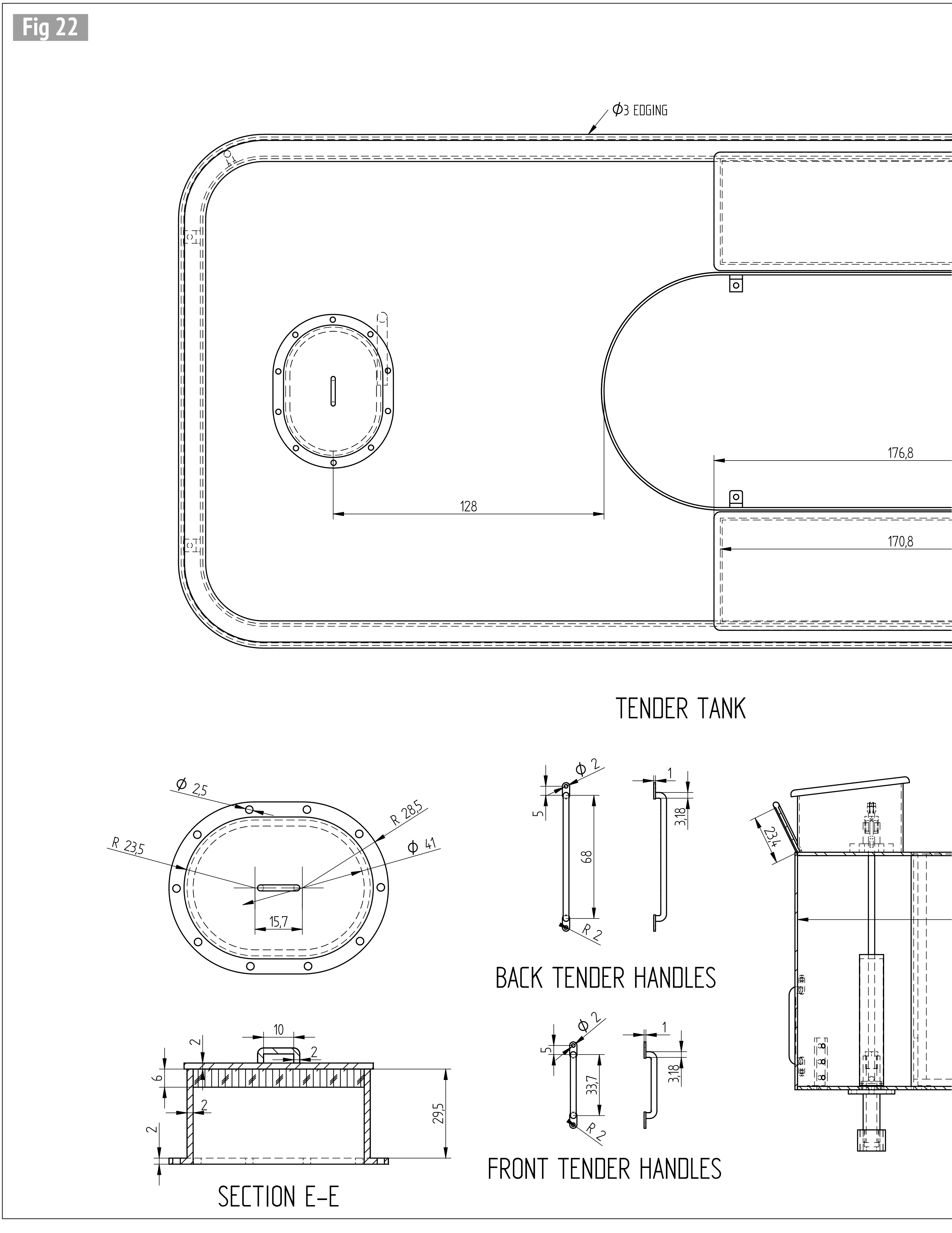
For the injectors a self-cleaning filter is a must and the easiest position is in the tank, where the natural sloshing will help keep it clean of debris. I had some stainless steel wire gauze that was soldered to the brass nut and a cap to make the filter. Stainless is a difficult material to solder - the best way to go about it is to wrap the gauze around a suitable sized drill and fold the ends over twice making a cylinder. This is slipped over the brass with a little flux between the two and the soft solder fed through the stainless with the flame on the brass. Technically the stainless is not really taking to the solder but as long as the soft solder sticks to the brass and wets the gauze all is good and it will work just fine.

The handle was an interesting component to make. The flat pattern was laser cut in stainless and this was silver soldered to a piece of round bar of suitable size with a slot filed down the

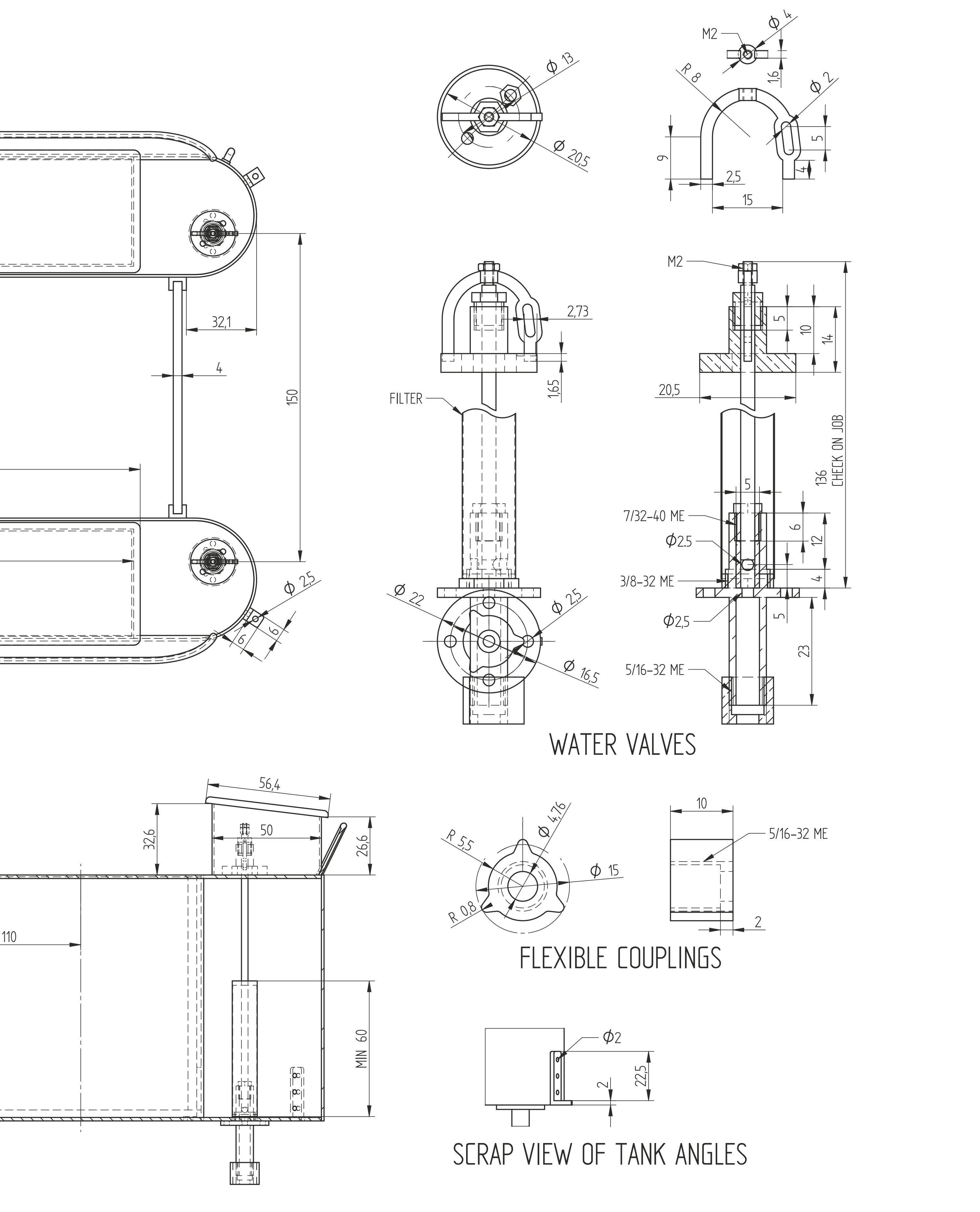
Water valve parts.

centre. The round bar was then parted neatly, drilled and tapped in the lathe. A threaded handle with a locking nut was used instead of the normal square hole for easier adjustment on the tank and to

Fig 22



Φ3 EDGING
176,8
128
170,8
TENDER TANK
Φ 2,5
R 28,5
R 23,5
Φ 41
15,7
Φ 2
1
5
3,18
68
R 2
BACK TENDER HANDLES
23,4
10
2
2
6
2
29,5
2
SECTION E-E
Φ 2
1
5
3,18
33,7
R 2
FRONT TENDER HANDLES



Tender tank and water valves.

make sure the handle lines up with the hole in the valve.

The flexible coupling looks fancy but a whole handful can be made in an hour or two. The trick is to solder three 3mm rods to a piece of bar, in a machined slot (**photo 87**). I used a cutter fashioned from a broken drill with a round cutting edge to cut these slots at a depth of 1mm. Then it's a simple soldering job and drilling and tapping in the lathe like you would a normal fitting. The pipe side is silver soldered with a flat brass ferrule that seals nicely on an 'O'-ring, and the little nib on the end to keep the pipe on is a piece of copper tubing one size bigger soft soldered in place with the coupling fitted - easy peasy (**photo 88**).

The manhole

The manhole flange was laser cut with the oval section bent around some 40mm bar stock held in the vice. The two components are welded together and the assembly used to open up the laser cut holes on the top plate of the tank.

The bottom side of the tank top plate was countersunk and, using small countersunk screws, the manhole was tightly fitted before the tank was welded. This will make sure the pre-cut holes in the top tank plate will not distort due to the welding of the tank.

The manhole cover is a very simple oval plate with a handle. Two holes are drilled and countersunk for the handle, which is made from some 2mm TIG welding rod and welded on the underside. Two more holes are drilled and countersunk on the sides of the lid for M2.5 studs that are welded flush with the top of the lid to hold the wood plug on the underside of the lid, just like the large tanks I might add. On my model I've taken some thin stainless steel rope from the electric fence and connected it to one of these studs and a round bar that will hang inside the tank to avoid the lid from growing legs at a public steam meet.

Tender tank

The tender tank is best made from brass but who can afford that in our current economy?! The next best material is stainless but the geometry will distort badly if welded incorrectly. The top and bottom plates are slightly thicker for bolting the valves and manhole, with the sides 1mm stainless. A thin (1mm max) TIG welding rod and thin filler rod with pulsed welding will help to limit the distortion but a little movement of the front tank legs is inevitable.

Don't expect to panel beat the tank into shape after it's been completely seam welded; it first needs to be tacked together and checked on a flat surface for any warp-age or assembly drift. For tacking the assembly together the front top and bottom plates need to align properly for the water valves to fit nicely without jamming. All the water valve mounting holes can be tapped and drilled prior to welding and two spacers turned to fit the holes for aligning the front end nice and square.

With the tank properly tacked the seam welding can be tackled from side to side balancing the heat input. I welded the whole boiler and pressure tested it to twice working pressure with no leaks - not even a droplet formed on any weld. The tender tank had three leaks on no pressure - go figure!

Even with all that the tank will most likely buckle a little, nothing a little body filler and some sanding won't correct.

With stainless getting the paint to stick can be an issue. I normally rough up the surface with an angle grinder mounted twisted wire brush before I fill any dings with body filler, prime and paint.

The 'wings' at the top of the tank interestingly enough are there to keep the sides of the tender clean. I read that in a very old book the other day and have always wondered why they are common on tenders after the turn of the century. The wings for this tender are very simple and can be step

87

Coupling ready for soldering.

88

A couple of couplings.

89

Tender tank welded.

welded to the sides of the tank just below the top. The gap can be filled neatly with body filler; no-one will be the wiser of how it was assembled. A round bar is tack welded to the wings to finish the top off nicely (**photo 89**).

The coal bunker was closed off by two channels where wood beams were fitted with a gap at the bottom for the fireman to access the coal from the bunker. My locomotive has a container that fits into this section for running that can be removed for cleaning and for the display stand when not in use. The bottom is left open like the large scale to make it easier to blow any stray pieces of anthracite that have dropped down the sides of the container.

The tender tank sandwiches wooden panels between the frame and tank by four angles at the front and back of the tender bolted through to the bottom frame.

