MODEL ENGINEER

Vol. 194 No. 4245

15 - 28 April 2005

NATIONAL MODEL ENGINEERING & MODELLING EXHIBITION

HARROGATE

6-8 MAY

MIDLAND RALLY

Fun at Kinver

VACUUM ENGINE

Alternative prime mover

VOL 194 NO 4245 £2.50

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HIGHBURY

74th MODEL ENGINEER EXHIBITION

VEHICLES AND AIRCRAFT

WARCO

The widest choice... the best prices!

GH-1322 Lathe
ONLY £2,550 inc VAT & Delivery

- 165mm centre height
- 560mm between centres
- Removable gap bed allows 476mm swing 38mm spindle bore
- Supplied with 3 and 4 jaw chucks
- Faceplate
- Fixed and travelling steadies
- Coolant system
- Halogen lighting
- Telescopic leadscrew covers
- Four way tool post

Also available as 750mm between centres.
£2,990.00

BH-600 Lathe
ONLY £1,600 inc VAT & Delivery

For a limited period we will include a revolving centre, tailstock drill chuck and a set of 16mm index lathe tools FREE of charge!

Optional equipment

- Quick change tool post hardened and ground, supplied with 3 tool holders and parting off holder with blade £170 inc VAT with fitting kit to suit BH-600 fitting
- Coolant system £130 inc VAT
- Tailstock die holder £39 inc VAT

- THE ULTIMATE MODEL ENGINEERS LATHE
- HARDENED AND GROUND BEDWAYS
- TAPER ROLLER BEARING HEADSTOCK SPINDLE
- TEE SLOTTED CROSS SLIDE
- POWER CROSS FEED
- NORTON THREAD CUTTING GEARBOX
- 2HP SINGLE PHASE MOTOR
- BACK GEAR WITH 50 RPM LOW SPEED
- 1 3/8" SPINDLE BORE

SUPPLIED WITH ACCESSORIES AT NO EXTRA CHARGE

- 6" 3 JAW CHUCK
- 8" 4 JAW CHUCK
- 10" FACE PLATE
- FIXED & TRAVELLING STEADIES
- FOUR WAY TOOL POST
- IMP/MET THREADING
- STAND, COOLANT TRAY, REAR SPLASH BACK

VMC Mill
ONLY £1,450
inc VAT & Delivery

SUPPLIED WITH POWER FEED TO X TRAVEL AT NO EXTRA COST

- ILLUSTRATED WITH OPTIONAL D.R.O AND POWER FEEDS
- TABLE SIZE 26" X 6"
- MOTOR 1 1/2 HP
- AVAILABLE 3MT R8 - METRIC - IMPERIAL

BV-20 Lathe
ONLY £525 inc VAT & Delivery
Optional floor stand £99

- FULL ENCLOSED GEARED HEADSTOCK
- SPEED SELECTION BY LEVER
- PRECISION GROUND VEE BEDWAYS
- LARGE BORE SPINDLE RUNNING ON TAPER ROLLER BEARINGS
- COVERED LEADSCREW
- SET OVER TAILSTOCK FACILITY
- INDIVIDUAL ACCURACY TEST REPORT
- SAFE ELECTRICAL INTERLOCKS TO CHUCK GUARD AND GEAR TRAIN COVER

SUPPLIED WITH:

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

SPECIFICATION:

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

WM-20 MILLING MACHINE
NEW

ONLY £3,500
inc VAT & Delivery

- INVERTOR DRIVE - INFINITE SPEED CONTROL
- SPEED RANGE 25 - 1480RPM
- TABLE SIZE 9" X 36"
- R8 SPINDLE
- 1.5HP WILL OPERATE FROM 13AMP SOCKET
- WEIGHT 750KGS

Warco Mini Lathe
ONLY £375 inc VAT & Delivery

- 31/2" CENTRE HEIGHT X 12" BETWEEN CENTRES
- SUPPLIED WITH 3 JAW CHUCK
- FACEPLATE
- THREADCUTTING
- COOLANT TRAY AND SPLASH BACK
- VARIABLE SPEED 0-2500RPM WITH BACK GEAR FOR MAXIMUM TORQUE
- HARDENED AND GROUND VEE BED WAYS
- ACCURACY TEST CERTIFICATE WITH EACH LATHE
- RELIABLE USA BUILT PRINTED CIRCUIT BOARD - THE HEART OF THE MACHINE
- OPTIONAL ACCESSORIES STEADIES AND VERTICAL SLIDE.

Special offer
Tailstock drill chuck and TCT indexable lathe tool set with each machine.

Warco WMT 300/1
ONLY £799 inc VAT & Delivery
Combination Lathe Mill

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

Warco WMT 300/2
ONLY £1099 inc VAT & Delivery

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

Warco WMT 500
ONLY £1399 inc VAT & Delivery

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

Delivery UK-Mainland

ZX-15 Milling Machine
ONLY £550
inc VAT & Delivery Optional Stand £89
Ideally matched to the BV-20 Lathe

Table size	654mm x 150mm
Longitudinal travel	455mm
Cross Travel	145mm
Spindle Stroke	90mm
Spindle Taper	3MT
Diameter of Spindle	63.5mm
Diameter of Column	66.65mm
Throat	165mm
Max distance spindle to table	320mm
Height with head at top of column	1067mm
Width	775mm
Depth	559mm
Spindle speeds	400-1640
Motor	1 phase 1/2hp with F/R switch
Weight	295lb
Head tilting	90-0-90 worm gear tilt mechanism

Warco, Fisher Lane, Chiddingfold, Surrey GU8 4TD Fax: 01428 685812
Tel: 01428 682929 warco@warco.co.uk **www.warco.co.uk**

WARCO

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On the cover ...

The well detailed cockpit of the 1:4 scale model of the twin cam Austin racing car built by Arthur Bodily. This remarkable model took six years to build and was awarded a Gold Medal and the Bradbury-Winter Memorial Challenge Cup at the 74th Model Engineer Exhibition.
For full reports on Classes G1 to L2 of the competition turn to page 432 of this issue.

(Photograph by Kelvin Barber)

TURN TO PAGE 428 FOR GREAT OFFERS ON SUBSCRIPTIONS

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Founded 1906 by Mr Stuart Turner

STUART MODELS

Workshop Machinery Models

Stuart Pillar Drill

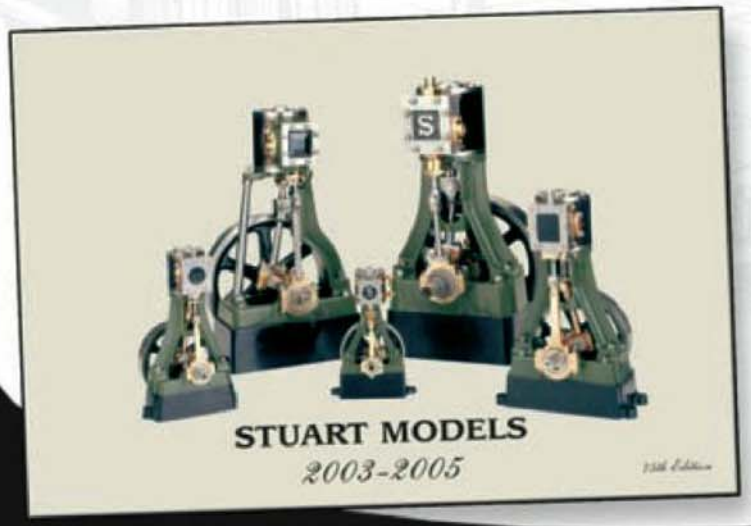
The Stuart Pillar Drill is now available from stock. this is the second release from our range of workshop machinery models, and makes an elegant counter piece to our first release, the Stuart Engineering Lathe.

Stuart Pillar Drill
Set of castings materials, fixings and precut gears

£147.00 inc Postage & VAT

Stuart Engineering Lathe
Set of castings materials, fixings and precut gears

£149.00 inc Postage & VAT



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NEW STORES GLASGOW COLCHESTER NOW OPEN

Where Quality Costs Less

Clarke VARIABLE SPEED LATHE AND SEPARATE MILL DRILL HEAD - CL250M & CL251MH

MASSIVE PRICE CUTS

- 259mm between centres
- 153mm swing over bed
- Power feed
- Screw cutting facility

SAVE £11.75

REDUCED £289.95 EX VAT £340.69 INC VAT WAS £352.44 INC VAT

CL251MH (ATTACHMENT)

- Transforms the CL250M into a superb Lathe/Mill
- 10mm max drill capacity
- Variable 30mm travel for drilling spindle

REDUCED! NOW ONLY £169.95 EX VAT £199.69 INC VAT WAS £211.44 INC VAT

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

ONLY £649.95 EX VAT £763.69 INC VAT

Full range of accessories available

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

Shown with optional floor stand ONLY £119.95 EX VAT £140.94 INC VAT

ALSO AVAILABLE: CL430 - As above but without the Mill/Drill head. ONLY £549.95 EX VAT £646.19 INC VAT

N.B: The Mill/Drill head is not available separately

Clarke DRILL PRESSES

MASSIVE PRICE CUTS

FROM ONLY £29.95 EX VAT £35.19 INC VAT

- Tables tilt 0-45° left and right
- Depth gauge • Chuck guards

Chuck sizes:
13mm CDP5DD-CDP25IF
16mm CDP30IB-CDP45IF
20mm CDP50IF

B=Bench mounted F=Floor standing

Full range of Drill Vices available

MODEL	WATTS/ SPEEDS	WAS INC VAT	EX VAT	INC VAT
CDP5DD	245/5		£29.95	£35.19
CDP101B	245/5		£54.95	£64.57
CDP151B	300/5		£79.95	£93.94
CDP201B	370/12	£129.19	£99.95	£117.44
CDP251F	370/12		£129.95	£152.69
CDP301B	510/12	£164.44	£134.95	£158.57
CDP351F	510/12		£149.95	£176.19
CDP401B	510/16		£159.95	£187.94
CDP451F*	510/16		£189.95	£223.19
CDP501F*	980/12		£379.95	£446.44

REDUCED

* Includes wet 'T' slot table & worklight

Clarke 12 SPD MILL/DRILL

CMD1225C

ONLY £599.00 EX VAT £703.83 INC VAT

Precision engineered with cast iron head, base & column

- Spindle speeds 100-2150rpm
- ¾ Hp, 230v, 1 Ph motor
- Accessories available
- 63mm milling cutter
- 13mm chuck
- Table size 585x190

Clarke METAL LATHE

- 300mm between centres CL300M
- LH/RH thread screw cutting
- Electronic variable speed
- Self centering 3 jaw chuck & guard
- Gear change set • Power feed

REDUCED £359.95 EX VAT £422.94 INC VAT WAS £434.69 INC VAT

FULL RANGE OF ACCESSORIES AVAILABLE

Clarke MICRO MILLING & DRILLING MACHINE

CMD10

ONLY £239.95 EX VAT £281.94 INC VAT

- 150w/230v motor
- Variable speed 1000-2000rpm
- MT2 Spindle Taper
- Face mill capacity 20mm, end mill 10mm
- Table cross travel 90mm, longitudal travel 180mm

Clarke VICE

MULTI - PURPOSE CMV125

ONLY £37.95 EX VAT £44.59 INC VAT

- Jaw width 127mm
- Jaw opening 120mm
- Jaw depth 75mm
- 360° rotating vice head
- 360° double locking swivel base

Clarke BENCH GRINDER STAND

BGS1

- Complete with bolt mountings & feet anchor holes

REDUCED £24.99 EX VAT £29.36 INC VAT WAS £30.49 INC VAT

TURBO AIR COMPRESSORS

TIGER 8/40 SLASHED £69.95 EX VAT £82.19 INC VAT

TIGER 8/40

MASSIVE PRICE CUTS

* Oil Free † Belt Driven

OTHER MODELS IN THE RANGE

MODEL	MOTOR	CFM	TANK	WAS INC VAT	EX VAT	INC VAT
8/45*	1.5Hp	6.3	24ltr		£84.95	£99.82
8/40	1.5Hp	7	24ltr	£93.94	£69.95	£82.19
Panther 25	2Hp	8.2	24ltr		£129.95	£152.69
Panther 50	2Hp	8.2	50ltr		£169.95	£199.69
10/70†	2.0Hp	9	50ltr		£254.95	£299.57
15/55	3.0Hp	14	50ltr		£259.95	£305.44
15/65†	3.0Hp	14	50ltr		£359.95	£422.94

REDUCED

Clarke rubber air hose (10m) FROM ONLY £10.95 EX VAT £12.87 INC VAT

Clarke BENCH

CBG8W features 8" wetstone & 6" drystone.

FROM ONLY £12.75 EX VAT £14.98 INC VAT

MASSIVE PRICE CUTS

MODEL	DUTY	WHEEL DIA.	EX VAT	INC VAT
CBG6RP	DIY	150mm	£12.75	£14.98
CBG6RZ	PRO	150mm	£18.95	£22.27
CBG6RSC‡	HD	150mm	£25.99	£30.54
CBG6RWC	HD	150mm	£29.95	£35.19
CBG8RSC	HD	200mm	£33.95	£39.89
CBG8W‡	HD	200mm	£33.95	£39.89

REDUCED

‡ REDUCED CBG8W was £41.07 inc VAT. CBG6RSC was £31.67 inc VAT

Clarke ENGINEERS WORKBENCHES

FROM ONLY £114.95 EX VAT £135.07 INC VAT

Shown with optional drawer ONLY £21.95 EX VAT £25.79 INC VAT

- 3mm high grade steel
- Runners for optional drawer units

MODEL	SIZE (LWH MM)	EX VAT	INC VAT
CWB1000	1000x650x880	£114.95	£135.07
CWB1500	1500x650x880	£149.95	£176.19
CWB2000	2000x650x880	£169.95	£199.69

Clarke AIR TOOLS & SWING ARM & MAGNIFYING LAMPS

MASSIVE PRICE CUTS

FROM ONLY £7.95 EX VAT £9.34 INC VAT

MODEL	LENS (MM)	EX VAT	INC VAT
SAL100*	-	£7.95	£9.34
SAM75	89	£14.95	£17.57
SAM100	120	£34.95	£41.07

Ideal for fine detail work

* Features clamp * Lamp Only

TYPE	MODEL	WAS INC VAT	EX VAT	INC VAT
Pro Spray Gun	-	£21.09	£16.95	£19.92
Super Pro Spray Gun	SP14C	£35.19	£27.95	£32.84
Super Pro Spray Gun	SP18C	£35.19	£27.95	£32.84
Air Hammer	CAT29B		£15.95	£18.74
Die Grinder Set	CAT36B	£24.66	£19.95	£23.44
Grit blast gun	SB1		£21.95	£25.79
Spot blast gun	SB2		£24.95	£29.32
6" Dual Action sander	CAT80		£24.95	£29.32
1/4" Sq. Drive Ratchet	CAT22B	£31.47	£25.95	£30.49
3/4" Air drill	CAT27B	£32.84	£26.95	£31.67
14pce 1/4" Ratchet set	CAT221B	£42.24	£33.95	£39.89
13pce 1/2" Impact wrench set	CAT231B	£46.94	£37.95	£44.59
High Speed Saw	CAT26B	£34.02	£25.99	£30.54

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Clarke ROTARY TOOL SYSTEM

CRT40

ONLY £25.50 EX VAT £29.96 INC VAT

Kit includes:

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

Clarke TAP & DIE SETS

FROM ONLY £12.95 EX VAT £15.22 INC VAT

- High quality tungsten steel
- Supplied in metal storage case, except 16pce

‡ REDUCED 28 piece was £24.62 inc VAT

TYPE	EX VAT	INC VAT
16pce Metric	£12.95	£15.22
19pce UNF	£14.95	£17.57
24pce UNC/UNF/NPT	£19.95	£23.44
28pce‡† Metric	£19.95	£23.44
33pce‡ Metric/UNF/BSP	£29.95	£35.19

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#28pce Best Budget Buy, 33pce Recommended: Practical Classics

Clarke INFRA-RED HEATER

ONLY £89.95 EX VAT £105.69 INC VAT

- Provides instant, clean, odour-free, infra-red heat
- 2.8Kw max output
- 2m cable
- Available in 230v & 110v

DEVIL 340

Clarke AIR COMPRESSOR

WIZ OIL FREE MINI AIR COMPRESSOR

REDUCED £54.95 EX VAT £64.57 INC VAT WAS £70.44 INC VAT

MASSIVE PRICE CUTS

- Ideal for airbrush work
- 1.58 cfm air displacement
- 2.8 Bar Max Working Pressure

Clarke PARAFFIN/DIESEL SPACE HEATERS

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"BUY WITH CONFIDENCE" Full Service & Parts Backup

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MODEL	MAX OUTPUT	APPROX HRS/TANK	WAS INC VAT	EX VAT	INC VAT
XR55	51,000Btu	7	£270.19	£219.95	£258.44
XR75	79,000Btu	9		£269.95	£317.19
XR105	96,000Btu	10.5		£339.95	£399.44
XR155	150,000Btu	10.5	£440.57	£369.95	£434.69
XRV100	89,000Btu	17.5	£621.58	£499.00	£586.33

Clarke MIG WELDERS

FROM ONLY £119.95 EX VAT £140.94 INC VAT

Includes free:

- Face mask
- Earth clamp
- Gas regulator

Pro90-150TE also inc:

- Welding wire
- CO_2 gas bottle

OTHER SIZES & ARC WELDERS AVAILABLE

MODEL	AMPS	EX VAT	INC VAT
Pro 90	24-90	£119.95	£140.94
100E	30-100	£139.95	£164.44
135TE Turbo*	30-130	£159.95	£187.94
150TE Turbo*‡	30-150	£179.95	£211.44
165TE Turbo*	30-155	£239.95	£281.94
175TE Turbo*	30-170	£299.95	£352.44
205TE Turbo*	30-185	£329.95	£387.69

*Turbo fan cooled for longer welding at full output

Clarke MEASURING INSTRUMENTS

MASSIVE PRICE CUTS

OTHER SIZES AVAILABLE

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£8.49	£9.98
CM145‡	150mm/6" Digital Vernier	£19.95	£23.44

SLASHED

‡SLASHED CM145 was £35.19 Inc VAT

Clarke HEAVY DUTY PROFESSIONAL TOOL CHESTS & CABINETS

THE ULTIMATE IN TOOL CHEST STORAGE!

BALL BEARING SLIDES

- Extra heavy gauge double wall steel construction

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CB8204	4 Dr chest	38kg	£74.95	£88.07
CB8205	5 Dr chest	38kg	£89.95	£105.69
CB8206	6 Dr chest	38kg	£94.95	£111.57
CB8209	9 Dr chest	38kg	£119.95	£140.94
CB8203	3 Dr step up	38kg	£54.95	£64.57
CB8215	5 Dr cab	43kg	£169.95	£199.69
CB8217	7 Dr cab	43kg	£199.95	£234.94
CB8212	3 Dr cab	43kg	£129.95	£152.69
CB8213	3 Dr cab	43kg	£159.95	£187.94

Clarke AIRBRUSH KITS

FROM ONLY £7.95 EX VAT £9.39 INC VAT

DIY KIT - CABIH

- Spray pattern adjustable

ONLY £7.99 EX VAT £9.39 INC VAT

PRO KIT - CAB2P(pictured)

- Double action trigger for accurate air/paint control
- Precision machined nozzle • Special lightweight hose

ONLY £23.95 EX VAT £28.14 INC VAT

Clarke GAS HEATERS

FROM ONLY £79.95 EX VAT £93.94 INC VAT

STAINLESS STEEL MODELS ALSO AVAILABLE!

- Ideal for low cost, highly efficient heating in workshops, warehouses etc

MODEL	OUTPUT BTU	WAS INC VAT	EX VAT	INC VAT
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DEVIL 650	51,600	£152.69	£119.95	£140.94
DEVIL 850	107,000	£182.07	£149.95	£176.19
DEVIL 1250	149,000	-	£179.95	£211.44
DEVIL 1850	200,000	£352.44	£289.95	£340.69

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Clarke ANGLE GRINDERS

FROM ONLY £12.95 EX VAT £15.22 INC VAT

Inc. disc & handle

* 115mm, ‡230mm

MODEL	DUTY	MOTOR	EX VAT	INC VAT
CAG121*	DIY	500w	£12.95	£15.22
CAG115*	PRO	500w	£25.95	£30.49
CAG115C*	PRO	720w	£24.95	£29.32
CAG230‡	PRO	1700w	£32.95	£38.72

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SMOKE RINGS
With the Editors

John Wilding FBHI receives Masters Medal

At the annual banquet of the Worshipful Company of Clockmakers, held at Merchant Taylor`s Hall on the 20 October, John Wilding was awarded the very first Masters Medal. The medal was presented to John by the Lord Mayor of London the Rt. Hon. Robert Finch.

The medal citation was as follows:

"In recognition of the unequalled contribution you have made over very many years to the furtherance and retention of hand skills in horology among a great number of amateurs. Additionally, your written and published work has been an inspiration to hundreds".

John Wilding, from Lurgashall, has designed and made around forty clocks. Most of John`s clocks have been fully described with photographs and drawings, and published as construction manuals so that other enthusiasts may enjoy building clocks and learning about horology.

John Wilding`s clocks can be seen at **www.RiteTimePublishing.com** or you can obtain a free catalogue by phoning 01420-487-747.

John who is now over 80 years-old, has said that he feels very lucky to still be able to make clocks of the type shown in the picture here. The clock movement shown in the photograph, finished only recently, is awaiting its case. The *Model Engineer* team send their best wishes to John and congratulate him this prestigious award.

A1 Tornado Project

Following the article that appeared in *M.E.* 4240, 4 February 2005 describing the above project, we have been asked by the author, I. D. Howitt, to mention details of the trust set up to build this locomotive should any of our readers feel inclined to assist or contribute to its work. Always happy to oblige the address is: **A1 Steam Locomotive Trust, Darlington Locomotive Works, Hopetown Lane, Darlington DL3 6RQ (website: www.A1Steam.com).**

Rally

Pembroke Model Engineers announce that they will be holding a Rally Weekend on 14-15 May 2005 at their track at The Meads, Milford Haven. The track is elevated, 2,700ft. long and can accommodate 3½ and 5in. gauge locomotives. Overnight camping is available but please book ahead. **Contact John Rawlinson (tel: 01437-890234), Alan Batt (tel: 01646-693856) or Trevor Thomas (tel: 01646-697426).**

Southern Railway Rally

The fourth in this series of events is planned for 21-22 May 2005 and is to be hosted by the Surrey Society of Model Engineers. Running will be from 10-30am to 5pm each day. The event is open for scale models of any Southern Railway locomotives or rolling stock including those of earlier associated companies. Running or static exhibits are welcome, the latter being accepted for display in the club house.

The Surrey SME track accommodates 2½, 3½ and 5in. gauges on a 1,000ft. long raised, alloy track and 5 and 7¼in. gauge items on a one mile ground level steel track. Where appropriate, boiler certificates must be available for scrutiny.

The Surrey SME track is in Mill Lane (off Waterway Road), Leatherhead, Surrey KT22 9AA. For further details contact John E. Cook on tel: 020-8397-3932.

Model Engineering Class

Kingston College, Kingston Upon Thames has announced a Model Engineering Class, which is scheduled to run on Thursday evenings from 6-30pm to 9-30pm. The cost is £95 for a ten-week term there being three terms in a year.

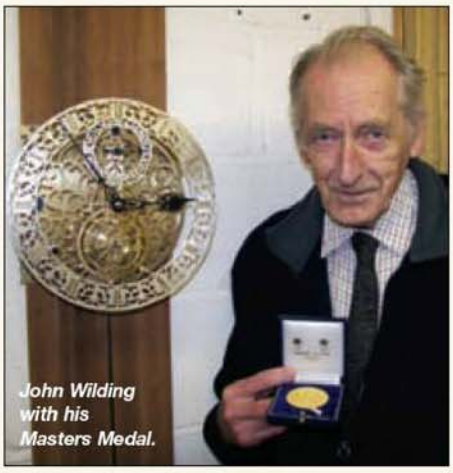
The workshop facilities available include: 15 manual lathes; one horizontal and six vertical milling machines; one CNC lathe; one CNC milling machine; sheet metal working machines; MIG, TIG, arc and gas welding; surface grinders and the usual drilling machines, etc.

Unfortunately the letter does not include course dates but those interested can contact the course tutor **Bryan Ruby on tel: 0208-268-2987; e-mail: eng.sci@kingston-college.ac.uk**

Training with SMEE

Following the undoubted success of the its Basic Training Course, the Society of Model & Experimental Engineers proposed to run a second course covering the building of a small oscillating engine. Unfortunately the records of those who expressed an interest in the course have been lost making it impossible for the society to contact them individually.

The volunteer group who put the basic training course together found they had underestimated the practical aspects of developing the content of a course covering the building of an engine, even something superficially as simple as an oscillating engine. Practical experience has shown that tackling the Stuart engine as an initial project is too ambitious and would result in an engine requiring further work in boiler making to produce a working model. The Polly Engine, described in one of the 'standard' model engineering books has been examined and a group are working on the design of a course covering the building of this model as an alternative 'first' model.



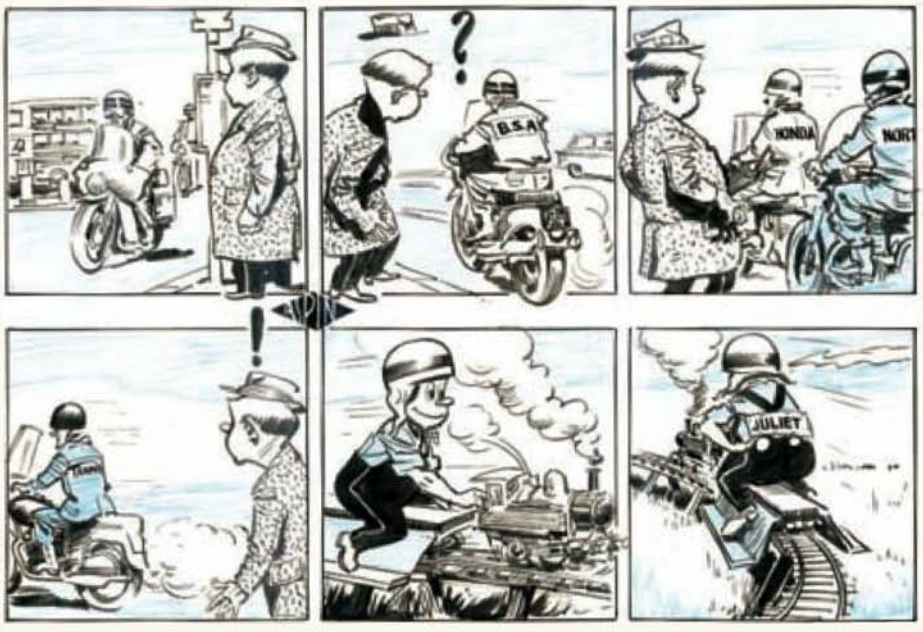
John Wilding with his Masters Medal.

The Polly engine combines a simple boiler and single acting oscillating engine in one model. However, it does require a variety of skills to build including: Understanding the legislation affecting model boilers; sheet metal work including marking out, rolling a cylinder, flanging, rivetting, silver-soldering, pipe fitting and bending, connections and sealing and boiler testing; preparing and making special lathe tools, arbors, tool sharpening, drills, reamers, taps and dies; turning-flanging plates, boiler fittings, safety valves, pistons, flywheels, cylinders; soft soldering and fitting.

The notes and lectures will be prepared to the same high standard as the Basic Course to ensure even the novice will be able to follow it. Those who have experience of the way the information is presented will understand the amount of work involved in preparation.

As soon as the work is completed information will be released, in the meantime anyone who is interest can register to receive the information by writing to the Society at **The Society of Model and Experimental Engineers, Marshall House, 28 Wanless Road, London SE24 0HW.**

CHUCK, the MUDDLE ENGINEER — by B. TERRY ASPIN



Crowd pullers

SIRS, - With reference to John Davies' letter, *M.E.* 4241, 18 February 2005. Through our long association with the Guild of Model Wheelwrights, Brian Young and I have become good friends. I know that he would be among the first to agree that his model room settings are NOT model engineering.

However, whenever one is on display at a model engineering show, it is usually one of the biggest crowd pullers on our stand, possibly because it is something different from the serried rows of locomotives. Surely, anything which provokes interest or discussion, as your cover picture has obviously done, is to be welcomed, even if it's not strictly 'model engineering'.

On the subject of choice of scale timber, I think that Mr. Davies has misunderstood your meaning. No one suggests that a 1/12 scale model could be mistaken for the real thing, but if the correct materials are chosen, then photographs of the model and photographs of the real thing should be indistinguishable if there is no other clue to size. I would argue that such is the case with your cover picture for *M.E.* 4237, 24 December 2004.

John Walford, Redditch.

Useful internet site

SIRS, - I've only recently started to receive *Model Engineer* and *Model Engineers' Workshop* by subscription but thought I would share the following link for an interesting, free electronic book that I've just stumbled across today as it might be of interest to your readers with internet access.

I've only attached its Acrobat title page here but it is from a 1907 American book titled *Railway Shop Up to Date* by the editorial staff of the *Railway Master Mechanic* and published by Crandall Publishing Company. It is currently freely available in nine Adobe Acrobat parts from the Gutenberg Project internet book archive or any of the various mirror sites worldwide. **http://www.gutenberg.org/etext/12148**

Jeremy Sinton, Calgary, Canada.

BSP sizes

SIRS, - Referring to I. D. Howitt's article on the A1 Pacific construction, *M.E.* 4240 4 February 2005; the construction of the jury rig to bore out and thread the errant hole in the cylinder reminded me of a similar arrangement we cobbled together to repair a power press in situ.

The press was an old Pattinson Sheffield Type, one of a number we had, all well over 100 years old but with badly worn shaft bearings through the main casting.

The cost was going to be well in excess of realistic or economic and the makers who were still around at that time obviously saw an opportunity to make some money refurbishing. We constructed a cutting head, located within the entrance of the mainshaft bore and aligned between the two bearings, driven by the overhead line-shaft and running on a very fine pitch screw shaft of several inches diameter. The resulting combination powered the cutter through the bore of the machine and out the other side without any intervention for a full shift.

We rebuilt the press and recommissioned it, enjoying the fruit of our labours for many subsequent years, as far as I know the machine is still in use today.

As a note to the text of Mr. Howitt, the thread system referred to, BSP (F) is *"Fastening Threads of B.S.P. Sizes, B.S. 2779;1956"* not *"Fixing Threads"*. Many years ago, when just out of my apprenticeship, I spent some years in the drawing office of Firth Brown Tools Ltd. working on the design and development of screw threads. You wouldn't think there was much left to design about screw threads but there certainly was! The designation of the Pipe Series of threads always caused much consternation and mis-understanding, there are parallel internal, parallel external, taper internal, taper external and longscrew designations whereby some tapers mate with tapers and some with parallel, some parallel mate with parallel and some with tapers and they are just the BSP designations, (BS 21). The BSP(F) designations were constituted as a fine series of fastening threads of standard Whitworth form for general engineering purposes and carried a completely different tolerance range from the pipe threads. In fact the tolerances made them eminently unsuitable for joints where a pressure tight seal was to be made on the threads. External threads to BS 2779 were not intended to mate with internal threads to BS 21.

Michael R. G. Bishop, Sheffield.

Malleable iron

SIRS, - I was interested to see Keith Wilson's design for the expansion links of *Lillian* in *M.E.* 4241, 18 February 2005. I notice that he has specified PTFE for the die block working on what I assume to be unhardened expansion links.

I am considering using carbon filled PTFE for the die block of my 4in. scale traction engine. The overall size is similar to that shown for *Lillian* and I wonder what operating experience Keith has with this material combination in the larger scales - good or otherwise. A traction engine with Stephenson's valve gear will have rather more die slip than a locomotive with Walschaerts.

I would also like to correct a couple of mis-conceptions with regard to malleable iron. In the old days, malleable iron was made by heating a fine white cast iron in a hematite bath for up to a fortnight. This would remove most of the carbon and produce a casting with properties about halfway to wrought iron. My trusty data book says *"malleable iron must not be subjected to great stress"*.

What is commonly known as malleable iron is usually spherical nodular graphite (SNG) iron. This is made by adding magnesium alloy to the melt which changes the distribution of carbon to nodules (instead of flakes). The result is a material with physical properties more like steel than brittle flake graphite cast iron. This is the material that is used for automotive crankshafts, for example and would be needed for locomotive connecting rods.

Some heat treatment of grey iron castings is possible for the average model engineer. Annealing will often make the hard spots machineable. However, attempting to manufacture a cast iron component that had a sufficient degree of malleability for connecting rods would not be possible.

Another possible confusion is that continuous cast iron bar is often referred to as 'Meehanite'. The Meehanite foundries are large producers of SNG iron, but they also produce ordinary grey cast irons, usually to a very good quality specification - which is why the cast bar machines so well. The Meehanite brand is actually a quality scheme to which participating foundries adhere. So if you have a piece of 'Meehanite' continuous cast iron bar, it is probably grey cast iron unless you have specifically ordered SNG iron.

Martin Johnson, Inverness-shire.

For tractor fans

SIRS, - For those readers who are interested in the restoration of agricultural machinery there are two books that would appear to be well worth investigating.

1: #127236/3. *This Old John Deere* by Michael Douglas Eaton.

2: #127232/21. *How to restore classic John Deere Tractors.*

These books are available from: Hampstead House Books Inc., 80 Doncaster Avenue, Thornhill, Ontario, Canada, L3T 7S3; tel: 905-881-0607. **www.hhbooks.com** (usual disclaimer)

The numbers are those used to reference and order these books.

Ted Wale, Canada.

