MODEL ENGINEER

Vol. 194 No. 4243 18th - 31st March 2005

NATIONAL MODEL ENGINEERING & MODELLING EXHIBITION

HARROGATE

6-8 MAY 2005

LEADSCREW REPAIR
Succour for old machines

HOT AIR ENGINES
Basic principles

HOBBYMAT
Milling head repair

FOWLER WAGON
Gully emptier

BL 5.5in. ARTILLERY GUN
Exciting new series

VOL 194 NO 4243 £2.50

74th MODEL ENGINEER EXHIBITION
Engineering classes: Competition reports

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

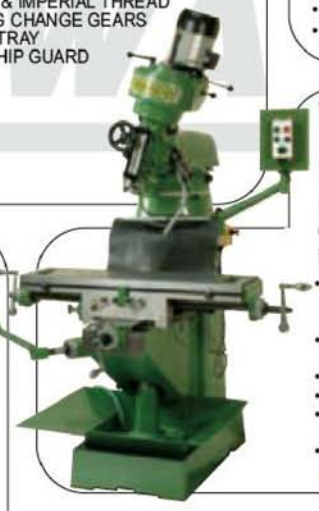
- ILLUSTRATED WITH OPTIONAL D.R.O AND POWER FEEDS
- TABLE SIZE 26" X 6"
- MOTOR 1 1/2 HP
- AVAILABLE 3MT R8 - METRIC - IMPERIAL

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

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

ZX-15 Milling Machine

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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IN THIS ISSUE

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On the cover ...

The Anti-War clock made by John Chandler and exhibited at the recent Model Engineer Exhibition. There have been many ornate clocks featured in M.E. over the years but few carry a message through their ornamentation. This year we mark the 60th Anniversary of the end of World War II and this clock provides a poignant reminder of events that took place all those years ago. To read more of the clock entries at MEX2004 turn to page 314 of this issue.

(Photograph by Mike Chrisp)

TURN TO PAGE 345 FOR GREAT OFFERS ON SUBSCRIPTIONS

INDEX to ADVERTISERS

G.L.R. DISCOUNT METAL PACKS

SAVE 15% OFF THE CATALOGUE PRICE WITH OUR BUDGET PACKS OF MATERIALS - 2 FEET EACH OF THE SIZES QUOTED BELOW

B.M.S. FLATS

AO	1/16 x 1/4 - 3/8 - 1/2 - 5/8 - 3/4 - 1 - 2 - 3 + 3/32 x 3/4, 1.	£10.45
A1	1/8 x 3/8 - 1/2 - 5/8 - 3/4 -1.	07.08
A2	3/16 x 3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1.	08.70
A3	1/4 x 3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1.	12.00
A4	5/16 x 1/2 - 3/4 - 1 - 1.1/2.	14.75
A5	3/8 x 1/2 - 3/4 - 1 - 1.1/2.	15.55
A7	1/2 x 3/4 - 1 - 1.1/4 - 1.1/2.	23.20

B.M.S. ROUNDS

B1	1/8 - 5/32 - 3/16 - 7/32 - 1/4 - 5/16 - 3/8.	04.92
B2	1/4 - 5/16 - 3/8 - 7/16 - 1/2 - 9/16 - 5/8.	10.55
B3	5/8 - 3/4 - 7/8 - 1.	17.45
B5	3/8 - 1/2 - 5/8 - 3/4 - 7/8 - 1 EN8M	23.52

B.M.S. HEXAGONS

C1	5/32 - 3/16 - 1/4 - 5/16 - 3/8	06.05
C2	1/4 - 9/32 - 5/16 - 3/8 - 7/16 - 1/2 - 5/8	11.58

B.M.S. SQUARES

D1	5/32 - 3/16 - 1/4 - 5/16 - 3/8	05.15
D2	7/16 - 1/2 - 5/8 - 3/4	11.58

BRASS ROUNDS

E1	1/8 - 3/16 - 1/4 - 5/16 - 3/8 - 1/2	11.65
E2	1/16 - 3/32 - 5/32 - 7/32 - 9/32 - 7/16 - 9/16 - 5/8	17.70

BRASS SQUARES

F1	1/8 - 3/16 - 1/4 - 5/16 - 3/8	09.90
F2	1/4 - 5/16 - 3/8 - 7/16 - 1/2	20.20

BRASS HEXAGONS

G1	5/32 - 3/16 - 7/32 - 1/4 - 9/31 - 5/16	08.20
G2	1/4 - 9/32 - 5/16 - 3/8 - 7/16 - 1/2 - 5/8	23.05

BRASS ANGLE

H1	1/4 x 1/4 x 1/16	5/16 x 5/16 x 1/18	
	3/8 x 3/8 x 1/16	1/2 x 1/2 x 1/16	09.00
H2	5/16 x 5/16 x1/16	3/8 x 3/8 x 1/16	
	1/2 x 1/2 x 1/8	3/4 x 3/4 x 1/8	15.45