The toolboxes, tank angles and tank handles

The tank angles were made from some scrap angle iron. I prefer this to bending plate, it looks a little neater and you end up with a corner at the back instead of the bending round. We don't get 2mm angle here so I had to skim the backs on the milling machine but this is a quick job and it helps to true up the angle; you have no idea how wonky our mill steel is!

The tender handles are bent around a mandrel and filed to size. The backing bolting flange is filed from some scrap steel and the lot is silver soldered together. Finally, it's filed as an assembly to make sure the back bolting flanges line up. You'll notice in the picture (**photo 90**) that these get added after the first layer of primer. This makes filling and sanding the filler to correct the inevitable warping due to the welding much easier and you're less likely to hide the detail of the backing flanges.

The handles and angles are screwed to the tender with M2 screws with the heads rounded to look like rivets and a little sealer on the threads to keep the water in the tank.

The toolboxes were made in a similar fashion to the cab, using small wood screws and some sleeper wood (**photo 91**). The hinges typically had the long legs extending over the box. Soft soldering some 0.5mm brass strip filed to size to a common jewellery box hinge looked very convincing.


90

Tank handles and angles.


91

Wooden toolboxes.

Painting and finishing the tender

Painting the tender is again entirely up the builder. After the turn of the century (the 1900 one) the builders stopped painting the beautiful murals on the side of the locomotive tenders that were common in the mid-west with most of the paint schemes becoming dull, simple and normally black to cut costs. The frame would have been black and the wheels should, at the very least, match the engine bogie wheels. But the tank… there you can go wild!

For my tender I painted it dark blue to match the boiler cleading on the engine. I wanted the tender to be a little ostentatious but it shouldn't detract from the bling of the engine. A little gold lining and the locomotive name on the side will do nicely and, being gold and flamboyant, I think the previous president of the land where this locomotive originated from would approve (**photo 92**).

Acknowledgments and what's next?

As always, my admiration and thanks go firstly to my beautiful wife who had an abundance of patience and tolerance, especially when it came to the storage of not-so-food-like substances in the fridge and diligently reading through my first drafts. To all the readers, thank you for taking the time to read my series. I hope it was inspiring or, at the very least, interesting!

Believe it or not the design for my next project is done and dusted and a number of castings have already been cast; this before the paint was dry on the *Wahya* tender. This little one, a 5 inch gauge 0-4-0 based on a timber tram locomotive, was designed as a simple build for a young chap that contacted me looking for his first locomotive build. It was already of interest to me because it has an interesting valve gear type and a sexy wooden cladded boiler. Barring the normal cylinder, chimney, etc. castings the locomotive is mainly constructed from laser cut plate with not too much machining, unlike *Wahya* where I wanted to add credence to the phrase 'live steam from castings'!

ME


92

The old girl's backside.

POSTBAG

Help Needed

Dear Martin,
Please would you advise/pass on my request, for a model engineer (person) who might be able and prepared to finish the motion work on my ¾ inch Bassett Lowke traction engine. Specifically, this involves the machining of steam ports in the cylinder, valve chest and making of valve gear.
This is a project I began sixty years ago, held in abeyance for fifty years. Now in my late seventies I am keen to finally complete it.
Your help on this will be greatly appreciated
Yours, John Highfield (Alton, Hampshire)

(Is there anyone, perhaps local to Alton, who could help Mr Highfield? – *Ed.*)

Micro Mills

Dear Martin,
I read Terence Holland's article, 'Trials and Tribulations with a Micro-mill' (M.E.4654/6) with interest and felt that he was being a little unfair. The more I think about it, I've reached the conclusion that it depends where you are coming from and your experience prior to purchase. So here is a somewhat different story.

About 50 years ago, I started an apprenticeship with a local engineering firm. I still remember my first day, being shown around the toolroom and being introduced to the various machines. I distinctly remember the shop foreman telling me that the pillar drill was the most dangerous machine, being responsible for most of the accidents that occurred in the shop. Mainly because workers tried to hold their workpieces by hand rather than taking the time to clamp them down! Unfortunately, I only spent six months in the toolroom before graduating to the drawing office and subsequently to senior management.

Years later, I had the opportunity to set-up my own workshop in the back of my garage and like many people I started with a Unimat 3. I soon found that the Unimat vertical mill/drill was very limiting and so bought a bench mounting pillar drill from Screwfix and it served me well! But over the years I did have a few accidents, nothing serious (I've still got all my fingers), but some quite painful, and embarrassing, incidents.

The main problem was the table, a square casting which moved up and down, and around the tubular pillar. It had four radial slots in the table, from the centre out to each corner. BUT underneath and adjacent to each slot was a strengthening rib. These tapered in depth from thick at the centre out to nothing at the corners. The result was that if you tried to clamp anything down, the clamps moved on the taper and dragged themselves and the workpiece towards the edge of the table. This made it very difficult to clamp accurately! But worse still, when you finally got something clamped in the right place, the vibration of drilling often loosened the clamps, forcing one to stop, reclamp, and try again.

So, the tendency was to try and hand-hold everything, either the workpiece itself or a machine vice with the work clamped in it! Hence the occasional accident. (The only thing worse than a machine vice spinning round on the end of a drill, is the drill breaking and setting the vice free to fall where it will!) Secondly, if you did manage to clamp something down, you couldn't start with a small drill and work up to larger ones, because every time you had to slacken the table to move it down, it could also swing around the tubular post, hence losing the position of the hole relative to the drill!

I always felt that it was an accident waiting to happen and treated it with a great deal of caution. For some time, I had been looking for a replacement and was occasionally seen at exhibitions peering UNDER the tables of drilling machines but many seemed to suffer from the same problems. Then a friend remarked that he had just replaced his pillar drill with one of the new-fangled 'Mill/Drills' and this got me thinking again. Time was spent browsing machine specifications and I started looking at the possibilities. I realised that, with very little reorganisation, a small mill/drill could be fitted in the same space occupied by the pillar drill. There was one machine I rather fancied, and I even visited their showroom, but it was quite expensive at over £600 and the sales staff didn't appear to want to sell me one, so I moved on.

I went to the Midlands Model Engineering Exhibition in 2011 with the specific intention of looking at other suppliers. I liked the look of the SEIG X1 mill-drill (on display at Arc Euro trade). The staff on the stand there were extremely helpful, even explaining what they thought might be disadvantages. (specifically, the nylon gears, which were known to break, but are easily replaced). They were very knowledgeable, not only about their machines but about the hobby in general and were able to recommend different machines depending on the interests and experience of each customer (not just the most expensive). They recommended the optional longer table, as it gave much more space for clamps on either side of a workpiece. When they also offered me a discount for ordering at the exhibition, which brought the price down below HALF of the price of the previous machine I had been looking at, and then they threw in a set of 'T' bolts, nuts and clamps! I was hooked. The machine was ordered at the show and delivered to my home just a week later.

It was no problem to install - just clean up and bolt to the

Write to us

Views and opinions expressed in letters published in *Postbag* should not be assumed to be in accordance with those of the Editor, other contributors, or MyTimeMedia Ltd. Correspondence for *Postbag* should be sent to:
Martin Evans, The Editor, Model Engineer, MyTimeMedia Ltd, Suite 25S, Eden House, Enterprise Way, Edenbridge, Kent, TN8 6HF
F. 01689 869 874
E. mrevans@cantab.net

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.

bench. So, is it any good?

Well I've found it easy to use and it has so many advantages that I am wondering why I didn't make the change years before. Let's just look at the advantages that I've found just using it as a drilling machine:

1 The 'T' slotted table makes clamping simple, either directly to the table, sometimes using a bit of wood under the work to protect the table, or using a machine vice clamped down. You don't even need to clamp the work accurately, just bolt it down and then use the 'X' and 'Y' leadscrews to centre the hole position under the head. It couldn't be easier.

2 When you start a hole with a small drill, and then work up in a number of sizes, to the final hole size, you can keep raising the head and changing the drill bit without losing the head position over the hole. The head raises and lowers on a square pillar so always maintains its position. Much easier than moving a table down!

3 The speed control has two ranges, 0 to 1000 rpm and 0 to 2000 rpm, selected by a lever which moves gears about for each range. Once a range is selected the speed is infinitely variable from ZERO to either 1000 or 2000 rpm. Unfortunately, there is no calibration of speed but it is relatively easy to choose a speed which feels, and sounds, comfortable for the task in hand.

4 With the work clamped down, you have one hand free to operate the drill, whilst the other hand can be employed dispensing cutting fluid on the work whilst the drill is still turning.

5 I was quite careful to choose a machine which has an MT2 taper and a drawbar. This is the same taper as my lathe (now upgraded to a Myford 7) so the same tooling can be used. I've already had cause to use a boring head to take a hole out to 1 inch diameter, something which I would not even have attempted without clamping down the workpiece. Furthermore, the same MT2 taper ER25 collet chuck system can be used on both machines.

6 The whole head can be tilted over for drilling at an angle (calibrated in degrees). Much easier than tilting the table on the pillar drill with no calibration.

7 Co-ordinate drilling is easy, you may need to be more careful clamping work down to get a good datum line. But once done you can use the X and Y axes to mark out and drill holes, taking due care to allow for the backlash in the feedscrews.

I find that drilling holes is now more accurate as well as very much safer. As a replacement for a normal pillar drill, these small mill-drills are simply the best thing since sliced bread!

On top of all the above 'drilling' advantages, I've got a small vertical milling machine in my workshop as well. It works well on milling tasks as long as you take into account the light nature of the machine, taking a number of light cuts, rather than a single heavy cut that might be possible on a 'Bridgeport'. I've certainly machined the port faces on gunmetal cylinders for a 5 inch gauge locomotive with no problems, using a ⅜ inch diameter replaceable tip end mill!

So, have I had any problems? Well, 'yes' after about six years use, I was using the milling facility to 'fly-cut' a flat surface on a piece of cast iron, when the drive failed. The intermittent cut had stripped a few teeth from one of the nylon gears. I stopped for morning tea, telephoned the suppliers, and was quoted the princely sum of £8.95 for a replacement set of gears. I gave them my card details, and the very next morning the new gears arrived on my doormat! Half an hour later it was back working. More of a minor hiccup than a problem.

So, as I said, it depends where you start from. For me, as a replacement for a cheap pillar drill, it's a fantastic bit of kit. I can understand Terence Holland's disappointment as a replacement for what I suspect is a far more rugged 'Rodney' milling attachment but to describe this precision machine as a 'TOY' was I felt a bit unfair! (I have no connection with Arc Euro trade, other than as a very satisfied customer.)

Dave Cox
(West Sussex)

Measurements

Dear Martin,

I have been reading *Model Engineer* since 1947, when I began my apprenticeship in Lincoln. All Imperial! Millimetres came my way in 1959, down south, and this was not a problem. My new firm had started thus in 1906 but ALL their machines had always been Imperial! It will intrigue you to know that the 100 strong workforce built engines of 120 tons and the place ran on 220V DC, with flapping belts throughout. Anachronism?

So, I went on in life and it was only years later that I learned that those French 'scientists', around 1788, started laboriously to define the metre as you say in your column. Only then, suddenly, did it occur to me that their work was a ludicrous waste of time. For all the difference it made in practical terms, they could have picked up any old bit of iron bar and said "There, that is the new metre and let's have no argument!". Aristocrats maybe, but still boneheaded. Even then, they got it wrong and concocted a value that was philosophically baseless! Of course, it did not matter. The deed was done, but what a silly process and a waste of effort. Quite impractical minds. No magic in the global diameter.

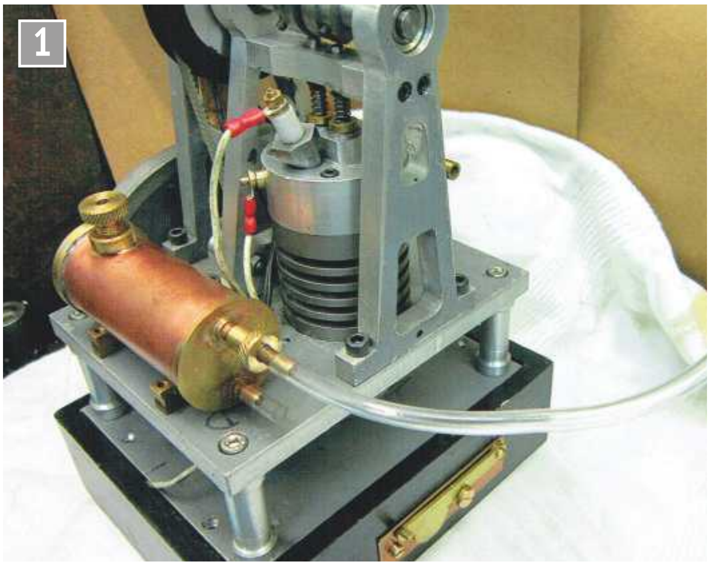
The odd thing is that nobody, not a soul, has ever approached me to state what a farce it had been to do all that wasted work from Barcelona to Dunquerque. Instead, it was applauded.