Plate thicknesses

SIRS, - I have followed the *Anna* series in *Model Engineer* with interest and I like some of the ideas put forward, particularly those which reduce the hard work involved in producing a locomotive. D. A. G. Brown and Mark Smithers should be congratulated on a fine contribution to model engineering.

Boiler design is a particular interest of mine and I would like to comment on the remarks in Part XII about dome bushes.

I am familiar with the idea that a hole in a pressure vessel should be reinforced by an equivalent section of metal in a bush or ring round the hole. I have not, however, seen the idea that reinforcing material should only be considered within the limit of 2.5 times the thickness (presumably the barrel thickness) from the barrel surface. Is there any theoretical justification for the 2.5 or is it just a rule of thumb?

On reflection, it seems that there should be some limit to the distance from the barrel surface beyond which the bush becomes ineffective though I would expect the ratio of width to height of the reinforcement to have an effect on how far this limit would be.

In considering the effective area of metal in the reinforcement I believe it is usual to discount the cross sectional area of the stud holes, even if they are not on the centre line and hence do not appear on the drawing. If calculations are done on this basis then:

$0.469 \times 0.25 = 0.117$ in^2 should be subtracted from the bush area making it a little less than the area removed from the barrel. I hasten to add that, even including this consideration, I do not think the

boiler design is inadequate. The barrel thickness is considerably more than the bare minimum and hence the reinforcement required is less than suggested. I make the point so that others who may not have as much spare metal in their design are not lead astray.

I disagree with the statement that *".... it is vital that bushes actually penetrate the vessel shell....."* I can see no objection to using a bush with its underside machined to the barrel radius and silver soldered to the outside of the barrel. I had seen boilers constructed thus and recognised that they had some advantages over the usual methods. That is; if the silver soldering is done before the hole is cut, the soldering is easier and it is easier to cut the hole afterwards. The edge of the hole can be profiled to provide lugs for mounting steam pipe and/or regulator.

The area of the silver soldered joint is much larger than with the usual construction. Fly cutting the radius on the bush may frighten some but I found it of small consequence when I made two boilers with this type of dome bush some time ago.

F. A. J. Collin, Oldham

Derek Brown replies:

Mr. F.A.J. Collin's question about compensation for holes in the pressure surface raises an interesting area of design for safe operation. My figure of $2^1/_2$ times plate thickness for the allowable section is certainly not plucked out of the air, but has its roots in the standards for pressure vessels, as used in the Chemical industry and elsewhere. The modern standard is BS 5500, which is a most involved and almost unintelligible document to the layman, but its predecessor was BS 1500, which was devised before the days of computers and is much more friendly. That figure is based on experimental laboratory work and finite element analysis, and relates not strictly to the plate thickness, but to that thickness required to resist the design pressure. Thus in *Anna's* case, the thickness required is slightly less than the practical plate thickness of $^3/_{16}$in. In describing the design method I may have been guilty of over-simplification, but I judge that the readership of this magazine in general does not want to get involved too deeply with the arcane world of design.

On the related subject of allowances for holes in compensating flanges, F.A.J.C is quite correct, but as he points out, there is adequate metal present in our case for the compensation process to be satisfied.

As for superimposed flanges, I stick to my statement that they ought to be outlawed. Your correspondent does point out that it is necessary to fly-cut their mating surfaces, which I should have thought is always more cumbersome than plain turning. What is more significant, however, is that it is imperative for the soldered joint between flange and barrel to have almost perfect penetration. My design philosophy is to have all the holes prepared before silver-soldering - much quicker and more accurate.

D.A.G. Brown, Rutland.

Cast frames

SIRS, - Regarding Malcolm Young's letter *M.E.* 4241, 18 February 2005 and Neville Evans' earlier comments, *M.E.* 4238, 7 January 2005. It may not be generally known that cast frames were considered at the design stage of the Britannias. In fact BR metallurgists went to America to discuss the matter. The idea was eventually rejected because of the additional weight, which would have taken the weight of the locomotive over the 20 ton axle load limit of British Railways.

The concept was reflected in the fact that the frames of these locomotives lie on the axlebox centreline. This change from the traditional design brought its own problems, for the motion brackets, cantilevered further out from the frames, allowed the slidebars to flex under the action of the crosshead. The slidebars were not attached to the cylinders, another departure from tradition, intended to avoid loose slidebar bolts from loose cylinders. The net result was that the flexing loosened the bolts on the three-bar crosshead and in the case of the Skipton mishap resulted in the loss of the lower slidebar and dropped motion. Another problem associated with the flexing of the motion bracket was the tightening of the reversing screw, which was relieved by taking off the roller bearing preload.

On another subject, referring to Derek Mosley's letter in the same February issue, I have always stored my two scribing blocks over the past 50 years or more, with the curved end of the scriber in the recess under the knob. I don't know where I got the idea from, but I have always done it; it just seems logical.

Dennis Monk, Derby.

A simpler solution

SIRS, - I have just received the latest copy of *M.E* 4240, 4 February 2005 and see that once again the tool height setting gauge has been reinvented by Peter Spenlove-Spenlove. It seems that no one to date has provided the correct and simple answer and that is to take a short piece of round bar and for say $^1/_2$in. mill the bar so that this end is only half the thickness. It then looks like a 'D' bit. It is easy to check this with a micrometer. The gauge can be used for front mounted tools as well as for the rear parting off tool.

A rough approximation can also be done by putting a small piece of brass sheet between the tool and a piece of round bar. Depending on whether the tool is above or below the centre so the brass strip will vary from the true vertical.

Philip T. Bellamy, Switzerland.

Final details on sock knitting machine

SIRS, - With regard to the mystery item sent in by Derry Dickson in *Post Bag* (*M.E.* 4241, February 18 2005). I can identify it as a sock knitting machine which was made by the Golden Fleece Company of Great Britain. I have a neighbour who has an identical machine, including the instructions, and one which is older that he uses to make socks which he sells from his croft here on the Northwest coast of Scotland. The cranked arm which sits over the top is called the dial and this is stored in the large round hole in the base when the machine is being set. The smaller hole in the base is for the yarn guide which appears to be missing along with the needles which fit into the cylinder which Dr. Dickson describes as looking like a commutator.

I have included two photos, one of which shows the machine identical to Dr. Dickson's while the other depicts the older machine. I am happy for Dr. Dickson to contact me if I can be of further assistance in this matter.

Peter Young, by e-mail.

SIRS, - I was very interested in Derry Dickson's mystery item (*M.E.* 4241, February 18 2005). Could this be an early sock or circular knitting machine? The 'commutator' slots would accommodate latch needles with the eyes uppermost and projections on the lower ends would engage with fixed internal cams in the base. Thus, as the cylinder rotates, the needles rise and fall to complete the stitches. The missing auxiliary pieces could have been a support for a cone of wool and the wool guide and tensioning system.

This suggestion has been confirmed by my wife who, in addition to coping with my model engineering activities, has had many years experience of home knitting machines both simple and electronic. I am well provided with jumpers!

Norman F. Smith, Oxfordshire.

The two hand-knitting machines referred to in Mr. Young's letter (the older machine is at right)

This 1:12 scale horse drawn charabanc of circa 1890 was made by Timothy Smith.

Brian Simpson's well presented, 1:8 scale model of a Bavarian Waggon caught the judge's eye.

COMPETITION MODELS
AT THE 74th MODEL ENGINEER EXHIBITION

Class G1: MODEL HORSE DRAWN VEHICLES
Reported by Barré Funnell

There were six entries in the Model Horse Drawn Vehicles class at Sandown Park this year, but one of them was a showman's engine! I couldn't deal with that, so it was quickly transferred to the correct class, leaving five models for me.

There was a charabanc, a proper horse-drawn charabanc not one of those newfangled vehicles with a motor in it. There was a night soil cart, always known in my part of the country as the honey wagon; a Bavarian farm waggon; a stripper - no, not that kind of stripper - but a kind of harvester, which tugs ears off the wheat rather than cutting it off at ground level and a lifeboat transporter.

The trouble with judging models can be that sometimes an entry can have what estate agents call 'kerb appeal'. Stand back and some models look quite superb. Judges have to get up close to look inside and out, underneath and round the back, even looking through magnifying glasses at details that the visiting public do not see.

This year I was particularly taken by Brian Simpson's Bavarian Waggon. The finish on a model horse drawn vehicle is a subject for discussion. Paint can hide a multitude of sins and, taking scale into account, glossy paint does not give the required result. In this case I would say that the finish (i.e. none) was quite alright. The white wood was just about free from any visible grain - quite right for a scale model - and the iron-work was black - again quite appropriate. It was as the original would have been if it were waiting at the paint-shop. It also meant that I could see all the joints and construction details, and it was all very tidy. This model was awarded a Gold Medal and the John Thompson Trophy.

Brian Young entered his model of Mellor's Stripper. Brian's models are always complicated well researched and skillfully executed, and Leslie Jones' Lifeboat Carriage, the one with 'kerb appeal, was also a tidy job and well researched. They were both awarded Silver Medals.

Class J1: THE JUNIOR CLASS
Reported by Neil Read

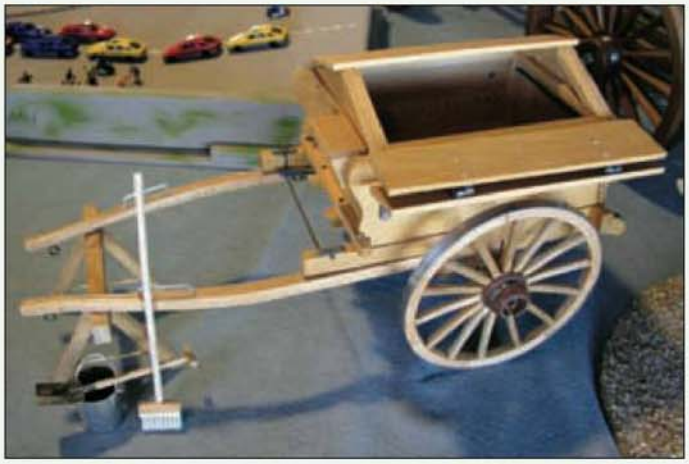
Only one entry was received in this class. This was a freelance cannon based on the type of weapon used in fighting ships circa 1800 and built by Curtis Church who is 12 years-old.

The model started life as a school casting exercise but had been finished off with a suitable wooden base and appropriate proprietary parts to give an authentic effect. The model no doubt now, quite rightly, occupies a place of honour in the Church household and the judges deemed it worthy of a Commended Certificate.

Class K1: NON-WORKING VEHICLES
Reported by Geoff Sheppard

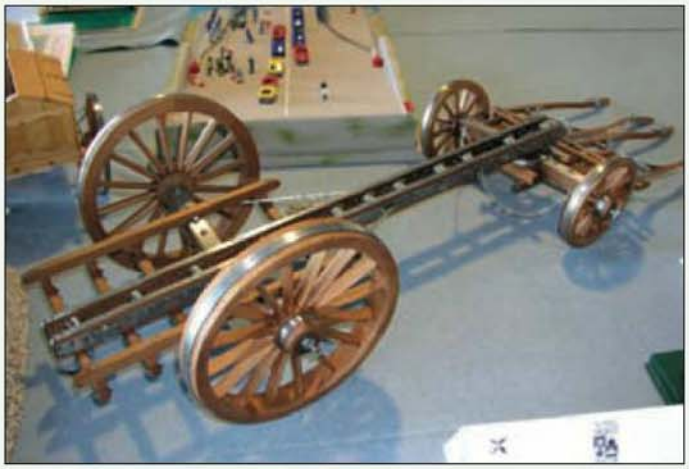
Although the entry in this class was small, consisting of only two items, the standard was exceptional. Stephen Atkinson of Belfast had made the long journey to bring his 1:8 scale version of the famous MG TC sports car of 1946 vintage. Attractively displayed on a rotating mirrored turntable, it was presented as if on a stand at the Earl's Court Motor Show of that year. Finished in authentic MG red and with nicely chromed bright work, this model caught the atmosphere of the well-loved prototype. Particularly pleasing was the dashboard and finely detailed instruments. The judges were sufficiently impressed to award a Silver Medal.

To an equal standard, but of a very different prototype, was the 1:12 scale model of the less



A reminder of times past if an unusual choice for a model, Ralph Kitching's 1:12 scale Covered Night Soil Cart.

Brian Young can usually be relied upon to model an unusual prototype. This is his 1:12 scale representation of Mellor's Stripper.



Having what the judge termed 'kerb appeal' was Leslie Jones' Robinson & Napton Lifeboat Carriage.

A commendable effort from young Curtis Church was this freelance cannon of circa 1800.

Stephen Atkinson's 1:8 scale MG TC of 1946 was displayed on a revolving platform with a mirrored top surface.

A view of the cockpit of Stephen Atkinson's MG showing the finely detailed instruments and controls.

familiar Leyland 'Gearless' fire engine of 1937, built by Ian Scott of Hazlemere, Bucks. The full-size version was the first Leyland appliance to be fitted with the Gearless Major pump and was stationed in Edinburgh for 20 years. The model was fully equipped, both internally and externally with a comprehensive range of accessories, including a highly detailed bank of water valves and hose connections. One can imagine the pride with which the crew members kept these in such a well polished state. This delightful reminder of by-gone days also deserved its Silver Medal.

Class K7:
FUNCTIONAL MODEL VEHICLES
Reported by Geoff Sheppard

The five entries in this class represented the widest possible range of miniature automobile engineering and contained what was, for many, the highlight of the Exhibition. Arthur Bodily's 1:4 scale Twin Cam Austin Racer has been some six years in the making and those of us who have been lucky enough to follow its progress have been waiting for the finished article with impatience. It has been well worthwhile.

The prototype, like its famous predecessors, the Austin Seven Saloons, Tourers, Sports Cars and Racing Cars had an engine of 747cc capacity, but there the similarity ended. Designed by T. Murray Jamieson, it featured a highly supercharged twin overhead camshaft engine in a neat single-seater chassis. Two prototypes survive, as part of the Donington Collection, and Arthur had access to both in order to gather precise details for the model. All components are machined from solid or fabricated, no castings being employed. The engine runs, but in unsupercharged form, as such a unit would be ineffective in this size. It has been demonstrated ▶

This striking 1:12 scale 1937 Leyland Gearless Fire Engine was the work of Ian Scott.

A close-up view of the engine compartment of Ian Scott's fire engine showing some of the detail incorporated into the model.

Arthur Bodily's 1:4 scale model of a 1936 747cc Twin Cam Austin Racer with the bonnet removed to show the engine compartment.

A close-up view of the cockpit of the model Austin with the seat removed to show the working gearbox and drive arrangements.

on a test bed, but operation in the car would be difficult, as Arthur has resisted fitting radio control. What is needed is a quarter scale version of Charles Dodson or Bert Hadley, the regular drivers. Anyone any ideas?

Prolonged study of this model confirmed how near perfect it is, so the judges had no hesitation in awarding a Gold Medal. When the time came for nominations for the major trophies, there was agreement that this model was worthy of the prestigious Bradbury-Winter Memorial Challenge Cup for the most outstanding example of amateur mechanical craftsmanship.

At the other end of the scale was a 1:10 version of the sole Euclid Hitachi 4500, the world's largest dump truck. Known as *Big Jim*, the prototype is 65ft. long, weighs about 500 tonnes and can carry 300 tonnes at 38mph – impressive. Built by David Lee of Sheffield, the model is constructed around 'correct' looking wheels and tyres, which dictated the scale. A cunningly installed 4.5hp Briggs and Stratton engine will drive the model at 10mph with a driver aboard, via a 3-forward plus reverse gearbox and a slipping belt clutch. The engine is equipped with key start and an alternator to provide electric lighting. This substantial exhibit received a well-deserved Highly Commended Certificate.

David Lee's 1:10 scale Euclid-Hitachi Dump Truck **Big Jim** *was an impressive model of an impressive prototype.*

Interestingly, John Nell of West Molesey, Surrey had entered a model of a very similar prototype, this time a Caterpillar 789B Mining Truck in 1:44 scale. Much smaller than the Hitachi, this model is electrically powered and radio controlled, the necessary equipment being hidden under a dummy gravel load. Again built around available tyres, the design was taken from a sales catalogue, which included photographs and a small line drawing. Neatly constructed, it was awarded a Highly Commended Certificate.

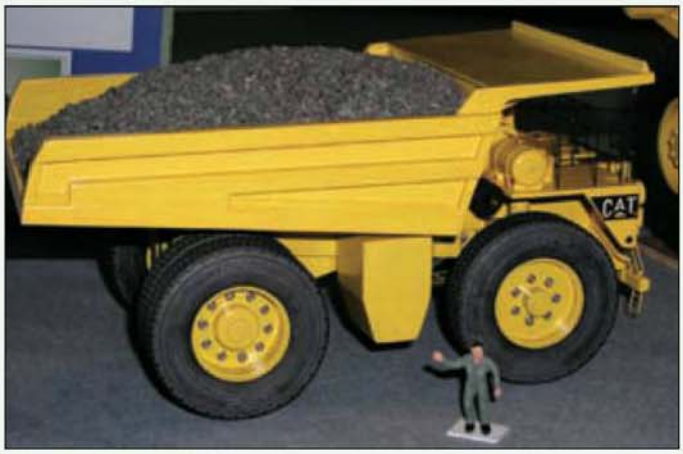
Also Highly Commended was the 1:12 scale Routemaster Double Deck Bus by Leonard Cooper of Bourne, Lincolnshire. This model depicts an ex-London Transport vehicle, now in the livery of the Delaine company of Bourne. Scratchbuilt using photographs of the original, the model is electrically powered and controlled by a 3-channel radio, which operates steering, forward and reverse and lights. The working lights include headlights, sidelights, rear lights, name and destination boards and internal lights. The sidelight bulbs were taken from broken digital watches.

A second entry by Leonard Cooper was a very interesting 1:8 scale Morris Minor fire engine. Somewhat smaller than the standard Morris Minor, the prototype, which still exists, was built to be used within the Morris Motors factory, and could be driven along the gangways between the production lines. This attractive little model was awarded a Commended Certificate.

Class L1 and L2: SCALE MODEL AIRCRAFT

Brian Perkins reports

There were three entries in Class L1 for radio control scale aircraft two of which were of variants of the same aircraft (Cosmic Wind) and both built by Mr. David Horton. They were finished in different colour schemes, well executed by the builder but apart from various minor details were identical. It is difficult to judge and award marks for this type of model as there is so much reliance on proprietary parts



A scale figure always helps put the size of the prototype into perspective. John Nell's 1:44 scale model of a Caterpillar 789B Mining Truck.

No longer as common as they once were, Leonard Cooper's 1:12 scale model of a 1964 Routemaster Double Deck Bus.

Another model by Leonard Cooper was this rather attractive 1:8 scale Morris Minor Fire Engine based on the prototype used in the Morris Motors factory.

Regular exhibitor David Horton entered this stylish 1:4 scale Cosmic Wind aircraft called Miss Julia Louise.

Also by David Horton was this equally stylish version of Cosmic Wind called Miss Milly Jane.

Colin Agate's handsome 1:5 scale Miles Falcon was built using a full-size aircraft for reference.

and the modelling content is fairly small apart from the obvious efforts put in to the overall finish which has already been commented on. From my days as a radio control modeller I would say that they represent a good standard of stand-off scale and, I felt, worthy of the Bronze Medals awarded.

The third model was of Miles Falcon for which the builder Mr. Colin Agate had access to a full-size aircraft for reference, attempts had been made to reproduce various details of the full-size but the overall effect was rather disappointing particularly with reference to the finish achieved which is so important in aircraft models. A Very Highly Commended Certificate was awarded.

In class L2 for scale model aircraft there were only two entries but both were, in their own way, fine examples of the art of aero-modelling. The control line stunt model of *Strega* by Mr. Paul Winter again stood out for its fine finish and I am sure was a sight worth seeing in action but again, the modelling content was minimal with the use of a prefabricated wing and the only marks that could be truly justified under the current system of judging were for the quality of workmanship and the finish.

The second entry, a Dornier Do 335 *Pfeil* free flight scale model of an unusual German aircraft of WW2 by Mr. Peter Morris stood out for the delicacy and quality of its construction and was a first-class example of the difficult art of free flight scale. Both Mr. Winter and Mr. Morris were awarded Bronze Medals for their different interpretations of the aero-modelling hobby.

I know that Ivan Law is keen to encourage more aircraft models for future exhibitions and I am sure that there are a great number of models out there which could be shown. How about it you aero-modellers?

This control line stunt model of Strega *was built by Paul Winter and was awarded a Bronze Medal.*

A model of an unusual Luftwaffe aircraft of late WW2, Peter Morris' 1:20 scale Dornier Do 335 Pfeil.

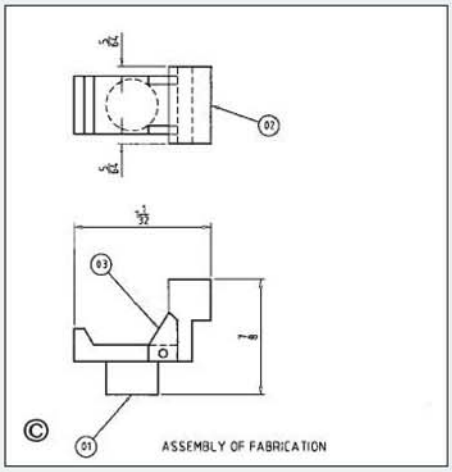
ELECTRO-PNEUMATIC CONTACTORS

Colin Beckwith

now looks at the moving contact carrier.

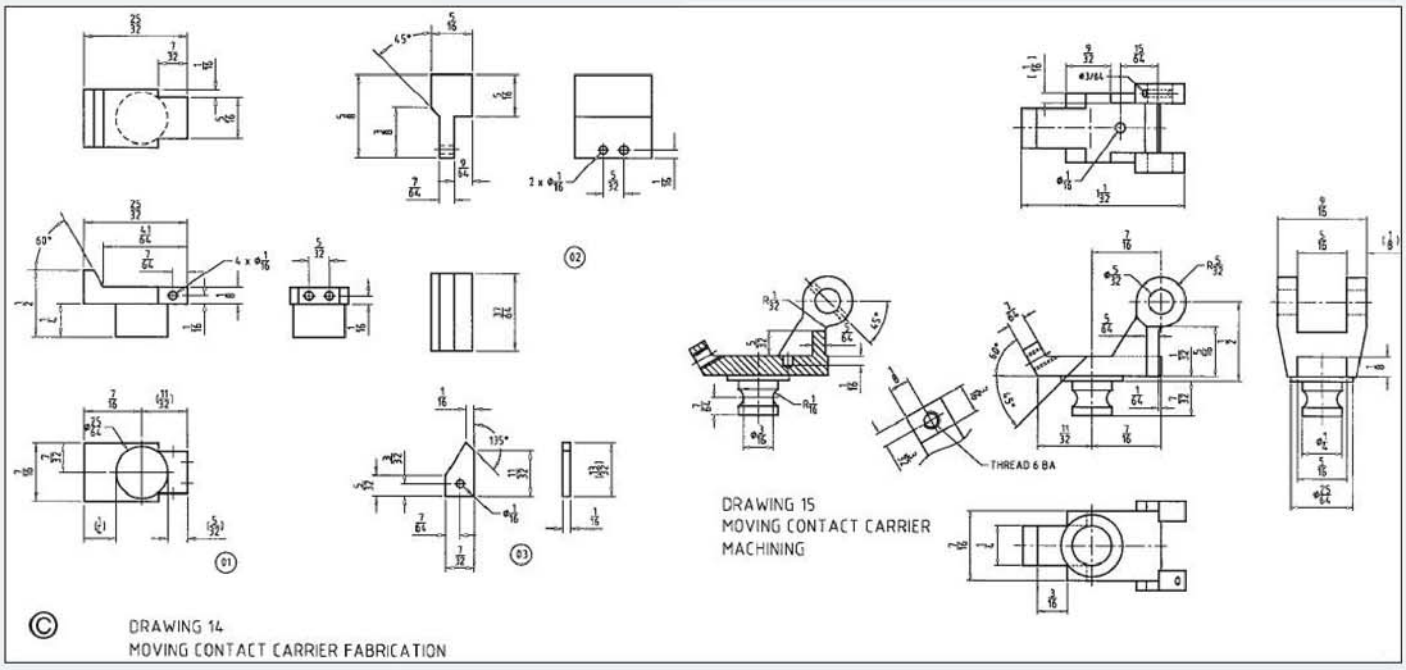
●*Part VI continued from page 320 (M.E. 4243, 18 March 2005)*

The purpose of this part is to provide a mounting for the moving contact holder. The part is shown in **drawings 14** and **15**. With this moving contact holder, it creates the necessary geometry and hinge for the knuckling feature. It also carries the bearing faces for the moving contact holder stops. There is also a mounting boss intended to fit into the moving contact insulator upon assembly. This feature is given a large washer faced projection with which to seat against the insulator. The boss also incorporates a cut-out to allow sufficient volume of epoxy to accumulate in the joint. The lower arc horn secures to the 60deg. face with a 6BA screw at the left hand end of the part. Notice the two steps visible in the plan view, terminated in the 45deg. faces. This allows the side plates of the arc chute to enclose the main contact tips which has importance mentioned later on. The main hinge bosses are at the right-hand end of the part and are raised quite high. This is partly to enable fitment of a decent sized knuckling spring that can endure the arduous loading cycles. Also the aforementioned insulator necessary for the springs protection has to be accommodated. The main hinge uses a silver steel pin of 5/32in. dia and the bosses are drilled and reamed for this purpose. It is necessary to configure this part as the fork of the hinge due to the need to accommodate the braid connection. I could have put the fork in the moving contact holder, but this would complicate its design. Also the current path is better this way round. Having said all this, I did spend many hours scratching my head over this one. I finally chose this option with the advantage that it was more like the full sized unit. The hinge pin is retained by a split pin that fits into holes in the pin and carrier. The hinge bosses are each stabilised with two webs, one is for and aft, while the other goes inboard and outboard. I am quite pleased with the way these webs turned out because they retain the character of the prototype.



The fabrication for this part is again made from brass. Incidentally the choice of brass or other non-ferrous material is not optional. The parts carry current and would become permanently magnetised over time. This would affect their efficiency and may cause them to attract 'bad company' namely magnetic particles. The full sized jobs could use one of any number of different non-ferrous alloys, mainly castings of course. Manganese bronze and chromium copper have been observed in this role. Anyway, the fabrication is shown in drawing 14 and it is suitably similar to the finished item shown in drawing 15. I designed it like this purely to simplify the silver-soldering process. However, design and practice are not inextricably linked and I had difficulty with this 'beast'. I have taken the plunge and thought up various fixes for the problems. The most universal fault is that there are still too many individual parts. These parts were difficult to stabilise during heating and tended to wander. The boss part wanted to fall back away from the webs, as the dowels were not ideally positioned. At the end of the day it all worked near enough as intended with the troubles being noted. I did mention that the fabrication had been subject to a rethink. This is very hard to reconcile as I am continually pushed this way and that on the best recourse. The fix is possible, but it loses the character of the part. My design engineer half tells me to simplify, always simplify. My model engineer half says, do not listen to him, go with your emotions. The model engineer won!

The machining operations started with the hinge boss. The part being mounted in the 4-jaw chuck and the hole was drilled right through and reamed 5/32in. diameter. The next stage was to cut away the middle of this single boss to make two bosses. This cut out allows the contact holder to pass through as mentioned before. I elected to saw and file this feature, as I am quite handy with these tools. I could have milled it with quicker results, but elected the slower alternative. Once all this was done I mounted a holding jig in the 5/32in. dia. holes. The jig was so shaped that it would only fit in once the face that forms the lower knuckling stop was correct. That is the correct distance between the hole and the upper face of the platform. The design of the jig was such that I could mount it in the 3-jaw chuck. The profile of the insulator boss was now turned with this set up. Doing it this way ensures that the boss is square with the contact holder mounting holes. Just as important, the jig allows all parts to be identical and therefore interchangeable. The cut-outs were machined in the milling slide as was the bolting



DRAWING 14
MOVING CONTACT CARRIER FABRICATION

DRAWING 15
MOVING CONTACT CARRIER
MACHINING

The contact rocker split pinned into the holder and insulator assembly. Note the knuckling spring.

The contact rocker from below showing the pocket for the knuckling spring.

A front view of the contact rocker showing the shouldered tip seating register.

face for the arc horn. The tapped hole for this purpose being drilled and tapped in the same set up. The contact holder boss exterior profiles are only cosmetic, so these were filed to shape, albeit with great care. I would have made this round profile a feature of the fabrication. The reason I did not was to simplify production of the fabrication components. Also it was easier to mount the part in the chuck with it square in profile.

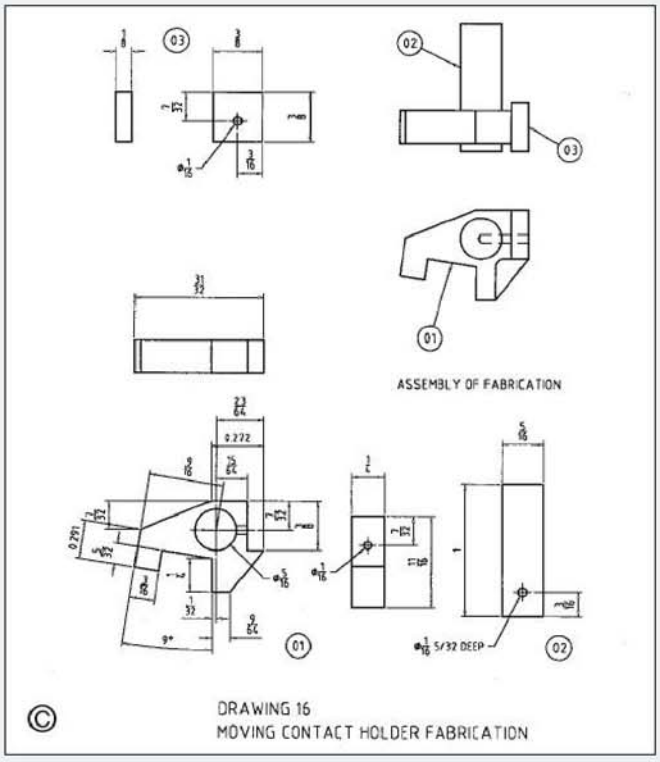
I elected to base it on a brass fabrication for the reasons mentioned earlier. Having said that, it would adapt well to becoming a casting. I would do this if I felt it necessary to use a tougher material - or produce many more units than I originally had intended to.

Moving contact holder

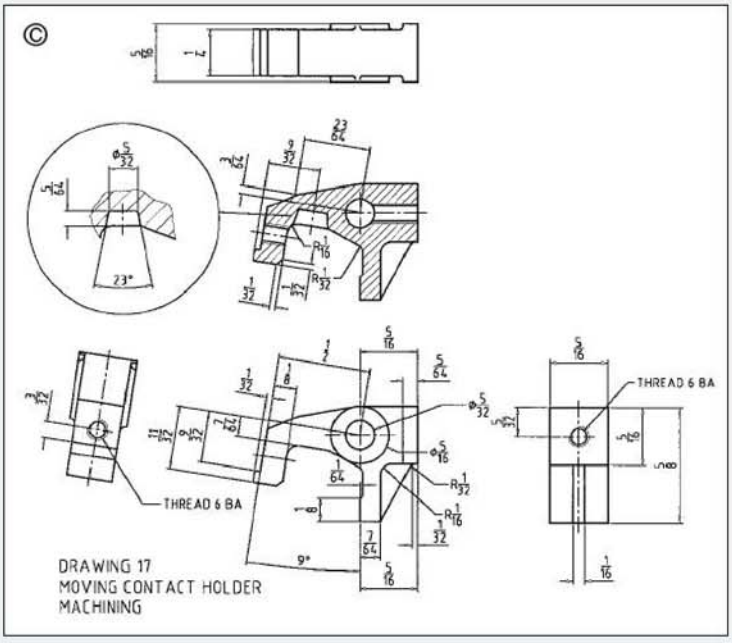
This part holds the moving contact tip and is the other half of the knuckling assembly. It has to be big enough to carry the circuit current so it may appear to be somewhat heavy. The seating for the contact tip is angled at 9deg to give the correct orientation. This is necessary in order to ensure that the toe of the tip touches first, as the contactor closes. At the other end of the part is the bolting face for the connection braid to the moving contact terminal. This face is square with most of the other features and it projects out slightly each side. The hinge-pin hole has a raised wearing surface each side. These mate with the inner faces of the hinge bosses on the moving contact holder. The fit of this interface is critical to the vertical alignment of the main contacts once closed. If unaligned, the tips would wear unevenly, resulting in a stepped appearance. This is bad for the current carrying ability of the contact set and would necessitate frequent and untimely tip renewal. The part includes features associated with the stops, which I have already explained. The placement of the stop faces shown in the machining **drawing 17** is again very critical for two main reasons. The first is pure interchangeability, as items may need to be replaced from time to time. Secondly, the angle of the moving contact tip has a direct relation to this. If the angle is incorrect, the tips may touch too early, or too late. The result of this may be a failure of the correct control sequence that is linked to the timing of the auxiliary contact operation. Much has been said about this potential problem and its manifestation elsewhere in the article. With lots of critical features, this part is particularly crucial to the satisfactory operation of the contactor.

The part is based on yet another brass fabrication, shown in **drawing 16** so no surprise there. It consists of three parts and it is a quite simple fabrication. It features a chucking boss to simplify the initial machining operations. Extensive finishing by way of filing and machining is required.