DRAWN STEEL ANGLE

H3	12mm x 12mm x 3mm	16mm x 16mm x 3mm,	
	20mm x 20mm x 3mm	25mm x 25mm x 3mm	£14.22

SEAMLESS COPPER TUBE

J1	1/16 x 28g - 3/32 x 28g - 1/8 x 28g - 5/32 x 24g	06.20
J2	3/16 x 22g - 1/4 x 20g - 5/16 x 20g	04.95

STAINLESS STEEL ROUND 303 F/C

K1	3/32 - 1/8 - 5/32 - 3/16 - 7/32 - 1/4	10.92
K2	3/16 - 7/32 - 1/4 - 5/16 - 3/8 - 7/16 - 1/2	28.32

BA STAINLESS STEEL HEXAGONS 303 F/C

L1	.152" - .193" - .220" - .248" - .275" - .324"	18.18

BA BRASS HEXAGONS

M1	.152" - .193" - .220" - .248" - .275" - .324"	09.00

BA STEEL HEXAGONS

M2	.152" - .193" - .220" - .248" - .275" - .324"	04.30

BRASS FLATS

N1	1/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1	09.00
N3	1/8 x 1/4 - 3/8 - 1/2 - 3/4 - 1	15.50
N4	3/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1	21.65
N5	1/4 x 3/8 - 1/2 - 3/4 - 1	24.65

ALUMINIUM ROUND F/C

P1	3/16 - 1/4 - 5/16 - 3/8 - 7/16 - 1/2	10.25
P2	5/8 - 3/4 - 1	17.70

PHOSPHOR BRONZE ROUND

Q1	1/8 - 5/32 - 3/16 - 1/4	09.45
Q2	5/16 - 3/8 - 7/16	24.00

SILVER STEEL 1 X 13" OF EACH

S1	3/32 -1/8 -5/32 -3/18 - 7/32 -1/4 -9/32 -5/16 -3/8 - 7/16 - 1/2	20.40
S2	3mm - 4mm - 5mm - 6mm - 7mm - 8mm - 9mm - 10mm - 12mm	18.00

ALUMINIUM FLATS

R1	1/8 x 1/2 - 1/8 x 1 - 1/4 x 1/2 - 1/4 x 1 - 1/4 x 1.1/2 - 1/4 x 2	14.28
R2	3/8 x 1/2 - 3/8 x 1 - 3/8 x 1.1/2	11.87
R3	1/2 x 1 - 1/2 x 1.1/2 - 1/2 x 2	18.00
R4	1/2 x 2.1/2 - 1/2 x 3	21.15

METAL FINISHING PRODUCTS

NICKEL PLATING KITS Bright 0r Black Electro Plate on to: **Copper - Brass - Iron - Steel** Welded Brazed or Soldered Joints
"TEK-NICK" Workshop Kit £59.50 + £6.50 carr. **"TEK-NICK"** Mid-Tec Kit £115.00 + £7.00 carr. **"TEK-NICK"** Maxi-Tec £180.00 + £7.50 carr.
Instructions with all kits. Replacement components available

"KOOLBLAK" Simple immersion at room temperature. Permanent heavy duty blacking for **Steel - Iron - Cast Iron**
Creates an integral, professional finish with no dimentional change. A superlative black oxide finish on steel.
"KOOLBLAK" Starter kit £30.00 + £6.50 carr. **"KOOLBLAK"** Workshop kit £48.50 + £7.00 carr.
Instructions with all kits. Replacements available

"TECHTRATE" Steel blackening in salts. Gives an uniform Jet Black finish or on a polished surface gives a Blue/Black finish.
The solution operates at 141C / 285F Ideal for - Tools, Fasteners or Fittings. £37.60 + £06.50 carr.

"ZINCFAST XL" Produces a bright zinc deposit on **Steel & Iron.** For **Car & Motorcycle** components. Zinc is highly valued as a rustproof finish, suitable for all types of fasteners.Instructions with all kits - Replacement components available. Workshop kit £76.50 + £6.50 carr.

"CASE HARDENING POWDER" This case hardening compound gives an acceptable depth of hardening to steel components
250gms £12.00 + £2.00 Carr. 500 gms £18.00 + £3.00 Carr. 1000gms £30.00 + £6.50 carr.
DRY ACID SALTS 500gms £8.50 + £3.00 carr. - **COPPER SULPHATE** 500gms £7.95 + £3.00 carr

LOCOMOTIVE & MILL ENGINE DRAWINGS & CASTINGS

Thinking of building your first Locomotive or starting another one. See what we have to offer below.