You were right about the simplicity of use, with the SI. Later, I was with the HSE and I saw a 5 ton Iron Fairy crane about to lift a big piece of pre-cast concrete and stopped it. Challenged, I judged the size in metres, got the volume, multiplied by 2.50 for the weight and stuck to my guns. All in seconds. Seven tons. Five-ton crane. The manager phoned later. 7.5 tons.

The one thing that I do wonder about though, is the use of 10 as the magic number. I am no great shakes with computer theory but I do puzzle about what would have happened if we had had eight fingers instead of ten. Counted - - -5-6-7-10 instead of - - 7-8-9-10. Would this have fitted in better with binary maths? Eight and sixteen seem to be important somehow. That is now beyond my poor old noddle!

Sincerely yours, John Illingworth (Sheffield)

(You are indeed right – computer people like octal (base 8) and hexadecimal (base 16) as they are convenient, and more compact, multiples of binary (base 2) – *Ed.*)



Otto, *a four stroke engine to the Jan Ridders design.*

Otto Four Stroke Engine PART 1

Keith Rogers builds Jan Ridders's four stroke petrol engine, *Otto*.

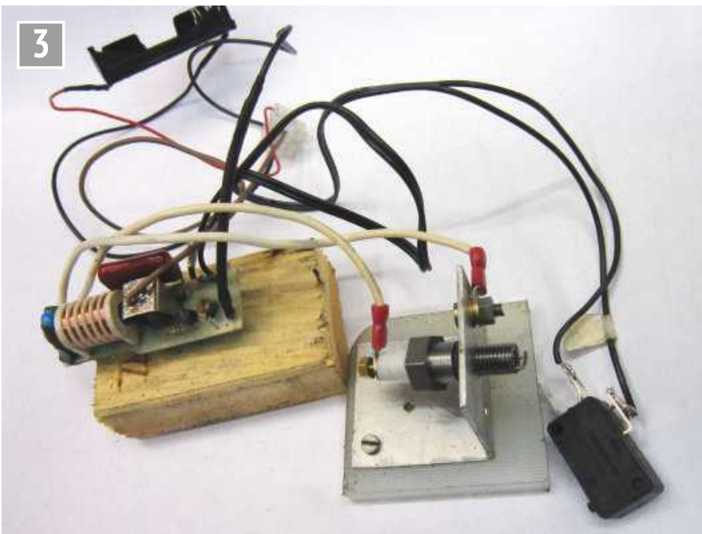
I was attracted to the Jan Ridders design for a four stroke petrol engine as a change from locomotives and as a project during the Covid-19 shutdown but I was worried that I wouldn't be able to make the ignition circuit as my knowledge of electronics is minimal. I made the spark plug first (**photo 2**) which was fairly straightforward but the side electrode created a slight problem in that drilling into the body of the plug with a 0.9mm drill broke the drill leaving the drill stub firmly stuck in the body of the plug. With more care I drilled another hole at 180 degrees from the previous as I had some 0.9mm diameter silver steel in stock (I don't know where that came from). To make the earth electrode I carefully flattened the end of the wire to flatten and expand the wire and, with a pair of pliers, forced it into the 0.9mm hole in the plug body, bending it over towards the central electrode.

For the electronics I bought a gas lighter from Amazon (£10). Unlike most gas lighters this one has no gas reservoir, it's purely electronic. I put it aside as I had a problem to fix on one of my locomotives but when I eventually picked it up again, it didn't work - not a spark! After some thought I decided to buy another, thinking perhaps I had damaged the first one. The second lighter arrived and it worked perfectly. After further thought I realised I had the opportunity to practise on the first lighter. There is a YouTube video showing how

Spark plug.

to modify the circuit board and the new components required. The video goes through the instructions at a fair rate, however, and it's difficult to take notes. (With my minimum computer knowledge I didn't know that if you clicked on the two short broad lines at the bottom left hand side of the screen it paused the video; a club member enlightened me.)

I managed to do the modifications to the circuit board having purchased a small soldering iron and stand from Aldi. To hold the spark plug for testing I made a mount from 10 swg aluminium and provided an earth connection (**photo 3**). To my utter astonishment it worked! I also received a sharp electrical shock from the circuit board. I was surprised that a 1.5V AA battery could do that. At this point I put the electrical part away whilst I concentrated on getting my non-functional Jeannie Deans compound locomotive to perform.



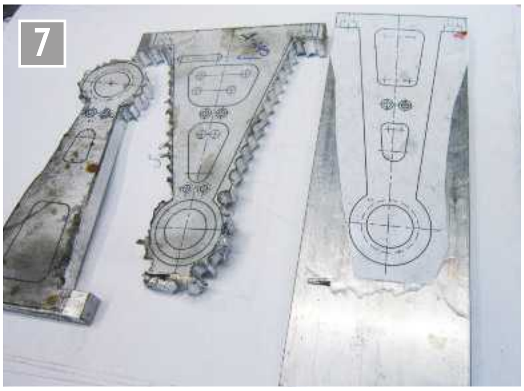
Rough set-up to test electronic circuit.

To hold the spark plug for testing I made a mount from 10 swg aluminium and provided an earth connection. To my utter astonishment it worked!

Boring the cylinder bed plate.

Preliminary machining of the cast iron cylinder.

Cylinder, piston and con-rod before the piston ring is added.



First stage in cutting out the three pedestals.

Rounding the end of the pedestals.

Milling the rough drilled edges of the pedestals.

Then came the lockdown; we couldn't visit the track and club meetings were suspended so I picked up the petrol engine again.

I ordered the aluminium and cast iron that I needed. I already had a lot of the aluminium in stock, donated by a club member. My first concern was - can I swing the upper bedplate on the Myford to drill and counterbore the cylinder mounting hole by just using two of the pillar fixing holes (**photo 4**)? I drilled the four pillar mounting holes in the bedplate and centre drilled for the cylinder locating hole using co-ordinates on the vertical mill. I offered the plate up to the faceplate, locating by using a centre in the tailstock. I then clamped it in position and, using a transfer punch, I spotted through the holes, removed the clamps, removed the faceplate from the lathe then drilled and tapped the fixing/ clamping holes.

I then machined the cast iron cylinder with the fins but I wasn't really happy with the finish of the 1 inch diameter bore (**photo 5**). I decided to try lapping and found a piece of old broom handle which I machined to just under 1 inch diameter. I drilled a small hole up the centre for about 2 inches then sawed a cross shape cut for this length and inserted a large woodscrew into the central hole. Mounting it in the lathe I coated the wooden plug with fine automotive valve grinding paste, set the lathe to low speed then worked the plug in and out of the cylinder, adjusting the screw, to gradually expand the plug until the piston which I had made earlier was a smooth sliding fit in the bore (**photo 6**).

To make the three pedestals I drew them out full size in CAD and pasted them to the 10mm thick aluminium sections (**photo 7**). I don't have a bandsaw so I had to chain drill to the drawing outline. I used my milling machine as much as possible to space out the holes on the straight sections. I used a $\frac{15}{64}$ inch diameter drill and indexed ¼ inch on the mill (two turns of the handwheel) on the X axis. This gave me a small amount to saw through with a junior hacksaw. For the round topped bearing housings I drilled the holes by eye, mounted the pedestals on the rotary table, joined up the holes and machined to form the radius (**photo 8**). I then held them in the machine vice and used ½ inch diameter cutter to bring the metal up to the line of the drawing (**photo 9**). Although I had the hole positions from the drawing, for accuracy I marked the positions using my Vernier height gauge and surface plate as a further check when I came to drill the holes using coordinates on the milling machine. For the bearing holes I mounted each pedestal in turn on the lathe faceplate and bored them to suit the ball races. The lower pedestals, although much simpler, were made in a similar manner.

As the ball races I used were metric I thought it would be a good idea to use 10mm Precision Ground Mild Steel (PGMS). Not a good idea; the 10mm shafts would not look at the bearings so to avoid forcing them on I used emery cloth to reduce to a push (Newall 'A' Slide, Push and Press) old tooling fit. I purchased the drive toothed pulleys (72 and 36T) which were rather more expensive than I expected.

●To be continued.

Polygonal Holes & Rotary Broaching

PART 1

Using a bubble level to get the punch truly vertical.

Jacques Maurel discusses the process of making non-circular holes.

Striking

Some time ago I wrote an article in *Model Engineer* (M.E.4310) about making polygonal holes (hexagonal and square) by striking a punch into a predrilled hole, the workpiece being held in the bench vice with the help of a 'striking block'. A method was given for machining the punches with a plain dividing block and more information was given about the bore dimensions for the screw head, about screw materials and about the force needed for punching.

Advantages of this method:

1 The hammer provides plenty of force for driving the punch into the workpiece.

2 The 'inertial' pulling hammer is also very effective for extracting the punch from the workpiece.

Drawbacks:

1 The polygonal hole must be made away from the machine (lathe or drilling machine).

2 It's difficult to keep the punch in line when striking and most often the polygonal hole is neither concentric nor in line with the predrilled one.

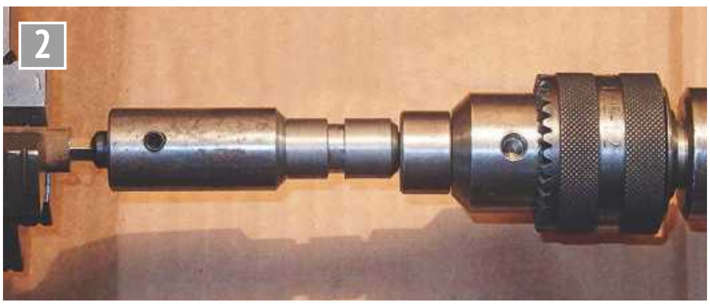
The second drawback arises, firstly, because while the bench vice jaws are at 'elbow height' (for the filing strokes to be in the horizontal plane) the striking point on the punch holder is too high above the elbow and the punch can easily move sideways, the striking movement being near an arc of circle the center of which is the elbow and the radius the distance between the elbow and the hammer head. This radius should be horizontal (perpendicular to the punch) at the end of the stroke but is not! Secondly, we cannot be sure that the punch holder is vertical before striking.
These problems can be partially solved in two ways:

1 By standing on the first step of a step ladder for striking, so that the elbow will be in the right position.

2 By using a small bubble level on the punch holder (**photo 1**). These levels are easy to find on old scales or in DIY stores. Mine was borrowed from a discarded scale and stuck with epoxy glue to a plate attached to the punch holder. As can be seen on the photograph, the holding hand should lean heavily on the vice for the punch not to move during the striking movement.

Rotary broaching

This process was thoroughly described in *Model Engineers Workshop* (M.E.W.157) by Jock Miller and this was a project I was planning to undertake when M.E.W.241 arrived and I decided to have a go with the solution proposed by Mike Cox in that issue. A prototype was quickly rigged up with the ball holder set to give a



Mike Cox's solution for rotary broaching.

1degree offset (see **photo 2** and **fig 1**). This was tried with quite good results but the ball was screaming (with a 6mm hex punch, despite the use of molybdenum disulphide grease) and the bit was not so easy to extract.

A groove was then machined on the punch holder to fit a pulling hammer so that the punch became easier to take out.