The machining operations begin by drilling and reaming the 5/32in. dia. hole for the hinge. This is run right through the chucking boss to avoid having a blind hole. The flat bearing surface is then faced in the same set up. Then the part was turned around and mounted in a jig for the facing of the other side. A bit of care is needed here in order to keep the contact tip mounting central to these bearing bosses. This ensures that correct tip alignment is obtained avoiding the problems mentioned earlier. The stops were then taken down to size, this operation being aided with a setting jig. This enables the part to be reproduced with similar accuracy come the next time. The rotational angle of the part was adjusted by removing small amounts of material then checking this with a setting gauge. This may seem like a long-winded way of doing it. However, it was the only way in which I could be sure that the angle was correct. The setting jig was then used to set up the angle for the main tip seating face. This was machined to dimension in the milling slide. The critical dimension being the 1/2in. shown. Once this had been machined, ▶



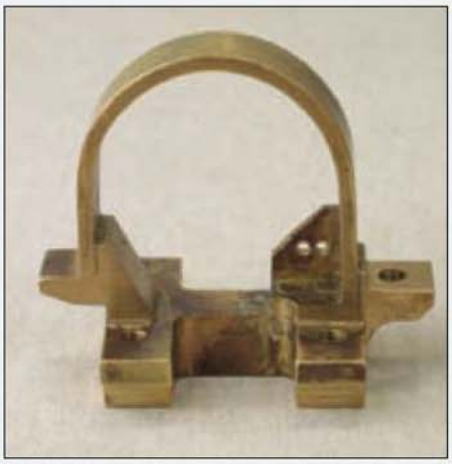
DRAWING 16
MOVING CONTACT HOLDER FABRICATION



DRAWING 17
MOVING CONTACT HOLDER
MACHINING

The contact rocker rear. The threaded face accepts the connection braid.

The fixed contact holder showing the loop of material that forms the arc horn and runner.



In this view the flange for connecting the blow out coil can be seen (right) plus the rivet holes.

the less critical abutment was taken down to size. The reason for this 1/2in. dimension's importance is that it can affect contact tip alignment. When the tips come together as the contactor operates, this face has to line up exactly with the fixed contact tip seating, this being on the fixed contact holder. If these faces are out of line uneven contact tip wear would result. Whilst the part was in the setting jig the 6BA hole for the tip securing screw was drilled and tapped. The only really critical feature remaining is the angular pocket for the knuckling spring, again sited with the use of a jig. A special cutter was manufactured in order to generate the profile of the pocket. Finally the bolting face for the connection braid was milled flat and the 6BA tapped hole produced.

This part will be subject to disproportionate wear and tear whilst in service. This is not too much of a problem as the replacement part can be manufactured by use of the original setting jig. Replacement parts do not have to be hand fitted which means that spares can be made for instant fitment. This idea has been used throughout the contactor wherever possible.

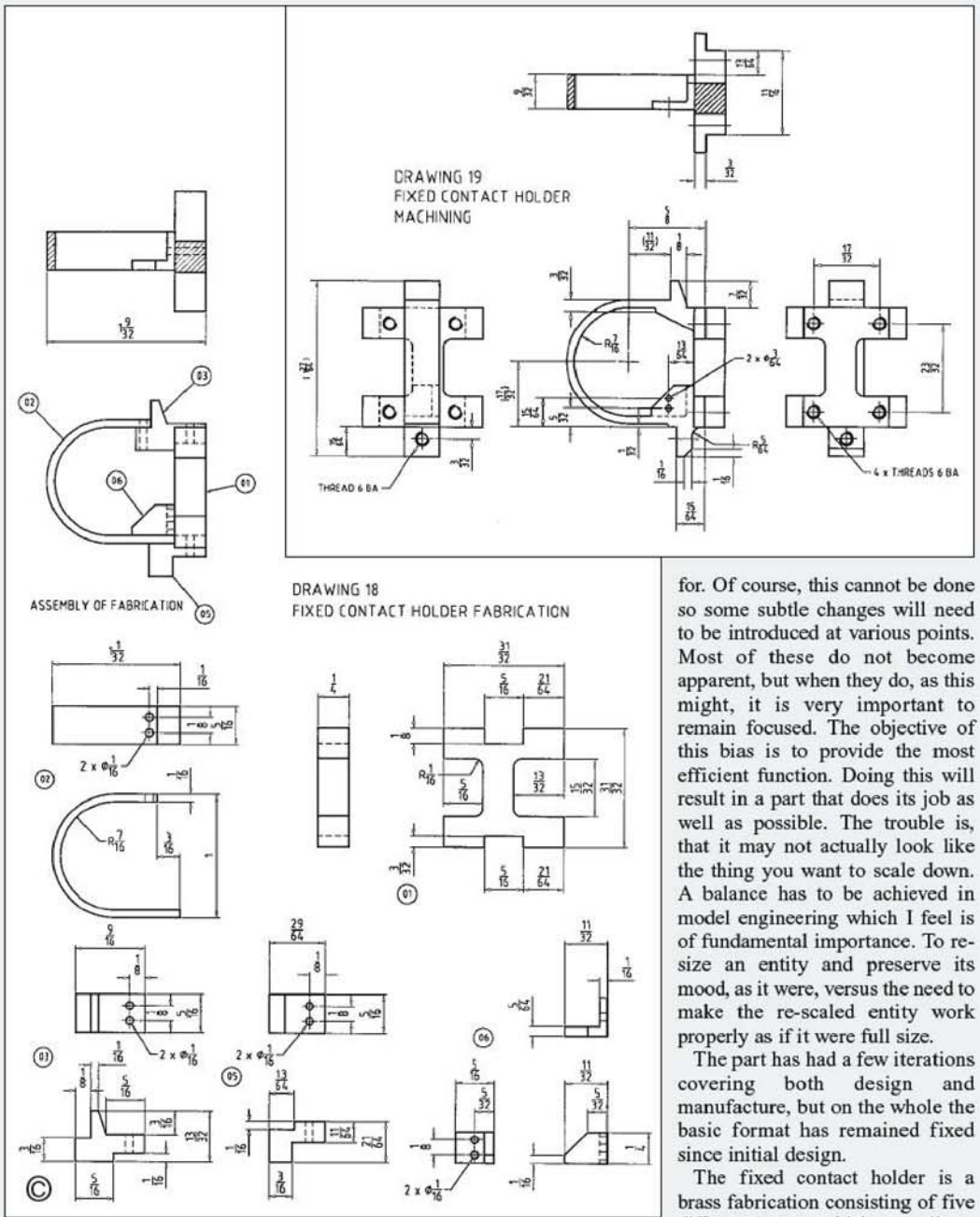
Fixed contact components

Fixed contact holder

The fixed contact holder forms the main support for the blow out coil. It has an arc horn section, which comes into operation when the arc is lengthened. This feature is subject to a fair degree of electrical wear from the arc. The burning action on the surface of the component is considerable. If allowed to remain stationary, the arc would soon cause irreversible damage. The job of the blow out coil is important in the limitation of this damage, as it should keep the arc root moving. I can see that there may be problems here with serviceability. The whole of the fixed contact holder will be deemed 'recycled' if the above feature is allowed to wear to excess. I am prepared to redesign this feature and even provide a separate removable arc horn to counter this difficulty. A lot of the design of this part was taken from that of the full sized contactor and it is, in fact, very similar. This is one of those occasions when the scaling of physics is called for. Of course, this cannot be done so some subtle changes will need to be introduced at various points. Most of these do not become apparent, but when they do, as this might, it is very important to remain focused. The objective of this bias is to provide the most efficient function. Doing this will result in a part that does its job as well as possible. The trouble is, that it may not actually look like the thing you want to scale down. A balance has to be achieved in model engineering which I feel is of fundamental importance. To re-size an entity and preserve its mood, as it were, versus the need to make the re-scaled entity work properly as if it were full size.

The part has had a few iterations covering both design and manufacture, but on the whole the basic format has remained fixed since initial design.

The fixed contact holder is a brass fabrication consisting of five different parts, which are silver-soldered together in the manner described earlier. The details of these parts and the fabricated assembly are shown in **drawings 18** and **19**. The main part of the structure is made from 1/4 x 1in.



brass section sawn and filed to profile. The two 5/16in. slots are machined initially and adjusted during 'dry' assembly of the parts. The 15/32 x 5/16in. and 13/32in. cut-outs did not need to be machined either before or after fabrication because they did not form a registration feature. They are there to reduce weight on one hand and give space for the blow out coil conductor on the other. The two support blocks were filed up from stock bar and 'fitted' to the main part. The U-shaped section was formed from 1/16 x 5/16in. brass strip by bending it round a suitably sized mandrel. The part that eventually forms the lug for the blow out coil connection is generated from 1/2 x 1/2 x 1/16in. brass angle cut down to fit.

All parts are doweled together for silver-soldering with one end of the U-shaped piece that forms the arc runner left free. This was done because I felt that it would remain stable due to its close contact with other parts. Once that all the parts were completed and fitted together dry, the key assembly dimensions were checked. Some adjustment was expected and made with further checks following on. The fabrication drawing dimensions have built in allowances for machining on all of the critical registration faces and features. This gives some leeway for pre-assembly, so small discrepancies could be tolerated, extra material being designed in for this reason. The parts were then fluxed and duly silver soldered together. When cleaned the part was checked and deemed suitable for the next stage of the manufacture.

The machining process started with the four registration steps that seat the part on the vertical support bars. This was done in the lathe with a milling slide and small angle plate. The loop formed by the arc runner was utilised to hold the fabrication on the horizontal face of the angle plate. Suitable bolts and packing being used to secure the part during machining. Care was taken not to distort the work in tightening the bolts, this was mainly accomplished by use of a spreader plate. The set up was only checked for square using rudimentary methods, as machining allowances permitted some deviation.

With the work still in the milling set up, the four 6BA mounting holes were drilled and tapped. The holes being sited with the aid of a drilling jig.

Now that the main registration faces for the component are complete the set up for machining the contact tip seating was next in line for attention. The part was mounted vertically in the milling slide on parallels under the registration faces. I used a 5/8in. end mill for this mounted in the 3-jaw chuck. The basis for the abutment position is the 1/32in. dimension from the arc runner. With this completed, the same set up was used to generate the 6BA thread for contact tip mounting. A jig being previously manufactured for this purpose.

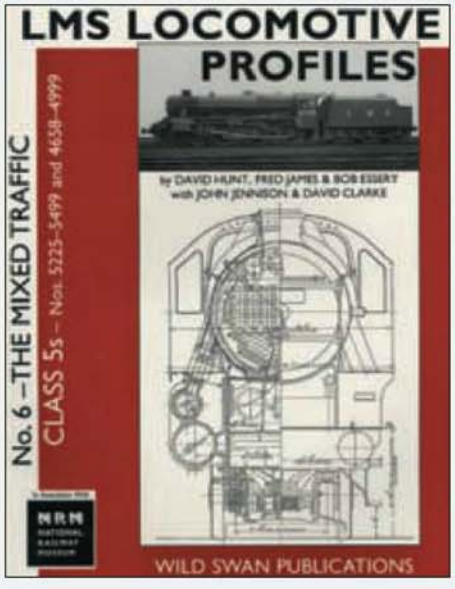
The arc runner machining operations can now be started. Basically it is required to remove 1/64in. from each side of the fabricated feature. The set up for this was accomplished with the angle plate in the vertical slide. The part was mounted with the arc runner uppermost and oriented so that the feed could be accomplished with the cross-slide. Parallels were used underneath the parts registration faces, thus ensuring squareness and giving a convenient measuring point. The milling operation was carried out using a large end mill with very light cuts and careful feeding. The part was reversed and the other face of the arc runner was taken down to size. The last face being correspondent with the 2 x 3/64in. blow out coil termination point holes opportunity was taken to drill these in the set up. Yes, you have guessed, it a further jig was used.The rest of the profile and features, being non-critical, negated the precision approach adopted for the other features, so these were filed to shape. Included in this category are the upper arc runner support and the contact mounting point rear profile.

●*To be continued.*

LMS Locomotive Profiles No. 6 The Mixed Traffic Class5s Nos. 5225-5499 and 4658-4999.

This book by Wild Swan Publications in conjunction with the National Railway Museum is the second part of their series dealing with the LMS Class 5 mixed traffic 4-6-0 locomotives (the ubiquitous 'Black 5') and, as is stated in the introduction, covers all of that class originally built with sloping-throatplate fireboxes and Walschaerts or Stephenson valve gear. The book will form part of a trilogy covering this very large class, the first part being published as *Locomotive Profiles No. 5* (reviewed in *M.E.* 4221, 14 May 2004). With this in mind, those who require information about a particular locomotive should take careful note of the numbers covered in each volume. I would also draw readers attention to the fact that, in common with the first part of the trilogy, there will be a separate pictorial supplement available to complement this book.

As is usual with this publisher the book is in high quality large format paperback form with good quality glossy paper, copies of drawings from the National Railway Museum and many excellent photographs. Fifteen drawings are included ranging from an incredibly detailed 'pipe and rod arrangement', which is in fact a fold out of three pages, down to detail of smokeboxes and motion arrangements. Because of the size of the subject locomotive the text on these drawings is very small although I have to congratulate the publishers on the quality of the reproduction which ensures it is still very clear. As with other books from this stable it is aimed at those who need full details of a particular locomotive such as model engineers or perhaps railway historians. The topic is covered under a number of logical headings including Production, Construction and Modifications, Livery and a chapter covering the locomotives in BR days. The construction and modifications section is the largest in the book and includes the wealth of detail we have come to expect from this source and will enable model engineers in particular to 'get things right'. Never again will you have to debate the number of rivets or bolts holding a particular component on to the locomotive or the way round they were fitted. If you were so inclined even the hammer marks on the motion work could be replicated.



All sections include relevant excellent quality photographs illustrating the detail, all with very detailed captions. If all this was not enough there are eight appendices covering such things as build variations, boiler and tender details, numbering and a the very interesting 'Tender Form and Specification' which includes the information that the LMS would provide two fusible plugs for each loco at a cost of 10d each. All in all this is an excellent book for the model engineer and although I do not believe it is intended to be 'an entertaining read' I am sure anyone interested in this very large class of locomotives will find it extremely informative.

LMS Locomotive Profiles No. 6 The Mixed Traffic Class 5s – Nos. 5225-5499 and 4658-4999 (ISBN 1-874103-93-3) is written by David Hunt, Fred James Bob Essery with John Jennison and David Clarke and is published by Wild Swan Publications Ltd., 1-3 Hagbourne Road, Didcot, Oxfordshire OX11 8DP. The price is £15.95. M.S.

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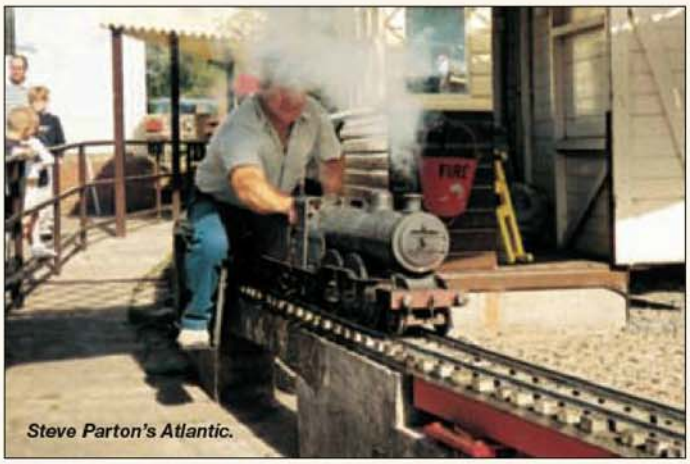
Keith Lovesay's Hymek Electric Loco.


Steve Parton's Atlantic.

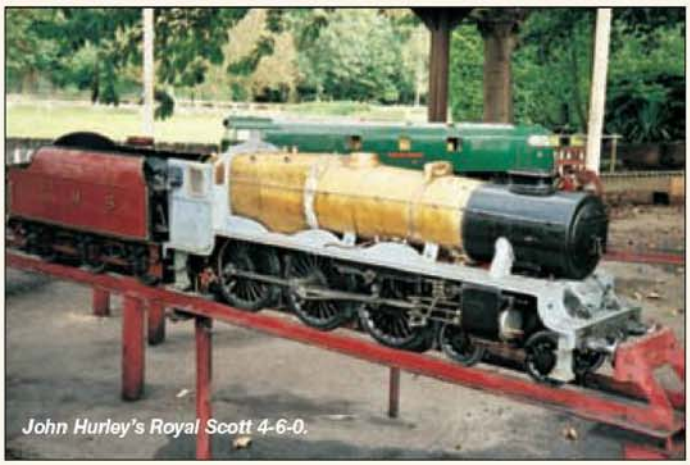
THE MIDLAND FEDERATION RALLY

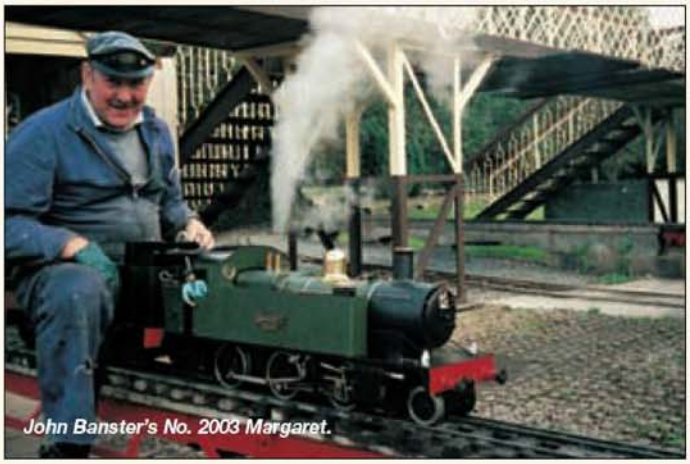
Harvey J. Fisher
reports on this event held last September with the kind permission of Kinver & West Midlands SME.

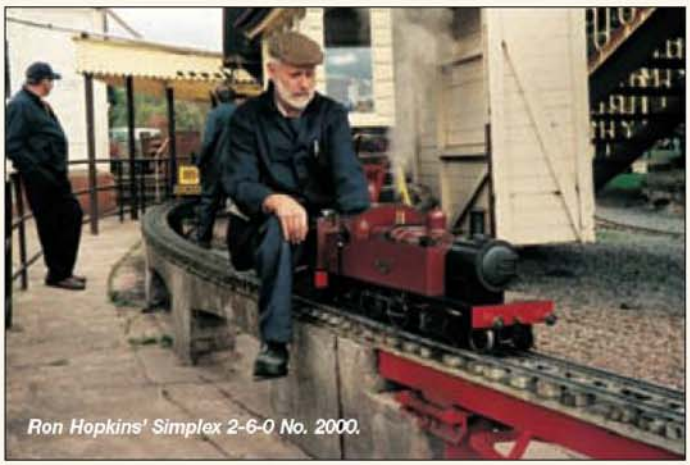
When I arrived with Keith Lovesey, it was about 12.30pm. The President Rae Humphries, vice presidents, John Gorfrey and Dot Gough with her husband, P. R 0. Ted Gough, were there to meet us with other members of the Kinver Club. First out on the track was your author, with Keith Lovesey's Hymek electric locomotive representing Northampton SME Ltd. A couple of slow laps to get used to the track, three more and then Keith took over. Next out was John Campbell with *Kerosene Castle* a petrol-driven locomotive (D7038), in Great Western Green, to 'cock a hoop' at the Great Western Lads. It had a right good turn of speed and later had to push me and the Hymek back to the steaming bays with problems.

Other locomotives in attendance were two Simplexes with large boilers, 2-6-0 No. 2000 owned by Ron Hopkins and, with the same wheel arrangement, No. 2003 *Margaret* owned by John Banster. Both of these locomotives were built by Eric Lee. Next up were a very nice Royal Scott 4-6-0 owned by John Hurley and an Atlantic belonging to Steve Parton. Later track runs came from Burt Briggs from Birmingham SME Ltd. and Mick Edmonds. Frank Collins from Burton-on-Trent MES turned up, but alas with no locomotives.

After a somewhat shaky start it turned out to be a very nice day so I must take this opportunity to thank Kinver who offered their club facilities at the last minute after Stafford DMES had to unfortunately drop out.


John Hurley's Royal Scott 4-6-0.


John Banster's No. 2003 Margaret.


Ron Hopkins' Simplex 2-6-0 No. 2000.


John Campbell's Kerosene Castle.

FOWLER STEAM WAGON

Tony Webster

adds some final remarks to his series on this splendid wagon.

●Part XVII continued from page 317 (M.E. 4243, 18 March 2005)

My Fowler steam wagon was built as a steam rally vehicle and one of the most important aspects of running any vehicle in what could be a crowded area, is to have good brakes. This wagon has good brakes if they are adapted to be operated from a seat on the load carrying area. A simple 'L' shaped pedal is pivoted about a bracket on the rear gearbox support cross-member. This extends rearwards to a screwed-in pedal, which protrudes through a hole in the load carrying area, and the downward arm is connected to the foot brake compensation links via a 4mm dia. rod and offset clevis. I used a clevis fork with one side cut off. The rod from the foot pedal in the cab is similarly treated and uses the same clevis pin. The pedal is operated by the heel because of its position and the difficulty (impossibility) of lifting your toe when sitting on a low seat. Downward pressure on the pedal has to create a pull in the forward direction to apply the brakes.

A hand-operated boiler feed pump was deliberately omitted to allow the builder to install his own pattern of pump. The feed pipe needs to be 8mm outer diameter copper tube to give the water a better chance of filling the pump chamber before the pressure stroke is applied. My pump is based on old Mini or Metro rear brake piston seals of 11/16in. dia. in 3/4in. outer diameter brass tube. If you use this method, turn the groove in the piston to width (deburr) and deepen until the piston and seal will enter the brass tube. If you do not get a good fit there is a tendency for air to be sucked in on the backstroke when using this type of seal. An O-ring in a groove behind the seal will cure it if this happens. Four or five strokes on a pump of this size will allow the safety valves to close and stop wasting valuable steam.

Errata

There are a few items in the text, which were not explained very well and some dimensional errors need correcting. The crankcase top half should have a flange at the rear, which is supplied as a separate casting fitted as follows. Bore the rear end of the crankcase to 2 1/16in. radius and turn the inward projection on the flange to match. Fix with eight 4BA countersunk screws on 2 1/4 in. radius.

The machining plate should be bored smooth to any convenient diameter when first machined to assist in setting up when it is turned over to machine the spigot for the gearbox/engine interface.

On page 328, *M.E.* 4217, 19 March 2004, top right, on the high pressure (HP) cover drawing, the 7/8in. dia should be 1 1/8in. dia. x 1/4in. deep.

On page 329, *M.E.* 4217, 19 March 2004, the top, HP diameter of the valve should be 11/16in. dia. and the ring groove 1/2in. diameter. The low pressure (LP) dia. of the valve should be 13/16in. and the ring groove 5/8in. diameter.

The bottom, HP bore of the liner should be 11/16in. dia and the outside dia. 15/16 inch. The LP bore of the liner should be 13/16in. dia. and the outside diameter 1 1/16 inch. The length of the valve liner should be 3 1/2 inches. Use four off 1/4 x 1/4in. cut-outs in both ends of the HP liner and five or six in the LP liner.

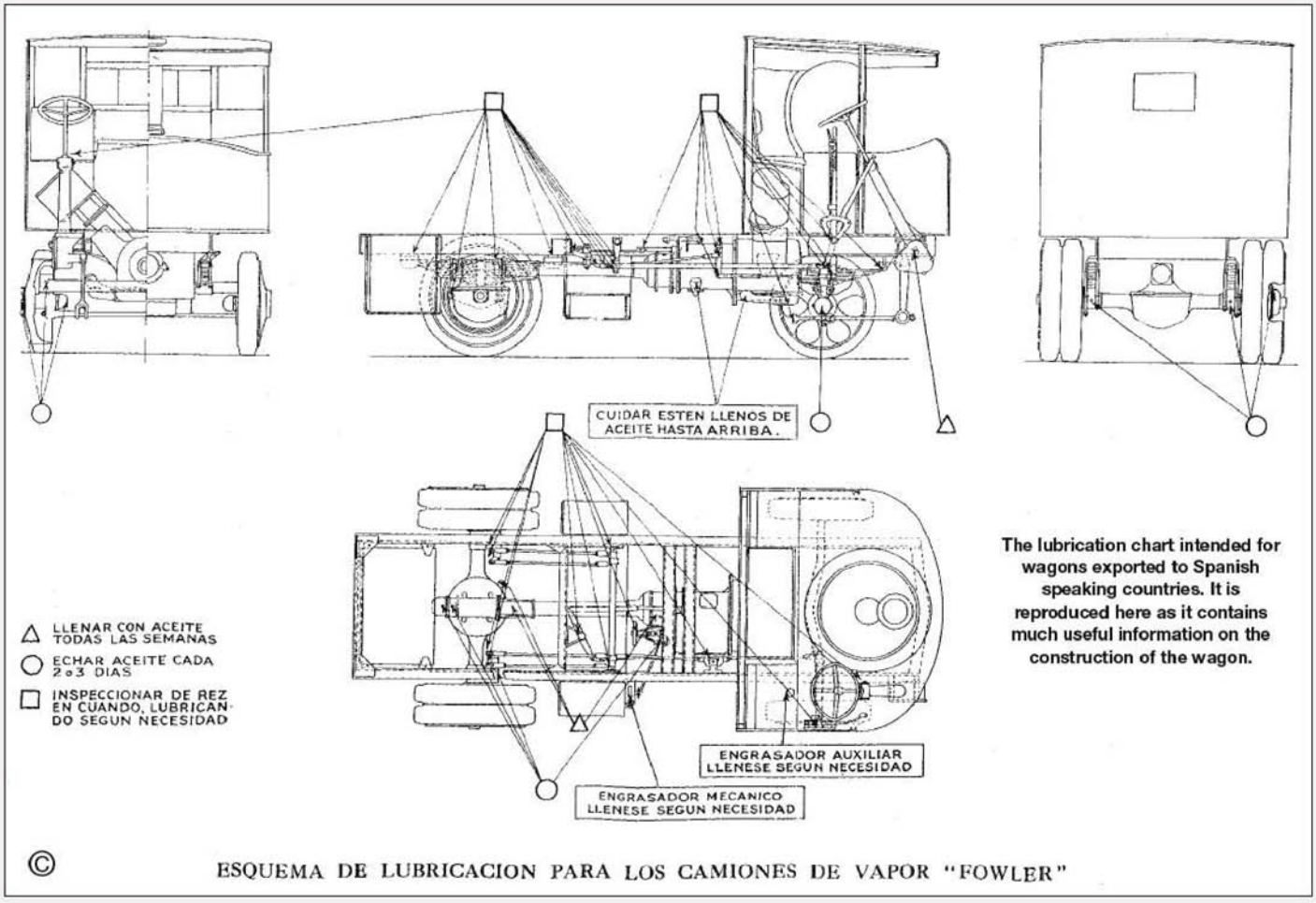
The top part of the valve spindle (*M.E.* 4221, 14 May 2004) should be as long as the valve plus a self-lock nut.

The flywheel (*M.E.* 4219, 16 April 2004) should be recessed to 5/16in. thick. The outside diameter of the flywheel may need reducing by 1/8in. dia. to clear the crankcase.

Centre to centre length of the connecting rod is 4.250 inch. The valve setting peep hole should be tapped 1/4in. x 40 threads per inch.

The eccentric rod (*M.E.* 4221, 14 May 2004) centre distance should be 3 1/16in. and the width 7/16in. (not 3/8in.).

Make sure that you use the correct casting for the front bearing housing cover. It has a chucking piece on the outer side. The other casting, with which it can be confused, is the keep-ring for the ▶



The lubrication chart intended for wagons exported to Spanish speaking countries. It is reproduced here as it contains much useful information on the construction of the wagon.

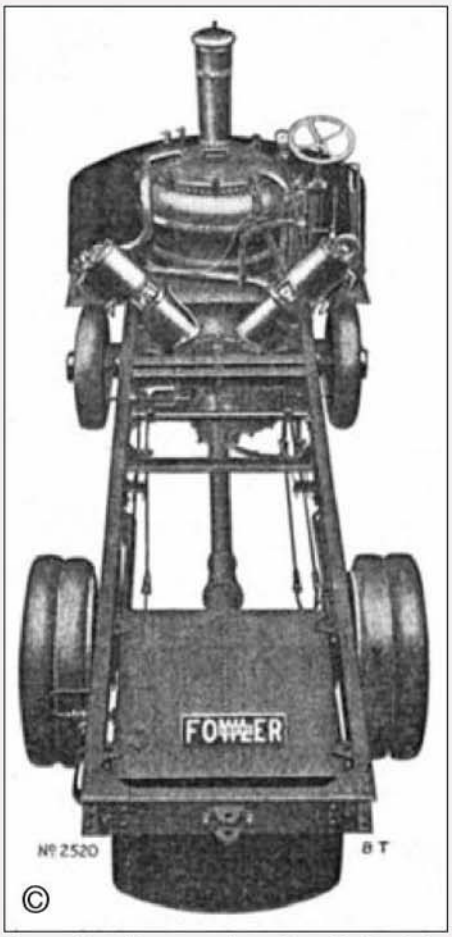
sphere at the front of the torque tube. It is cast blind to make mould making easier and it does not have a chucking piece.

To assist with repeated assembly of the torque tube to sphere and torque tube to rear flange (*M.E.* 4225, 9 July 2004), drill and tap 4BA through the socket and tube for a short 4BA screw. Repeat at the other end. This will ensure the same position and length will be achieved each time, and be a quick means of location when finally assembling them with Loctite.

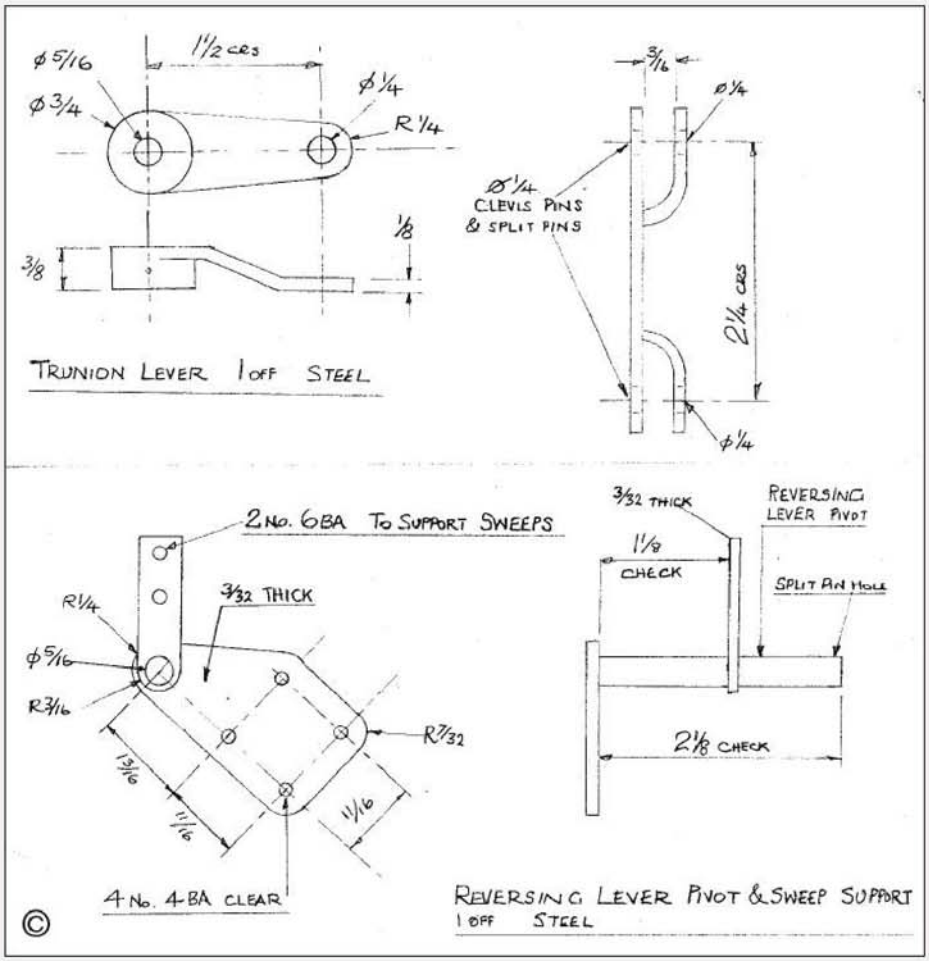
On page 511, part XI (*M.E.* 4233, 29 October 2004) in the boiler construction materials list the main shell and steam space data have been reversed. On page 512, the firing chute should be 2in. outer diameter x 10swg as drawn.

Other things

If you are unfortunate and pull a 4BA stud out of an aluminium alloy casting it shows that you did not drill and tap deep enough to get a secure hold on the casting, but all is not lost. Re-drill and tap to 2BA (which unfortunately means dismantling) and reduce a length of 2BA screw or studding (all thread) to 0.142in. dia. and thread 4BA. Cut off the 2BA end to allow it to be screwed in to the maximum depth possible. The lengths of the two ends depends on the situation in hand. Two nuts, which are locked together on the 4BA end, make the best way of screwing a stud into its tapped hole. The use of thread-lock compound stops it coming out with the nut, especially after painting. In some places a machine screw can be screwed into a tapped hole from the reverse side of the flange, right up to the head, and make a very secure fixing. This technique can be used on the lower flange of the lower crankcase half. By using hexagon headed screws and washers, screwed in from the top side, the nuts can be quickly run on or off with a nut-runner when fitting or removing the sump.



The photograph of the chassis of the model is herewith reproduced for comparison alongside Fowler's catalogue illustration of the full-size wagon.



The damper control rod can be made by hammering 1/8in. or 3mm dia. rod to make it 3/32in. or so thick and with rounded edges. At the lower end, any kind of securing pin to connect to the arms on the damper door, will be very obvious to the viewer. A solution is to silver solder a short length (5/32in.) of 3/32in. dia. rod into a hole in the control rod, 1/32in. projecting each side. The double arms on the door are sprung apart when fitting or removing the ash-pan. The top end of this control rod is 3/16 x 1/16in. flat material (stainless for preference) and extends up to just clear of the steering wheel when in the open position. This makes it possible for the full size driver to reach the control over the right-hand cab door.