7.1/4"G	Tich	0-4-0	3.1/2"G	Britannia	4-6-2
7.1/4"G	1366	0-6-0	3.1/2"G	Molly	0-6-0
5"NG	Dholpur	2-8-4	3.1/2"G	Cant. Lamb	0-4-0
5"G	Butch	0-6-0	3.1/2"G	Petrolea	2-4-0
5"G	Chub	0-4-0	3.1/2"G	Iris	0-6-0
5"G	Simplex	0-6-0	3.1/2"G	Doris	4-6-0
5"G	Springbok	4-6-0	3.1/2"G	Rainhill	0-2-2
5"G	King John	4-6-0	3.1/2"G	Heilan Lass.	4-6-2
5"G	Dean Goods	0-6-0	3.1/2"G	Rob Roy	0-6-0
5"G	2251	0-6-0	3.1/2"G	Miss 10 to 8	4-4-0
5"G	Firefly	2-6-2	3.1/2"G	Juliet	0-4-0
5"G	Mogul	2-6-2	3.1/2"G	Virginia	4-4-0
5"G	Peggy	0-4-0	3.1/2"G	Maisie	4-4-2
5"G	Twin Sisters	0-6-0	3.1/2"G	City of Truro	4-4-0
5"G	Pansy	0-6-0	3.1/2"G	P.V. Baker	0-6-0
5"G	Tich	0-4-0			
5"G New	Combpyne	4-4-2T	Radial Tank - L.S.W.R. 415 Class		
5"G New	Nine Elms	0-4-2	L.S.W.R. A12 Class with Beyer Tender		
5"G New	Salisbury	4-4-0	L.S.W.R. 460 Class		

Plus 6 0'gauge Locos

BUILD OUR POPULAR HORIZONTAL MILL ENGINE
1" Bore x 1.1/2" Stroke - Slide Valve. Base plate 12"
Diameter of Flywheel 6" Height 6" Width 6" Weight 4.1/2 Kilos
Complete with building instructions & 3D Drawings
£125 + £6.50 carriage

MULTI TUBE BOILER MATERIALS
Runs on Coal - Gas - Spirit
8.1/2" High plus chimney 4" Dia. X 16swg Copper Tube
25 5/16" x 20swg Copper fire tubes. Firebox 3.1/2" x 3.1/2" High
Working pressure 80psi - Suitable for above or similar engines
£65.00 +£6.50 carriage

Vertical engine with Governor coming soon
Also nice Grasshopper Type Hot Air Engine

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- Fixings

Founded 1906 by Mr Stuart Turner

STUART MODELS

Workshop Machinery Models

Stuart Pillar Drill

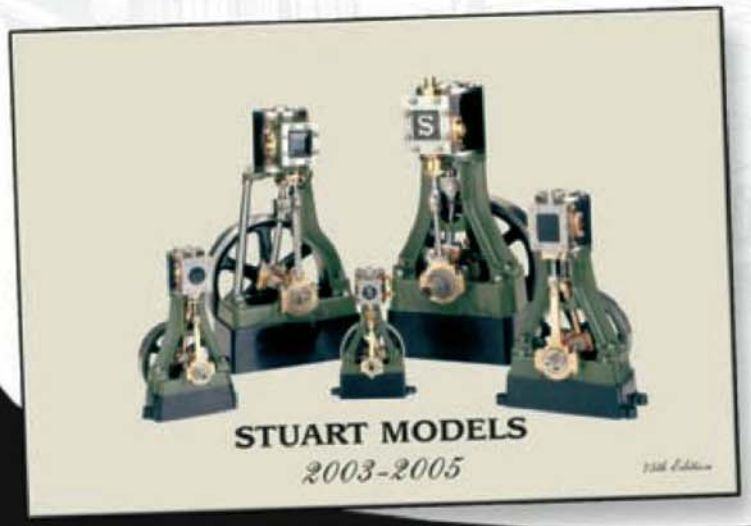
The Stuart Pillar Drill is now available from stock. this is the second release from our range of workshop machinery models, and makes an elegant counter piece to our first release, the Stuart Engineering Lathe.

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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Full Colour Catalogue

The all new Stuart Models catalogue is now available, featuring many new models including our range of workshop machinery, which are available as Sets of Castings, Machined Kits and Ready to Run Models.