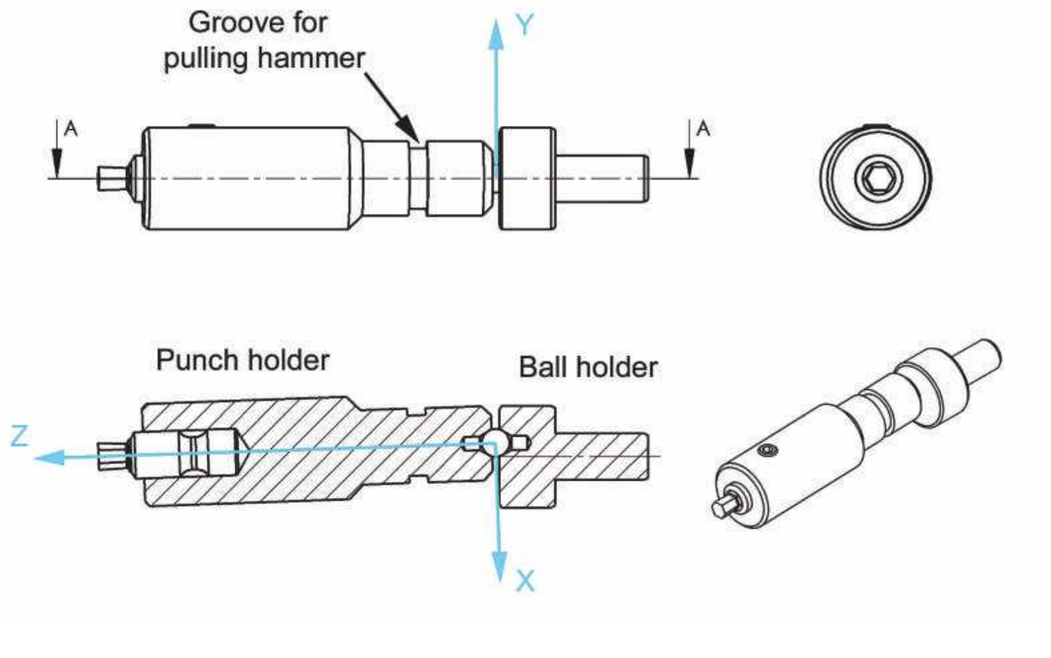
As I didn't want to have any problem with the 'Society for the Prevention of Cruelty to Balls' I made a prototype to solve the 'ball screaming' problem. In fact, from the three independent rotations possible around the ball center, only two are theoretically necessary, one continuous around the punch axis (Z) and one for 1degree only around the vertical axis (Y) (if the punch axis Z is set in a horizontal plane). A third one around the X axis (perpendicular to Z and Y) may also be necessary but less than 1° for good alignment of the punch inside the bore starting chamfer (if we are not sure that the lathe axis is truly within the YZ plane).

For the Z axis continuous rotation I used a needle thrust bearing (to withstand the high axial force) associated with bronze sintered bearings (low radial force) for guiding and pulling the bit out. For the Y rotation, a plain axle with cylindrical contact was used, some axial and radial play giving also the X rotation (**photo 3**).

There is a problem involved by these 2 free rotations - we must stop the machine (lathe or drill press) to set the punch in the part hole chamfer before starting the machine. This is not a great problem on a lathe for a one-off job but could be for a drill press, as the attachment can take a dangerous run out when the punch is pulled out from the work. These rotations should be locked, and the easiest way for this is to use a spherical contact (**fig 2** and **photo 4**). The 20mm diameter ball (11) (from a ball bearing) is set on

Fig 1

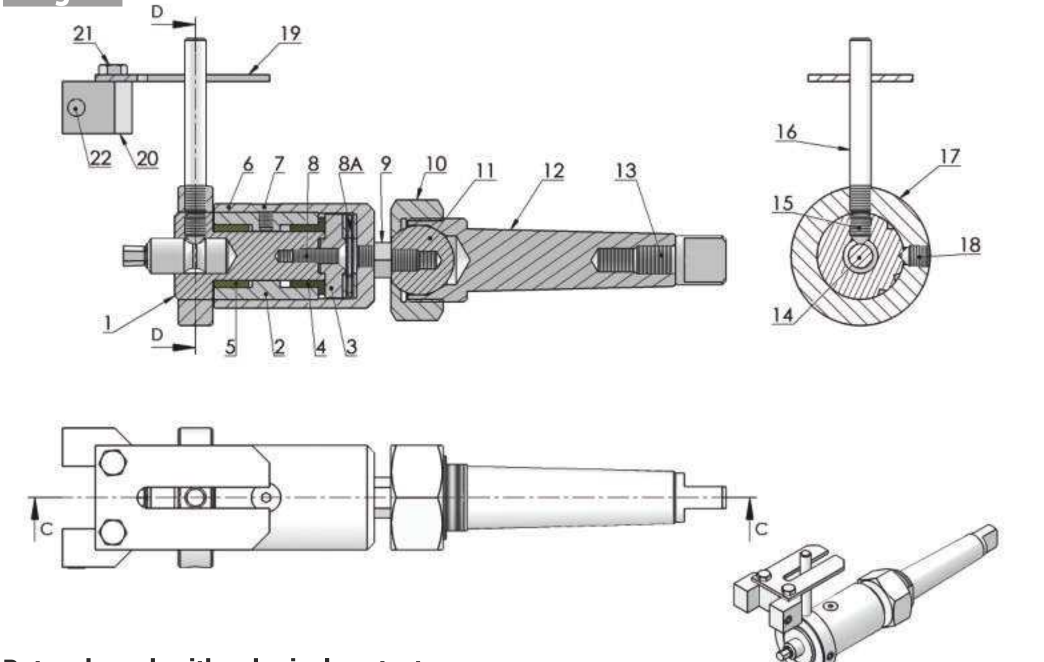
Rotary broach prototype.



3

Cylindrical contact.

Fig 2



Rotary broach with spherical contact.

a 30 degrees angle conical bore for a strong locking action when pushed by a lock nut (10) having a 45 degrees conical contact with the ball. An eccentric stud (9) is used to link the ball with the punch bearing and get the right 1degree offset angle. In use, free the nut, set the punch in the hole chamfer, and lock the nut; tighten with a 30mm spanner while locking the Morse taper shank with a 19mm spanner.

Advantages of this method:

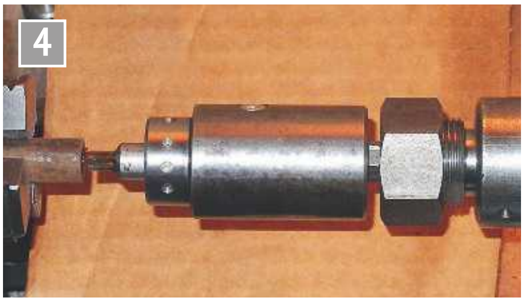
1 The punch bearing is fitted with a Morse taper so there is no problem on a drilling machine or for batch work on a lathe.

2 The punch length can vary slightly (and also the offset angle but it's not a problem).

3 Compared to striking we have the benefits that the bore is made with the machine and the machining force is smaller – by ⅙ for hexagons and ¼ for squares.

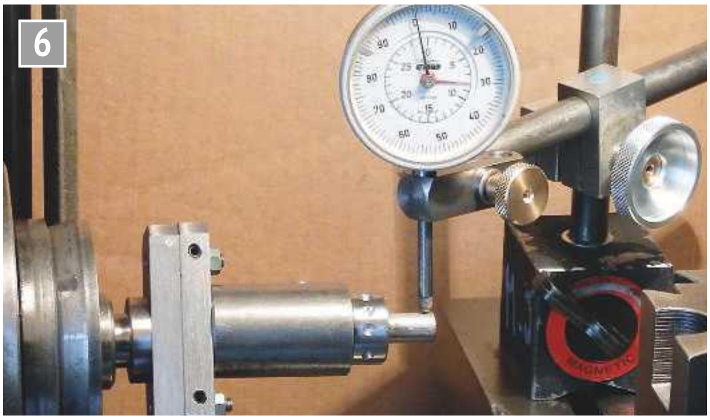
Drawback:

The machined bore is parallel but possibly not coaxial with the part axis.

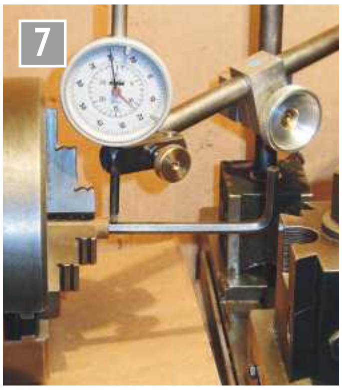


Spherical contact.

Two planes contact.



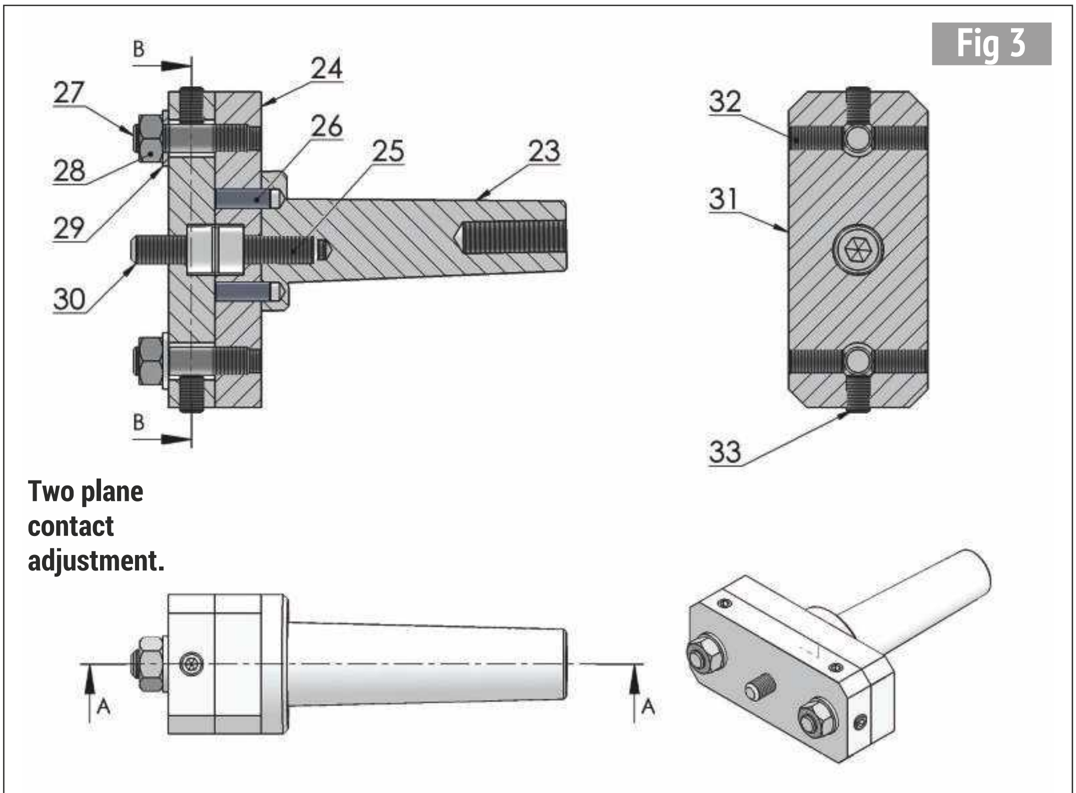
Adjusting the punch concentricity.



Measuring the centricity of the machined bore.

To get good coaxiality, drill for a short length (0.5mm) a cylindrical hole the diameter of which is the diameter of the circumscribed circle for the polygon, or say 0.1mm less, measured across the punch edges. Free the ball, push the punch into the bore and lock the nut (10).

The most usual way (**photo 5** and **fig 3**) of linking the punch bearing to the taper shank is to use a two plane contact (between parts 24 and 31 in the figure) and six set screws (parts 32 and 33) acting on the stud shanks (27) for concentricity adjustment. This adjustment is fairly laborious, and good only for a fixed extension of the punch (it must be repeated after punch sharpening). **Photograph 6** shows the set up for adjusting the punch concentricity, the attachment being set in the lathe spindle and the DTI stem set on a 10mm diameter piece of silver steel at a 15mm extension. Search on Youtube for a video from 'Slater' that describes this process – 'slater tools internal rotary broaching tool holder set up video'.



Two plane contact adjustment.

Measuring the concentricity of the machined bore

Set a good quality hex wrench in the machined bore (**photo 7**). Set the DTI stem (as vertical as possible and aligned with the lathe axis) on one side of the wrench, rock the spindle to find the lowest reading, push the wrench upwards to take out the play and zero the DTI. Follow the same routine for the other five sides and check the run out (DTI maximum variation for the other five sides). The result should be less than about 0.05mm for good concentricity.

●To be continued.

Obituary David Piddington

David was an extremely skilled modeller and was employed by A.J. Reeves for very many years until the company's change of ownership and move from Marston Green. At Reeves David was responsible for drafting some of the designs and produced many patterns for castings. To customers he was best known as their technical adviser answering the vast majority of the queries that came into the company and he kept meticulous records of customers who had purchased sets of drawings of any of the designs he had been involved with. After leaving A.J. Reeves he went to work with the late John Barrett at Barratts Steam Models Ltd and remained with them until his retirement.