Ensure that the door catches are easy to operate to make it quick and uncomplicated to open and close the doors. The right-hand door gives access to the boiler water level sight glass blow-down. This is difficult to access without burning one's fingers. The solution is to bring the blow-down pipe across the floor to a new valve situated just behind the hand brake sweeps inside the door. The original blow-down valve is left horizontal in the 'on' position. All other valves and controls are arranged to be orientated vertically when in the normal running position.

The sump casting has three small angular projections around the rounded edge of the

rectangular part of the sump. These are there to make a more secure, and therefore safer, grip in the 4-jaw chuck when facing the main joint flange. Afterwards these are cut off and filed to make a continuous curved edge to the sump casting.

If you wish to build the long wheel-base 'standard' wagon, but have limited available length in your transport, make the load carrying area easily removable. The chassis can have a join in it, just behind the rear spring pads, and the short rear section, complete with water tank, is turned over to rest on the chassis. If all the feed pipes have extra long rubber connections this will allow for the 180deg. bend. The flexible rubber pipe connections are prototypical.

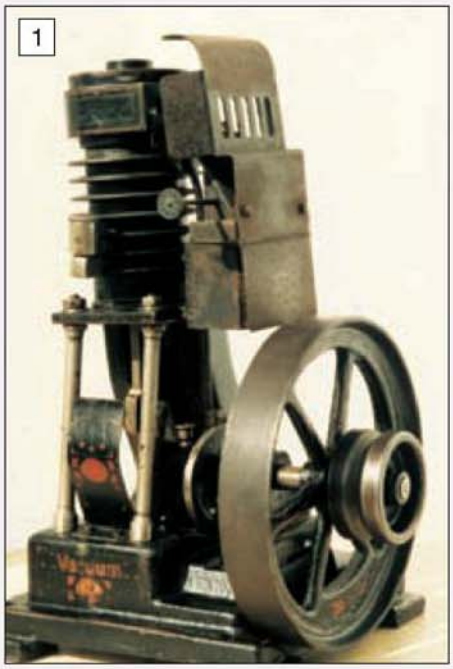
There is no evidence that any Fowler wagons were made, or subsequently converted to, articulated tractor units. There was, however, a ballast tractor drawn up and offered for sale but none were made. The wagon load carrying area should be quickly detachable, without the need for tools, and yet secured, perhaps by the use of over-centre catches. The cab should also be quickly detachable and arranged to lift off without first disrupting the carrying area to the rear. It can be very frustrating to have to unload the wagon before the cab can be removed to inspect the engine.

The cab should have the crew's seats securely fixed to the cab side and the coal-bunker, thus improving the rigidity of the cab. This is especially important if the steering shaft is extended up through the roof to a crank. A spherical Oilite bearing is useful here. It can be trapped between two washers above and below the cab roof. There is room for a triangular bracket above the front mudguard, secured to the chassis web and supporting the cab floor out towards the vertical channel roof support. This will help make the cab more rigid although I cannot find a drawing for such a bracket in the full size drawings.

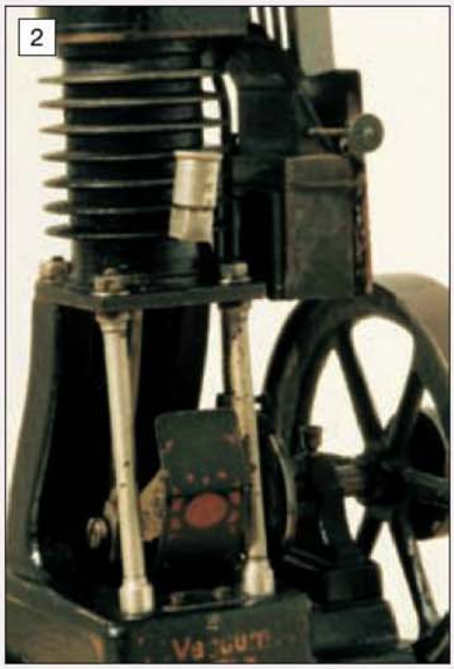
Gears for the wagon can be supplied by HPC Gears in Chesterfield; tel: 01246-268080, e-mail: **sales@hpcgears.com**; who have also designed the worm and worm wheel for the rear axle. The relevant part numbers are: wheel, no boss, PM10-24/5, and worm M10-24/5. The differential gears have the part numbers: DB1.5-15 and DB 1.5-30, 2 off of each are required.

The rear wheel drive centre, or hub, should have a recess in the outside face to accept a core plug as used on car engine cylinder blocks. Obtain your plug from the garage before turning the recess.

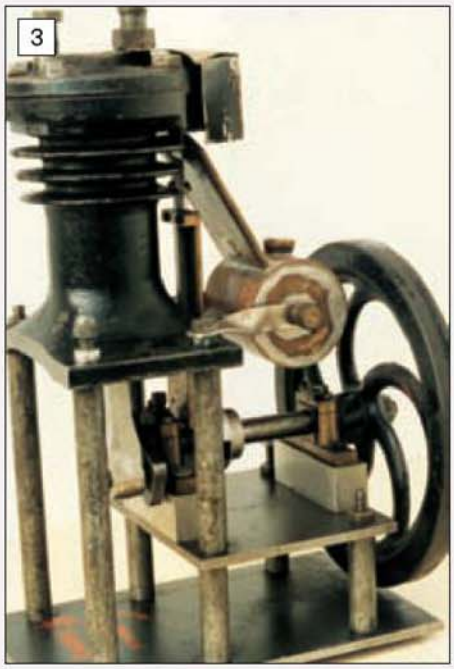
On the differential cage it may be better to offset the central joint to one side of the cage, in line with the side of the worm wheel plus 3/32 inch. Make the worm wheel seating 3/32in. wider and recess the other half by 1/8 inch. This will ensure that the worm wheel is securely clamped between the two halves. The holes for the pinion shaft are drilled in the worm wheel seat. Finally on page 148, *M.E.* 4227, 6 August 2004, the right-hand column, bottom paragraph should be headed: Bearing caps part number 09189.



The original vacuum engine is of German origin but of unknown make.



Details of the cylinder lubricator and wick feed arrangements can be seen in this photo.



The author's version of the engine was built up from old refrigerator compressor parts.

A VACUUM ENGINE (AND MY COPY)

W. J. Manley

describes an engine that was once a popular alternative to steam or internal combustion engines.

From time to time I see articles published on vacuum engines, flame engines or flame gulpers (or lickers) as they are sometimes called. I believe they are also sometimes referred to as atmospheric engines, which may be the more correct name.

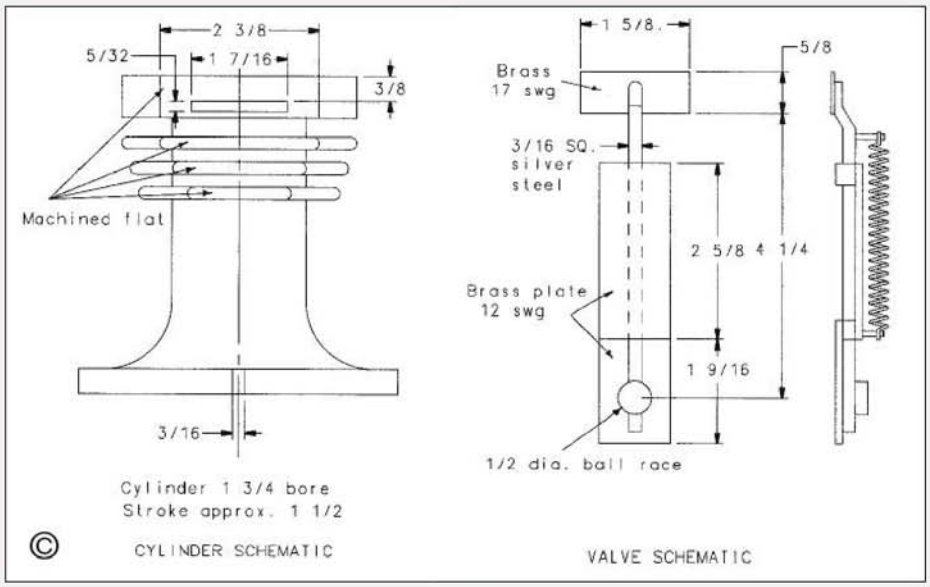
I know that the one shown in the **photo 1** is of German manufacture, although I am at a loss to know who made it. All the books I have looked at showing various manufacturers' motifs, trademarks etc. have not revealed who the maker is. However, the engine goes very well and is very well made, and when eventually it has warmed up I estimate it runs at approximately 1000 revs. per minute. The methylated spirit flame provided from the 1 1/2in. wide wick provides the motive power.

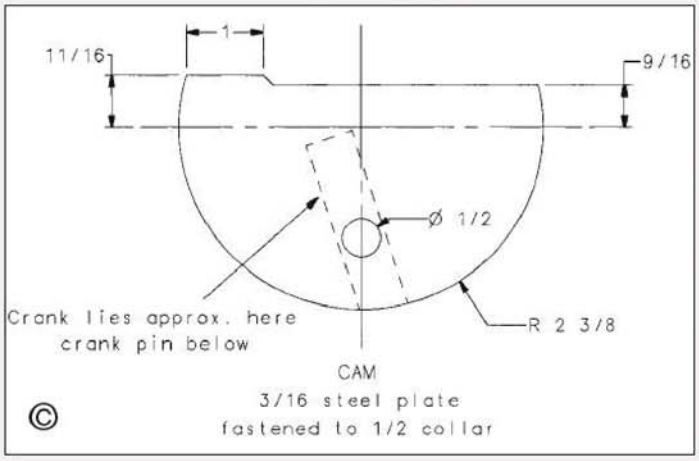
When the piston is on its way down the stroke a cam mechanism operates a perfectly fitting flat valve and uncovers a narrow port, virtually as wide as the cylinder diameter and at the top of the cylinder bore. The partial vacuum in the cylinder draws in the hot gases from the adjacent methylated spirit flame. As the piston nears the bottom of its stroke the flat valve closes. The hot gases in the cylinder cool and cause a partial vacuum and the piston is forced up by atmospheric pressure acting on its ▶

underside. Any remaining gases are forcibly ejected via a flap valve in the cylinder head. The momentum of the flywheel continues the cycle with what can only be described as a loud snorting noise. My friends have given various names to this engine but it is probably best not to repeat them here.

The methylated spirit flame is controllable with a wick adjuster knob seen in the photograph and the flame itself is somewhat shielded from above. Cylinder lubrication is catered for with an oiler in the cylinder wall, somewhere near its lower end. Other parts are lubricated in the usual manner (**photo 2**).

A cam on the main shaft controls the flat inlet valve. A small shaft is attached to the side of the valve, which has a foot resting on the cam. It is retained in contact with a small compression spring.





The complete engine is quite heavy, mostly cast iron with an 8in. dia. x 1 1/2in. wide flywheel with a small V-pulley on the outside. This is so useful when starting. A cord is wrapped around this pulley and the whole main shaft rotated with a seesaw motion, the whole engine firmly secured to the bench, of course. This may take five minutes or so, but it gets going eventually.

If you are too energetic with the starting cord the flame is blown out so gently does it. It is not the sort of engine to use indoors because of the noise, and the smell of burnt oil discharged from the exhaust valve in the cylinder head.

I first came in contact with this engine when a friend loaned it to me. In fact, I had it to play with for a weekend. It intrigued me so much that I made some sketches with dimensions, having in mind that I would like to build one like it myself one day.

I had seen designs at various times for this sort of engine but they were all rather small. The power output is very low and the bigger they are in that respect the better. I know of a few people who have had a go at making an engine of this type but most were unsuccessful

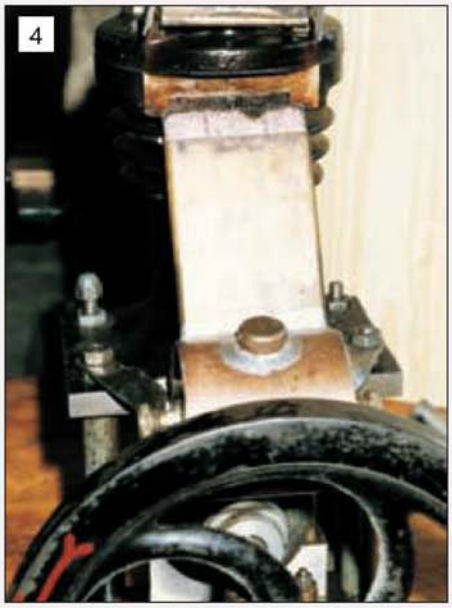
For my attempt at making a copy I utilised the cylinder and piston from a domestic refrigerator compressor unit. The cylinder is massive, almost 2in. bore and has a detachable head. Luckily for my there was plenty of 'meat' around the top of the bore and into this I was able to machine the narrow inlet port. Above this, in the cylinder head, I have a steel disc, pressure relief valve. It is not as big as I would have liked but in practice it works quite well.

My copy of the engine was made in rather a hurry from materials I had on hand - sheet steel, galvanised gas tubing, 1/4in. Whitworth screwed rod, a pair of 1/2in. brass plummer blocks and a flywheel which came from another domestic refrigerator compressor. The main shaft is of 1/2in. dia. steel and the crank from bar material with a steel crank pin. The connecting rod is made from Dural and has not been bushed.

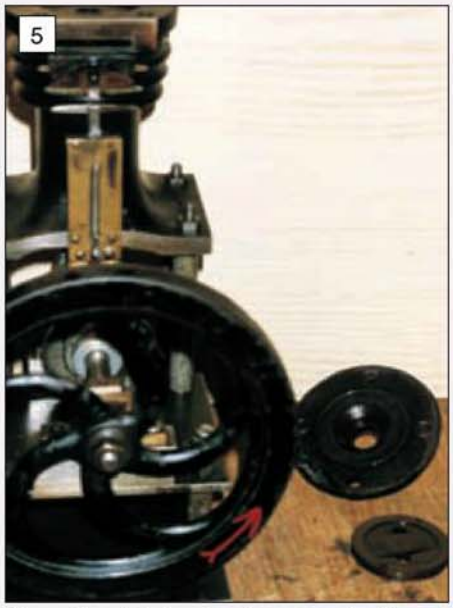
The cam to operate the inlet valve is attached to one half of a 1/2in. dia. shaft coupling and the foot of the valve operating rod is held in contact with the cam by a small spring. One day I will fix a small starting pulley to the outside of the flywheel. It will save my present method of flicking the spokes around, which can sometimes be painful on the fingers.

A piece of 2in. dia. copper tube was utilised for the methylated spirit fuel tank and another piece of smaller flattened brass tube let in at the top of the tank serves as a wick tube. The wick has to be pulled up by hand as required, no luxuries here. I was thinking all the time that my copy may not work, hence the bits and pieces on hand used to make it all up. How right I was! Try as I might it would puff and snort but could not be made to run continuously.

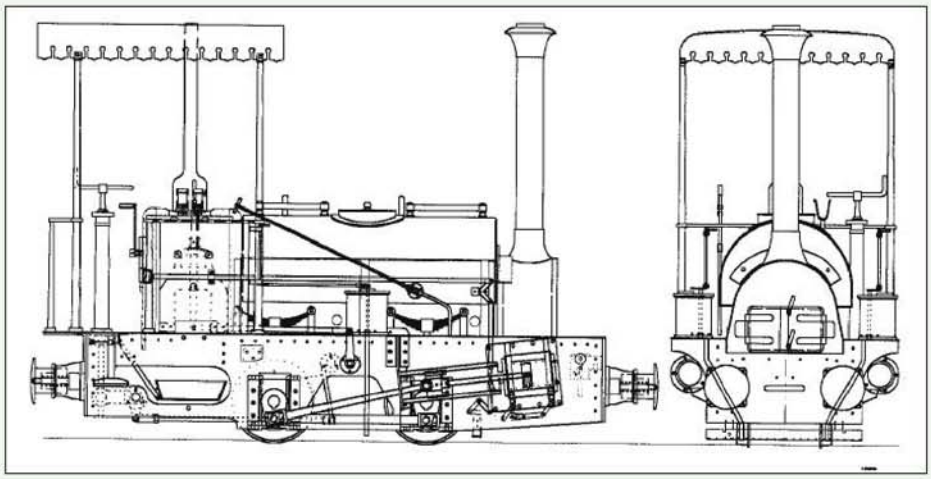
I made numerous tests with various valve timings, wick positions, flame lengths, etc. By the way, the timing is very critical as I discovered in the end. Eventually I was able to have another look at the original engine and paid special attention to the valve events and the amount of wick showing above the wick tube and also the distance away that the wick was from the port. I see I have it recorded as 1/2in. of wick, 1/4in. away. One afternoon was spent experimenting with timing and wick positions, etc. and I was eventually rewarded with an engine that would run after all. With plenty of noise, snorting and smoke from burnt oil I was 'over the moon' with my results. **Photographs 3, 4 and 5** shows my copy of this fascinating flame or vacuum engine.



Details of the methylated spirit burner used on the home-made version of the engine.



The engine with the valve down exposing the port (burner removed). Cylinder head is on the right.



ANNA
A MANNING WARDLE LOCOMOTIVE FOR 7 1/4in. GAUGE

D.A.G. Brown and Mark Smithers describe the saddle tank and fittings for this neat industrial locomotive.

● *Part XIV continued from page 328 (M.E. 4243, 18 March 2005)*

I realise that there will be cladding to go on the boiler and this has been drawn, to appear in a later instalment. At present, however, we are going to build the tank, fit it out with characteristic Manning Wardle components, and allow it to be fixed to the chassis with a minimum of screws.

Look first at the tank body. It is rolled up from 1mm 3Cr12 and is supplied as two sheets of laser-cut material and two end panels, tabbed and slotted, ready for rolling and welding. On each end of the tank is implanted a panel of 2mm thick metal, clear of the edge of the tank by 1/8 inch. This gives the impression that the ends are flanged and let into the outside wrapper prior to flush riveting of the original. Such a procedure is, of course, not relevant in our scale, but the visual effect is important.

When I built my Hunslet tank I carefully cut around the pieces, to finished size, before having them TIG welded in the trade. Such a procedure made it extremely difficult for the welder, who had to weld inside the tank in small bites, thereby taking quite a long time to achieve a good job. I neither trust my own welding skill for such a job, nor have I the argon arc tackle, which can make such a neat joint. The current design will allow easy access to the joints if done in the designed sequence.

Let us start with the tank top sheet, quite a chunk of metal which is to be bent and then rolled, leaving the short vertical sections, which are drilled to accommodate the drain cock gear and the pump water valve. The smaller holes in the curved surface have been detailed for laser cutting, but the filler hole is 'ghosted' in for later finishing. The maths of the sheet has been worked out assuming a 1/8in. internal radius on the bends. If you can get the use of a folder, practice on a scrap of 1mm sheet, to ensure that the bend goes in the right place. This can be judged by the relative positions of the holes for the drain cock gear and rear tank supports according to the drawing. The sheet is continuous from side to side and continues horizontally towards the boiler surface at the bottom of the piece. These horizontal extensions have an extra 5/16in. on their long edges, which is to be ground off after welding, but the slots for location of the bottom panel are positioned just inside this selvedge. When you have a satisfactory right angle in both positions, you can perform the rolling operation on the top, leaving the 2in. straight verticals as drawn. As I mentioned when describing the boiler, my method when using a 2in. dia. bending roller, entails drawing a pencil line 1in. from the finishing line (i.e. 1in. above the tank bottom), which indicates the starting and finishing positions of the semi-circle curve. Take it slowly, repeatedly reversing the piece in the rollers, so that both ends get a similar chance of finishing to the correct radius. Gauge the radius using a suitable MDF templet.

You can now cut out the filler hole and check that the tabs on the top sheet fit into their corresponding slots in the end panels. Extra metal is provided all around the end sheets, for removal after welding. A beautiful TIG weld can now be run around the insides of both ends. This welding process gives good penetration and a neat finish, leaving very little finishing to be done for a final operation.

You can now roll up the tank bottom from side to side, a span of 168deg., noting the tabs on each edge. Hopefully these will mate up with their opposite numbers in the ends and top sheets, leaving an accurate positioning for welding, on the outside this time. This design keeps the joint to be formed always accessible and the penetration which should be achieved will enable any excess filler material to be removed along with the selvedge. Good visibility via the filler hole enables a check to be made on weld penetration.

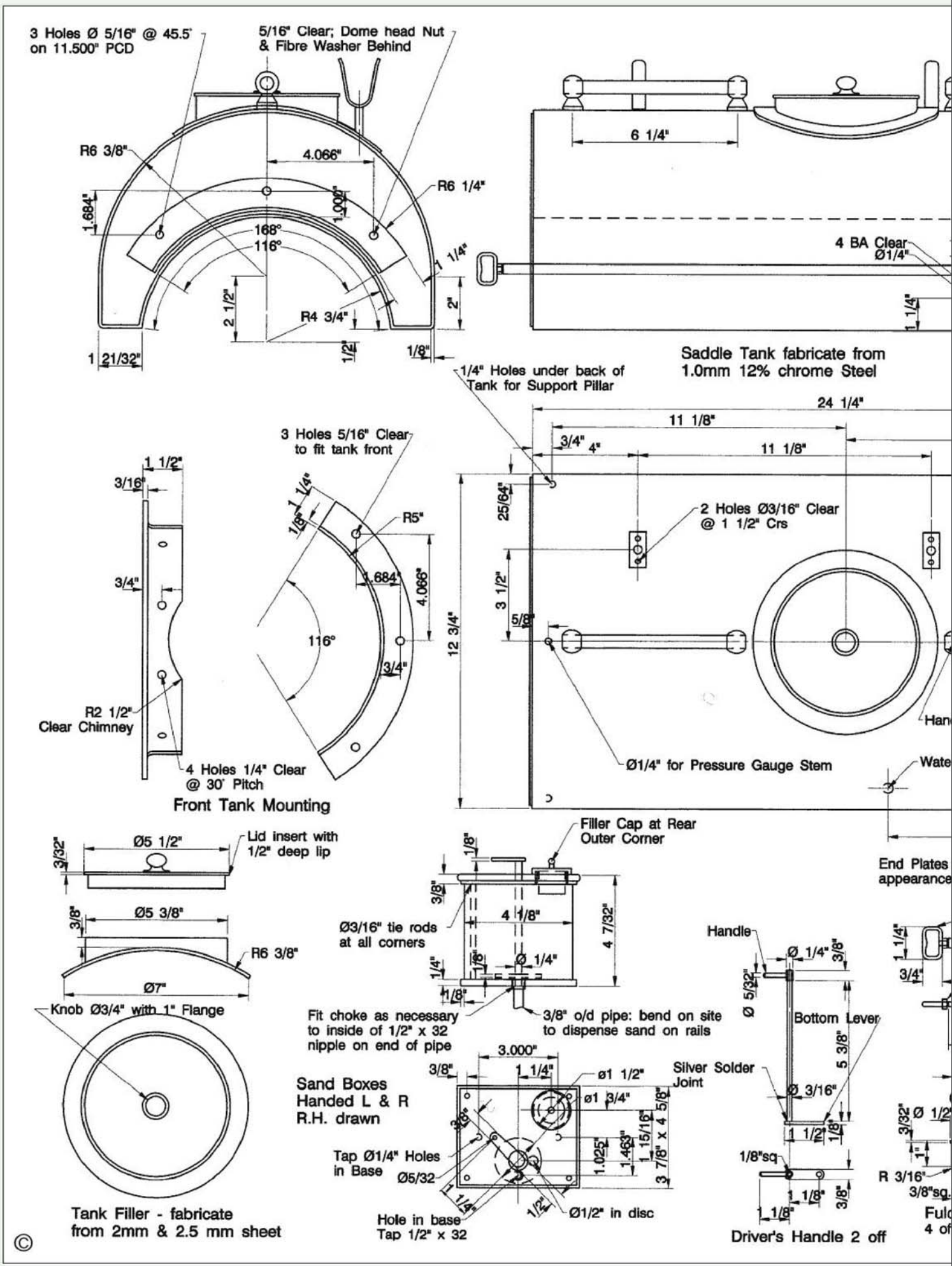
Whenever I carry out this type of work my mind goes back to the days when I was running some ICI workshops north of the border. I had a mixture of trades and the time came to appoint a new shop foreman. Easily the best candidate was an experienced sheet metal worker who had become an estimator, dealing with all the minutiae of work planning. His appointment caused ructions among some of the other trades, the turners and fitters trying to maintain that a man from another trade could not possibly be competent to oversee them. Their hidden agenda was, of course, that they wanted to maintain the job for a member of their own union, and they chose to ignore the fact that for a number of years their own appointee had controlled the sheet metal workers, welders and plate-workers extremely competently. So, I think it is not an exaggeration to say that we had a bit of a scrap for a few days. Clearly my view of the unions was equal and opposite to their view of me; however, we agreed amicably in the end and things settled down well as planned. It is difficult, nearly 40 years on, to see how such entrenched positions could have been taken, but in hindsight it was to sound the death-knell for many heavy industries where custom and practice dictated far more than logic, thereby inhibiting healthy and inevitable change.

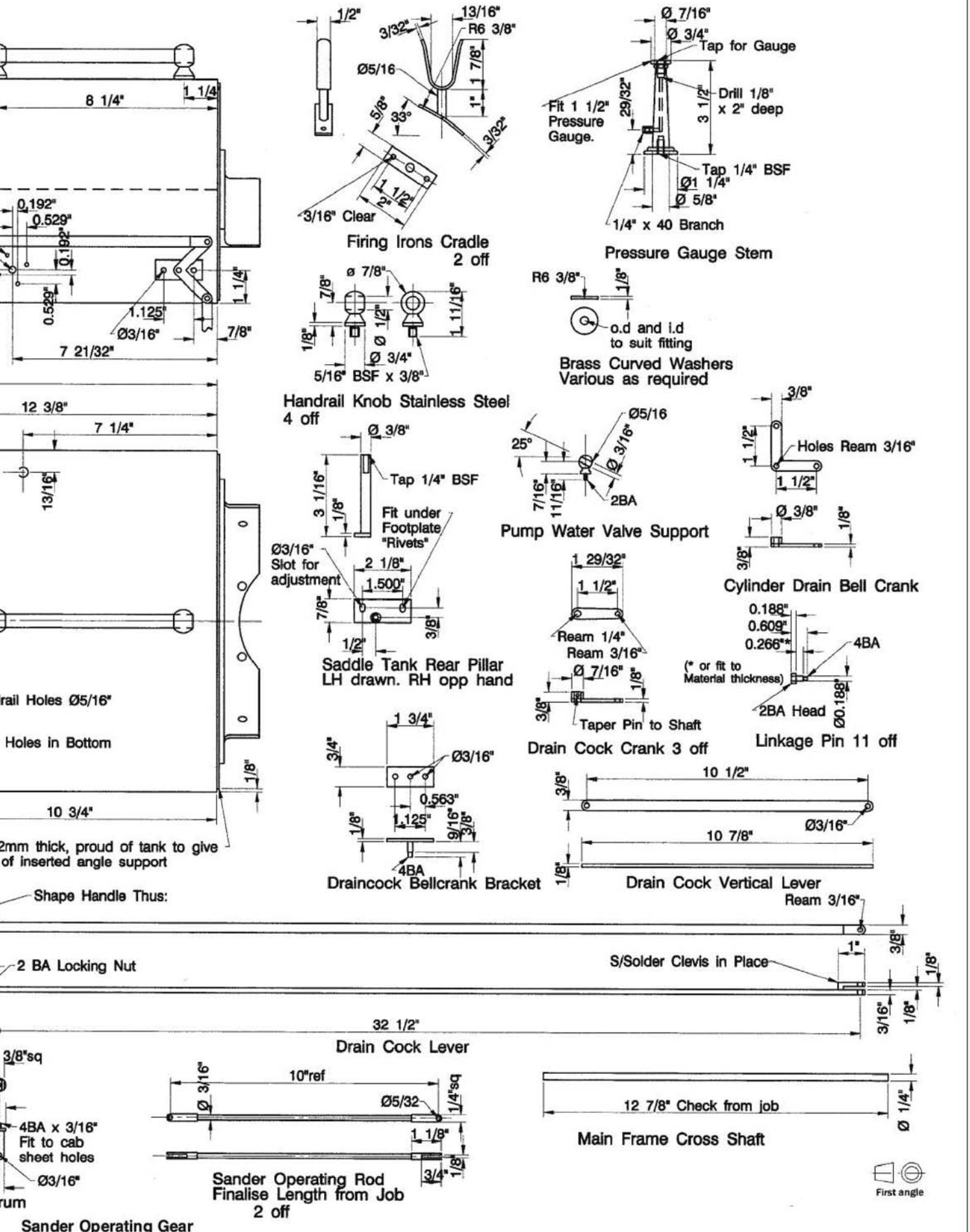
Returning to the tank, the Filler is fabricated from two pieces of laser-cut 3Cr12, the elliptical one being rolled to conform with the tank shape and the cylindrical insert again requiring trimming after rolling, if that is deemed to be worth doing. The pieces are best fabricated by silver soldering. You now have a 'saddle', which must be fixed to the top of the tank. I favour 1/8in. dia. copper rivets snapped into a ring of say eight holes on 6 1/4in. p.c.d., with some liquid jointing in the joint. In creating the Filler Cap, do produce an aesthetically pleasing knob; of brass ensuring continuing business for Reckitt & Colman through use of their *Brasso* cleaner! If you are going to transport the model on a trailer, you should consider anchoring the Cap in some way, otherwise it will jump out of its normal place and damage the paintwork.

Tank Supports

The front of the Tank is held by three screws which retain the dummy End Plates and the Front Tank Mounting that purports to be a rolled angle ring segment. This piece is in fact fabricated from two pieces of mild steel, which are joined by silver soldering. All the holes are put in first, but the cut-out for the chimney shape must be formed after fabrication, to conform to the chimney's contour. The Mounting is shaped to follow the outside of the Smokebox wrapper, which requires four holes to be drilled at the fitting stage. I deemed it to be too risky to plant these holes in the smokebox at the drawing stage, but I should point out that several of the rivets (alias 2BA screws) holding the wrapper in place must be countersunk where they are to be covered by the Mounting. The Rear Pillars support the back of the Tank and are handed so that they can be retained by the appropriate screws above the Running Plates. The Pillar bases are furnished with slotted holes to compensate for errors in tank fabrication (e.g. if the corner radii stray from the drawing dimensions).

At the rear end of the tank an identical array of three fixing holes will eventually pick up the boiler cladding. In all cases the fitting of short 5/16in. BSF set screws from the outside enables them to be nutted inside the tank. Produce some ▶


3 Holes Ø 5/16" @ 45.5°
on 11.500" PCD
5/16" Clear; Dome head Nut
& Fibre Washer Behind
R6 3/8"
4.066"
R6 1/4"
1.684"
1.000"
168°
116°
1 1/4"
2 1/2"
R4 3/4"
2"
1/2"
1/8"
1 21/32"
6 1/4"
4 BA Clear
Ø1/4"
1 1/4"
Saddle Tank fabricate from
1.0mm 12% chrome Steel
1/4" Holes under back of
Tank for Support Pillar
24 1/4"
11 1/8"
3/4"
4"
11 1/8"
25/64"
2 Holes Ø3/16" Clear
@ 1 1/2" Crs
3 1/2"
5/8"
12 3/4"
Ø1/4" for Pressure Gauge Stem
3 Holes 5/16" Clear
to fit tank front
1 1/2"
3/16"
1 1/4"
1/8"
R5"
3/4"
1.684"
4.066"
116°
3/4"
R2 1/2"
Clear Chimney
4 Holes 1/4" Clear
@ 30° Pitch
Front Tank Mounting
Ø5 1/2"
3/32"
Lid insert with
1/2" deep lip
3/8"
Ø5 3/8"
R6 3/8"
Ø7"
Knob Ø3/4" with 1" Flange
Tank Filler - fabricate
from 2mm & 2.5 mm sheet
Filler Cap at Rear
Outer Corner
1/8"
3/8"
4 1/8"
4 7/32"
Ø3/16" tie rods
at all corners
1/4"
1/8"
Ø 1/4"
1/8"
Fit choke as necessary
to inside of 1/2" x 32
nipple on end of pipe
3/8" o/d pipe: bend on site
to dispense sand on rails
3.000"
3/8"
1 1/4"
ø1 1/2"
ø1 3/4"
Sand Boxes
Handed L & R
R.H. drawn
Tap Ø1/4" Holes
in Base
Ø5/32
1.025"
1.463"
1 15/16"
3 7/8" x 4 5/8"
1 1/4"
1/2"
Ø1/2" in disc
Hole in base
Tap 1/2" x 32
Handle
Ø 1/4"
3/8"
Ø 5/32"
Bottom Lever
5 3/8"
Silver Solder
Joint
Ø 3/16"
1 1/2"
1/8"
1/8"sq
1 1/8"
3/8"
1 1/8"
Driver's Handle 2 off
1 1/4"
3/4"
3/32"
Ø 1/2
1"
R 3/16"
3/8"sq.
End Plates
appearance
Wate
Han
Ful
4 of


8 1/4"
1 1/4"
0.192"
0.529"
1.125"
Ø3/16"
7/8"
7 21/32"
12 3/8"
7 1/4"
13/16"
Holes in Bottom
1/8"
10 3/4"
2mm thick, proud of tank to give
of inserted angle support
Shape Handle Thus:
2 BA Locking Nut
3/8"sq
4BA x 3/16"
Fit to cab
sheet holes
Ø3/16"
Sander Operating Gear
1/2"
3/32"
13/16"
R6 3/8"
Ø5/16
1 7/8"
1"
5/8"
33°
3/32"
1 1/2"
2"
3/16" Clear
Firing Irons Cradle
2 off
Ø 7/16"
Ø 3/4"
Tap for Gauge
Fit 1 1/2"
Pressure
Gauge.
29/32"
3 1/2"
Drill 1/8"
x 2" deep
Tap 1/4" BSF
Ø1 1/4"
Ø 5/8"
1/4" x 40 Branch
Pressure Gauge Stem
ø 7/8"
7/8"
1 11/16"
1/8"
Ø 1/2"
Ø 3/4"
5/16" BSF x 3/8"
Handrail Knob Stainless Steel
4 off
R6 3/8"
1/8"
o.d and i.d
to suit fitting
Brass Curved Washers
Various as required
Ø 3/8"
3 1/16"
1/8"
Tap 1/4" BSF
Fit under
Footplate
"Rivets"
Ø3/16"
Slot for
adjustment
2 1/8"
1.500"
7/8"
3/8"
1/2"
Saddle Tank Rear Pillar
LH drawn. RH opp hand
Ø5/16
25°
Ø 3/16"
7/16"
11/16"
2BA
Pump Water Valve Support
3/8"
1 1/2"
Holes Ream 3/16"
1 1/2"
Ø 3/8"
1/8"
3/8"
Cylinder Drain Bell Crank
1 29/32"
1 1/2"
Ream 1/4"
Ream 3/16"
Ø 7/16"
1/8"
3/8"
Taper Pin to Shaft
Drain Cock Crank 3 off
0.188"
0.609"
0.266"*
4BA
(* or fit to
Material thickness)
2BA Head
Ø0.188"
Linkage Pin 11 off
1 3/4"
3/4"
Ø3/16"
0.563"
1.125"
1/8"
9/16"
3/8"
4BA
Draincock Bellcrank Bracket
10 1/2"
3/8"
Ø3/16"
10 7/8"
1/8"
Drain Cock Vertical Lever
Ream 3/16"
S/Solder Clevis in Place
1"
3/8"
1/8"
3/16"
1/8"
32 1/2"
Drain Cock Lever
10"ref
Ø 3/16"
Ø5/32
1/4"sq
1 1/8"
3/4"
1/8"
Sander Operating Rod
Finalise Length from Job
2 off
12 7/8" Check from job
Ø 1/4"
Main Frame Cross Shaft
First angle

domed brass nuts for these and the other positions, sealing with a fibre washer to keep out the water. These nuts require say 5/8in. of suitable hexagon bar, drilled with a centre drill deeply enough to remove the first thread. Drill the tapping size to a depth of 9/16in. and tap to full depth. Make sure that the outer end is chamfered nicely. All nut positions are accessible from inside the filler hole.