Please send £5.00 for our New Catalogue

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Machine Mart

49 SUPERSTORES NATIONWIDE

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 CDP301B-CDP451F
20mm CDP501F

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

CMD125C

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

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	REDUCED
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	

Clarke rubber air hose (10m)

FROM ONLY £10.95 EX VAT £12.87 INC VAT

Clarke VICE

MULTI - PURPOSE CMV125

ONLY £37.95 EX VAT £44.59 INC VAT

- Jaw depth 75mm
- Jaw width 127mm
- Jaw opening 120mm
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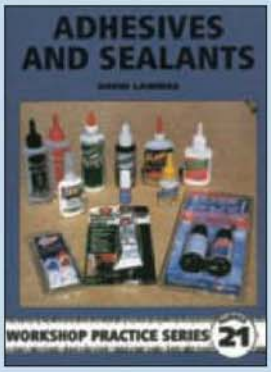

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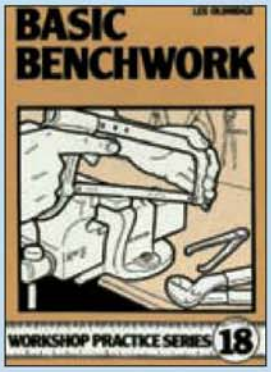

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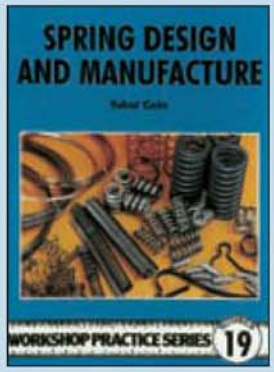

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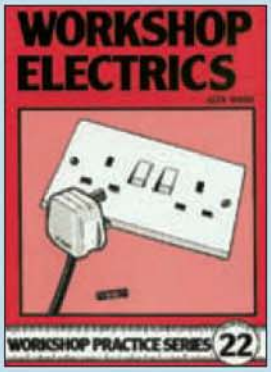

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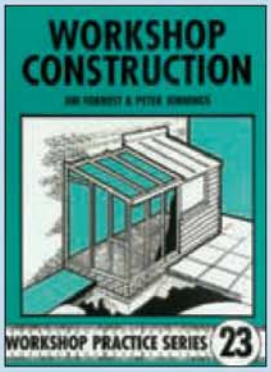

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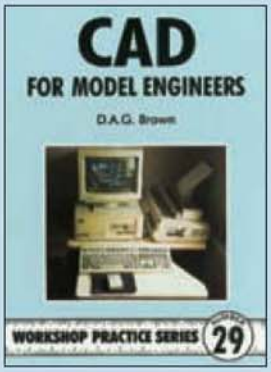

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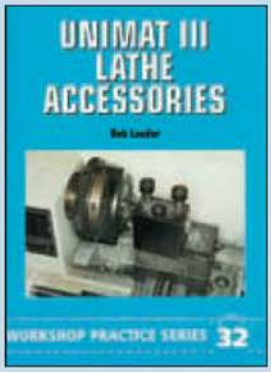

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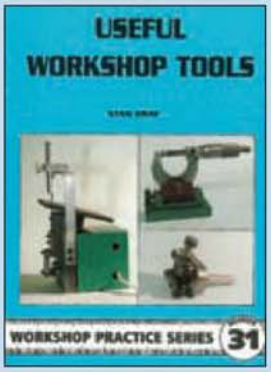

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SMOKE RINGS
With the Editors

Gatling gun

Regular readers may recall that in the classified advertisement sections of several issues published last year in volume 193 and also *M.E.* 4239, 21 January 2005 there appeared advertisements for plans for a working replica of a Gatling gun. These gained in detail as time went on. A non-technical colleague working in our advertising section unfortunately accepted these advertisements for publication. We were alerted to the potential consequences of building this replica gun by reader Mr. S. Trendall, whose letter appeared in *M.E.* 4240. Unfortunately Mr. Trendall's letter arrived too late to prevent the advertisement running in *M.E.* 4239 but it has now been removed from our classified pages and will not run again. Naturally our advertising department have been advised to reject advertisements of this nature in the future.

So readers fully understand the potential consequences of building one of these replicas we publish verbatim a letter from the Home Office: -

Advertisement for plans for working replica Gatling gun

"My attention has been drawn to an advertisement in your magazine for plans to construct a one third scale working replica Gatling gun.

Expert advice from the Forensic Science Service is that such a weapon is prohibited by section 5(1) (a) of the Firearms Act 1968. Unauthorised possession of a prohibited weapon is an offence punishable by up to ten years imprisonment. You may, therefore, care to advise your readership that if they obtain the plans and construct one of these guns without first obtaining the authority of the Secretary of State, they will be committing a very serious offence".

Keith Bottomley, Firearms Section
Crime Reduction and Police
Co-operation Unit.

The message is therefore clear. Readers are strongly advised not to undertake the building of one of these replicas as to do so would mean they are breaking the law.

The Railway Children

Those readers who are fond of railways and need to find something to keep younger members of the family happy over the Easter holidays may care to note the following news.

One of the best-loved children's books of the last century, E. Nesbit's classic story, *The Railway Children*, has been adapted for the stage. The play opens at London's Peacock Theatre on 23 March, making it a perfect treat for the Easter holidays.