David was a lifelong member of the Birmingham Society of Model Engineers and did a significant amount of work in sorting and cataloguing the society's extensive library of books and drawings etc. and took a great deal of pride in the finished catalogue which was distributed to all the members.

In addition to his involvement in the design and drafting at Reeves and his committed involvement with the Birmingham Society he was also a prolific author producing a wide range of workshop tools and accessories and stationary engine designs for publication in the model engineering press over many years. In addition to writing under his own name he wrote under the pseudonym A.J. Yallup and occasionally as Stuart Rome. Perhaps his best-known model was the stationary steam engine *Monarch* and its derivatives and fittings.

Such was his interest in the model stationary engine that in 1992 he joined the judging panel of the Midlands Model Engineering Exhibition and remained a member of the judging team until ill-health prevented him continuing some 24 years later. He thoroughly enjoyed his involvement with the exhibition and could often be seen most days at the exhibition stewarding and discussing model engineering with all - the exhibition was regarded as a holiday! Although suffering from increasing ill health which obliged him to give up his licence he still managed, through the good offices of friends, to visit the exhibition for a couple of further years after giving up judging and stewarding.

Outside of model engineering his chosen form of transport was a motorcycle and as a devout Christian he was a member of the Christian Motorcyclists Association. Unfortunately, he suffered with Parkinson's disease which obliged him to give up his much-loved motorcycling, which he deeply regretted.

David was a very modest man who did not enjoy being in the limelight and in his passing the hobby has lost a dedicated and highly knowledgeable modeller and author.

He leaves a wife Mary and a daughter Miriam and we extend our deepest condolences to them both.

Geoff Stait and Chris Deith

Here is a little anecdote from David himself, which readers may find interesting. It is part of a letter to Postbag written by David in response to the news that Martin Evans (Mk 1) had died:

'I hope many readers will still remember me from my thirty years and three months wonderfully enjoyable employment with A.J. Reeves & Co. Ltd., first at Moseley Road, and later at the Marston Green works until closure in December 2000. Working there was more like being part of a family. Martin was already editor of *Model Engineer* when I joined the firm in late 1970 though I knew him by sight from when I was a steaming bay assistant at the very first IMLEC at the Birmingham SME track the previous year.

'Martin was fiercely protective of his job and his magazine. An example of Martin's attitude was when he wrote to the directors [of Reeves, asking them to add the Shand Mason fire engine to their range]. Well, Reeves did. Alex Farmer and I studied the drawings and decided to have a go; I made all the patterns except one.

Castings were put into stock and Martin was contacted with a request for an editorial mention that this design was now available. Martin's reply was short and to the point: *'You will have to advertise like everyone else.'*

His views on correcting drawings, and the hazards associated with that, are perhaps currently topical:

'…I was able with the copyright designs of my employer [Reeves] to make corrections to master tracings, though even that task was fraught with unknown dangers. One professional builder of a 7¼ inch gauge tank locomotive with outside Walschaerts valve gear brought his chassis to us and demonstrated various major discrepancies in the design as he had constructed it. Unfortunately, my company lacked a metrology department; it could not actually measure this customer's work, and took it in good faith that he was right. Over a period of months 'corrections' were made, an advertisement put into *Model Engineer* and free replacement drawing sheets supplied to customers who had already purchased drawings provided that they returned the originals so they could be destroyed. Then, one of the company directors built two of these chassis to the original drawings and they assembled almost perfectly!'

An Astronomical Bracket Clock PART 3

Adrian Garner makes a bracket clock showing both mean and sidereal time.

Continued from p.613
M.E. 4664, 7 May 2021

Design approach

Before construction commenced all parts were drawn using Autocad LT. To save the cost of expensive brass, I made a mock up using Tufnol (**photo 5**) for the main plates and initially using nylon rod for the pillars, mild steel arbors and card cut out wheels. Tufnol is quick and easy to machine and, being cheap, caused no angst when additional but unnecessary holes were drilled. This proved useful at various stages of the design. Where changes have been made these are incorporated in the accompanying drawings.

Many parts will be seen to be similar to those designed by John Wilding and others. Full credit must be given to them for their articles and books which have helped me, and so many others, construct clocks.

With a few exceptions, the measurements on the drawings are in Imperial units as these match the tooling in my workshop. The threads, however, are generally BA which is an elegant metric thread. Sheet brass is now normally supplied in metric thicknesses. The nearest equivalent sizes should be used e.g. 1⁄16 inch = 1.5mm, 1⁄8 inch = 3mm etc. The differences are small and easily taken up when machining the lengths of pivots.

Other than the photographs of the completed clock, the pictures were all taken during construction before polishing.

Construction

General

Constructing any part requires three processes: setting up any needed machinery, cutting the part and polishing. The cutting

The astronomical bracket clock.

Clock mock-up.

is by far the shortest process. To minimize set up time I often make all similar parts as a batch rather than aim to complete each sub-assembly as a unit as often described in clock construction articles. In particular, I cut all the wheels as one exercise, made the cocks as another exercise etc. This suits my temperament - it is not better or worse but it follows that the descriptions below lean towards this approach. Those wishing to complete sub-assemblies as they go along will need to wait until the assembly is described and then look back at the parts to be made.

Materials
To reduce cost I purchase brass in 2ft x 4ft sheets which has the secondary advantage of avoiding scratches caused by cut pieces of plate being bunched together in retailers' stores. Large sheets, however, are not easy to handle and my solution is to rest each on a wooden bench which has been cleaned and to mark out the sections I need with a broad felt tip black pen on top of masking tape secured to the brass. The mark is about ⅛ inch wide and easily seen when I use my jig saw with a metal cutting blade. I use a T118A Bosch blade with the jig saw set at a slow speed which works well with brass. It is, of course, essential to clamp the brass, not forgetting to use wood pads between the brass and the clamps. The masking tape helps avoid scratches but you should also check that your jig saw has a smooth base. This is not precision work. Allow a healthy contingency; typically I allow ⅛ inch on all sides but the contingency needed will depend on your accuracy with a jig saw. Better too much than too little!

When cutting out blanks for the wheels, the jig saw is too crude so I revert to using my Hegner fret saw. Some have had difficulty using these machines. I find I can cut material from 3⁄16 inch down to 3⁄32 inch thick brass using a No.9 metal saw as supplied by Hegner with the saw running at 1400rpm without lubricant. Metal saws Nos.1 and 5 work well on thinner sheets. Experience indicates that the key points to watch are:

* The thin blade of the saw must remain upright (it is easy to apply side pressure, causing the saw to bend).
* The saw needs some forward pressure (remember saw blades are expendable).
* Every 1⁄16 inch or so back off the pressure and sweep away the debris with a brush to ensure you can see the line.

For the finest work I always revert to a hand held piercing saw but for cutting out the blanks for wheels and other shapes the Hegner saves a lot of effort.

Main plates
My rough sawn plates measured about 10¼ inches square (**fig 1**). The positions of the two No.55 holes for the taper pins to register the plates were marked on one plate and, with the two plates clamped together, the holes were drilled and opened up with a broach for the taper pins. With the plates registered by the taper pins, they were mounted on the milling machine and four edges milled to size using the side of a ½ inch diameter end mill running at about 700 rpm.

Plates this size are not easy to set square on the milling table for each cut. The solution is to use a fence. I used a 1

Fig 1

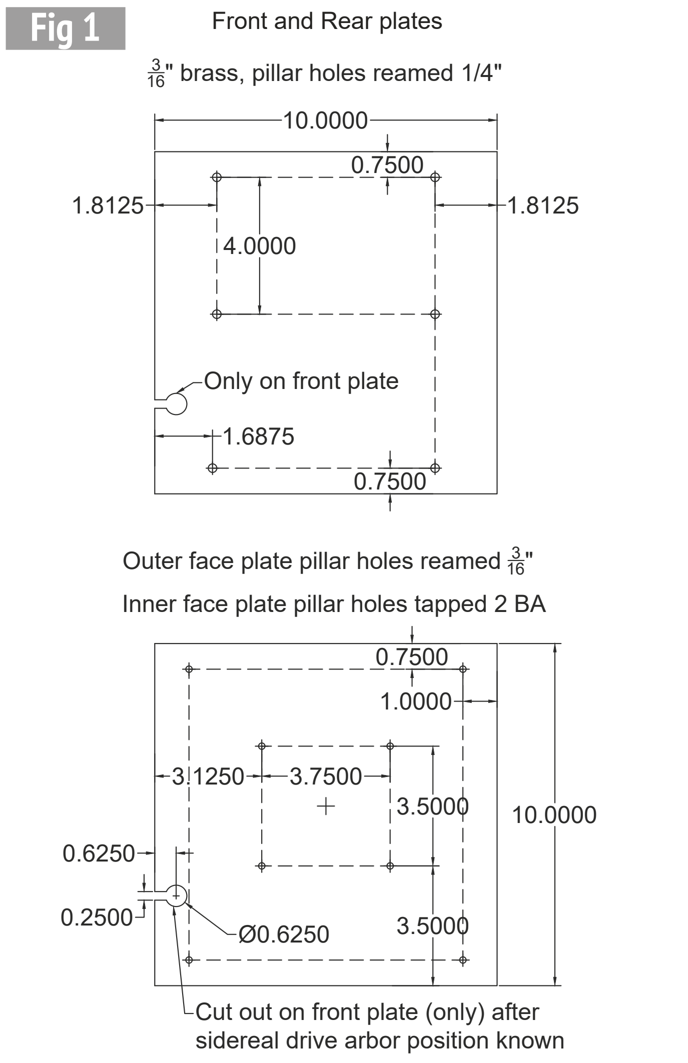
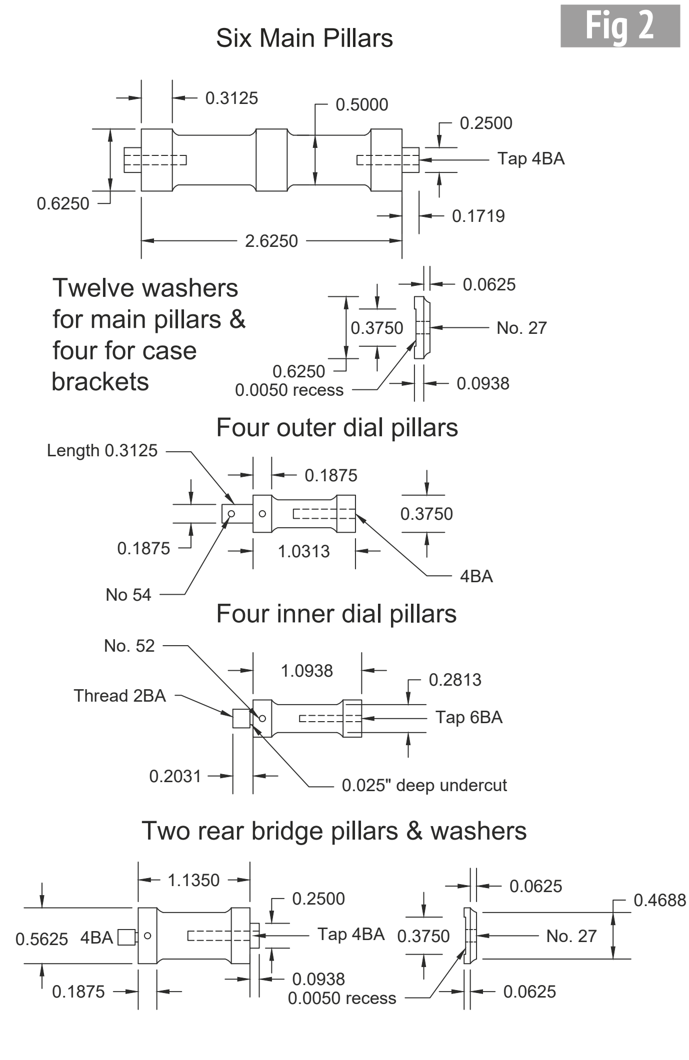


Fig 2



Many parts will be seen to be similar to those designed by John Wilding and others. Full credit must be given to them for their articles and books which have helped me, and so many others, construct clocks.