Fitting out

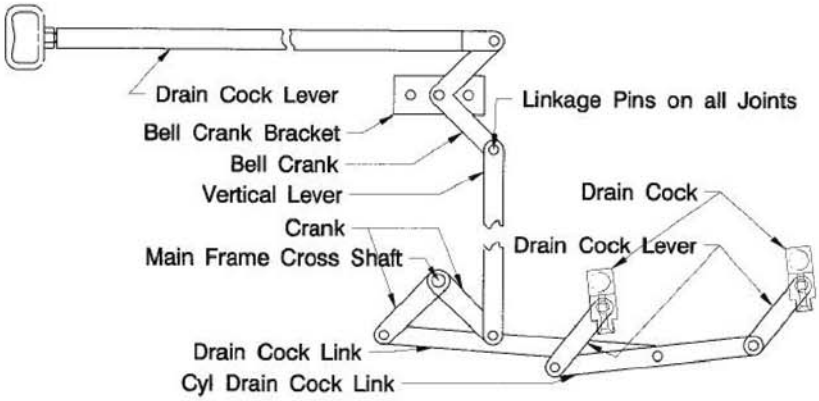
Two short hand rails span the top of the tank, made from 1/2in. dia. stainless steel. If this does seem excessive, it is because Manning Wardle called from their stock of standard gauge fittings. I can imagine their stores, dimly lit by gasoliers, smelling of a mixture of paraffin and pipe tobacco, with musty tickets placed on the wooden shelves with all the different components, each one being justified at stock taking time. A grumpy old storeman in a grubby fawn coat and flat hat greets the drawing office junior who has been sent to check on the availability of a particular length of hand rail stanchion. Enough of my recall from the past, let us get on with the job of turning the four stanchions. These need to be from 7/8in. dia. stainless steel, a ball turning tool making short work of the spherical surface after the rest of the profile has been roughed out. Leave the screwed spigot at full 3/4in. dia. until the ball has been formed, then turn down to 5/16in. dia. and screw cut 5/16in. BSF before parting off to length. It may well be that the thread requires finishing with a die after parting, but this is easier to maintain concentricity than it would have been if starting the thread from scratch.

It is really worth the hassle of making some Curved Brass Washers to fit under the flanges of the stanchions and the Pressure Gauge Stem; otherwise there is an unsightly gap between fitting and tank. While geared up for turning ball ends, do produce the small Pump Water Valve Support. This will eventually be fitted to the top of the cab plate rail in order to support the axle pump bleed valve which is prominent on the General Arrangement.

The Pressure Gauge Stem is a simple turning job from brass, but forms an important M-W fitting with a pigtail arrangement which will be detailed with the other cab fittings. The other obtrusive detail is the pair of firing iron cradles, fabricated from three parts, the cradles themselves being in 3Cr12, which do not need to be painted and thus ruined the first time a hot firing tool is placed upon them. The locating holes are already in the tank sheet, again for fixing with brass domed nuts.

Cylinder Drain Cock Gear

In part VI of the series it was promised that the drain cock operating gear above the footplate would come at this stage. Keeping my promise, here it is! For good measure I append a diagram of the layout, which I have merely lifted from the G/A and massaged to suit our present purpose. Hopefully the labelling will be helpful. Little description is required; suffice it to say that all the joints are made by means of standard Linkage Pins, of which eleven are required, tailored to suit the link material thickness used.



© Cylinder Drain Cocks - disposition of components

I recommend the use of spacing washers, which will keep painted surfaces apart. All the small levers have been laser cut in 3mm material, requiring only to be drilled and finished around the edges, before silver-soldering on the small bushes where drawn. The only departure so far has been the production of Drain Cock Levers in 2mm material to assist in the accurate formation of the square holes.

Assembly requires the Drain Cocks to be in their places, with the Frame Bushes pressed into the Main Frames. Fit the Main Frame Cross Shaft, threading it with the three Drain Cock Cranks and fitting a couple of small stop collars (not drawn) to restrict end movement. Now fit the linkage starting at the Drain Cocks, stacking and washering the links to avoid conflicts, the objective being to determine and mark the positions of the three Cranks on the Cross Shaft. Withdraw this shaft and pin the three cranks and two collars, using taper pins, making sure that the two cranks between the frames are in line and the one outside the frames is at 90deg. as shewn. In positioning the pins, remember the action of gravity, to avoid the possibility of loose pins falling out. The Drain Cock Lever passes through its dedicated bracket on the Reversing Gear Stand, already detailed.

When dispensing sets of laser cut bits, such as those for the drain cock gear, I provide a full-size paper templet, labelled to aid identification. I trust that constructors will find this helpful.

Sanding Gear

We now make another visit to the M-W stores to reveal some standard sand boxes. Few narrow gauge models seem to have such fittings, but they are so prominent in the current design, that it is to be hoped that they will find a place on every footplate, even if not always working! Their locating holes are already in the footplates, two for fixing and one for letting the sand out. The top and bottom plates display conspicuous mouldings around their edges and I shall be making mine from some brass plate for which I have been looking for a home for a few years! Cut a rectangular rebate say 1/16in. deep with a 2mm slot drill for the side panels and take care with the aesthetics for the edges. The sides can be bent up from either steel or brass sheet and silver soldered out of sight. Remember to make the two sets as a mirror image pair, as drawn, so that the filler caps are at the rear outer corners of the footplate positions. The top and bottom are held together by four tie bars inserted underneath (rather like an electric motor assembly). Use either long countersunk bolts or rebated nuts to taste for this purpose. Drillings in the base are: 1/4in. (blind) for operating lever, 2 x 1/4in. BSF for fixing, 4 x 3/16in., counter bored or countersunk for corner rods and 3/8in., possibly tapped 1/2in. x 32 for sand exit.

The vertical lever within the box is furnished, near the bottom, with a 1 3/4in. dia. disc containing a 1/2in. dia. sand hole. The disc is silver-soldered to the shaft to give a small clearance from the box floor. At the top end the operating lever is fixed at 135deg. to the sand hole, not forgetting to hand the two units left and right. Pulling the lever back 90deg. opens the sand supply. The filler cap needs little comment, being made a neat fit in the small upstand which is fitted into the Box top. Thus the Cap straddles the upstand to keep rain water out of the Box and is fitted with a long spigot to afford stability. It is little details like this which make for reliable operation.

The Driver's Lever has its two end components fixed at 180deg., so that pushing the handle opens the sand valve. Provided that you have included the two fulcrums on each shaft, the top lever may also be fixed permanently. The fulcrums are designed to fit into holes in the Cab Sheets which will come later. If in doubt, consult the G/A drawing.

The Sander Operating Rods have clevises at each end, machined from 1/4in. square material, slotted, drilled, tapped and cross drilled in accordance with the drawing. The finished length of the 3/16in. dia. rods should be left until final assembly, but screw them 2BA to fit the clevises and assemble everything with 5/32in. dia. pins duly machined and constrained. It is rather remarkable that there is no connection between the sanding gear on the two sides of the locomotive, but if you examine the positions where the levers are fitted, there is really no way that a link could have been accommodated. So you will have the choice of a left sand, a right sand or a complete job: what an exciting thought!

The job is completed by the installation of 3/8in. dia. pipes bent in an S-shape to direct the sand onto the rails. They therefore go between the frames through the valve gear access hole and should be clipped to the bottom of the frames in a suitable manner. I think that the best way of securing the pipes into the tank bottom plates is by means of nipples silver-soldered to their top ends and screw cut 1/2in. x 32, to mate with similar threads in the exit holes in the bottom plates. It will be essential to fit a choke in the top of each pipe, in order to control the sand flow. Try starting with a hole of 1/8in. dia. in the pipe nipple and trim as necessary to suit your source of sand.

● *To be continued.*

The compact fine feed gearbox assembly. Although designed specifically for Camcutter this item may have uses on other types of machine tool.

The set up used to cut the worm wheel for the fine feed gearbox assembly. The fourth attempt brought the required result.

CAMCUTTER

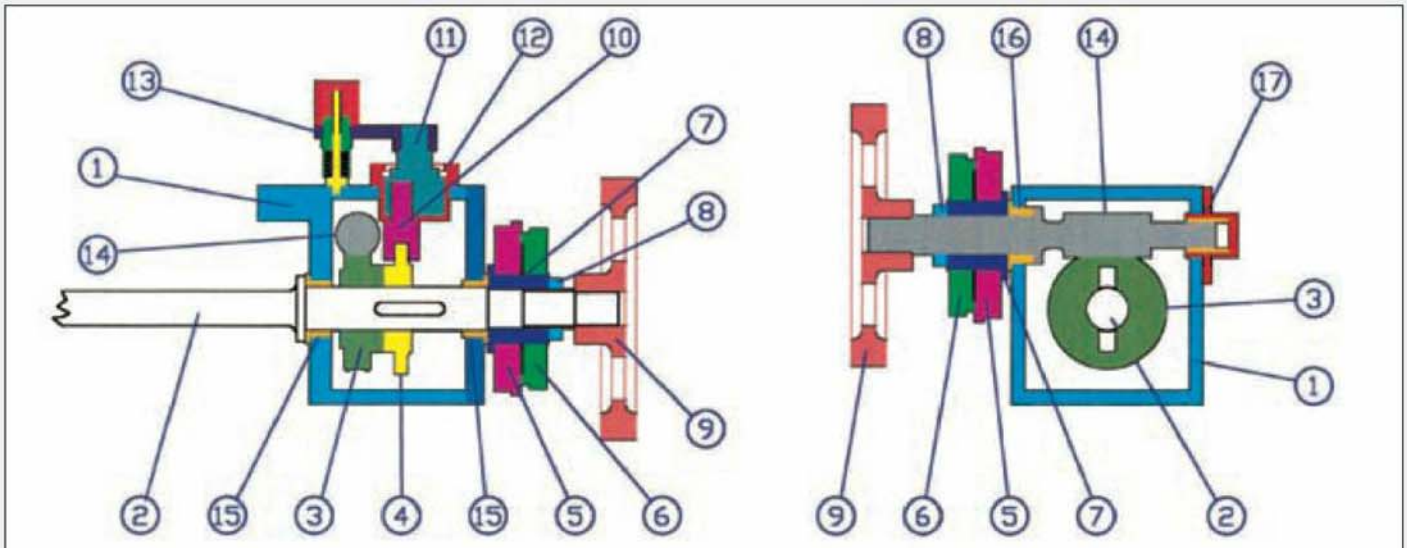
A. J. Aldridge

describes a fine feed gearbox that was designed for Camcutter but could have uses on other types of machine tool.

●*Part X continued from page 332 (M.E. 4243, 18 March 2005)*

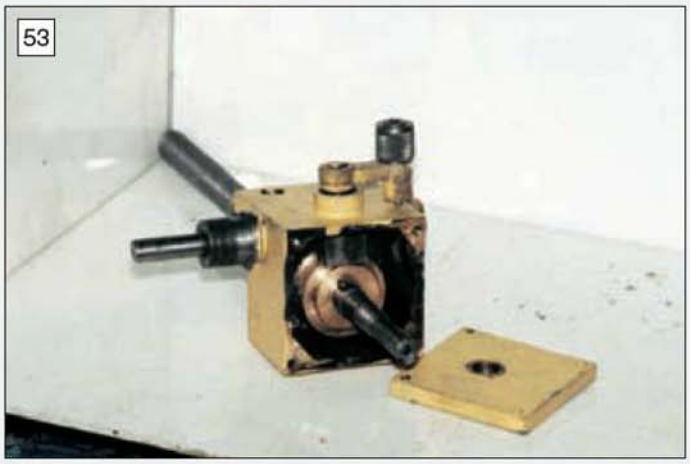
At the concept stage it was thought that when using the machine there could be situations where the feed of the tool would need a rapid advance or retract and a fine adjustment to bring it into cut. This would be particularly true of the grinding wheel, where it would be necessary to graze the work piece and then advance into the work a known amount under very tight control. To do this a two speed gearbox was designed (**fig 33**) that started much larger than the finished product but is now a quite neat and small unit (**photo 51**). The heart of this little unit is the clutching arrangements. The other item that needs great care is the worm wheel and worm meshing and as this was the first time I had attempted anything like this it was, perhaps, not unexpected that I should run into trouble. In fact, I made four worm wheels before I had one that delighted my eye. The Acme pitched worm had been made and now it remained to make an appropriate wheel to match it. The text I followed suggested it was all too easy and in essence it is. **Photograph 52** gives all that is needed to know about the set up. We require a 'tap' that was made together with the Acme thread in silver steel and then hardened and tempered. Now, here was the root of my problems and did not know how to get out of it except by trial and error. Fortunately making the blank wheels in bronze and cutting them with the tap is not a difficult or long job, just wasteful. Theoretically the diameter of the worm wheel should be given by: -

(the number of teeth required) x (the hob (tap) pitch (3.175), divided by π (3.142) which should ▶



1. GEARBOX HOUSING
2. FEEDSHAFT
3. WORMWHEEL
4. CLUTCH
5. LOCKING WHEEL
6. GRADUATED DIAL
7. COLLAR
8. LOCKNUT
9. HANDWHEEL
10. SLIDER
11. CAM
12. CAM HOUSING
13. SPEED CHANGE HANDLE
14. WORMSHAFT
15. FEEDSCREW BUSH
16. WORMSHAFT BUSH
17. WORMSHAFT END BUSH

Figure 33 TWO SPEED GEARBOX



The unit undergoing final assembly. Particular care is needed to ensure the correct degree of mesh for the worm and worm wheel.

The lever used to oscillate the grinding wheel during cam grinding operations.

give 25.26. Add the depth of the thread, which is 2.17mm, given by formula (0.6866 x pitch = depth). Therefore the starting outside diameter is 27.43 millimetres.

The first problem was a matter of work holding and this had me painted into a corner. The wheel is turned and, before it is parted off, it must be milled for the keys that form the clutch dogs. The wheel is very difficult to hold but if it is not held correctly it is going to end up as scrap. My first wheel was made right for dogs and diameter but ended up with about 26 teeth. Some of the teeth were ill formed.

I am pretty certain that the error comes from incorrect depthing of the Acme thread which is not easy to measure and is really a piece of dead reckoning with the lathe dials. Incorrect depthing will give incorrect pitch diameter to the worm. Assuming that to be the case I did a calculation and tried again. My third wheel had 24 teeth but at least I knew by measurement the mean diameter, which I now had to aim for. For the fourth time a wheel was made and gashed by the tap as the wheel was fed in. Initially it looks an absolute mess, to the extent that one wonders if this is the right procedure but the form emerges quite quickly and there it is a fine looking wheel but it does require some attention to small details, apart from the base diameter problem. Namely, the pin on which the wheel turns has to be a tight but turning fit to the wheel centre and the centre has to be truly concentric to the outer diameter. Getting the true outside diameter might remain a problem but attention to the hob or tap manufacture will cure that. The graduated dials follow a pattern which I converted my lathe to many years ago and have given good service. The concept is simply to jam the graduated dial up against a collar on both sides with a threaded nut that then holds the dial tight in a set position. For a machine that is meant to be metric the dial graduations are imperial which is a fault of working with an imperially dimensioned lathe and maybe a touch of laziness. I personally have no difficulties switching from one system to another as with a calculator or wall chart the conversion,is very simple. When dealing with 'thous' and hundredths of a millimetre, the only figures to remember are that one thou is 0.025 mm and 1mm is 0.039 inch. It is surely not beyond anyone who aspires to the name engineer to work with that situation. I am aware that the conversion is not 100% accurate but over the distances we are interested in it does not matter a jot. The error is not measurable in our hands.

Graduating dials is a subject all of it's own and one that everyone appears to have answers for. I

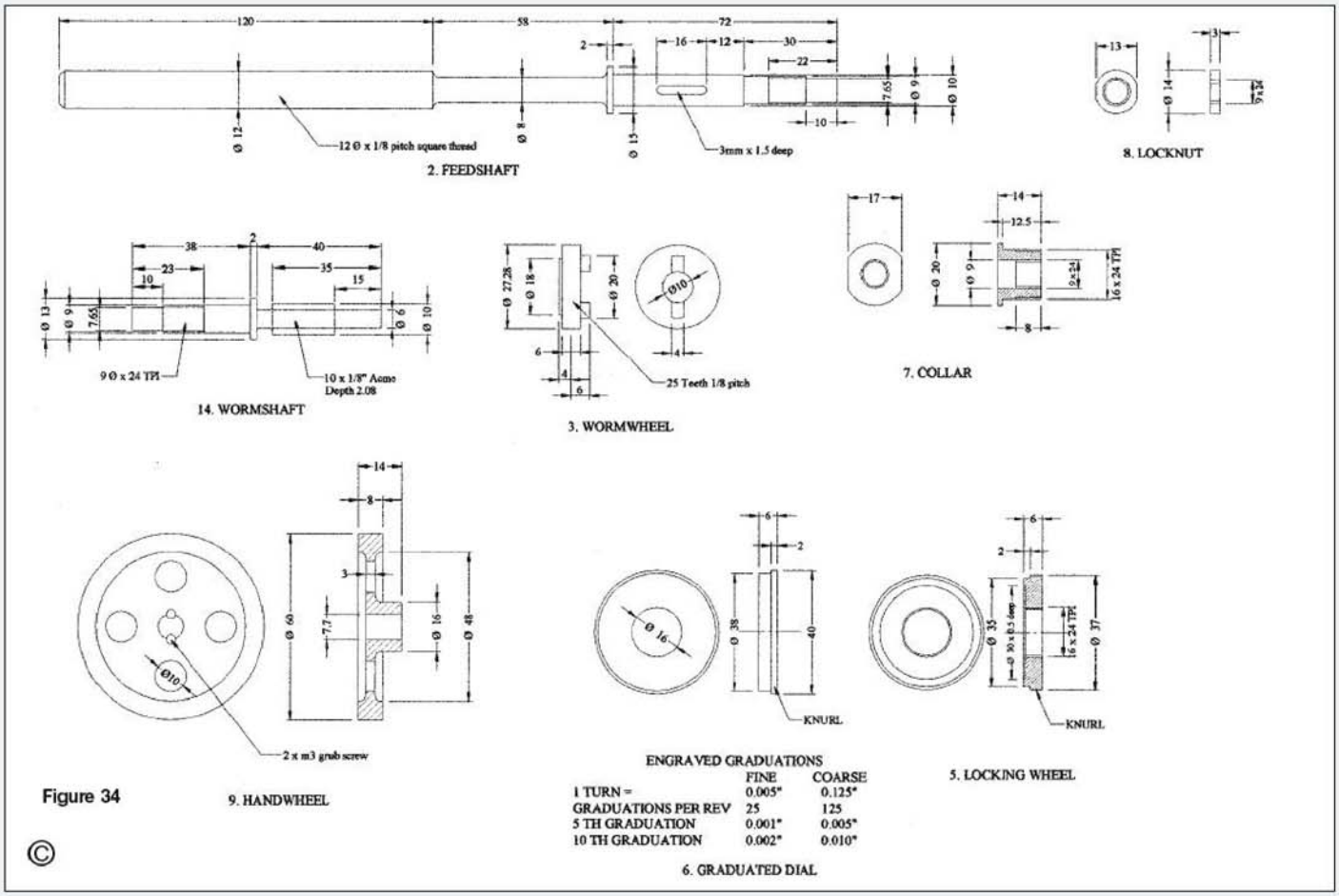


Figure 34

The fine feed gearbox assembled on the machine. The items that look like paint damage are brass index pointers.

would recommend that reference is made to *M.E.* 3663, 21 August 1981 where a Mr. R. Main described a graduating tool that I made and which has served me extremely well. The only difficulty I find with graduating is sharpening the tool to the right profile and depthing properly. Part of that problem is getting the work piece to stand on an arbor absolutely concentrically which comes from slack on its holding pin if the dial is graduated off the lathe. This is another reason for using the Main machine as the tool is set up like another cutting tool on the saddle and as long as the machine is substantial and does not bend on cutting then we have perfect conditions. The real reason for using the tool is that it is self-counting and does differential line marking in sequence without having any input from the operator other than pulling the handle. It is therefore a highly effective piece of mechanisation. The clutch looked too simple to be true but is fully effective and has given no trouble at all. The actual dogged section is the same operation as the worm wheel.

The tricky parts are the engaging levers and spotting the correct position of those levers, but we need a case before we get to this juncture in proceedings. The case is another brazed fabrication using sheet steel. On reflection an off cut from a piece of square tubing would make a nice starting point for a box. I made the bushes for the fine feed screw and worm eccentric initially to get the mesh absolutely tight but am not sure that this is at all necessary if careful work is done in marking out and machining, but it is an option. The degree of eccentricity is only about 0.25 mm at most. The same effect can be gained by drilling the hole through the casing to give the feed screw bush clearance and adjusting, at the stage shown in **photo 53**, the mesh of worm and feed screw.

Put a doubled slip of newsprint in between the meshing wheels and clamp the mesh by wedging under the worm wheel. If the newsprint pulls out then file the bush holes at the top to alter the meshing and try again. With the mesh correct the back bush may be silver-soldered in place. Note that this work is done without the front bush in place so there is danger of cocking the shaft so that must be kept in mind as we progress.

One of the lessons soon learnt with the grinding procedure was that the finish was not quite as expected with a maze of fine lines across the surface. Talking to those that know it was suggested the fault was more than likely due to the wheel being stationary or improperly sharpened. The latter I think I have mastered but there was no means of oscillating the wheel. **Photograph 54** shows a suitable and relatively simple arrangement that has cured the problem. The lever must have a relatively long stroke and small actual movement for the saddle. The lever works on a pivot, which has to be tight in its bush, oscillating between two screws set into the carrier plate. The latter is bolted back to the bar bed end. Both the saddle and the lever end carry lightly riveted, rotatable, holders for the rod, which is silver-steel and can be pushed through the eyes to allow the saddle to come to a new position. I have only the one bar to cater for the full length of the machine but at the time of the photograph only a short length was available. The bar is held by a grub screw in the ends of the holders.

I also get better results if the milling cutter is oscillated as well but this is not as important as the grinding operation.

The feedbox stands over the end of the slide and needs to be pushed hard up to the end and the holes spotted through for drilling and tapping. In **photo 55** the feed box is shown attached to the slide with what appears to be two, bad paint scrapes at 90deg. to each other. These are in fact, ▶

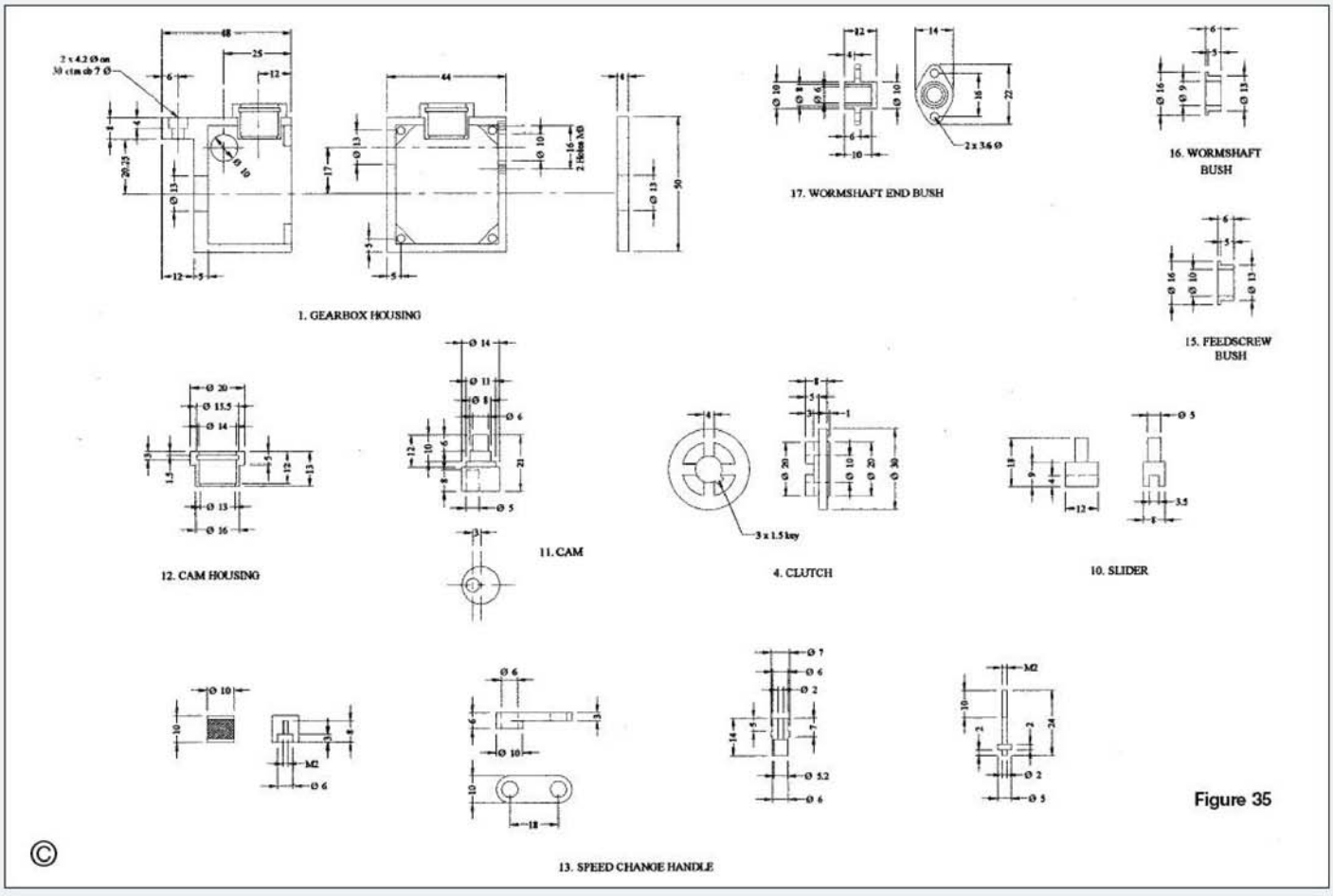


Figure 35

the two arrows indicating the dial position, made in brass and should be held in place with rivets but were actually glued. The fine feed one is canted over at an angle rather than being in the normal central position as this gives a better view. The view shows the clutch lever turned to provide the coarse feed drive.

With all the wheels and shafts available make a trial run as far as possible to ascertain the placement of the stop pin so that the lever lies along the axis of the fine feed shaft when it is fully engaged in the hole about 1.5 mm from the box edge and drill 3 mm about 2 mm deep. The hole for the cam that drives the engagement can be plotted and drilled and reamed if necessary and the cam turned up. Make sure the eccentric throw is such to bring the slider over to fully engage the clutch before the eccentric dead centre is reached. One would want to have the angle of the lever movement as near 90deg. as one can make it with the two lines indicating the screw which actually doing the driving without having to think about it. We are now in a position to cut the arm to length and braze it into the assembly. The cam is restrained by a circlip that can be, as is mine, a coil of 1mm dia. spring wire tucked half into the tiny groove. The clip should not be more than 300deg. around or you will battle to get out again. The outside arm can be pinned vertically or horizontally. The front plate is just that with a bush let in to carry the feed screw end and then cut to mate all round with the box. The corners of the box have triangular pieces of sheet soldered in to carry the four fixing screws. Glue the key that secures the clutch in place to its shaft but not the wheel or you may find that when everything is boxed up that the clutch is inoperative. Why, because the key has dropped out. From the photos one can see how small the finished unit is. Do not use the plain bush at back of the feed worm as seen in the photos as it works out even if it is glued in. The retention must be by bolts. A gearbox of this nature might have other uses than for Camcutter as it could be adapted for a variety of machine tools which would gain from a dual feed speed.

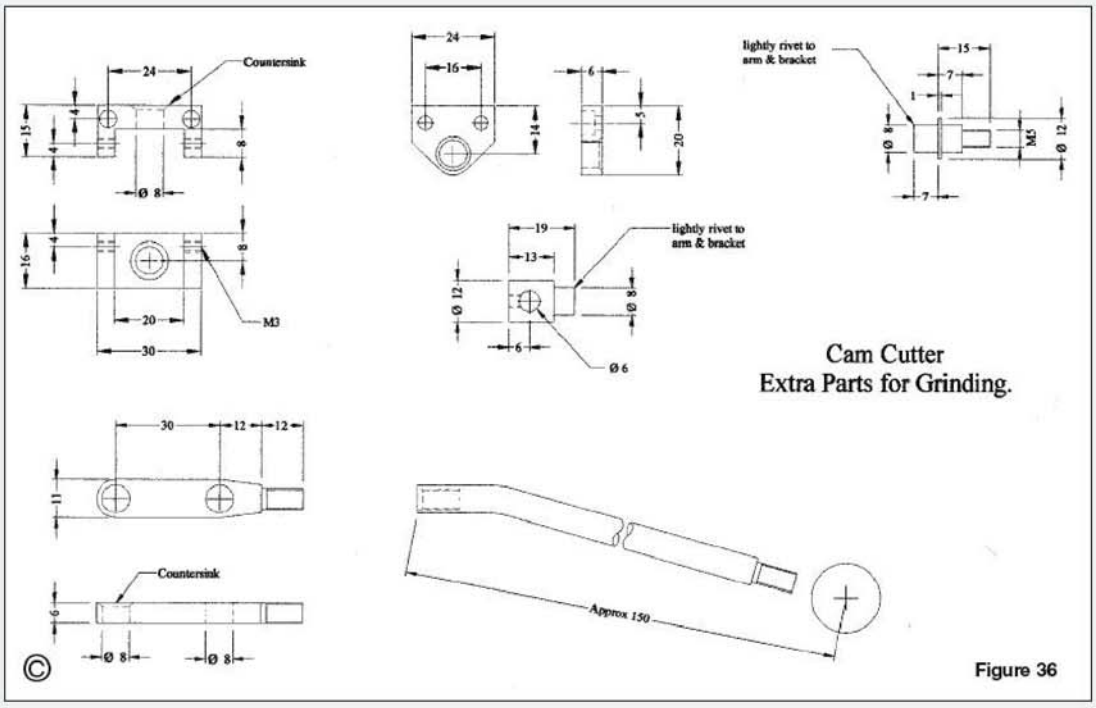


Figure 36

●*To be continued.*

USING RADIANS TO MARK OUT BELPAIRE FIREBOXES

Hugh Castellan
describes the mathematics behind his technique.

Some while ago I found myself contemplating the construction of my biggest boiler yet. This boiler was for Martin Evan's *Highlander* the 7¼in. gauge Black 5 designed by him some years ago. I had put off the construction for a long time being scared of the very idea. However I made a start doing those parts I could make such as the fire tube nest assembly with the inner firebox throat plate and machining the diameter of the front tube plate. The boiler barrel was obtained pre-rolled by Alec Farmer, then at A. J. Reeves, but eventually only the inner and outer firebox wrappers remained to be made before construction could be completed.

Belpaire fireboxes are divided into two main types, i.e. those that are flat, rectangular and parallel and those that are multi-curved and tapered. In the first case we have fireboxes like Fowler's Royal Scot boilers. In the second case we have fireboxes like Stanier's Black 5 boilers.