Generations of children have been captivated by the story of Roberta, Peter and Phyllis whose middle-class London life is shattered when their father has to go away suddenly. When they move to a small country house near a station, their world changes completely. As they adjust to their new life, the railway and the trains become ever more important, introducing them to new friends and a wealth of new experiences. The story was immortalised for many enthusiasts in the 1970 film, starring Jenny Agutter as Roberta and Sally Thomsett as Phyllis.

Every day, the three children run down the field behind their cottage to the railway, to wave at the train to London, sending their love to their father. Little do they know that the kindly old gentleman traveller who waves back, holds the key to their father's disappearance.

Directed by Andrew Breakwell, this production features an old-fashioned station set, with real steam, flags, whistles and a replica steam train. The play has been adapted from the original book by Mary Elliott Nelson.

Presented by Nottingham Playhouse Theatre Company at The Peacock Theatre, Kingsway, London WC2; Wednesday 23 March - Sunday 10 April. Tickets sales: 0870-737-0337; website: **www.sadlerswells.com**

Dennis Hoyles

Norman Smedley, Chairman of Melton Mowbray & District MES writes: -

"It is with regret that we have to report that Dennis Hoyles, one of the vice presidents of the Melton Mowbray & District Model Engineering Society, passed away on 16th January 2005 aged 79 years.

Dennis' working life spanned the motor industry, where he served his apprenticeship, and the pet food industry where he managed a maintenance section before retiring. His hobbies included motorcycles, cars, power boating, shooting as well as model engineering. Having set up a workshop at home, he built a 'Simplex' and almost completed a 'Britannia' before having to set this aside to care for his wife.

He was a one of the founder members of our society. Dennis was a great motivator and worked tirelessly with other members to develop our track site at Whissendine. His friendly enthusiasm and energy, although he did not enjoy the best of health, will be remembered both by the 'track gang' and also the many other members to whom he offered encouragement."

The staff of *Model Engineer* extend their sincere condolences to Mr. Hoyle's family and also the members of Melton Mowbray & District Model Engineering Society.

Model engineering course - Evesham College

Readers living in the Evesham area may care to note the following announcement from Ms. Jane Dunn, part time course co-ordinator for the above course: -

"We have been running a Model Engineering course at Evesham College for over 15 years. During that time there has been a hard core of students, some of which are working on long term projects.

Unfortunately, over the years, numbers have depleted and in January this year we were faced with the possibility of having to cancel the course. Once cancelled, I doubt we will ever be able to start this up again. I am told that ours is the only such facility within 50 miles and these students are desperate not to lose their weekly class. They are working on anything from clocks to traction engines.

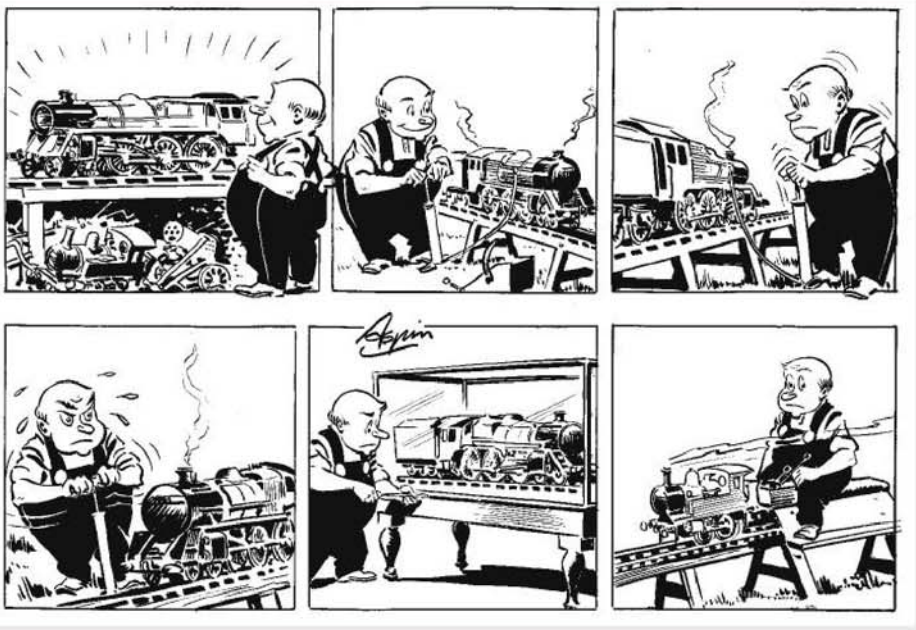
Our next course is due to start on 18 April 2005 (7-9pm). We just need a few more recruits to make the class viable. Anyone who is interested can contact our registrations department on 01386-712601 or contact myself on 01386-712648 for further details."