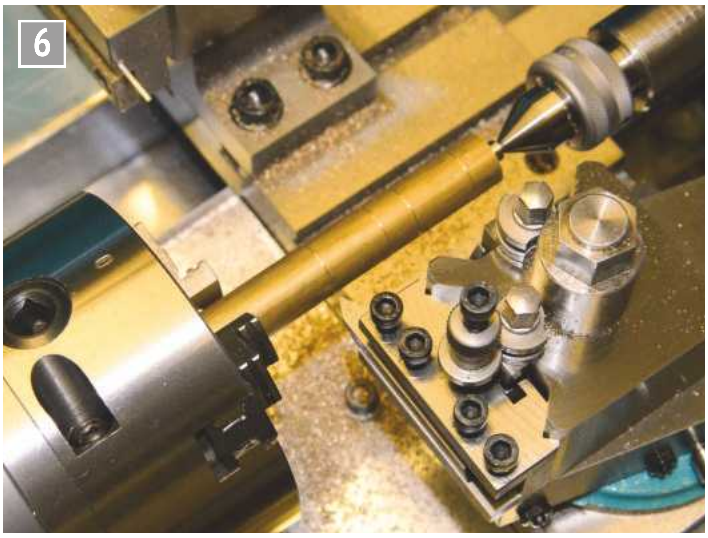
inch by ½ inch length of steel adjusted with a dial gauge to be within a thou square to the table before tightening the bolts to the table. Use a dial gauge rather than just a square as any error will be magnified on the long sides of these plates. After each side is milled it is easy to reposition the plates by pushing the milled edge against the fence. Before doing so ensure there is no swarf present. A vacuum cleaner helps.

The main pillar holes were also machined at this time but DO NOT drill the inner and outer face plate pillar holes at this stage. Indeed, do not start drilling more holes in the plates until the assembly stage which will be described later.

Pillars

The six main pillars (**fig 2**) were turned from ⅝ inch diameter brass rod held in a three jaw chuck. If the 0.250 inch diameter shoulders are machined precisely to this size they are at risk of jamming in the plates. A slight taper should be applied with a fine file. The resulting diameters on my pillars were about 0.249 inch at the inner end and 0.248-0.247 inch at the outer end. They were then reversed for turning the other end but this time held by their outer surfaces in an ER collet which ensured both accuracy and avoided marking the surfaces. The accompanying photograph (**photo 6**) shows the embryo pillar being marked out for turning.

The main pillars are secured to the plates by 4BA screws with washers. To make the washers, the outer ends were turned to shape, the clearance hole drilled and each parted off. They were then reversed and lightly held in a three jaw chuck with a backstop to ensure they ran true to allow



An 'embryo' pillar.

machining of the rear face, including the 0.005 inch recess to ensure they sit flat (**ref 5**). An alternative holding method is to use Loctite to hold the washer in place on the end of a faced bar with a short spigot to match the clearance hole. Once turned, heat the bar and washer in a flame over the gas cooker to release.

In line with making parts in batches I also turned the two bridge pillars and the two sets, each of four pillars, for the inner and outer dial plates, noting that the outer pillars are slightly shorter. The washers can also be turned ready for use.

The small cross holes in the inner and outer pillars allow them to be tightened when mounting on the front plate.

●To be continued.

REFERENCE

5. 'Revisions to the Radford Lathe Chuck Backstop' by Adrian S. Garner, *Model Engineer* 20 January 2006, pp98-100.

SUBSCRIBE

To *Old Glory* or *Stationary Engine* and get your first 6 issues for just £12*

WHEN YOU PAY BY DIRECT DEBIT

If you love the spectacle of immaculately-restored old machinery, or are fascinated by Britain's rich industrial and transport heritage, *Old Glory* is the magazine for you!

The collection, restoration and study of stationary engines is a hugely popular hobby, brought alive each month by the experts at *Stationary Engine* magazine.

SUBSCRIBE ONLINE AT:

shop.kelsey.co.uk/SECON21 (Stationary Engine)

Shop.kelsey.co.uk/OGCON21 (Old Glory)

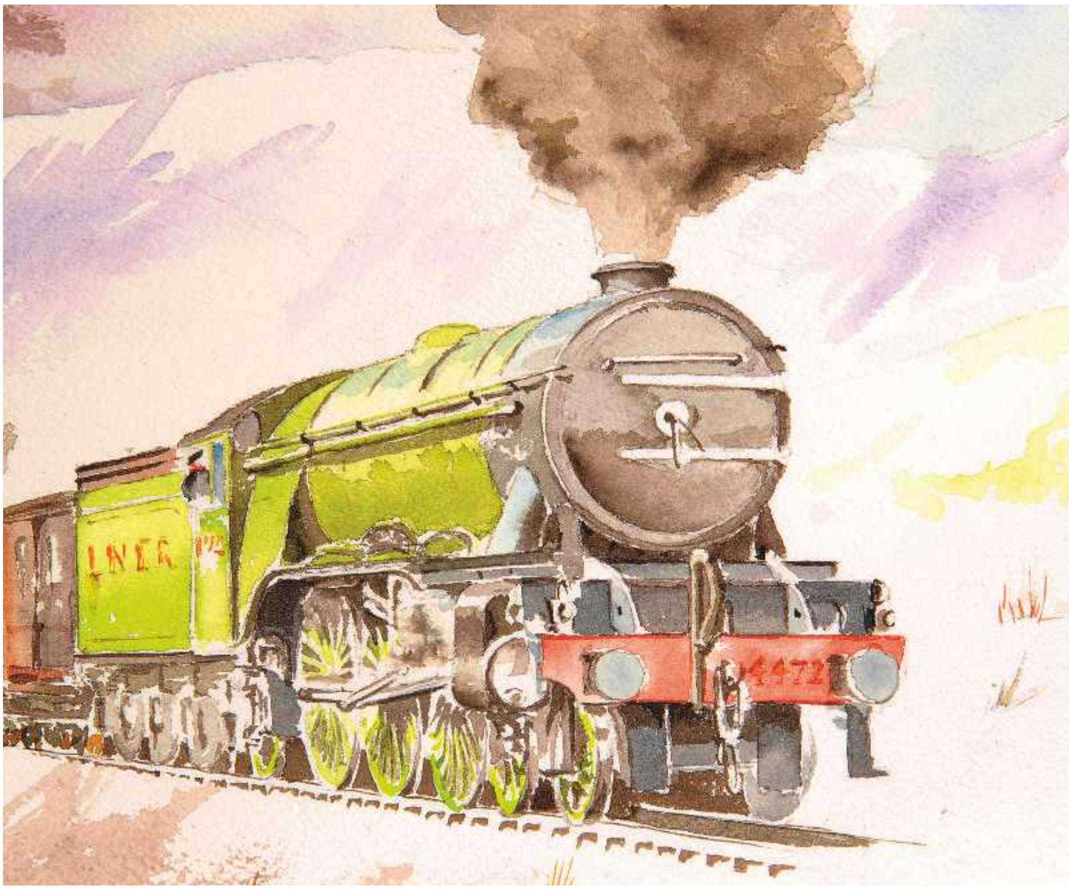
Or call **01959 543 747** and quote code **OGCON21** (Old Glory) or **SECON21** (Stationary Engine)

Lines are open Mon- Fri, 8.30 am – 5.30 pm. Calls charged at your standard network rate.

This is a direct debit offer. After the initial term, the six monthly rate will increase to £20 every six months (Stationary Engine) and £21 every six months (Old Glory). Offer ends 31.7.21. UK print subscriptions only. For digital subscriptions and overseas rates, please visit shop.kelsey.co.uk. Subscriptions will begin with the next available issue. At Kelsey Publishing, we take your privacy seriously and will only use your personal information to administer your account and provide the products and services you have requested. We will only contact you about our special offers via the preferences you have indicated, and you can update these at any time by emailing subs@kelsey.co.uk or calling us on 01959 543 747.

Peter Seymour-Howell builds a fine, fully detailed model of Gresley's iconic locomotive.

Continued from p.649
M.E. 4664, 7 May 2021



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge

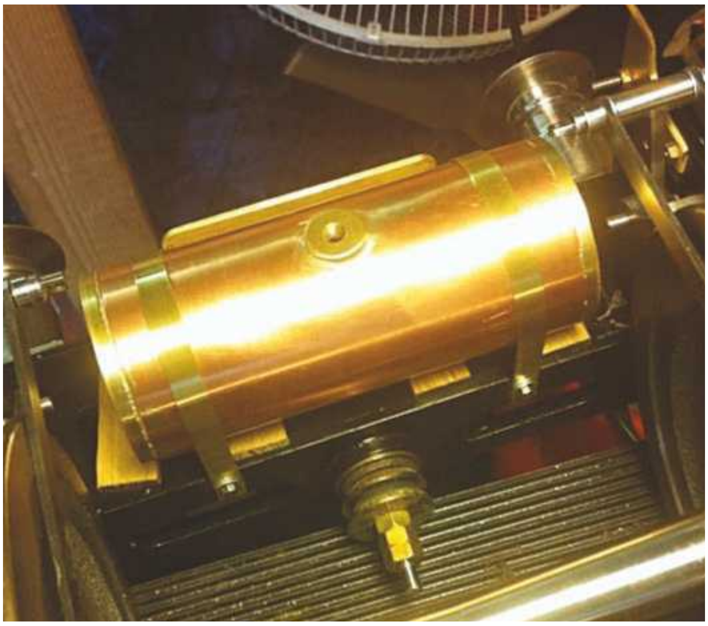
PART10 - BRAKE VACUUM RESERVOIR AND CYLINDERS

1 Here are the tank components ready for assembly. The copper tube is to drawing. The end caps are supposed to be 3mm copper sheet of which I had none but I did have some brass billet left over from the filler neck so I made use of it. Rather than just turning up two plain 3mm discs I decided to include a 2mm step to be a tight fit inside the tube ends, one of which was centre drilled and tapped for the brake line. A small bush was also made, which fits into the hole seen in the tube centre.

Brake vacuum reservoir

The vacuum brake reservoir stores enough vacuum to enable the brakes to operate. The brakes on this locomotive are the auto-brake system, that is, if the locomotive becomes separated from the tender the brakes are automatically applied. The reservoir tank is a simple thing to build but I have deviated from Don's drawing (I often do to make use of the materials at hand) and have machined up the ends from bar stock material and with a locating step for ease of manufacture.

2 Here we have the finished tank after silver soldering together. It was then pressure tested to 150psi.



3 This underside view of the tender shows the tank fitted. With the tank in situ the bands were pulled tight over and marked for a slot to be drilled/filed. At the same time the drag box was marked, drilled and tapped 8 BA on its front face to hold the bands via the slots.

Vacuum cylinders and relief valves

Dons 'Doncaster' has four cylinders, two each for the locomotive and tender. These are vacuum controlled and incorporate an auto-braking system.

4 The picture shows the eight cylinder castings which are identical but the tops and bottoms are machined differently - many of the lathe setups though are shared.

5 Using the exterior jaws in the three-jaw chuck all eight castings were held by their peripheries and the spigot is faced and turned to ⅜ inch. The backs of the castings were, of course, first filed to remove any high spots before setting in the chuck. They were then reversed in the chuck, faced and turned down to just above 1⅝ inches diameter and the insides cleaned up.

6 Then the back face was machined leaving the rim ⅛ inch thick and stopping just as the outer casing of the chamber is reached. The next job was to reverse in the jaws and machine the spigot to ⅛ inch diameter.

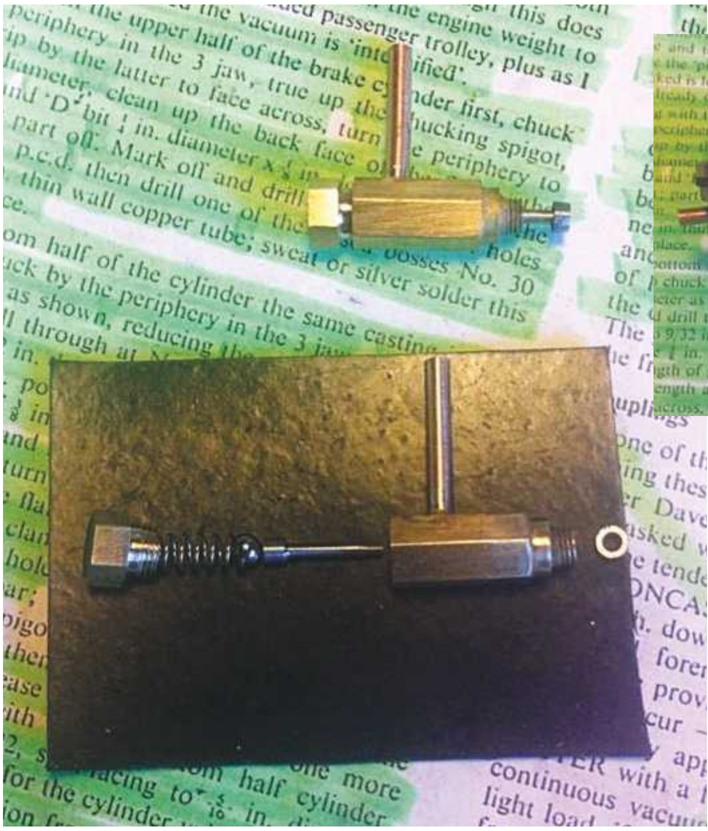
7 All eight cylinder halves then had a No.30 hole drilled into the side of each chamber to accept a ⅛ inch diameter copper tube.