Taking the first case, we have a rectangular box with rounded top corners along its length. Since the top and sides are flat with a corner radius, if we take one eighth of the circumference of a circle equal to that radius and add it to half the flat top width we obtain the dimension from the vertical centre line of the boiler to the point of application of the bending former at each end of the wrapper. If we scribe a line between each of these points we can position the bending former.

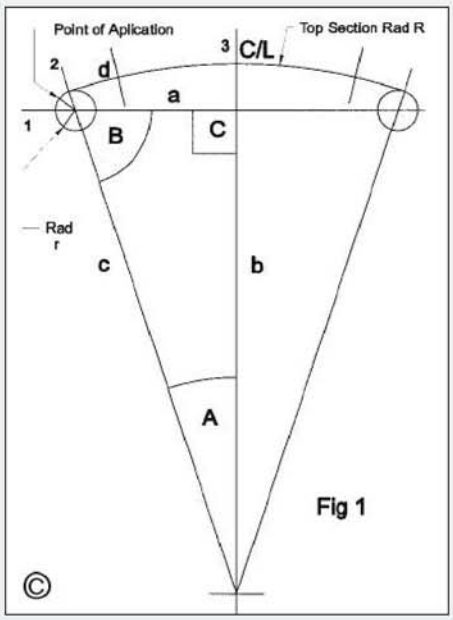


Fig 1

Taking the second case we have corner radii, curved tops and often sides as well. These are usually combined with tapered tops and sides. The fireboxes normally taper from the front to the back. All the curves must blend in smoothly and this can only happen when the end of one curve and the beginning of the next share a common tangent. This occurs when the radius of each curve coincide.

In defining angles there are three common forms of measurement, namely grads, degrees and radians. Of these grads are of no use to us as they are used for the gradients of things like roads or mathematical curves. So we shall use degrees and radians. Most of us are familiar with degrees but what about radians. Radians allow us to calculate the length of arcs.

Definition

A radian is the angle subtended at the centre of a circle by an arc equal in length to the radius.

A radian is thus equal to 57.296deg. since

2π radians = 360 degrees.

If the circle has a radius of 1 then 2π is the circumference of the circle and π is its area; given that the circumference = $2\pi r$ and area = πr^2

We shall use radians to calculate the length of the various arcs used on fireboxes.

Now to the practical application of these formulae. **Fig1** shows diagrammatically a top section and corner radii of the outside of, say, the front throat plate or backhead of a Belpaire firebox. It is also the corresponding shape of the inside of the wrapper. The sides are not shown in the diagram to avoid confusion, since these are vertical, curved or sloping outwards. This depends on the particular design of boiler. In each case the length of the arc 1 to 2 will vary and hence the point of application will also vary. We shall assume for simplicity that the sides are vertical as in the Highlander design.

In fig 1 the following definitions apply.

1: A is the angle between the vertical centre line 'b' and the radius line 'c'.

2: B is the angle between the horizontal line 'a' and common radius line 'c'.

3: C is a right angle.

4: The point of application is defined as the point where the bending former is applied.

5: d is a data position to allow the easy lining up of the copper when placed in the bending machine and will be explained later.

Important dimensions for Martin Evans' *Highlander* boiler firebox are as follows: -

1: Width of the firebox	9.75in.
2: The corner radius inside the throat plate	0.937in.
3: Radius of the top section inside throat plate	30.000in.
4: Thickness of the outer wrapper copper	0.187in.
5: Thickness of the throat plate copper	0.156in.

Note that this data is for the front throat plate.

In order to do the calculations we need to find the value of R, r, a and c in fig1.

R = The radius of the top section + the thickness of the throat plate copper.
= 30.000 + 0.156
= 30.156in.

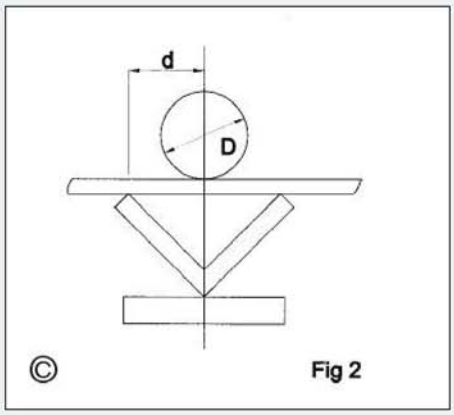


Fig 2

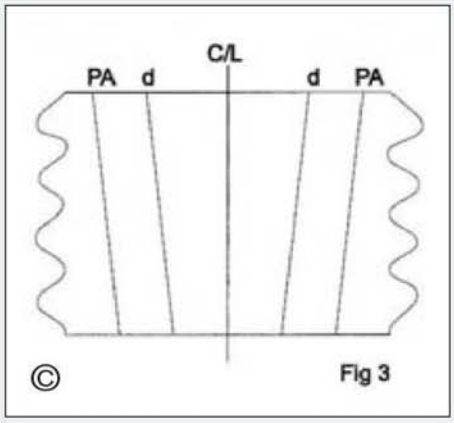


Fig 3

r = The corner radius inside the throat plate + the thickness of the throat plate copper.
= 0.937 + 0.156
= 1.093in.

a = (The width of the firebox /2) - (the thickness of the wrapper + the radius r)
= (9.75/2) – (0.187 + 1.093)
= 4.875 – 1.281
= 3.595in.

c = The top section radius R - the corner radius r
= 30.156 – 1.093
= 29.063

Thus R = 30.156
r = 1.093
a = 3.595
c = 29.063

Note that for the following calculations a scientific calculator with a mode button is needed, allowing you to switch from degrees to radians.

To find the angle A: -
Sin A = a/c
= 3.59/ 29.063
= 0.1236

A = 7.1deg. or 0.1239 radians
Read off $\sin^{-1}$ in degrees or radians.

To find the length of the arc 2 to 3 we multiply the radian measurement by the top section radius R.
Length of arc 2 to 3 = 30.156 x 0.1239
= 3.736in.
Say 3.74 inches.

To find the angle B
Cos B = a/c
= 3.595 / 29.063
= 0.1237

B = 82.894deg. or 1.4467 radians.

To find the length of the arc 1 to 2 we multiply the radian measurement by the corner radius r.

Length of 1 to 2 = 1.093 x 1.4467
= 1.581in.
Say 1.58 inches.

To find the point of application divide the arc 1 to 2 by 2 and add to the arc 2 to 3.

The point of application measured from the vertical centre line of the boiler.
= (1.58/ 2) + 3.74
= 0.79 + 3.74
= 4.53 inches.

The backplate dimensions pose a problem since various designs have been used over the years. As originally designed the firebox had a flat top instead of the taper top of the prototype. The maths shown here assumes a top taper of 2deg. and a side taper of 3deg. each side. Using radians it is just as easy to have the correct tapers ▶

The hydraulic press devised to create the bends in the the copper for the authors boiler. It is based on that designed by Alec Farmer.

A sample bend in the copper made in the press shown in photo 1. Note the marking out lines to aid positioning.

as not. It is very important that you check that you have the correct width of copper, as it would be very expensive to get it wrong.

The length of the *Highlander* firebox is 14.375 inches.

Therefore given that side taper is 3 degrees:

Then tan 3 x 14.375 = 0.753 inches
Say 0.75in.

The width of the firebox at the backplate
= 9.75 – (2 x 0.75)
= 8.25 inches

The boiler centre line is thus
8.25/ 2 = 4.125 inches
R = 30.156in.
r = 1.093in.
a = 4.125 – 1.281
= 2.844in.
c = 30.156 – 1.093
= 29.063in.

Sin A = a/c
= 2.844/ 29.063
= 0.0978

A = 5.612deg. or 0.0979 radians

Length of Arc 2 to 3
= 30.156 x 0.0979
= 2.952in.
Say 3 inches

Cos B = a/c
= 2.844/ 29.063
= 0.098
= 84.38deg. or 1.4727 radians

Length of Arc 1 to 2 = 1.093 x 1.4727
= 1.61in.
Say 1.6 inches

Point of Application = (Length of Arc 1 to 2 / 2) + (the Arc 2 to 3)
= (1.6/ 2) + 3
= 3.8in.

A line scribed between the two points of application gives the position of the bending former designated 'D' on the diagram **fig 2** (where D = 2 x r). Little 'd' is the distance between the point of contact of the bending former 'D' on the wrapper copper and the front setup position on the lower part of the bending tool. Measure the distance between the two lower points of contact and divide the result by 2 to obtain 'd'. This dimension is then scribed on the wrapper and is measured from the line of application inboard towards the centre line of the wrapper. The completed marking out is shown in **fig 3**.

Notes

1: All marking out is scribed on the inner surface of both the inner and outer firebox wrappers.

2: The diameter of the bending former must be equal to 'D' or the bend will not be the correct length and the wrapper will not fit properly.

The author's* Highlander *boiler nearing completion. An excellent standard of workmanship is evident in this photograph.

Practical application

Having completed the theory for laying out a firebox wrapper let us turn to the practical side of things. **Photograph 1** shows the type of bending machine I used to make my outer firebox wrapper. It is an enlarged version of the one shown in Alec Farmer's excellent book 'Model Locomotive Boiler Making' which is now unfortunately out of print. This machine can be homemade and would be improved by the use of one centrally mounted 20ton hydraulic car jack. One of the plain bearings in the lower cross member of the tool should be a close fit to its column but the other should be machined oval to stop jamming. Oilite bearings were used. The two halves of the tooling are made interchangeable so that the reverse curves in the firebox sides can be put in as well. This tooling is fixed with cap head screws to the upper and lower cross members.

When ordering the copper sheet the back to front width must allow for the top taper down at the back and the tapered sides as the bottom edges of the bent wrapper will swing forward by a considerable amount and at the bottom backhead edges there will be no copper at all. To understand this, take a piece of cardboard and draw a centre line across the card top to bottom and then draw in the slopping sides of the top surface. Bend along the two lines so that you have an embryo firebox. Turn the model sideways and turn it clockwise so that the back is lower than the front edge and you will see what I mean. The backhead being vertical there is a gap between the card edge and the vertical. Also allow plenty on the length of the copper sheet. My copper sheet of 5mm copper weighed 60lbs so you must get this right ($7^1/4$in. gauge boiler).

Having obtained your copper sheet, take a large propane torch and anneal it thoroughly. Allow the copper to cool to room temperature. Never pickle this size of sheet hot as this highly dangerous. I use very dilute sulphuric acid pickle (3 litres of concentrated sulphuric acid in sufficient water to completely cover the complete boiler lying horizontal in a large attic type black plastic cold-water tank. It is so dilute that it is safe to put your hand in as long as you wash your hands soon after. Remember the acid is dissolved into the bulk of cold water very slowly. Wear goggles and a plastic apron.

Wash and dry off the sheet. Then mark out the centre line from front to back of the wrapper. Let the excess width be at the backhead edge so that the front edge becomes the reference edge for all marking out. Using the list of calculations, mark out the construction lines as per the drawing fig 3. Feed the copper into the bending machine such that the line of application is in the centre of the lower V-tool with the 'd' line nearest you. Note; the side of the copper with the marking out must be upper-most in the bending tool.

Next raise the bottom half of the bending tool such that it just pinches the copper but allows you to position the sheet accurately. Align the 'd' line vertically with the front point of contact of the V-tool. Check the alignment carefully as you only have one go at making the bend. When all is ready operate the jack to bend the copper, making sure the copper is fully pressed into the V-tool and that you finish with a full right angle (**photo 2** shows a sample bend). Then repeat the procedure for the second bend. When the bending is complete you should have a tapered channel in front of you. Place the channel on a flat firm wooden surface and using your hands push the sides outwards to form a 'W'. Complete the push when the bottom of the channel rises to approximate the radius of the top of the throat plate and the backhead. Making sure that the two sides do not come in, beat the hump down flat using a rubber mallet. Then pull the sides in vertical again. This will produce a top radius, which should fit the top radius of the two plates. A little adjustment may be required until you get a good fit but using the method described the plates and the firebox should fit together accurately.

Turn the two plates outwards so that they can be clamped to the firebox at each end using toolmaker's clamps. Place the assembly on its side on the flat surface and lean on the ends of the firebox sheet so that the sheet bends and touches the bottom ends of the plates. Place the assembly on end and look down at the reverse curves where the plates neck in to form the bottom of the firebox. Using a marking pencil, mark the wrapper opposite the centre of the curve at top and bottom on each side. Again lay the assembly on its side. Draw a line between the two marks. Repeat on the opposite side. Now remove the tooling from the bending machine. Bolt the V-tool to the upper mounting and the round tool to the lower. Remove the clamps and plates from the wrapper. Place the wrapper in the bending machine with marking out upwards. Nip the wrapper between the two halves of the tool and move the copper until the marked line is on top of the round tool midway between the Vs of the V-tool then bend the copper to about 45deg. outwards. The copper will now look like the channel with wings. Replace the plates back and front with the clamps and lay the assembly on its side on the flat surface. Press down on the assembly so that the wings come in against the throat plate and backhead. Use a large G-clamp to assist in getting the assembly to fit snugly. Very little use of the hammer should be necessary and the completely bent wrapper should be virtually free of hammer marks. Marking out and removal of unwanted copper now follows to finish the job. **Photograph 3** shows the almost finished boiler and the firebox.

THE BL 5.5 inch MEDIUM GUN

David Wilcox

continues the description of his model of this famous and formidable gun.

●*Part II continued from page 336 (M.E. 4243, 18 March 2005)*

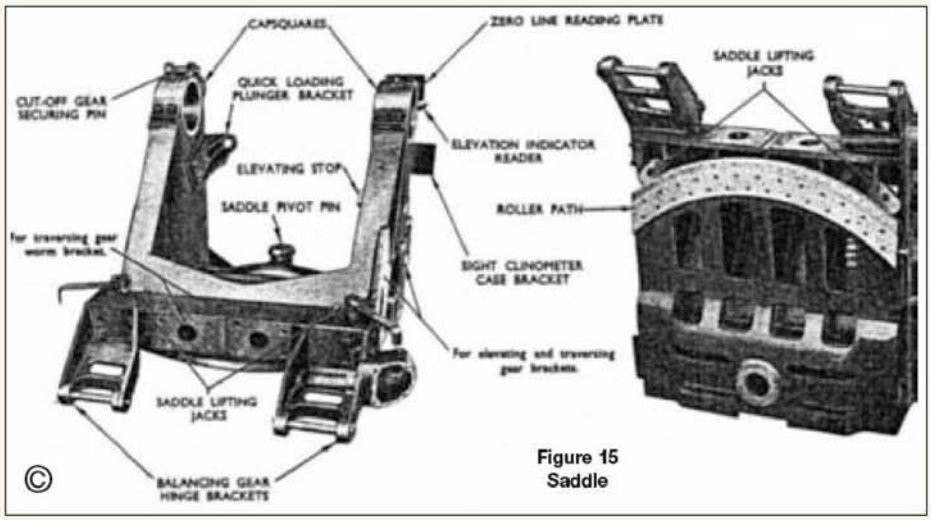


Figure 15
Saddle

A large number of fittings are attached to the saddle and some of these are shown in **fig 15**. Others are shown in **photos 8** and **9**. The fittings include: -

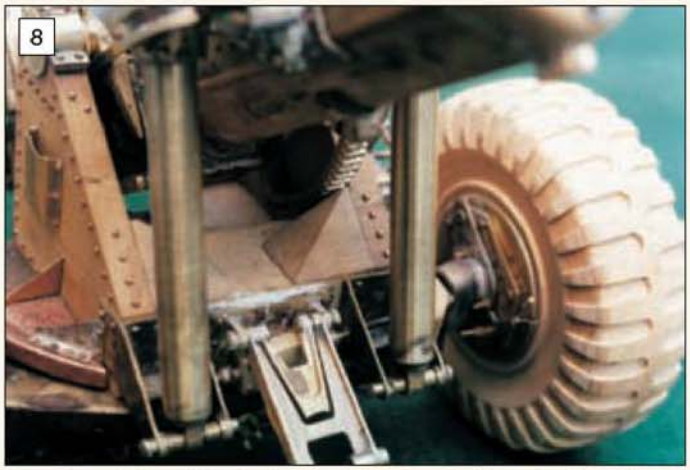
1: The elevating handwheel and gearbox
2: The traversing handwheel and bevel and worm gearboxes.
3: The balancing gear hinge brackets **(photo 10)**
4: Saddle pivot pin
5: Cap squares to secure the cradle
6: Quick loading plunger bracket
7: Front cradle clamp
8: Two wing-like plates either side of the saddle to protect the traversing ring **(photo 11)**

Most of these fittings were fabricated from copper or brass sheet, brass rod, tube and other sections including for example, H section brass curtain rod and scale model railway line, generally using silver solder paste. Thin copper sheet was used where a part had to be shaped over a former. Rivets were 1/32in. copper or brass and to simulate rivetted fabrication of box-like structures, several hundred of these were inserted directly into the boxwood pieces including the trail legs.

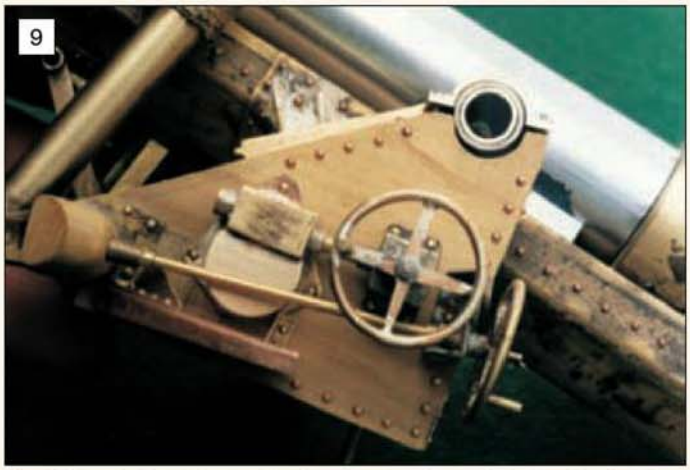
Cradle

Next came the cradle and this is best seen in **fig 18**. It carries the gun and recoil system and pivots vertically about the trunnions and is secured to the saddle by the cap squares. The cradle is trough-shaped and on either side is fitted with guide-ways in which the gun and cylinder block guides slide during recoil and run out. Run-out is when the gun returns to its normal rest position after recoil. The cradle extends to the rear of the breech to support the gun during recoil. The principal fittings to the cradle include: -

1: The trunnion band and arms and beneath them is the cross shaft for the quick loading gear **(photo 12)**.
2: Two strengthening bands, one with cradle clamp bracket for travelling.



Front view of the saddle showing the balancing gear hinge brackets, front cradle clamp, protecting wing plates and simulated rivetted construction.



The left-hand side of the saddle showing elevation and the bearing hand wheels and gearboxes.

The balancing gear hinge brackets fabricated from brass sheet. Their size can be gauged from the match in the foreground.

The protective wing plates. These were shaped from copper sheet beaten over a hardwood former.

Underside view of the trough showing the trunnion band and cross shaft for the quick loading gear.

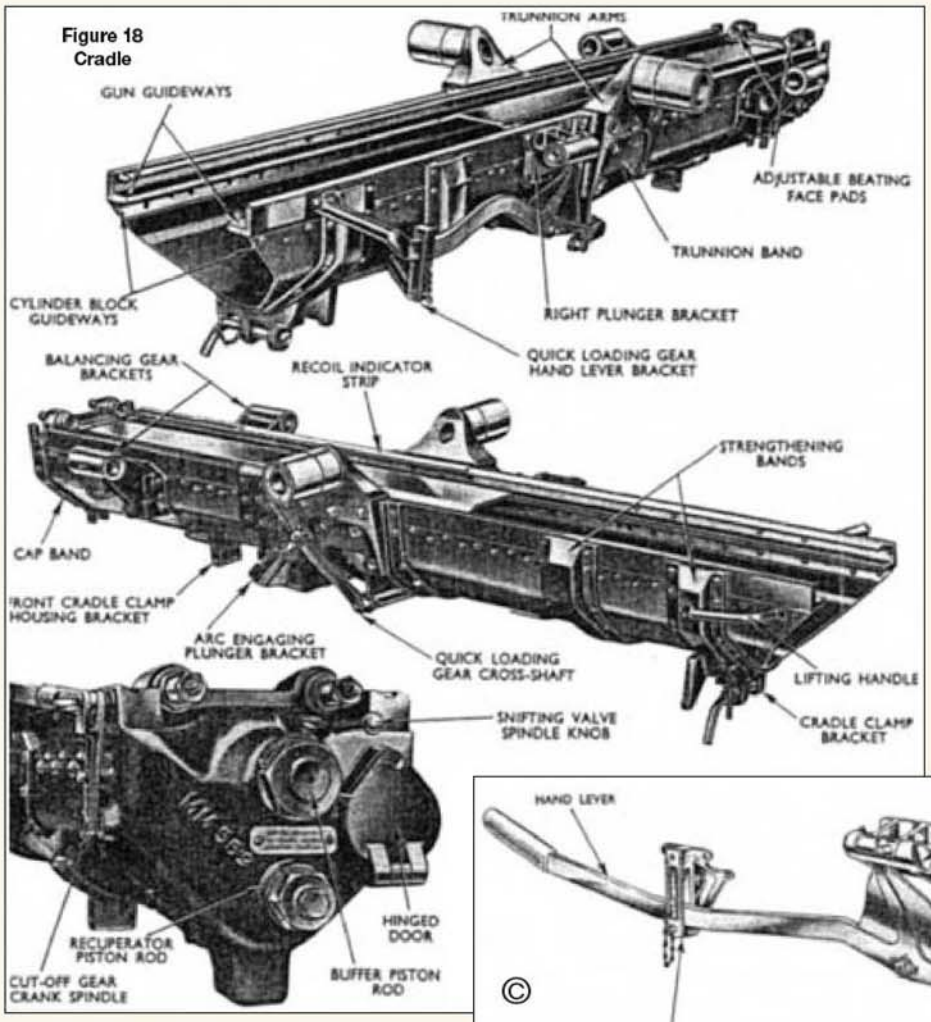


Figure 18
Cradle

3: Towards the front, the two balancing gear brackets (**photo 13**)

4: The front cap which anchors the recuperator and buffer piston rods plus the cut off gear crank (this latter adjusts recoil length depending on gun elevation) also to be seen in photo 13.

5: On the right-hand side behind the trunnions, brackets for the quick loading gear lever and right-hand plunger (**photo 14**).

Quick Loading Gear

The quick loading gear shown in **fig 20** enables the gun to be brought rapidly to the loading position and returned to the firing elevation without using the elevating gear or interfering with the sights.

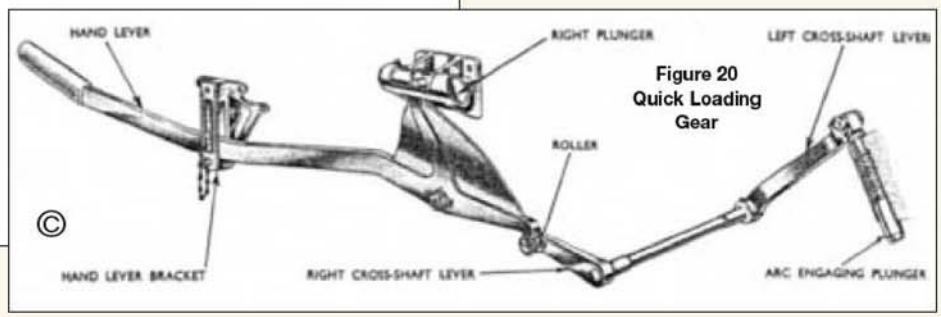


Figure 20
Quick Loading Gear

The gear consists of various levers, a cross shaft and two plungers. In the normal firing position, the right-hand plunger disengages the cradle from the saddle and the left-hand plunger locks the cradle to the elevating arc. When the hand lever is moved to the load position, the left-hand plunger unlocks from the arc and then when the cradle is brought to the loading elevation, the right-hand plunger locks the cradle at 10 degrees. After loading, the hand lever is used to return the cradle to the normal position. Photograph 14 shows the hand lever pivot and right hand plunger.

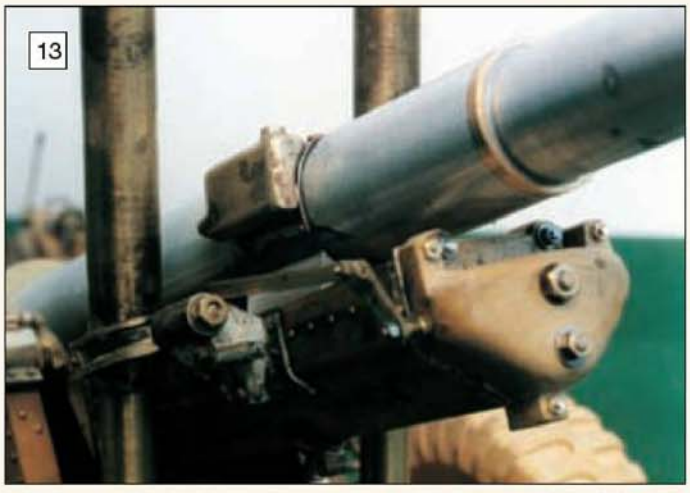
Cradle Trough

The cradle trough was constructed from copper sheet annealed and bent to shape over a hardwood former. The two guide rails were made from lengths of brass curtain rail modified so that the channels became the guides. Alternatively, they could have been milled from brass bar. Initially these were tack rivetted in place and then silver-soldered with a generous fillet so as to achieve the cross section shown in **drawing 4**.

The various fittings were once again fabricated from various copper and brass sections as shown in photos 12, 13 and 14. The end cap is a shaped piece of boxwood and to represent the buffer and recuperator, the front half of the trough was filled with hardwood (actually part of the former used to shape the trough). The quick loading gear was similarly fabricated and even at 1:15 scale, a working gear was achieved.

Elevating Arc

The elevating arc was cut from an existing brass gear wheel conveniently residing in the 'magpie' box. As shown in drawing 3, the web is cut out and a small socket is formed at the 8 o'clock position for the left-hand quick loading gear plunger. The elevating arc swings freely on the left-hand trunnion unless locked to the saddle by the quick loading gear. The arc meshes with the elevating pinion, which is driven by the elevating hand wheel via a bevel gear box. The elevating arc is connected by a yoke over the trunnions to the sighting system as seen in **photo 15**.



This shows the balancing gear brackets attached to the trough and also the cut-off gear and front cap of the cradle.

The quick loading gear lever pivot and right hand plunger assembly mounted on the gun.

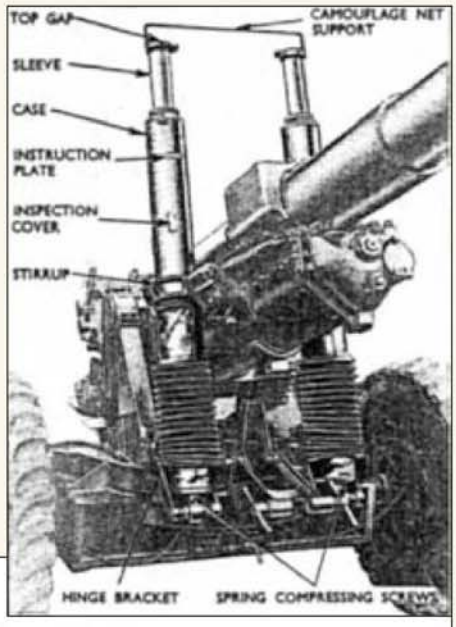
Figure 21 Balancing Gear

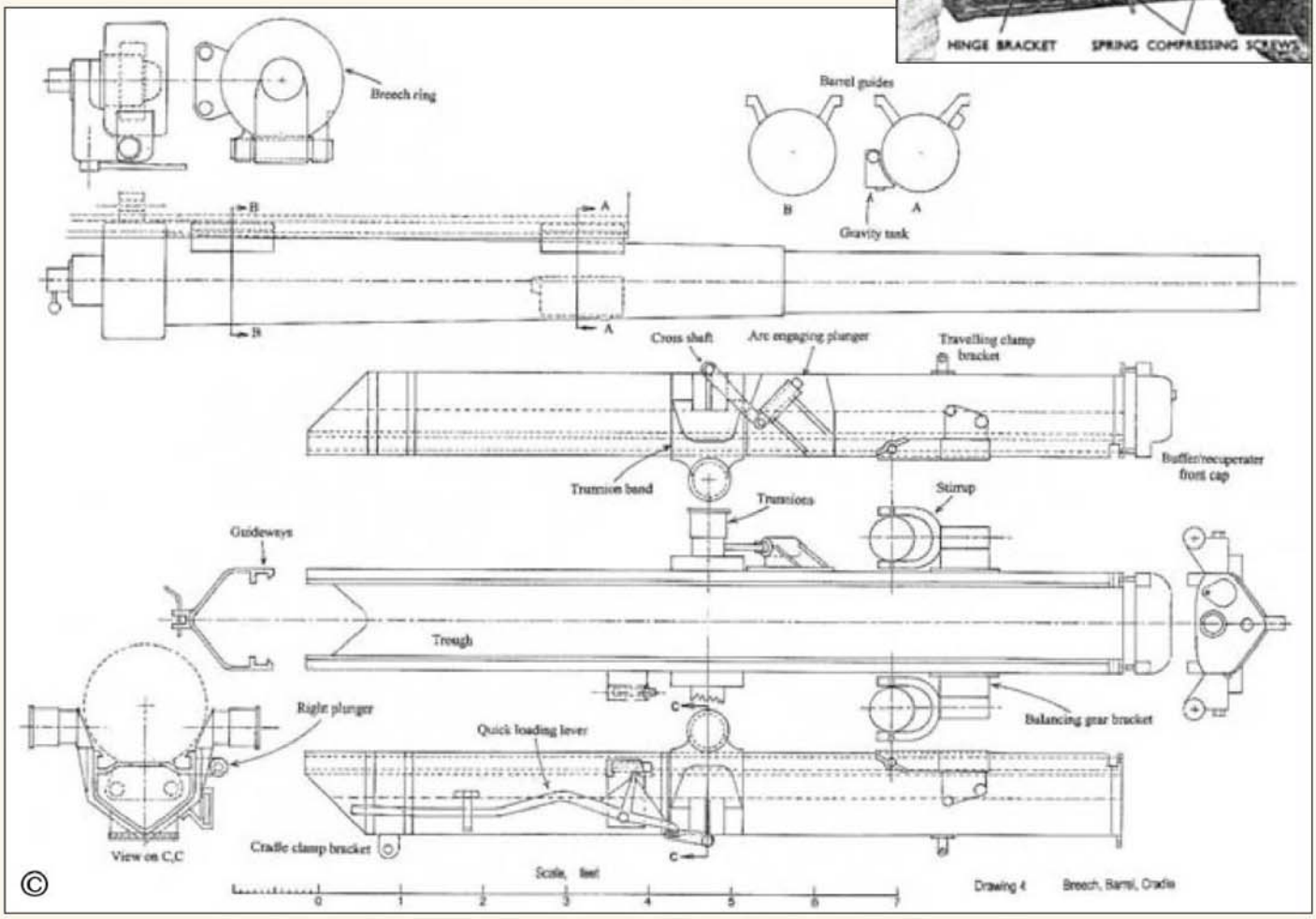
Front view of the sight attached via a yoke over the trunnions to the elevating arc. Note the left hand locking plunger within the elevating arcs.

Balancing Gear

The balancing gear is illustrated in **fig 21** and dimensioned in drawing 2. The stirrups attached to the cradle in drawing 4 and the balancing gear hinge brackets in fig 15 and Drawing 3. The spring cases (often termed horns) were made from appropriate diameter brass tube so that the lower tube can freely telescope into the centre, larger diameter tube. A telescoping, corrugated, leather gaiter to keep the mud out of the spring cases surrounds this lower tube section. I was unable to find any corrugated rubber or plastic tubing of the correct diameter for the gaiter, so this feature was omitted. However, if the gun is not expected to elevate or depress, it is easy to simulate the gaiter by turning and boring a length of boxwood dowel to the correct profile and painting it black. I have even seen the gaiter painted white but I suspect this was just a bit of 'gunner bull'. The diagrams show the bottom of the spring cases attached to the hinge brackets on the saddle and the trunnion rings on the spring cases attached to the stirrups which are attached to the balancing gear brackets on the cradle (photos 13 and 15). A little Milliput was used to fill out these brackets.

●*To be continued.*





M. J. H. Ellis

continues his narrative on the engines of James Atkinson and in particular his 'Cycle' engine.

●*Part LXXV continued from page 329 (M.E. 4243, 18 March 2005)*

Figure 1

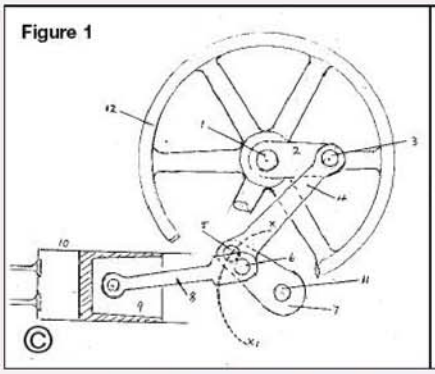
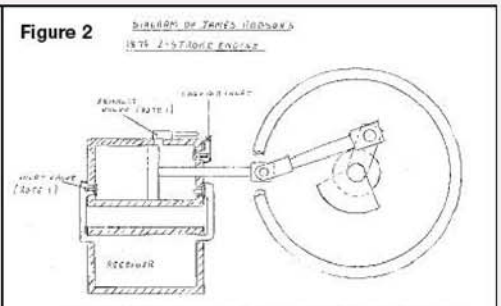


Figure 2



The exhaust valve was mechanically operated. The inlet valve could have been automatic, but the description does not make it clear whether it was or not.

LETTERS TO A GRANDSON

Dear Adrian, You may have thought that James Atkinson's 'Differential' gas engine, which I told you about in my last letter was ingenious, but I think that you will probably agree with me in thinking that his 'Cycle' engine, which he came out with in the following year (1886) went one better. Once again, he achieved the objective of a ratio of expansion greater than the compression ratio, and also completed the four-stroke cycle in one revolution of the crankshaft.