With the shrinking number of places on such courses now available around the country we urge interested readers to follow up Ms. Dunn's suggestion without delay.

John Haining

As we go to press we have just been advised of the death of our respected technical consultant and contributor John Haining. He was just a few weeks away from celebrating his 90th birthday. We will publish a full obituary in the next issue but the thoughts of the editorial team are with John's family and friends at this sad time.

CHUCK, the MUDDLE ENGINEER **by B. TERRY ASPIN**



Monotube steam generators

SIRS, - The statement by Mr. Cannell (*M.E.* 4238, 7 January 2005) that amateur constructors of his patented steam system would need to pay a licence fee (even a nominal one) cannot pass without comment.

Intellectual property law is a very complex subject. I have no knowledge of the details of Mr. Cannell's invention, so cannot comment on whether it meets the requirements of novelty and inventive step required for a patent to be valid (and note that the fact that the Patent Office issues a patent is no proof of these points). Normally, to make, import, sell or offer for sale a patented invention is an infringement of the rights of the owner of the patent, and can give rise to claims for damages or other legal redress. However, it is very clear is that this protection only covers the 'commercial' exploitation of an invention.

Section 60(5)(a) of The Patents Act 1977 (the current UK law on this point) provides a defence against an action for patent infringement where *"the act (the alleged infringement) was done privately, and not for commercial purposes"*. Note it must be both privately 'and' not for commercial purposes to qualify, though it is unlikely that using the item in public view would cause this test to be failed.

Also, S 60(5)(b) exempts *"acts done for experimental purposes relating to the subject matter of the invention"*. This would cover work designed to see how it worked, to see if it could be made better etc. There is no 'privately' condition in this exemption.

Thus a private individual making solely for his own use any item covered by a patent (or using likewise a process covered by a patent) could not be required to pay royalties to do so, nor could he be sued for doing so without payment. Indeed to make groundless threats of infringement proceedings can render the maker of such threats himself liable for damages (S 70 of The Patents Act 1977), though this is most unlikely to be applicable in such a case.

The 'amateur' would also probably be protected by the above defences if he later decided to sell the item constructed, or for instance if his executors sold it after his death, provided he had no commercial intent when he made it. However, I can offer no cast-iron opinion on this point. The exemption would not cover someone who sold kits of parts *"to make Mr. X's patented widget"*, or otherwise induced others to infringe a patent; this may (the position seems unclear) give rise to infringement proceedings. However, simply selling standard materials and leaving it up to the buyer to figure it out for himself would not.

Now I have no problem with Mr. Cannell taking steps to make money from what I am sure is his ingenuity, indeed I wish him well if he does so in a lawful way, for example by licensing suppliers or manufacturers to sell kits or finished products, or by selling drawings and manuals. However, I think it would be a sinister trend if every person who designed some ingenious model engineering item, some neat little gadget for the workshop, or some convenient little process for making things in a better or cheaper way, were to seek from all private individuals making or using it non-commercially a payment to which he has no entitlement.

I am no lawyer, I merely work from time to time with intellectual property issues. In particular, I refer only to UK law; the law in other jurisdictions may be different. I therefore simply suggest that the parties involved should look more carefully into the legal position before making such assertions.

David Littlewood, by e-mail.

Car name solved

With reference to M. J. H. Ellis' *Letters to a Grandson* (*M.E.* 4239, 21 January 2005). Mr. Ellis refers to a car called the *Cowal* and wonders how it acquired that name. It is most likely named after the area of Scotland to the north west of Glasgow, the peninsula between the Firth of Clyde/Loch Long and Loch Fyne, upon which the town of Dunoon is found. That area is called Cowal. I'm not the least interested in petrol engines but I do read everything within *M.E.* - it's such a good read!

Alan Topp, by e-mail.

Every picture tells a story

Seeing the Foden C type tractor on the front cover of *M.E.* 4236, 10 December 2004, brings back many memories of the days when I was the owner of a Foden D type *Mighty Atom* which I had in 1952.

I had made acquaintance with Peter Van Houten at an Appleford Rally as he had driven down from Leicester to take part and said he would like to go to more rallies in the south. Remember rallies were still thin on the ground in the early 1960s. What was agreed for the following year was that Peter would drive the Foden down to the Abingdon area towing his van and we from Andover would meet up in a lay-by or café at an agreed time, we would maybe have to wait an hour or so but life was a lot slower then and there was no mobile phones to communicate.

On changing crews the fire was cleaned for the run to Andover and storage was arranged in a contractor's yard ready for the coming Andover Rally. Peter would arrive in his van with his wife Edna and little Pete (son), sleeping bags were laid on the floor and the only heating was a square cast iron solid fuel stove, the type used in air raid shelters on which engine coal was burnt. After the rally it was back to the yard and store for a month or so to take in the Beaulieu Rally at the Motor Museum.