8 The bottoms then had a No.22 hole drilled (tapped later 3/16 x 40) on the opposite side to the 1/8 inch tube which is also spot-faced with a 5/16 inch end mill. This will be for the cylinder relief valve body to locate in.

9 The four cylinders so far. Jobs left to do here are the four No.34 holes around the rims to hold the two halves together and various tappings to do.

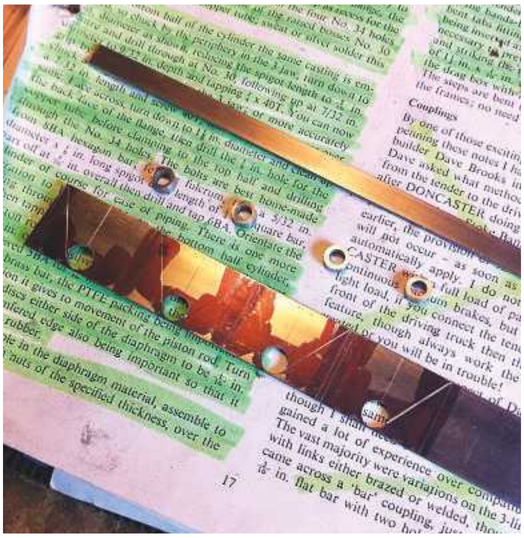
10 Here the two holes in the bottom half are being threaded. The cylinder halves were then moved to the rotary table for drilling the four No.34 holes. These holes were then spotted through to the bottom half. The securing bolts had to be turned up from bronze hex bar as they are of a locating type requiring a plain shank section for a good fit into the No.34 holes and then threaded 6 BA.

11 And so we have the finished cylinders. Testing by sucking on the inlet pipes proved that all four cylinders work well both opening and closing.



13 The brake cylinders fitted with the relief valves.

12 Here are two of the cylinder valves, one left in component form to show what's involved. These were mainly simple turning but have to be made precisely for the striker pin to work properly. The valve body has a turned spigot at one end to fit into the cylinder, and there is also a hole drilled at this end for the striker pin to poke through. The other end is drilled and tapped to accept the end cap that also holds one end of the spring central via a small recess.



14 The picture shows the various bracket parts ready for brazing. Rather than make all the parts separately I find it easier and quicker to construct as one piece and then to split them up for final shaping. I soft soldered the web piece on after these parts were silver soldered and cleaned.

15 Here the fulcrums have been machined and fitted to a cylinder.

Brake cylinder brackets

Here, I've deviated from Don again (making a habit of that) both in method and design. Don states to bend up the brackets from 1 x 1/16 inch steel, drill a ¼ inch hole for a bearing which is turned to suit the fulcrum pieces, braze all together and shape to drawing. I wanted a sharp 90 degree bend with no radius so decided to make the brackets up from two separate pieces.

17 A step is machined underneath both ends of the doubler plate.

16 Cylinders fitted to brackets and doubler plate

18 Doubler plate fitted - note the recesses cut to clear the wheels. The plan is to leave the plate like this as it will be held firmly in place once the tender body is fitted on top since it will be trapped between the frames within the machined steps.

19 Here, the vacuum pipes have been run but not everything is connected yet and the train vacuum hose has not been fitted.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

The Prologue…
At risk of coming over all Ffotherington-Thomas ("Hello trees, hello sky") it is good to see the wildlife flourishing; yea, even colonising our tracks and club sites, after a dismal year spent almost under house arrest. Some of us have taken the opportunity to crack on with long delayed projects, even me, prevaricator *par excellence*.

Work on *Deborah* continues. I am currently awaiting delivery of more chain, for the drive to the powered axle. The bodywork is attached, only partly complete to give good access to the transmission, the batteries are charged, the speed controller works. I found that setting up the chain drive was most exacting. The chain is constantly shunned if the sprockets are not properly aligned.

Only slightly connected to model engineering (I was working on my locomotive *Deborah* in the garage), I had a magic moment... I heard what sounded like the honking of geese. Not being aware of any geese in the locality, I stepped outside the garage to investigate. Nothing was evident until I looked up and saw a perfect skein in classic 'V' formation, flying west overhead with the crescent moon behind them. Oh! for my camera to be near at hand! A moment to treasure, nevertheless. (There are numerous such photos online - search 'geese in flight, crescent moon'.)

I am to bid at Sheffield Auction Gallery for an etched brass locomotive ('0' gauge J67). I always fancied making one but not for a couple of hundred pounds. The estimate is £20-40, so I'm in. Recently I bid for a box of radios. Estimated sale price was similar to the brass kit but it went for about £480! Obviously to someone who knew more about it than the auctioneer.

In this issue: a lost tramway, a 90-year build, thoughts from Court, glazing, Linux, a banished clock, a plasma cutter, a mining town, a safety valve and painting a fence (not Tom Sawyer).

North London Society of Model Engineers introduction, Part the Twoth, continued from last time, concerns the March *News Sheet,* and - Glory Be! After admitting my *galanthophilia* last time, here are the very plants, the star of the site, says editor Keith. 'Bookworm' writes on finding a series of books on old locomotive sheds, or so he thought... Two hours later he was red faced with embarrassment - not '50 Sheds of Grey', or '50 Sheds More' - nothing about locomotives at all. As for lubrication… And then finding in a 1941 issue of *Model Engineer* a detailed drawing of a hand grenade. Not to mention the 1949 issue which mentions using an Austin 7 gearbox, complete with gear lever, to motorise a lathe. Keith prints a picture of some unusual track, known as 'Gauntleted'. This is where two tracks run parallel but interleaved. There is a good one at Crich tramway museum and also at Sheffield's Cathedral tram stop, that I know of. Here is a three-track version (metre, standard and Russian broad gauge) commons.m.wikimedia.org/wiki/File:%C5%A0koda_gauntlet_track2.jpg George, eschewing Quentin Crisp's remarks on house dust, has used a plastic dustbin and a cyclone from eBay, plus a 5 metre 'Henry' hose, for keeping the workshop clean without giving the vacuum cleaner indigestion. (I hope you are all making notes...) Ultimately, a useful item is a list of car aerosol colours and their railway livery near-equivalents.
W. www.nlsme.co.uk

Ryedale Society of Model Engineers' February newsletter explains that the bulk of the newsletter is taken up by Patrick Howst who has discovered on old maps a tramway from Gilling to Ampleforth and it was not the first! Taken mostly from the College's *Ampleforth Journal*, it records humorous events, runaways, crashed aircraft and industrial archaeology of the area.
W. www.rsme.org.uk

A new *Newsletter* from Doug Hewson is always welcome; this issue notes Dave Kinsella's new locomotive. An L&Y type, begun 90 years ago in Rochdale, it has possibly the longest gestation period I have yet encountered! It has been identified as a Class 2 'Peacock'. An unidentified picture shows a Scammel Scarab and box trailer in BR maroon/cream, or 'blood and spilt milk' (**photo 1**). I'm not sure about the windscreen though…

Chingford & District Model Engineering Club informs us that Bradley Sainsbury has bought himself a birthday prezzie in the 'interesting' shape of a 1956 Buick

Scammell Scarab, neat BR livery, from Doug Hewson's Occasional LMS Newsletter.

Special. It is very 'of its time' complete with 'Dagmars' and wrap around windscreen. The contemporary UK Vauxhall (aka GM) Velox and Victor were complete rustbuckets from the start and the stylish windscreen, if it didn't distort the ¾ aspect (45 degrees to port and starboard) still bashed your knee as you got in and out. My school headmaster at the time had one. Members checking the club site have also spotted further wildlife, in this case, a brace of young foxes.
The Society's *Echo*, in 1953, mentions that a very large Christmas card was received from the Honoured Guest as previously mentioned, Walt Disney. Ted Jolliffe, contemplating life from the Crown Court, as one does in idle moments (he was giving evidence...) had inspiration concerning a loose mandrel in a taper bore. Not wishing to irk and vex the legal notables at court, or be the instigator of dovecote fluttering, he courageously waited until he was pronounced free to go. Returning to normality, he closely examined the offending bore and cleaned it with a scraper/hone which dislodged lots of foreign bodies which had taken up residence therein. Result: true taper behaviour and concentricity. To keep it in good condition, bottle brushes, or circular brass versions from the gunsmiths, for use with shotguns, are recommended.
W. www.cdmes.co.uk

Bristol Society of Model & Experimental Engineers sends the spring *Bristol Model Engineer*, which opens with Jim Slater who needed some pipe clips but couldn't find his requirements from the usual sources. He decided to try making press tool formers by 3D printing. It worked! The form tools don't last very long but enough to fulfil his requirements. David Ward tried glazing a locomotive, using the transparent part of a box of chocolates (I've done the same thing – Geoff) which attracted favourable comment from the editor, Richard Lunn, on his efforts in reducing landfill. David had problems cutting the material, which tended to crack during machining. (I used a thinner, more flexible type, held in by the corner screws.) Bert Roberts offers an idea for use with older computers, a free, open source, alternative to Microsoft Windows, named Linux, on a memory stick. I use it to write this column and I am very happy with it. N.B., a certain amount of 'computerese' is required to follow the instructions and corrections online but it is soon learned. Plus, I made up some 'crib sheets' for immediate use and they have been invaluable. Please note, I may be an electronics enthusiast but I had no programming or computer usage outside Windows for decades before.
W. www.bristolmodelengineer.co.uk

In **Reading Society of Model Engineers'** March *Prospectus,* Alasdair Milne writes of his interest in Scottish locomotives and especially the 4-4-0s of Charles Cumming. In building his own, he used software from Charlie Dockstader which analyses the movements of Walschaerts valve gear. Ken Morris writes of making a 16th century clock using hand tools only. It ran appallingly (he says). After consulting the great John Wilding, it was improved but its tick still kept the household awake at night. It has now been banished to the conservatory. Mike Manners also likes clocks and found one that responded well to his blandishments, including making a new hand. This, he found, was the most difficult part of horology, says Mike, and goes on to cover 'blueing' the digit, and refers to several methods. Alan Thatcher has built his own plasma cutter, a rather ambitious undertaking, methinks. As in 3D printers, the operation takes place on a horizontal table, and the X and Y movements are controlled by stepper motors. The 1.5mm gap at the 'business end' is where it all happens. An electrode creates a spark in compressed air at 70 psi, forming a plasma at 30,000 degrees, which is conductive, and this completes an electrical circuit through the workpiece back to the controller. Alan's machine can cut up to 18 mm of material. Finally, editor, John Billard apologises for having to hold over several contributions. John, you must be doing something right - many of your peers are desperate for copy!
W. www.prospectparkrailway.co.uk

Lionsheart, spring, from **The Old Locomotive Committee,** begins with Harrye Frowen building his model of *Puffing Billy* and a video of it running on air can be seen by searching online for 'Harry Frowen Puffing Billy'. Some photographs of *Lion* as rescued from the Liverpool docks pump house raise a list of uncertainties to which definitive answers are sought. Chairman, John Brandrick, holds a rail chair (and is thus entitled to be known as 'Professor' (a man who holds a Chair - Geoff) which was made in about 1825 for the Stratford & Moreton-in-Marsh Tramway, the creation of William James, the man who encouraged George Stephenson. Mr James researched the various track designs and found those from the North East of England were most suitable. So, John has a lump of old iron, bearing the history of railways in Britain, the origins of the S&MiM Tramway, the development of the Liverpool & Manchester Railway (via the Stephensons) and the sad tale of William James, all in one artefact.
W. www.lionlocomotive.co.uk

March *Maritzburg Matters*, from **Pietermaritzburg Model Engineering Society**, begins with some detail about the oldest mining town in South Africa, O'Okiep, where copper was (and still is) mined, continuously from 1855. It is also the home of a Cornish steam pump, the only remaining example in the Southern Hemisphere. A 2 foot 6 inch gauge railway line connected it to Port Nolloth 90 miles away, through which the copper was exported.
W. www.pmes.co.za