Before going on to consider the engine in detail, however, it would be as well for me to explain the reason for seeking to increase the ratio of expansion in the first place. Works on thermodynamics stress the point that the higher the temperature at which a heat engine takes in heat, and the lower the temperature at which it discharges it, the more efficient it will be. In order to take in the heat at a high temperature, internal combustion engines compress the charge (or, in the case of the Diesel, the air) before combustion is initiated. If the gases which compose the charge are an explosive mixture, there is usually, a limit to the amount of compression (and the heating which accompanies it) which the mixture can stand without catching fire spontaneously. This is called pre-ignition. In the case of a motor car engine, what limits the compression ratio is the compression pressure and temperature on full throttle. Car engines only run at full throttle for short periods of time, and consequently, could stand a higher compression ratio at other times, if such a thing were possible. I once took out a provisional patent for a type of engine which would do this, but although it was conceded by professional engineers that it could probably be developed for practical use, it undoubtedly complicated the design; and at the time, fuel then being much less expensive than it is today, they considered that alternative methods of improving the economy of an engine were more promising.

In a stationary engine, particularly one governed on the 'hit-and-miss' principle, where only a full charge is ever drawn in, such considerations are either less important or, indeed, irrelevant. But if a full charge is drawn in, it stands to reason that after it has been compressed, ignited, and then expanded in the same ratio, the hot gases must be at a considerably higher pressure than that of the atmosphere. Hence, the desirability of expanding the gases further before releasing them to exhaust. Experiments were even carried out around the 1880s with compounding on the same lines as steam engines, but the fuel which would have been saved was so inexpensive that the increased cost of compounding was not considered to be justified.

Once more, Grandpa has been straying up tempting by-ways, so let us return to the 'Cycle' engine, a schematic diagram of which is shown in my drawing (**fig 1**). You will see that 10 is the cylinder, provided with the usual inlet and exhaust valves. The crankshaft 1 carries the flywheel 12 and a crank 2. The crank-pin 3 works the link 4 to-and-fro, and the lower end of the link is articulated by the pin 5 to a crank 7 which oscillates about the shaft 7. The link 4 is broadened at its lower end to carry the pin 6 to which the connecting rod 8 is, connected. Please note that although pin 5 follows the circular arc X - X, pin 6 moves round a curved loop, by reason of the link 4 swinging from side to side as crank 2 goes round. It took me a little while to appreciate what happens, which is as follows:

During one rotation of the crankshaft, crank 7 moves first from top to bottom of its arc, and then, back up again. During both of these excursions, it pushes the piston inwards, and then draws it back out again. But, in part by virtue of the side to side swinging of link 4, the piston comes further out on the expansion stroke than it did on the induction stroke. It is all achieved so elegantly, and with so few moving parts, that I would call it a case of *"Ars celere artem"*, - the art lies in concealing art.

The valves were operated by cams via pushrods and rockers; and if the two additional components (4 and 7) compared to a conventional engine are to be considered a disadvantage, it is offset by the elimination of the camshaft. The ratio of expansion stroke to induction stroke in the engine was 1.79.

One of the uses of gas engines was driving a dynamo for providing electric light. If the speed of the engine varied, because of the appreciable interval between firing strokes, the lights would flicker in an annoying manner, even though heavy flywheels, might be used. Atkinson was awarded the Gold Medal of the Society of Arts because of the superiority of the 'Cycle' engine in this respect. Its speed variation at full load amounted to only 1.73% whereas that of a representative conventional (Crossley) engine was 6.57%. The Atkinson engine also proved to be slightly (0.68%) more efficient. Its overall efficiency was 17.0%.

Before I forget, I think I should mention that pre-ignition can be an insidious cause of loss of power in an engine. I have known of motorbikes which, if driven hard, would slow up for no apparent reason, so leading the worried rider to suspect that the piston was seizing up. I even experienced the same trouble with the decidedly woolly engine of the motor-mower. Decarbonising it for the first time in 35 years set it to rights. The point is, that in no instance was there any noise such as one hears when an engine is 'pinking'. That is not caused by pre-ignition, as if the ignition is switched off, the engine stops.

The reason is reputed to be that the charge is in an unstable state, in which it does not ignite spontaneously; but when the spark does set fire to it, it does not burn smoothly, but a detonation front passes very rapidly through it, with enough violence to produce the characteristic 'ping' when the wave-front strikes the metal of the cylinder wall.

You may like to hear, such personal details about the talented Mr. Atkinson as I have been able to glean. He came from an engineering family, and was born near Manchester in 1846. A marine engineering company in Jarrow (a town on the south bank of the Tyne estuary, close to Newcastle Upon Tyne, and, at the time, celebrated for its ship-yards) accepted him as an apprentice, and here his activities centred about steam propulsion equipment for ships.

However, he began to take an interest in gas engines, and in 1879 he was granted Patent No. 3213 for a form of hot-tube ignition. He went on to produce two-stroke engines of the type which James Robson (1833-1913) had devised in 1879. I have only read a short description of this engine, and my conception of it is shown in my sketch (**fig 2**).

The right-hand end of the cylinder is used to pump a combustible mixture into the receiver beneath. When the piston is at the left-hand end of the cylinder, it has compressed a charge, and when this explodes it drives the piston to the right. As soon as the piston starts to clear the exhaust port, the exhaust valve opens to clear the way. The inlet valve now opens to admit compressed charge from the receiver, and on its return stroke the piston compresses it. Meanwhile, the exhaust valve has closed the exhaust outlet, so as not to interfere with the pumping action of the piston.

In 1882 Atkinson gave his full attention to gas engines, and in 1883 the British Gas Engine & Engineering Co. was established in London with Atkinson as Managing Director. The company ceased operations in 1893, having built over a thousand 'Cycle' engines. Atkinson was then engaged by Crossley Bros. Ltd. as their chief engineer. Here, he devised the 'induced scavenge' system, which used a 'tuned' exhaust pipe, which could be as long as 60 feet. He retired in 1912, and his productive life ended in 1914.

And at this appropriate point, my letter also comes to an end.

●*To be continued.*

ROLLING ELEMENT BEARINGS

Gerald Martyn

comments on some recent correspondence.

There are so many misconceptions in Peter King's letter regarding needle roller bearing (*M.E.* 4241, 18 February 2005) that I think it rather important I try and correct some of them.

Firstly, but last in his letter, is the suggestion that catalogue bearing ratings have some sort of safety factor. Unfortunately this is no more true than it is to say there is a safety factor in the 60tonf/in^2 specification strength quoted against the steel he is using. The detail may be different but the data for bearings still defines failure states without any factors of safety, leaving the installation designer with the task of deciding what factors to use to achieve the required safety and reliability for the product he is designing. Evidently the ratings do not describe failure in the same way as the strengths quoted for steel do, so what do catalogue bearing ratings actually mean? These are described as follows.

The load carrying capacity of rolling element bearings is standardised across the industry and enshrined in various national and international standards. The basic dynamic rating, C, is the load at which 90% of the bearings will survive failure after 1 million revolutions. Looked at the other way (the cup half-empty way) 10% will fail. For a 4in. diameter passenger trolley wheel this is about 198 miles running, not very far. The static load rating is the load at which permanent indentations of the raceways or permanent squashing of the rolling elements (balls or rollers) equal to 0.01% of rolling element diameter occur. It is at about this level of damage that noisy operation will be noticed in subsequent use. Given this information it is the installation designer's job to select a bearing, which gives the required level of reliability and strength for his/her application, applying any safety factors deemed necessary. In the subsequent discussion I will limit the content to look at the dynamic rating only, otherwise this article will become far too long.

Perceptive readers may realise that as the dynamic rating relates a load to a survival life then metal fatigue may have something to do with the failure, and this is indeed the case. Fatigue is the brittle fracture of materials following repeated stresses of less than the static failure stress. In the case of bearings the fatigue damage occurs due to high stresses at the contacts between the rolling balls or rollers and their raceways, generally leading to pitting damage and rough running rather than structural collapse (unless you ignore the warning noises). Now fatigue failure is a vast subject, but interestingly was first seriously investigated in rolling element bearings back in the 19th century when some of the basic empirical formulae were laid down. One interesting fact is that the higher the repeated stress the shorter the life and, not unexpectedly, the lower the stress the longer the life. Experimental data is usually plotted on a log-life scale and the resulting curves known as S-N curves. In the case of bearings the curves are described by a formula as follows (and remember this describes the life for 10% probability of failure) is:

$$L_{10} = (C/P)^n$$

Where L_{10} is the life in millions of revolutions, C is the basic dynamic rating, P is the applied load. Exponent n is 3 for ball bearings and 10/3 for roller bearings. This equation is empirically derived from large quantities of historic data and is standard across the industry. Using this equation it is possible to work out the life at loads other than the dynamic rating; and note that loads higher than the rating are permitted, the bearing will just fail earlier than the 1 million cycles. Note also that there is no value of load at which failure will not occur, i.e. if you run it long enough even at very low load then failure will eventually occur. Modern theory (put forward particularly by SKF) suggests that with high quality, super-clean, specialist bearing steels and clean lubrication this is not the case and at a low load, defined as the endurance limit, no failure will occur, ever. Because the bearings in question here are running on commercial grade structural steel we are best to ignore this along with several other tweaks and tucks now available in the literature, and use the basic equation.

Rolling bearings are almost universally manufactured from highly refined and hardened specialist steels. These are usually (for catalogue listed bearings) a through hardening steel whereby the entire thickness of material is in the hardened state. It would be hardened and then tempered probably at temperatures no higher than 175-200deg. Celsius. This leads to a very hard and not very ductile steel which is not much use for anything but bearings. The tempering temperature may seem a bit on the low side to some readers, but in fact is adequate to provide stable material properties in most applications. In any event most lubricants are incapable of operating at much higher temperature so this itself helps define the required operating conditions and hence bearing requirements. The steel hardness would typically be 58-64 Rockwell C, with an implied tensile strength of 142tonf/in^2 (in old units), 2200MPa (for younger readers). All the bearing equations assume hardness in this range; anything less is simply not going to achieve the required reliability. Balls or rollers and raceways would also be honed to a very high standard as surface roughness (high spots) are stress raisers and lead to early failure. Those shiny steel balls you buy are like that for a reason and it costs money to achieve that finish. Mr King is proposing to use 60tonf/in^2 ground steel to form the inner races on his bearings. This steel has a hardness in the region of 29 Rockwell C. Now, to discover the effect of hardness on load rating is not easy. The stresses in rolling element contacts are complex and even the equations describing the simplest model, Hertzian contact stress, take many pages to describe. The important point to extract, though, is that the stresses between contacting spheres, cylinders and their curved tracks are not in a linear relationship with applied load i.e. 10% increase in load does not get a 10% increase in stress. This is because the area in contact changes as load is applied, unlike a beam in simple bending, for example, where the area is fixed. The effect of this is that reduced material hardness seems to have a dramatic effect on load carrying capacity. The fatigue strength of steel is roughly proportional to its tensile strength, but in rolling bearing contacts the non-linear effects mean that halving the strength does not lead to a mere halving of the load rating; it is much worse than that. There is not much readily available information on this because, for a bearing manufacturer, it would be such a pointless thing to do as such a bearing would be hopelessly uncompetitive. One source suggests an empirical equation for load rating of ball bearings at hardnesses below 58 Rockwell C is:

$$C' = C(R/58)^{3.6}$$

Where C' is the revised dynamic load rating for the 'soft' steel bearing, R is its Rockwell C hardness and C the basic dynamic rating for a bearing of that size. Whilst this is applicable for ball bearings it may not be (and probably is not) true for rollers. However, using this equation for illustration, if the value of R is taken as 29 the revised rating may be seen to be less than 10% of the normal bearing and it becomes self evident why bearing manufacturers all use the hardest steel they can find! Because bearing rollers have line contacts which can only grow in width under load (ignoring any crowning) as opposed to ball bearings which have elliptical contacts, which can grow in two directions, intuitively I would expect a roller bearing to be less susceptible to de-rating with hardness change than a ball bearing, but a bit more investigation is required to come up with an equivalent equation.

As to surface roughness I can find little useful data at short notice. I do recollect experimental data showing significant life reduction due to some poor quality balls, but have been unable to locate it. Looking to the SKF catalogue, the recommended surface finish for shafts forming the inner race of their bearings is 0.2 micron Ra or better (i.e. polished), which also comes with some pretty tight limits on roundness and conformity all of which most amateurs would find pretty hard to achieve.

Taking Mr King's bearing; the SKF HK 2820 does indeed have a dynamic load rating of 20,100 Newtons. But taking account of the above discussion I believe it should be de-rated by a factor in the region of 10 for the use proposed. Thus the dynamic rating becomes 2,010N (451lbf). Using his applied load of 210lbf and the life equation above gives a 10% failure life of 12.8 million revolutions. So after all that the life is not too bad. Guessing his wheel diameter as maybe 10-12in. the bearings are good for 6,300 miles, but one or two of them may be getting a bit rough by then.

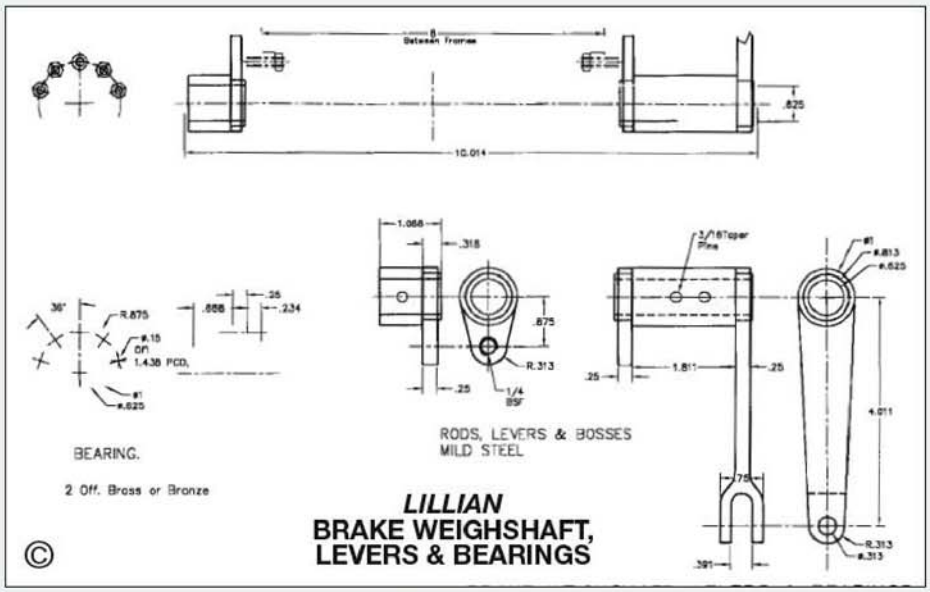
In conclusion, then, rolling bearing ratings describe failure states which are quite different to those for engineering structural materials, but in common they contain no safety factors. The dynamic rating describes a load, which will cause 10% of bearings to fail in 1 million revolutions. This may be scaled to other operating loads using the industry standard equation above. Static ratings describe a load which will damage the bearing sufficiently to cause rough running rather than any structural failure. Both the dynamic and static ratings must be significantly reduced if the balls or rollers are to be run on unhardened engineering structural steels or other unhardened materials. In any application very fine raceway surface finish is required to maximise the life.

KEITH'S COLUMN

Wilson's Words of Wisdom:
You can have peace or you can have freedom. Don't ever count on having both at once.

Keith Wilson
describes the brake gear.

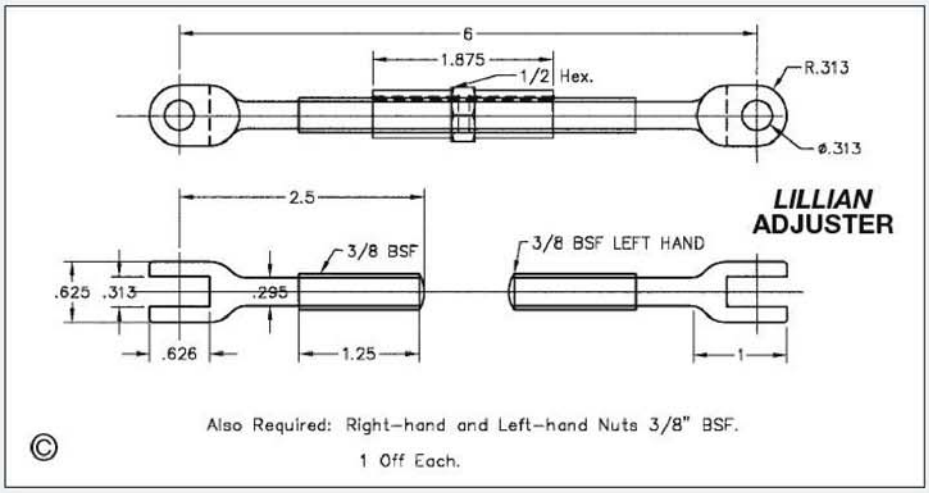
●*Part VII continued from page 340 (M.E. 4243, 18 March 2005)*



LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7¼in. gauge

I have already mentioned the advantages of fully compensated brake gear, the effectiveness of this compensating increases the effective power of the brakes amazingly. If non-compensated, it is virtually certain that only one wheel will be actually braked; however if the pull is directed at the centre of a crossbeam, two wheels - of course on the same axle. Not good, even with coupled axles as on this beastie.

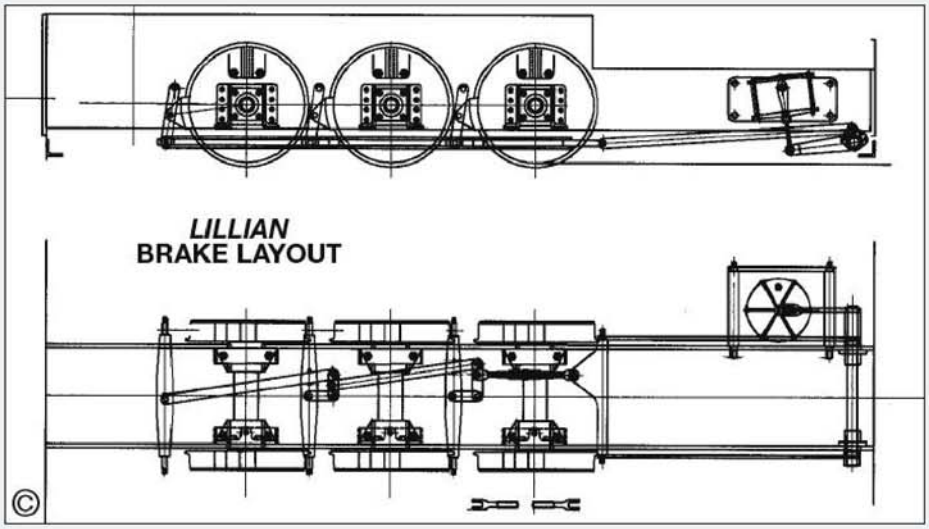
I used to employ plain brake gear on engines and tenders 'way back when' but when I tried a demonstration for myself, I was convinced once and for all. I compared a plain braked tender with a fully compensated one; put the handbrake on until the brake weighshaft is seen to bend, you can still push the tender along fairly easily.




An adjuster, the thinner nut marks the left-hand thread.

With full compensation, put the handbrake on - not too hard, certainly nowhere near as hard as the 'plain' tender, and try to shift it. I guarantee you'll be sadder and wiser afterwards - certainly wiser! It means a few extra parts have to be made, but the extra work pays for itself if faced with an emergency situation.

Brake blocks are easily made, I got a couple of flame-profiled steel rings; these can be mounted in the lathe and bored out to the exact size of the wheels; what's more they can be made tapered to match the 3deg. taper on the wheels. The outsides can be machined off to profile as shown, followed by cutting the rings into individual blocks. The pivot pins are plain lathe jobs and may be set up on the frames immediately but make them secure.



Brake levers

Best cut out by laser, for they must match well in pairs. Silver-braze them to the bosses in pairs.

Crossbeams

These are easily made from three pieces silver-brazed together. This is rather simpler than chewing them out of solid. The flat portions are plain milling or sawing jobs, the end part equally simple lathe jobs, followed by slotting in the milling machine. To hold them tightly enough, either clamp a lathe chuck on the milling table or alternatively a rectangular block of steel could be

reamed to an appropriate-sized hole, slotted to give some flexibility, then closing of the vice jaws will grip it remarkably tightly.

If the slot is a reasonably firm fit on the bar, an assembly jig will be superfluous. If a bit slack then prop up the centre bar on a couple of bits of steel (to keep it level) when the ends will remain in place during silver-brazing.

Links and levers

Plain marking out and filing jobs. Great accuracy not important.

Yoke

This part is useful in order not to restrict access to the grate and ashpan. Although I have shown a sideways ashpan well above the brake system level, it is still most useful to be able to reach up inside the firebox - when cold! I suppose it's not really a yoke, but we've got to call it something. To make life easier, the ends of this item may be made in the same way as the crossbeams.

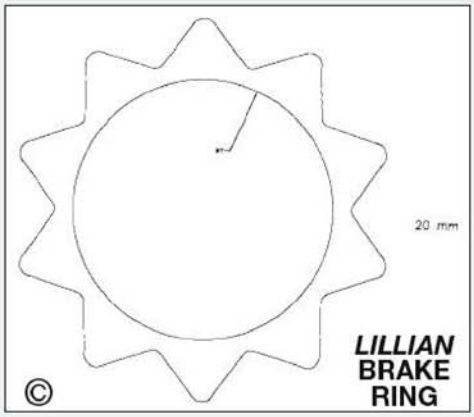
Adjuster

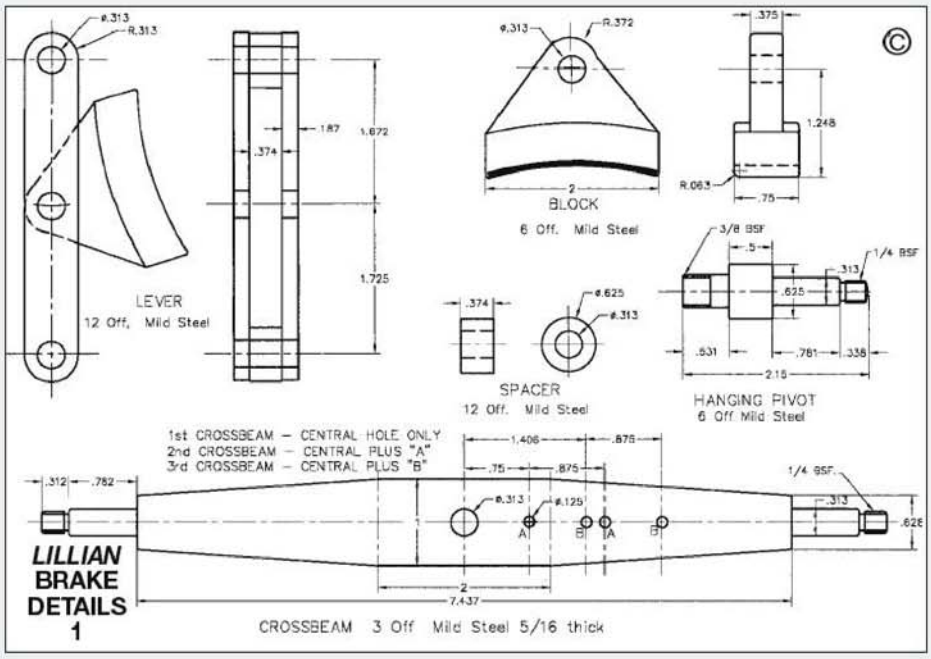
This item is more useful than might at first appear. However accurately the engine may be made, not only can tolerances build up as well as even out, but there is not a lot of travel available in the brake system after all, the compensating gear has taken up slack. Very little travel is needed, in fact the less the better, provided of course that the blocks will contact the wheels as well as leaving them clear. Therefore, an adjuster. Left-hand taps and dies are about the same price and availability as the normal right-hand ones. Using them keeps you on your toes, the number of times I have run the lathe in reverse to tap a left-hand thread, only to reverse it again to back the tap out, is now quite a high number! As well as the items shown for this device, a pair of nuts are required, one to each hand. The process of adjustment is obvious, but I will elaborate it in due course when we come to set up the complete engine.

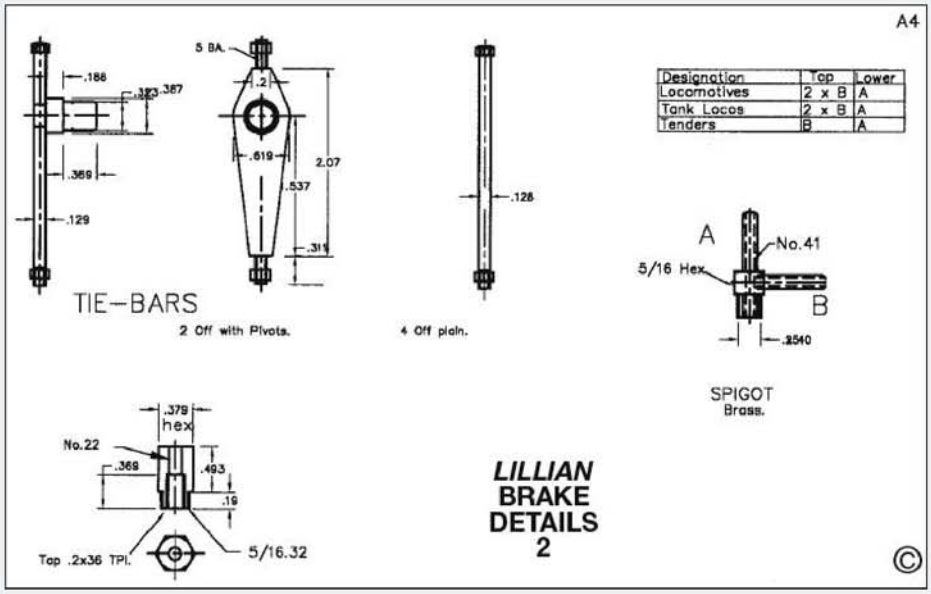
Brake cylinder

This is based on the standard 30in. vacuum brake cylinder as used on GWR engines. It delivers a pull of about 47lb on a 10in. vacuum. For those who are not over familiar with vaccua (correct plural of vacuum) it/they are usually measured in inches of mercury. That is, the height of a column of mercury that can be supported by the vacuum concerned. Maximum possible is about 14.7lb/in.^{2}, and is 30in. of mercury. It will vary slightly on variations of atmospheric pressure, but not enough to concern us. Miniature railways like about 5in. minimum to 10in. maximum, the former gives pretty good braking power, but 10in. is of course twice as good.

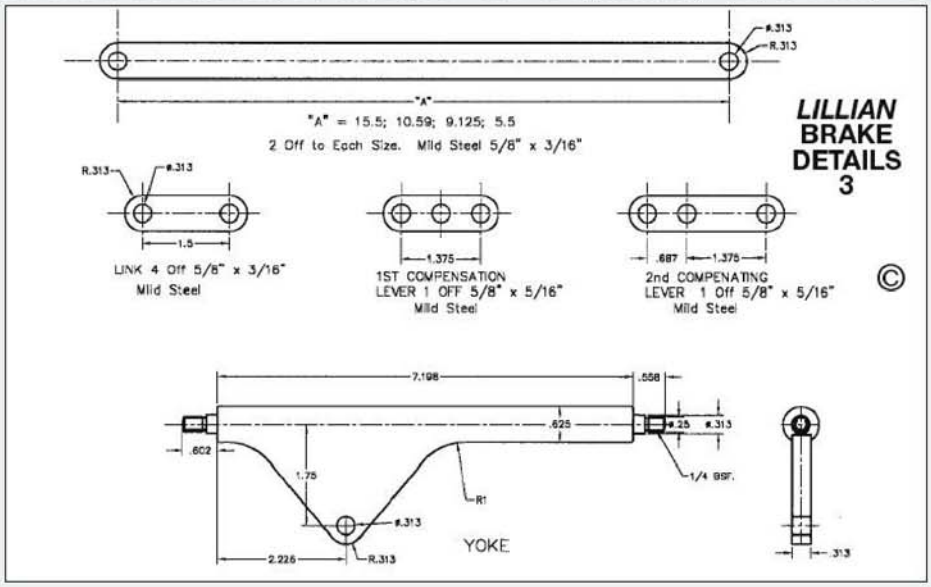
The leverage of the weighshaft is 4/0.875, a ratio of approximately 4.57, so already our ▶

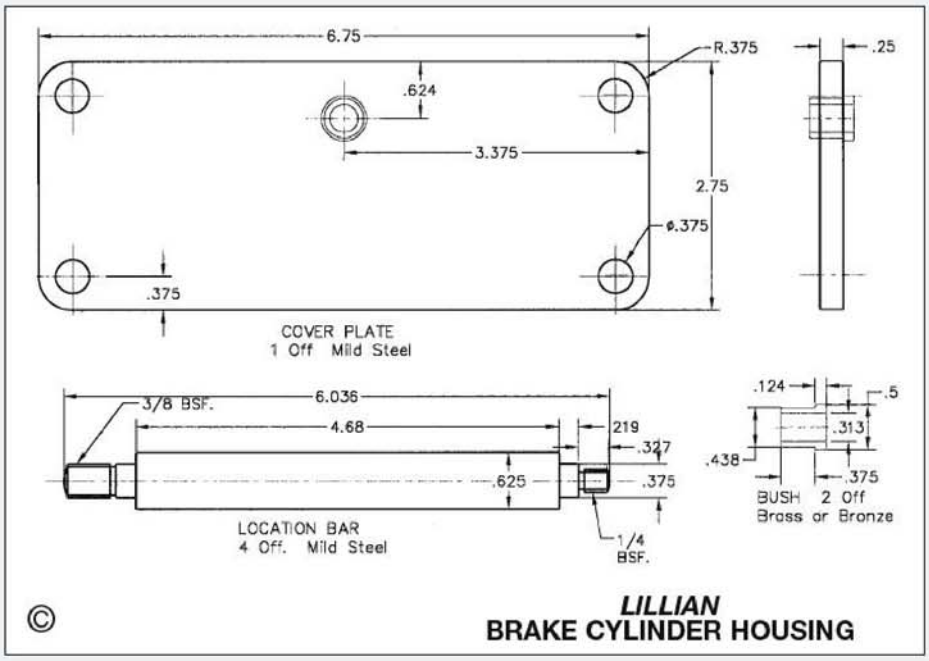






Designation	Top	Lower
Locomotives	2 x B	A
Tank Locos	2 x B	A
Tenders	B	A





A standard GWR type brake cylinder.

effective pull has reached 215lb. The brake levers double this (430lb) so with a full application on a 10in. 'wackum' we get a brake force of just over 72lb per wheel. Stopppp!

To make the cylinder, a piece of brass tube (10 gauge, 3 3/4in. O/D) needs machining 'square' at each end. The end covers can be made from plain brass discs; they will work just as well as the castings shown - we are writing of GWR type bits so back to shown for a time. The top and bottom shoulders should be reasonably good fits in the cylinder, especially the bottom one, for the piston must be held smoothly and centrally, but preferably not touching the cylinder. Once finished, the top is best fixed permanently to the cylinder - soft solder being recommended.

The piston is plain lathework; it needs to be axially true, for if the seal looses contact with the cylinder it won't seal. Hence care needed with the piston, rod, bottom cover, gland etc.

The standard 'U' seal may not be so familiar as the O-ring seal, but fits this situation perfectly. The little valve shown in the piston is important - unlikely as it might seem, it increases activity in the unit, and also adds considerably to the available force developed.

I only know of one type of valve that is absolutely tight, it is a 'soft' seating valve. The car tyre valve is such, and the nearest Imperial thread is 0.196in. x 36tpi. Halfords sell a fitting that will cut the thread, which there is good reason to believe is actually metric - probably 5 x 0.075mm pitch. However, there is no trouble with making your own tap - it has only to cut into brass after all.

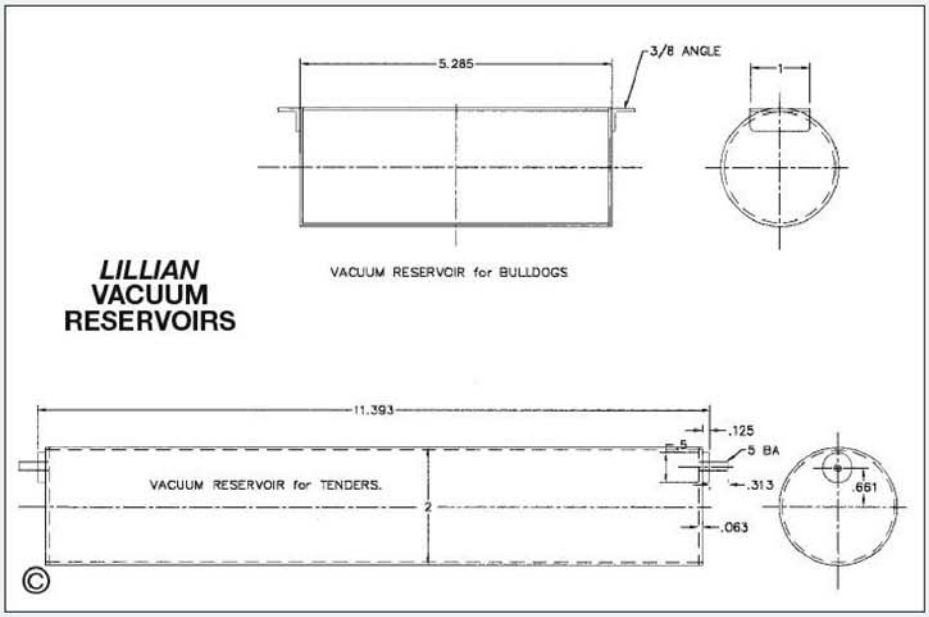
I don't think that the remaining bits need much explanation, but after fitting the piston to its rod, use some fairly fine carborundum or emery paper to get the rod smooth in the parallel direction - I hope that's clear. It will help the life of the O-ring.