Peter would arrive with wife and 'Little Pete' in the van, stay the night and be away early in the morning with the van in tow to do the 35 miles to Beaulieu. It was on this trip that disaster struck as a distressed Peter arrived back in the yard to say he had 'dropped the plug' going up a hill outside King's Somborne on the A3057 road but had managed to get in a lay-by on the hill top. I was nearly ready to leave with my Foden No. 14078 *Mighty Atom* which was coupled up to my four-wheel Showman's Living Wagon. I told Peter to go back to his Foden and I would be along in about an hour and would tow him on down to Beaulieu. While you are waiting, I said, take off the ash pan and get the fire bars out ready to take out the plug. We will be able to re-lead it in the museum's workshops, as I knew them very well.

On arrival at the lay-by my living wagon was left behind Pete's Foden with room enough to get my tractor out, run round the front of Pete's Foden and couple the two together with my 8ft. push pole which was always carried across the back of my tractor. The two Fodens were backed onto the living wagon and we were ready to leave. Peter to steer his Foden and his wife to go on in the van to advise those in charge that we would be there later. The journey went very well and once we were away and down two hills it was mainly flat all the way. Pete was doing the braking and we also had a winch brake back to the living wagon from my Foden which my mate could use so we were confident we were not going to lose the lot.

We duly arrived amid cheers and whistle blowing, parked up in our approved spaces and went round the workshops to fix the plug after which he was able to take part in the two days of the rally. After this rescue operation the Chairman of the National Traction Engine Club wrote to the *News of the World* describing how I had helped another road user in trouble and I was made a 'Member of the Order of the Knights of the Road' and was given a certificate to this fact and also a windscreen badge.

To get Pete's Foden to the Appleford Rally he would drive it to Eastleigh and go back to Leicester in the van. It was stored under sheets at the loco depot for my mate John Davis and an Eastleigh loco man to do the run to Appleford. For some reason it was parked right by a mountain of coal, they said it would be sheltered there and out of sight which it was, to our advantage (enough said!). After leaving Eastleigh loco depot (S.R.) it was worked out that we would both meet up in a café outside of Newbury at and estimated time, this worked better than anticipated for as we were coming onto the roundabout on Andover side of Newbury Pete's Foden was coming in from the Winchester Road so we both met up more by luck than judgement I would say. We proceeded on to Appleford where Pete got his engine back, he then took it on back to Leicester. We did this rallying method for a few years until I suppose Pete died (Big Pete) and all contact was broken. It's only the picture on *Model Engineer's* cover that brings all this back to me, events which happened some 45 years ago.

Gordon Howell, Hampshire.

Let there be light!

SIRS, - May I pick up on Mr. Arthur Rowe's letter (*M.E.* 4238, 7 January 2005) concerning illumination and take this further please.

This is a subject which I feel could benefit from a lot more exploration. We frequently read of articles on workshop layout both in books and *M.E.* and each time the point of good illumination is mentioned. But actually how to get it is quite another point altogether. It is probably fair to say that most model engineers are older men - whatever older means! - and therefore suffer more or less with older sight. At 56 typically I do not need glasses to

read or work in my workshop because I am short-sighted but what I do need - and it has become very apparent over the last five years or so - is light and lots of it too.

To this end I have experimented and generally messed around with various lamps of all shapes and sizes but have not really solved the problem successfully. My workshop is small about 10ft. by 8ft. and about 8ft. high with only a small window so natural light even on a good day is not available. Currently I have six lamps in various positions around the room and operate them as needed. But the over-riding problem is just how much light is needed in a small area. For example, I need a 150 watt lamp within less than a foot for fine work and then it over heats the back of my hand if I'm not careful. I have tried halogen lamps and found that 250 watt gives the required background level of light but that due to the size of the room I cannot get far enough away from the heat.

The problem then persists but it is not an overriding snag now. I have also looked into specialist lighting with a view to getting the heat down and the light up but to no real avail and cost. One could pay a small fortune for a sophisticated lighting system in a workshop.

Does anyone have answers that are really effective and could this be the subject of an article in your pages perhaps?

Andrew Howard, by e-mail.

Kelvin Barber replies:

Have you considered Natural Daylight bulbs? These are available in either screw or bayonet fittings and a variety of different wattages. The cool white light they produce is glare free and of low heat and their use should alleviate headaches and eye-strain. Colours appear naturally under them so artists and model painters will definitely benefit from their use. Contact your local art shop or supplier for availability.