The April issue of *Steam Chest*, from the **National 2½ inch gauge Society,** has been received, bearing a picture of a B & O Pacific *President Washington* rolling chassis which Dave Wootten is renovating. An item from the *Railway Gazette* of January 1942 concerns a visit to LBSC's workshop to see a Pacific locomotive with four cylinders, cranks at 135 degrees and conjugated Baker valve gear. This was *Tugboat Annie.* The valve events were laid out in conjunction with Harold Holcroft, the actual designer of 'Gresley's' conjugated valve gear. Mike Boddy had a new safety valve break under pressure and found that the thickness of metal at one point between the bore and outer dimension was just half a millimeter. Mike suggests all similar safety valves should be checked for this weak point. Editor Cedric Norman adds a Ewin type lubricator to his *Ayesha II*. Tom Barnes reviews *LNER 4-6-0 Locomotives* by David Maidment. If I said he liked it very much indeed, that would be a gross understatement! It costs £35 but all proceeds will go to the *Railway Children* charity.
W. www.n25ga.org

The Blower, March, from **Grimsby & Cleethorpes Model Engineering Society**, contains a contribution from Chris Cruickshank on his 2½ inch gauge Kerr Stuart Skylark class *Princess* as delivered to the 6 mile Campbeltown & Machrihanish Railway in 1900. Chris proposes a 5 inch gauge version as a club locomotive, to be built by the members. The aim is to have several similar, archetypal narrow gauge locomotives, which would be almost 'scale' in 5 inch gauge.
W. www.gcmes.com

City of Oxford Society of Model Engineers sends *CoSME Link,* spring, another one with beautiful daffodils on the front cover. A 'two-minute tip'

»

Leon Nel, his 'Durrans' and Hulk *(photo courtesy of Errol Koch).*

follows, regarding shortening 8BA screws in a repeatable manner. Simple, too. Richard Brown was reunited with an old Merryweather steam fire pump last seen 60 years ago during his then employment at Pressed Steel in Cowley. It was being restored before being returned to Oxfordshire Fire Service, where it remains. Originally horse-drawn, it has been fitted with a tow hitch for use with modern vehicles. Next, Ron Head makes expanding arbours. (For use when life becomes vexatious, after all any port in a storm… Arbour? Port? - Oh, well - Geoff)
W. **www.cosme.org.uk**

Gauge 1 Model Railway Association, Yorkshire Group, plans meetings from 17 April at Ashover, under restrictions and has to decide whether to run G1North this year. Deadline is 30th April for a decision. The Bakewell location has been provisionally booked. Steve Russell acquired a Class 20 from eBay, and 'mis'quotes Eric Morecambe - 'All the right bits, but not necessarily in the right place'.

Leon's 'Durrans' earning its living (photo courtesy of Errol Koch).

The Workbench, from **Durban Society of Model Engineers,** reports the sad passing of Leon Nel, from the Covid virus. This has now touched our very community, as we knew it would, but hoped it wouldn't. Editor Errol Koch reminds us that people like 'Curly' Lawrence ('LBSC') carried on making their models and writing for *Model Engineer* right through the Blitz and we should remember their privations too. If members wish to know more, it is all in their library. Leon holds the record for the fastest build of a locomotive - three months, for his 'Durrans' type, named after their president, Ron Durrans, who designed it. Here he is, with the vehicle in question, almost finished - the blue and yellow one; the leading locomotive is Ron's original, *Hulk* (**photos 2** and **3**). Gerald Hall, asked to creosote a fence, decided to do it *in situ*, using parts from an old washing machine. Overspray is caught by a rear screen and runoff collected for reuse.
W. **www.dsme.co.za**

UK Mens Sheds sends their March *Shoulder to Shoulder,* which advises several fundraising opportunities and a similar number of newsworthy tales from Sheds across the nations.
W. **www.ukmsa.org.uk**

And finally, the darkest hour is just before it gets completely Pitch Black.

CONTACT

geofftheasby@gmail.com

AMAZING SAVINGS!

6 issues for £20

Saving 42%

Saving 30%

Saving 37%

Saving 33%

Saving 33%

Saving 41%

Saving 40%

Saving 37%

Saving 33%

Saving 33%

Saving 28%

Saving 33%

SUBSCRIBE SECURELY ONLINE:

WWW.MYTIMEMEDIA.CO.UK/6FOR20

CALL 0344 243 9023** AND QUOTE 6FOR20

TERMS & CONDITIONS: Offer ends 31st December 2021. *UK print subscriptions offer only. Subscriptions will begin with the next available issue.
MyTime Media collects your data so that we can fulfil your subscription. We may also, from time to time, send you details of MyTime Media offers, events and competitions but you always have a choice and can opt out by emailing us at unsubscribe@mytimemedia.com
We do not share or sell your data with/to third parties. Details you share with us will be managed as outlined in our Privacy Policy here http://www.mytimemedia.co.uk/privacy-policy.
Please visit www.mytimemedia.co.uk/terms for full terms & conditions.

**Calls are charged at the same rate as standard UK landlines and are included as part of any inclusive or free minutes allowances. There are no additional charges with this number. Overseas calls will cost more.

Model Engineer *Classified*

To advertise on these pages contact Angela Price at angela.price@mytimemedia.com

M-MACHINE

Unit 6 Forge Way, Cleveland Trading Estate
Darlington, Co. Durham. DL1 2PJ

Metals for Model Makers

Contact us for Copper, Brass, Aluminium, Steel, Phosphor Bronze, etc.

PHONE & FAX 01325 381300
e-mail: sales@m-machine.co.uk
www.m-machine-metals.co.uk

ModelFixings.co.uk

ALWAYS IN STOCK:
Huge range of miniature fixings, including our socket servo screws.

also the home of **ModelBearings.co.uk**

- *Taps, Dies & Drills*
- *Adhesives*
- *Engine & Miniature bearings*
- *Circlips, etc. etc.*

Tel/Fax +44 (0)115 854 8791 Email: info@modelfixings.com

www.model-engineer.co.uk

THINKING OF SELLING YOUR LATHE, MILL OR COMPLETE WORKSHOP?

and want it handled in a quick professional no fuss manner?
Contact Dave Anchell, Quillstar (Nottingham)

Tel: 0115 9206123
Mob: 07779432060
Email: david@quillstar.co.uk

TAPS & DIES

Excellent Quality manufactured-supplied

British-box HQS taps dies cuts stainless
ME5(33pcs) **ME4** (30pcs) **BA3**(35pcs) has all Model Eng 32+40tpi BA, BSB, MTP etc

THE TAP & DIE CO
445 West Green Rd, London N15 3PL
Tel: 020 8888 1865 Fax: 020 8888 4613
www.tapdie.com & www.tap-die.com

BA SCREWS IN BRASS, STEEL AND STAINLESS

SOCKET SCREWS IN STEEL AND STAINLESS • DRILLS • RIVETS • TAPS • DIES • END MILLS SLOT DRILLS etc

Phone or email
lostignition8@gmail.com
for free list

ITEMS MAIL ORDER LTD
Mayfield, Marsh Lane, Saundby
Retford, Notts. DN22 9ES
Tel/Fax 01427 848880
www.itemsmailorderascrews.com

To advertise here please email Angela Price at angela.price@mytimemedia.com

Complete home Workshops Purchased

Essex/Nottinghamshire locations
Distance no object!

Tel: **Mike Bidwell**
01245 222743
m: 07801 343850
bidwells1@btconnect.com

GB BOILER SERVICES

COPPER BOILERS FOR LOCOMOTIVES AND TRACTION ENGINES etc.
MADE TO ORDER
Constructed to latest European Standards
7¼" guage and P.E.D. category 2 Specialist
No VAT
Enquiries, Prices and Delivery to:
Telephone: **Coventry 02476 733461**
Mobile: **07817 269164** • Email: **gb.boilers@outlook.com**

Cowells Small Machine Tool Ltd.

Cowells Small Machine Tools Ltd.
Tendring Road, Little Bentley, Colchester CO7 8SH Essex England
Tel/Fax +44 (0)1206 251 792 e-mail sales@cowells.com

www.cowells.com

Manufactures of high precision screwcutting lathes, 8mm horological collet lathes and milling machines, plus comprehensive accessory range.
Talk directly to the manufacturer

Meccano Spares

New Reproduction and Pre-owned Original Meccano Parts.
www.meccanospares.com
sales@meccanospares.com
Tel: 01299 660 097

Complete home Workshops Purchased

Essex/Nottinghamshire locations
Distance no object!

Tel: **Mike Bidwell**
01245 222743
m: 07801 343850
bidwells1@btconnect.com

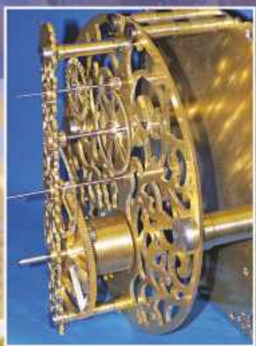
THINKING OF SELLING YOUR LATHE, MILL OR COMPLETE WORKSHOP?

and want it handled in a quick professional no fuss manner?
Contact Dave Anchell, Quillstar (Nottingham)

Tel: 0115 9206123
Mob: 07779432060
Email: david@quillstar.co.uk

CLOCK CONSTRUCTION & REPAIR

Books by:
John Wilding MBE FBHI, E. J. Tyler, John G. Wright, Eric Woof, John Tyler and others.



SPRINGS
BEARINGS
FRAMES
DIALS etc.

FREE Catalogue
Telephone: +44 (0) 1420 487747
www.ritetimepublishing.com

webuyanyworkshop.com

Re-homing model engineers' workshops across the UK

It's never easy selling a workshop that has been carefully established over a lifetime. I will buy your workshop so you don't have to worry about finding a new home for much loved workshop equipment and tools.

Please email photos to
andrew@webuyanyworkshop.com
Or to discuss selling your workshop, please call me on **07918 145419**

All equipment considered: Myford, Warco, Chester, classic British brands etc
Polly steam locomotives also purchased, especially those needing a bit of 'TLC'


HOME AND WORKSHOP MACHINERY
144 Maidstone Road, Foots Cray, Sidcup, Kent, DA14 5HS
tel: 0208 300 9070 - evenings 01959 532199
website: www.homeandworkshop.co.uk
email: sales@homeandworkshop.co.uk
stay safe! taking orders;
visit our eBay store at: homeandworkshopmachinery
RotoCAMM MDX-40A CNC Router £2000
Check out our eBay store to view our large amount of stock!
Stanier precision vice 55mm jaw New / New Zealand £195
Myford Super 7, ML7R, ML7 Ml10 Speed 10 Change wheels Genuine £10 - £37
Brookes, Quorn, Stent tool and cutter grinders £950 each
Modelmark M/M press £225
MEDDINGS MB4 £645
Bridgeport milling machine 42" x 9" (metric) £3750
Centec 2A V/H mill quill head + height block £1950
Boxford 260 VMC mill less software £1495
MYFORD SUPER 7B PCF £3250
Drummond lathe £325
Harrison Graduate wood lathe 240V £1375
Morgan Rushworth BP50 / 16 50" x 16G box and pan folder £1750 Complete with fingers
DP / MOD gear cutters £20 each, please enquire for availability
Ajax UP Universal Mill £1750
Smart and Brown Model L second operation lathe £750
MYFORD SUPER 7B 3 1/2" x 31", gearbox, clutch, power cross feed £3750
Denbigh No 6 Fly press £345
Boxford AUD MK11 lathe, gearbox, PCF £1825
Sedgwick 10" planer / thicknesser Nice example! £750
COLCHESTER STUDENT ROUND HEAD Hydraulic copying attachment and TRUGRIP collet chuck £2950
MYFORD SUPER 7B 3 1/2" x 31", gearbox, clutch, power cross feed £3250
Rolls 48" x 3" 16g (slip roll) £1400
Tripus 240v switch £90
Myford rifle / bridge felts 5 for just £20
Meddings Driltru pedestal drills 1/2" & 1MT models £295 each
Edgwick centre lathe 7 1/2" x 44" 240 volts £1400
Baltec Type 5 arbor press, 90mm throat / three off available £200
Neat cut and soluble cutting oils £10 each
Large Vee Blocks 12" bar £425
Union centres 7.5" x 24" £425
Pipe centre 4MT 4-8" £245
Colchester Mascot VS2000 fixed steady £575
Keetona Box-Form 100" 14g box and pan folder £2950
Please phone 0208 300 9070 to check availability.
Distance no problem – Definitely worth a visit – prices exclusive of VAT
Just a small selection of our current stock photographed!
Worldwide Shipping
POWERED BY barclaycard
VISA