I have shown some likely spigots for connecting the top of the cylinder to the reservoir, and the bottom of the cylinder to the 'train pipe'. Some 3/16 O/D plastic tube is adequate for this, it goes tightly over 5/32in. spigots. One of the 'over the cylinder' fittings will need to be a twin or 'T', because although when required for normal braking it is quite possible for leaks to reduce the braking power quickly, a certain Murphy's Law says that when you have let the steam out of the boiler and can no longer create a vacuum, the pesky system will go incredibly airtight and you certainly won't be able to push the engine along. It is quite amazing how true this is, but I suspect that it's probably the train that has tiny leaks, whereas the locomotive is probably better maintained. The spare branch on the 'T' is connected to a vacuum release valve mounted somewhere convenient - usually near the rear buffer plate for the engine, and about halfway along the side of the tender. This should be another car-tyre valve mounted in a convenient fitting. Incidentally, you will need another cylinder of this size for the tender; for although it's a tank engine, you've got to sit on something to drive and a tender with coal and extra water is highly recommended.

To explain the purpose of the valve in the piston. When the vacuum is created in the system, air must be drawn past the piston seal to evacuate the 'above piston' region to as near as possible to the same pressure as the under-piston system. Note that although the 'vacuum reservoir' - silly name really - may be nearer the ground than the piston, it is still 'above the cylinder'. There is clearly a pressure difference needed to pull air past the piston in the downward direction, this can be quite high, almost as much as the 'vacuum' itself. It is possible to purchase a variation on the 'U' seal, it is called a 'magneto seal' if my memory is not playing too many tricks. This is deeper than the 'U' seal, with one lip longer than the other, this lip being tapered to a very fine edge. This longer edge would just touch the inside of the cylinder. Thus the pressure difference could be minimal. However, many years ago I used this system, finding it not too reliable. The slightest lack of concentricity rendered the cylinder useless, and I measured the pressure differential and found it to be about 3lbf/inch^2.

This being so, no way could we get much useful pull from the cylinder. But with this little valve, there is a good pressure available to pull it to the bottom of the cylinder - thus firmly releasing the brake system. (Full size, the weight of the piston and rod will suffice for this). When it reaches the bottom, the valve is pushed open by contact with the bottom and the vacuum - or better still, the low-pressure - is equalised above and below. When the air is let into the 'train pipe' on brake applications, maximum power is obtained.

There is no such thing as a perfect vacuum, even inter-stellar space has quite a population of stray atoms and molecules; hence when the air is admitted and the piston moves upwards, it promptly compresses the residual air. This of course (Boyle's Law) increases its pressure, and



with a relatively short cylinder such as this one, the pressures soon equalise, all pull being lost. We cannot directly increase the length of the cylinder except by a small amount, however we can do so indirectly by attaching a tank above the cylinder. It follows that an empty tank carried on the vehicle gives far greater brake efficiency - just what we need.

Although old square-cube says our system is more powerful than 'scale', tiny leaks are far more important to us, so there is not much to spare. We need a system as tight as possible, 101% if attainable, and 'above the piston' tightness is absolutely vital. So testing is not time wasted. Bung bits under water, apply lung pressure (at least) and see what bubbles you get. Cure them - no arguments.

When testing the completed cylinder, note that it can give your fingers quite a nasty pinch if they get into the wrong position, 40lb or more thrust (or pull) can be darned painful!

Vacuum reservoir

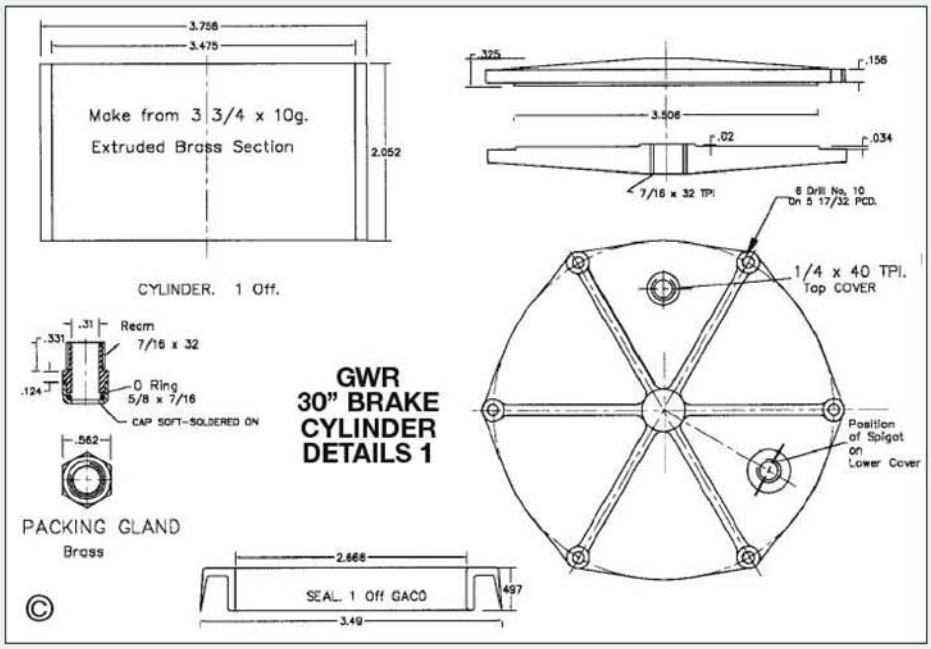
This is impossibly named - but it has no other name that I know of - device can be mounted anywhere convenient, as long as it is piped to the top of the brake cylinder and the release valve. It must be absolutely airtight. I show a suitable cylinder, its size can be altered to suite your desires, but in general the bigger the better.

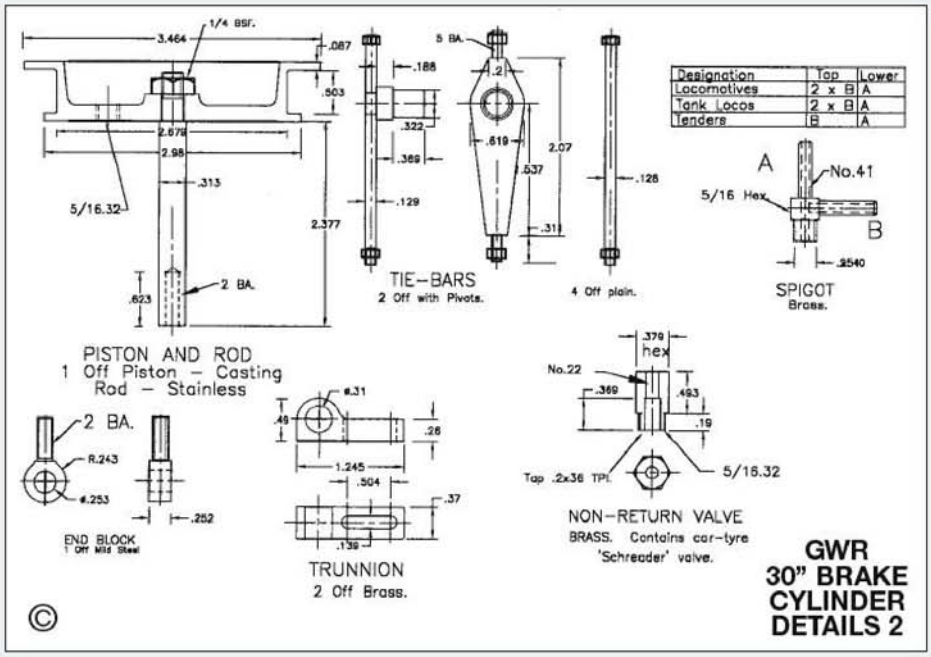
A vacuum pressure gauge (ugh!) is desirable somewhere in the cab; it should be a reasonable size (2in. suggested) and should read from 0 to 30in., unlikely as this may appear. To be sure, vacuum is normally measured in inches of mercury, about 30in. being the maximum possible. I do not know of any ejector that will reach this target, but about 45 years ago I knocked up a near-scale GWR air pump (correct name) that pulled up to 28in. when connected directly to the gauge. I never attached it to the engine and it has disappeared. This gauge is to be connected to the train pipe, it is not too important just where. If you manage to get hold of a duplex gauge, then one side connects to the train pipe and t'other to the top of the cylinder or to the reservoir. If the two needles are showing identical vaccua, then no brake pressure is applied; the difference between the two at other times will show the pressure difference across the piston and therefore the brake power applied; this is however a luxury in our size. It has been done, however, and looks good.

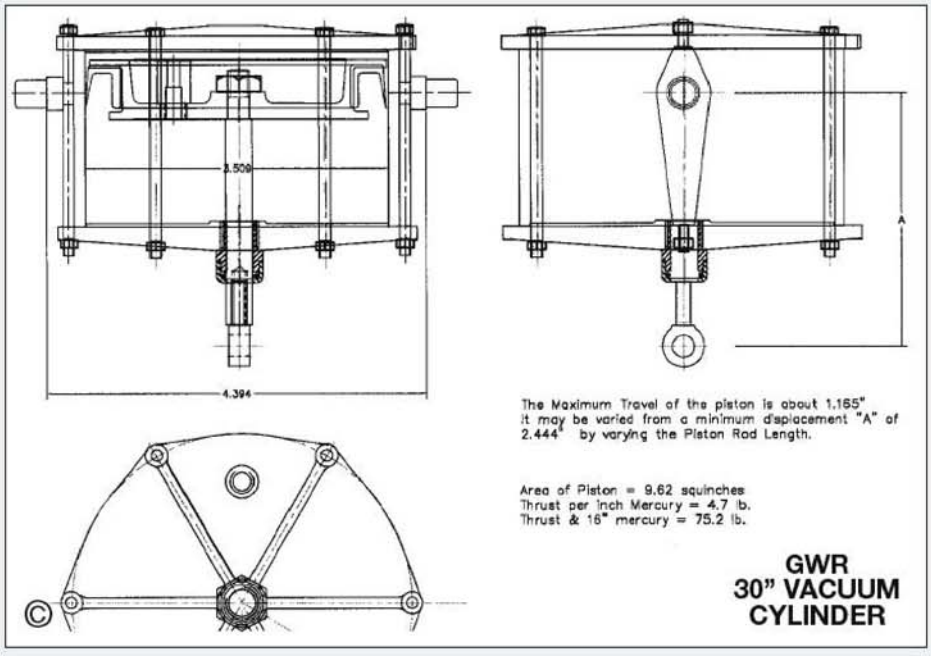
The supply of vacuum is created by an ejector. The one I will show was designed by Bill Hughes; I believe that some minor modifications can increase its potential. The original will pull up to 16in. with ease; occasionally I find one that pulls to 22 inches. It requires a couple of taper reamers, made after the form of a D-bit. A non-return valve can be used, but generally it is safest to leave the thing running all the time you are operating. The usage of steam is minimal.

A fascinating test with your first ejector (incidentally, they will work well with air as well as with steam, unlike an injector) is to couple it up to an empty plastic milk container, turn the ejector on and watch the container slowly collapse due to atmospheric pressure on the outside.

●*To be continued.*







CLUB CHAT
With Malcolm Stride

UK News

Under the heading *"Trains Revived"* in the newsletter of the **Furness MRC** is the interesting item that following the demise of the travelling Post Office trains last year, some are now being revived. The west coast main line from Euston to Glasgow being one. EWS has provided a special class 67 (67005 – Queens Messenger) in Royal Mail livery for the trains. The society have had problems with the roof of their club house leaking resulting in a night storage heater being doused in water. The council have now found and sorted out the problem. The night storage heater will, however, not be connected until the work is proven.

Doug Hewson reports that it was freezing cold weather at the recent **Lindsey Model Society** running day and AGM but that Chris Nesbitt and himself "*braved the two signalboxes with windows shut and heaters on to make sure things kept running*" Member Peter Layfield also braved the cold and had his first taste of signalling in Belle Isle box. The longest travelling member was Stuart Laidler from Northumberland and the society also hosted four members from Lincoln Society who were interested in seeing the signalling but mainly to look at the point motors to see how they operated. The running finished at about 1pm and the members tucked into a super lunch which was followed by the AGM. Doug comments that "*as usual the longest discussion was on Insurance*".

Alan Thatcher's 8 stroke engine and pump.

The **National 2½" Gauge Association** reports the good news that they have had *"a huge influx of new members in the last few months – the results of two successful model engineering exhibitions – that of Bristol (in mid August) and of the Midlands (late October)"*. This influx takes the society membership to over 350. The summer rally at the **Sutton Coldfield MES** was a great success with nine locomotives running and four more on static display. Scribe Steve Eaton reports that his son Toby had his first drive of *"Toby 2"* and *"seems to be getting the bug"*. He also reports seeing Peter de Salis-Johnston driving a 7¼in. gauge locomotive on the ground level track. The track got so busy at one point that the signals were turned off because everyone was stopped at a red! Perhaps this is the answer to full-size railway congestion problems?

The **Northern Mill Engine Society** have notified us of their open days for 2005. These are Sunday and Monday 1/2 May, Sunday and Monday 30/31 May, Sunday and Monday 29/30 August and Saturday and Sunday 11/12 September. Full details can be obtained from 01257-265003 or from the society website at **www.nmes.org** The next major project to be undertaken by the society will be the construction of the new boiler house. The society have received the all important planning permission and are now analysing costs.

Joy Brown, Editor of the **City of Oxford SME** newsletter reports being surprised when something she has printed in the newsletter appears in another magazine, in this case *Model Engineer*. Don't be surprised Joy, if you send newsletters in I endeavour to publish something out of them all. At the AGM, Chris Kelland was presented with the Savile Bradbury award for his services to the society over the year. A set of engraved garden tools was presented to Bill Tully to mark his retirement for gardening for the society. Also at the AGM the entire committee was re-elected en bloc so they must be doing a very good job. Projects for the year include developments to the track and a proposed new club house. This year marks the society's Golden Jubilee and we will hopefully report details of the celebrations in due course. The society was founded in 1955 as the 'Witney & West Oxford SME' and had access to the workshops at Witney Technical College and eventually built a track in the grounds of Blenheim Palace. The move to the present site at Cutteslowe Park took place in 1986 as did the change of name. Richard Brown reports the sad news that the Cornish boiler at Combe Mill has failed its annual examination due to severe corrosion at the seatings. It appears that the weight of the boiler on the brickwork was all that was holding the pressure in!

John Tomlinson with his Glasgow and South Western 2-6-0 at Fylde 2½" Gauge Rally.

Members of the **Peterborough SME** are looking forward to a talk by Alan Pell on 'Fairground Organs' on the 18 April. The annual traction engine rally will be held on July 16/17 this year and those who attended last year should by now have received this years entry forms.

Ivan Hurst, secretary of the **Pinewood Miniature Railway Society** has notified us of a change of contact details. Ivan can now be contacted at 16 Cypress Grove, Ash Vale, Aldershot, Hants GU12 5QN. Telephone 01252-510340 or via e-mail at **ivanatshed73d@yahoo.co.uk**

Reading SME are making progress on the fitting out of their latest container which will be used as a carriage and locomotive store. A redundant lorry tail lift is being adapted to act as a lift for rolling stock in order to make life easier for the members on running days. An extra lifting section is to be inserted into the raised track to facilitate access to the club house. The society have also ordered a commercial 5in. gauge electric powered Class 58 diesel locomotive for use on public running days. They are also celebrating their successful first visit to the Model Engineer Exhibition at Sandown and have already booked space for this year. Those who admired Alan Thatcher's unusual Aermotor eight stroke engine at Sandown will be pleased to know that it is now running well and powering the scale water pump.

Members of the **St. Albans & DMES** are very forward looking as evidenced by the fact that Chairman Michael Dyer is looking for a volunteer to put together an illustrated booklet detailing the history of the club ready for the 60th anniversary in 2007. The Christmas meeting was attended by about 60 members who had a very enjoyable evening with entertainment put on by Malcolm Beak and Mike Grossmith.

Members of **Taunton Model Engineers** report good progress on the new track at Creech St. Michael. The carriage shed is in use, albeit unfinished and track is now laid down to the bottom circle of stage one. The majority of the track for the return to the station is also made but the rate of future progress is governed by availability of funds and the society are keen to get enough track finished in order to be able to start public running. The situation has been helped by a donation of electrical items for the club house by Cory Medical of Culmhead. The newsletter also reports that the track has been welcomed by the local villagers with one now helping out with the track building efforts and three local football teams using the field. The society will be celebrating their 60th anniversary in 2006.

Members of **Tyneside SMEE** were entertained to a slide show covering British Steam Locomotives from all parts of the country from before World War Two up to the end of steam. What was noteworthy about this show by Norman Blackburn was the number of good quality colour pictures from the pre-war era. The show was so good that the tea break was cancelled! Tyneside is another club working on track improvements and have completed the link from the steaming bays to the bridge on the raised track

and are now planning to start work on the new ground level track.

Welling & District MES are celebrating their Diamond Anniversary this year and have notified us of their two open days. The days are Saturday, 7 May and Saturday, 8 October and will cater for 5in., 3½in. and gauge '1' locomotives together with traction engines. Further information can be obtained from Secretary R. Hawes at 7 Brendon Road, New Eltham, London SE9 3RP.

Members of **Wigan & DMES** are having the car park area improved with assistance from the local council. This is after last year's wet weather resulted in members cars regularly getting stuck in the soft ground. I would have thought this could be the ideal excuse *"I would have been home earlier, but the car got stuck!"*. The society are to hold their annual dinner on the 20 May. The Horace Hall Trophy, *"for significant contribution to the well being of the society"*, was awarded jointly to Alan Atherton and Geoff Winnard. Congratulations to both on this recognition of their efforts. The newsletter also carries yet another warning story about buying locomotives on E-bay. Apparently someone sent a cheque off for a 'Tich' which subsequently never arrived. The cheque was fortunately not cashed but the sellers have apparently received over £10,000 for goods that have never arrived and are under investigation by the police. So if you are thinking of buying locomotives on E-bay, it would seem sensible to ensure that you see them before handing over any money. The 'Noble Cup' awarded at the discretion of the committee for any outstanding piece of work that appears during the year was awarded to Norman Mathews *"for the remarkable work shown on his Garratt locomotive"*. The locomotive has reached the stage of being run on air.

World News

Australia

The **Model Engineers & Live Steamers Association** report a very successful exhibition weekend. Following a tribute by President George Bishop, a commemorative plaque to the late Des Rowland was unveiled by his widow, Heather, at the event. George reports that although the quantity of work was down this year, the quality was equally good. Dale Smith won the 'Doug & Mary Kuskie' and the 'Locomotion Trophy' awards for his unusual model of a Comet Model 'D' windmill on a stick tower, the 'Lynton McWatters Memorial Trophy' went to Des Pedley for his BB18 chassis and the 'Encouragement Trophy' was awarded to Dudley Curd for his *Blowfly* locomotive, also under construction. Dudley is a newcomer to model engineering and the *Blowfly* is his first project. The society have made and fitted cast aluminium locking protective covers to prevent vandalism to the track points. This removes the need to put down and take up the points for each running session.

Members of the **Steam Locomotive Society of Victoria** are carrying out work on the track and have modified the ground level riding cars which is having the desired effect of reducing derailments. The newsletter carries a warning for those mowing the grass to *"beware of new shrub plantings when mowing around – when it is a case of seedling versus mower, the mower will win every time"*.

The newsletter also carries this tale *"A council worker was observed digging a hole at the side of a city street. When it was finished he moved along 50 yards and dug another, similar hole. He then moved on again and dug another, and so on and on. While he was digging the third hole another council worker filled in the first hole. As he was digging hole number four his counterpart filled in the second hole, and so on and on. Asked by an interested passer-by what was going on he explained. "Well, it is like this, mate - we are usually a gang of three - but the bloke who puts in the trees is off sick today"*. It couldn't happen in the UK, could it? A tip in the newsletter by Dave Riches is for tying the drive dog and catchplate together when turning between centres. Dave uses electrical tie wraps for this job.

Canada

At a recent meeting of the **Toronto SME** various members brought items in to discuss. Gerry Reed

In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

E. M. (Mike) Collins	*SM&EE*
Peter Crookes	*Durban SME*
George Dockrell	*Stamford MES*
Bob Kaye	*Tyneside SMEE*
Ted Maga	*Wigan & District MES*
Alexander McLuckie	*Edinburgh SME*
Frank Parrington	*Pinewood Miniature Railway Society*
David Smith	*Mid Cheshire SME*

CLUB DIARY

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

APRIL

15 **Canvey R&MEC.** *Meeting.* Contact Brian Baker: 01702-512752.

15 **North London SME.** *Slide Show: Ian Johnston & Others.* Contact David Harris: 01707-326518.

15 **Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.

15 **Romford MEC.** *David Render: Wartime Tanks.* Contact Colin Hunt: 01708-709302.

16 **York City & DSME.** *John Chambers: Recent American Steam.* Contact Pat Martindale: 01262-676291.

17 **Bedford MES.** *Public Running.* Contact Ted Jolliffe: 01234-327791.

17 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.

17 **Frimley & Ascot LC.** *Club Running.* Contact Bob Dowman: 01252-835042.

17 **Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.

17 **Saffron Walden DSME.** *Public Running.* Contact Jack Setterfield: 01843-596822.

17 **St. Albans DMES.** *Club Running.* Contact Roy Verden: 01923-220590.

17 **Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.

18 **Leicester SME.** *John Bailiss: Video Evening.* Contact Raymond Wallis: 0116-285-8824.

18 **Model Steam Road Vehicle Soc.** *Colin Hawkins: Pecketts, Bristol's Locomotive Builders.* Contact Geoff Miles: 01869-247602.

18 **Peterborough SME.** *Alan Pell: Fair Organs.* Contact Tony Meek: 01778-345142.

19 **Chesterfield MES.** *J. Ward: Rolls-Royce Heritage.* Contact Mike Rhodes: 01623-648676.

19 **Erewash Valley MES.** *Safety Valves Talk.* Contact Jim Matthews: 01332-705259.

19 **Nottingham SMEE.** *Noel Coates: The Lancashire & Yorkshire Railway.* Contact Graham Davenport: 0115-8496703.

19 **Romney Marsh MES.** *Malcolm Hayward: Film Evening.* Contact John Wimble: 01797-362295.

19 **West Wiltshire SME.** *Exhibition.* Contact R. Nev. Boulton: 01380-828101.

20 **Bournemouth DSME.** *Bits & Pieces.* Contact Dave Fynn: 01202-474599.

20 **Glasgow & S.W. Rly Ass'n.** *AGM.* Contact Bruce Steven: 0141-810-3871.

20 **Guildford MES.** *Bits & Pieces.* Contact Dave Longhurst: 01428-605424.

20 **Leeds SMEE.** *Meeting Night.* Contact Colin Abrey: 01132-649630.

20 **MELSA.** *Monthly Club Meeting.* Contact Graham Chadbone: 07-4121-4341.

21 **East Somerset SMEE.** *AGM.* Contact Roger Davis: 01749-677195.

21 **Isle of Wight MES.** *Marine Night.* Contact Ken Stratton: 01983-531384.

21 **Rugby MES.** *Doug Hewson: Talk.* Contact David Eadon: 01788-576956.

21 **Sutton MEC.** *AGM.* Contact Bob Wood: 0208-641-6258.

22-24 **Guild of Model Wheelwrights.** *Midlands Woodworking & Woodturning, Warwicks Exhibition Centre.* Contact Biddy Hepper: 01492-623274.

23 **Chesterfield MES.** *Running Day.* Contact Mike Rhodes: 01623-648676.

23/24 **Guild of Model Wheelwrights.** *Arley Hall, Knutsford.* Contact Biddy Hepper: 01492-623274.

23 **Newton Abbot & District MES.** Exhibition at Bearnes School, Queen Street, Newton Abbot, Devon. Open from 10am - 4pm. Contact Graham Day: 01626 772739.

23 **Northampton SME.** *Birthday Party – Nigel Smith.* Contact Pete Jarman: 01234-708501 (eve).

24 **Basingstoke DMES.** *Traction Engine Day.* Contact Guy Harding: 01256-844861.

24 **Guildford MES.** *Members' Running Day.* Contact Dave Longhurst: 01428-605424.

24 **Harlington LS.** *Public Running.* Contact Peter Tarrant: 01895-851168.

24 **Isle of Wight MES.** *The 21st IWMES Model Loco Rally.* Contact Ken Stratton: 01983-531384.

24 **New Jersey Live Steamers, Inc.** *Steam-Up.* Contact Karl Pickles: 718-494-7263.

24 **N. W. Leicester SME.** *Miniature Traction Engine Rally.* Contact John Elliott: 01455-847040.

24 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.

described the techniques used for marking out our work and how these were influenced over the years by this illustrious journal. One tool, little seen in industry now, are Tool Maker's Buttons. Tool Maker's Buttons are either attached to the work by a screw, the clearance allowing for some adjustment, or in a closely reamed hole. The Buttons then provide a datum for subsequent operations. Kevin Close showed the hardware he is making for a 5 string electric headless Bass he is constructing. The device is in place of the worm and wheel used to tension the strings on a 'conventional' instrument and will be located at the bridge. After studying Scraping, Jeff Kingma has come to the conclusion that it is an acquired art that requires considerable patience, a view that will no doubt be echoed by many of our readers! It is another skill that is rarely seen in modern industry having been replaced by improved machining but is still useful in the final finishing of plain bearings and surfaces. Jeff described the various types of hand scrapers and their uses, as well as the other tools required such as reference surfaces, hones/stones, bluing compounds, squares, etc. Ernie Hill is building a 4in. scale Case Traction Engine and displayed the cylinder, trunk guide, crank and fly wheel assembly. Despite the bearings (Babbit) not having yet been scraped - they will be done after assembly with the boiler – it ran well in both directions on as little as 5psi of air. Ernie tells us that the boiler has been designed and detail drawings are being prepared.

South Africa

There has been some progress with facilities at the **Centurion SME** recently. The steaming bay roof is almost finished, and the members say they are very happy with it. Some painting still needs to be done, the foundation holes need to be filled, and then it will be time for some paving on the ground underneath. Another hard working group has made lots of progress with upgrading the other points. The society have also asked for tenders on an extension of the storage tunnel, which involves also fixing the roof of the current tunnel.

Shunting at Stowmarket at the Lindsey Model Society AGM.

Members of **Durban SME** have been busy at the track site on various tasks including repairs to the track, clearing overgrown bush, working on steaming bay plumbing and various other routine tidying up items. A recent survey regarding a new ground level track resulted in some 67% of those who replied stating that they are in favour.

United States

A varied selection of items on display at the January meeting of the **Bay Area Engine Modellers** included the main casting for Ken Hurst's straight six four stroke engine, Dwight Giles ball turning tool, Al Vassallo's tandem cylinder hot air engine and the very nice looking radiator by Dave Palmer which had all the fins machined from solid. Readers can see more detail on these and other items of interest in the excellent *Crank Calls* newsletter at **www.baemclub.com**

New Zealand

The Haswell Site of the **Canterbury SMEE** is reported as being *"in full swing with the raised track useable"*. The club F7 was completed in time for the Show weekend thanks to the sterling efforts of Ross Fielden and Kelvin Lewis. The locomotive has hydraulic drive powered by a Kubota 13hp diesel engine.

25	**Bedford MES.** *Favourite Videos.* Contact Ted Jolliffe: 01234-327791.
25	**Canterbury DMES (UK).** *B. Doorne: Windmills of Kent.* Contact Granville Askham: 01227-463295.
26	**Romney Marsh MES.** *Track Meeting.* Contact John Wimble: 01797-362295.
26	**Stafford DMES.** *Prepare for Summer Running – Talks on Boiler Testing, Operating Matters & Safety.* Contact Chris Dobbs: 01889-270533.
27	**Hull DSME.** *Jim Smith: Teaching Traditional Metalwork.* Contact Tony Finn: 01482-898434.
28	**Leyland SME.** *Lathe Attachments and Machining Aids Evening.* Contact A. P. Bibby: 01254-812049.
30	**Guernsey Model Engineering Society.** *Track Day.* Contact Dave Simon: 01481-251017.
30	**Leyland SME.** *'Uncle Sam's' members & guests afternoon driving session.* Contact A. P. Bibby: 01254-812049.
30	**National 2^1/2in. Gauge Ass'n.** *Locomotive Rally at Romney Marsh MES.* Contact Clive Young: 01233-626455.
30	**Romney Marsh MES.** *2^1/2in. Gauge Association Spring Rally.* Contact John Wimble: 01797-362295.
MAY	
1	**Amnerfield Miniature Railway.** *Public Running.* Contact David Jerome: 0118-9700274.
1/2	**Bedford MES.** *Public Running.* Contact Ted Jolliffe: 01234-327791.
1/2	**Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
1/2	**Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
1/2	**Elmdon MES.** *Family Days.* Contact Chris Giles: 0121-458-1291.
1	**Frimley & Ascot LC.** *Public Running.* Contact Bob Dowman: 01252-835042.
1	**Guild of Model Wheelwrights.** *Steam & Vintage Event, Monmouth Showground.* Contact Biddy Hepper: 01492-623274.
1	**Guildford MES.** *Public Running.* Contact Dave Longhurst: 01428-605424.
1	**Leeds SMEE.** *Running Day.* Contact Colin Abrey: 01132-649630.
1/2	**Northern Mill Engine Society.** *Open Days.* Contact John Phillp: 01257-265003.
1	**Plymouth MSLS.** *Public Running.* Contact John Brooker: 01752-671722.
1	**Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
2	**Cardiff MES.** *Steam-Up and Family Day.* Contact Trevor Jenkins: 029-2075-5568.
2	**Northampton SME.** *Public Running Day.* Contact Pete Jarman: 01234-708501 (eve).
2	**Saffron Walden DSME.** *Running Day with Barbecue (public running after 2pm).* Contact Jack Setterfield: 01843-596822.
2	**Stockholes Farm MR.** *May Day Running.* Contact Ivan Smith: 01427-872723.
2	**Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.
3	**North Cornwall MES.** *Club Meeting & Track Evening.* Contact Ray Reed: 01237-424254.
3	**Peterborough SME.** *Bits & Pieces.* Contact Tony Meek: 01778-345142.
3	**Romney Marsh MES.** *Track Meeting.* Contact John Wimble: 01797-362295.
3	**Taunton ME.** *Trophy Night & Boiler Testing.* Contact Don Martin: 01460-63162.
4	**Bradford MES.** *Spring Auction.* Contact John Mills: 01943-467844.
4/5	**Kew Bridge Steam Museum.** *Historic Fire Engine Rally.* Information: 020-8568-4757.
4	**Leeds SMEE.** *Problem Forum.* Contact Colin Abrey: 01132-649630.
5	**South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.
6	**Aylesbury (Vale of) MES.** *Clive Ellam: An Australian Adventure.* Contact Andy Rapley: 01296-420750.
6	**Canvey R&MEC.** *Quiz Night.* Contact Brian Baker: 01702-512752.
6-8	**Guild of Model Wheelwrights.** *Model Engineering & Modelling Exhibition, Gt. Yorks Showground, Harrogate.* Contact Biddy Hepper: 01492-623274.
6-8	***National Model Engineering & Modelling Exhibition.*** Great Yorkshire Showground, Harrogate. Friday/Saturday (6/7) 10am-6pm, Sunday (8) 10am-4-30pm. Adults £8, Over 65s £7, Under 16s accompanied by an adult £2. Information: 01977-699669 or 01977-661998 (eves).
6	**Maidstone MES (UK).** *Bits & Pieces.* Contact Martin Parham: 01622-630298.
6	**North London SME.** *AGM.* Contact David Harris: 01707-326518.
6	**North Norfolk MEC.** *Bits & Pieces.* Contact Gordon Ford: 01263-512350.
6	**Nottingham SMEE.** *Graham Davenport: Visit to the 12th Model Engineering & Modelling Exhibition, Harrogate.* Contact Graham Davenport: 0115-8496703.
6	**Portsmouth MES.** *General Meeting.* Contact John Warren: 023-9259-5354.
6	**Rochdale SMEE.** *Work in Progress.* Contact Mike Foster: 01706-360849.
6	**Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
7	**Ickenham DSME.** *Public Running.* Contact David Sexton: 01895-630125.
7/8	**Romney Marsh MES.** *RMMES Open Weekend.* Contact John Wimble: 01797-362295.
7	**SM&EE.** *Do it Ourselves Afternoon.* Contact David Boote: 01202-745862.
7	**Welling DMES.** *Open Day for 5in. & 3^1/2in. gauge locos & traction engines.* Contact Reg Hawes: 0208-859-1952.
8	**Cardiff MES.** *Open Day.* Contact Trevor Jenkins: 029-2075-5568.
8	**Guernsey Model Engineering Society.** *Liberation 60th.* Contact Dave Simon: 01481-251017.
8	**Guildford MES.** *Diesel/Electric Day.* Contact Dave Longhurst: 01428-605424.
8	**Harlington LS.** *Public Running.* Contact Peter Tarrant: 01895-851168.
8	**Rugby MES.** *2^1/2in. Gauge Invitation Day.* Contact David Eadon: 01788-576956.
8	**Sutton MEC.** *70th Annual Exhibition.* Contact Bob Wood: 0208-641-6258.

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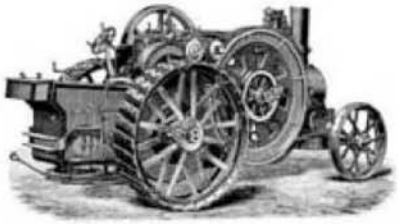

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