Mr. Stewart traced

SIRS, - I respond to the penultimate paragraph in the letter from Derek Alford (*M.E.* 4240, 4 February 2005). A D. M. Stewart wrote four letters to the *Model Engineer*, the first appearing on 27 February 1908 (Vol. 18, page 210), in which he describes, with photographs, the construction and operation of his 3in. gauge Midland Railway locomotive, and mentions some of the difficulties of model engineering in India; a two month wait for small screws and bolts sent from England and the crudity of wheel castings from a foundry in an Indian bazaar. The letters after his signature (A.M.Inst.C.E., P.W.Dept.) indicate associate membership of the Institution of Civil Engineers, and work in a railway permanent way department. In his next letter, 1 May 1924 (Vol. 50, page 503), he discusses at some length the comparative merits of water-tube and fire-tube boilers and methods of testing them and miniature locomotives; this was the period following the 'Battle of the Boilers'. He signs himself 'Lieut.-Col.' from Rajputana, India. His last two letters, 28 August and 11 September 1924 (Vol. 51, pages 250 and 306) reply to letters from other correspondents, and both were sent from Jodhpur State, India. I have not answered the question *"who was D. M. Stewart?"* beyond surmising that he was a qualified army railway engineer working in India, with a practical interest in miniature steam locomotives, but hope this information will assist Derek in his quest.

Chris Orchard, Northants.

Mystery item

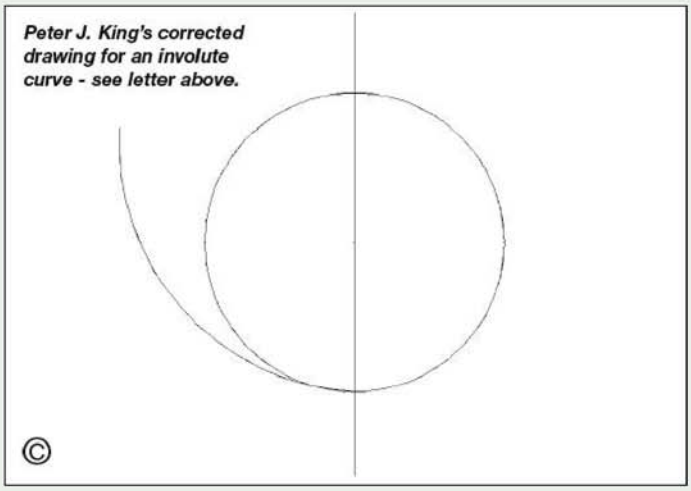
SIRS, - I wonder if one of our readers could recognise the item in the enclosed photo, and say when and where it was used. It is quite clever the way the smaller vial can be moved to suit all positions.

Pat Twist, Hampshire.

Re. Paradoxical Gears

SIRS, - Pardon my being pedantic, but I regret to inform you that the illustrations in the above article on (page 80 of *M.E.* 4239, 21 January 2005) that purport to show involute curves - do not! I enclose a drawing that is approximately correct - CAD programs don't like drawing involute curves much either. An involute curve starts as a tangent from the circumference of a circle but proscribes a line with an ever increasing radius, it does not start as a radius! I expect that you are being overwhelmed with letters about this point.

Peter J. King, New Zealand



Peter J. King's corrected drawing for an involute curve - see letter above.

More on Robertson

SIRS, - In *M.E.* 4239, 21 January 2005 you published number 72 in my series *Letters to a Grandson.* This article made reference to the very ingenious two-stroke engine invented by James Walter Robertson, but at the time that I wrote it I did not know a great deal about Robertson's career. Since then I have investigated the story of Robertson the man in considerable depth and have written a short biography of his life. He took out two further patents, number 720360 (improvements in electric motors) in 1954 and number 890065 (improvements in fishing reels) in 1962. Both are ingenious inventions, the first notably so. He was born at Strone on 4 July 1902 and died at Lochgilphead on 13 January 1984. A copy of my paper, together with a good photograph of Robertson, is held by Mr. Alistair Smith, curator of the Museum of Transport, 1 Birnhouse Road, Glasgow G3 8DP. He was so helpful to me that I feel sure that he would be pleased to do the same for any readers who want to know more about this very interesting inventor. I have also found out that the name of the car 'The Cowal' is derived from the peninsula of that name in Argyll.

M. J. H. Ellis, Bristol.

A secret admirer?

SIRS, - In *M.E.* 4237, 24 December 2004 you printed a letter from Ray Nightingale regarding a copy of LBSC's *Shops, Shed and Road* that he bought in a second-hand bookshop. I also purchased an old copy of this book some years ago in a second-hand bookshop in Chichester, Sussex, and this one has the signature 'K. N. Harris' inside the front cover. I well remember the often vitriolic correspondence that took place in the letters pages of this magazine between K. N. Harris and LBSC; could it be that K. N. Harris was a secret admirer of his arch-nemesis?

Malcolm Young, Bucks.

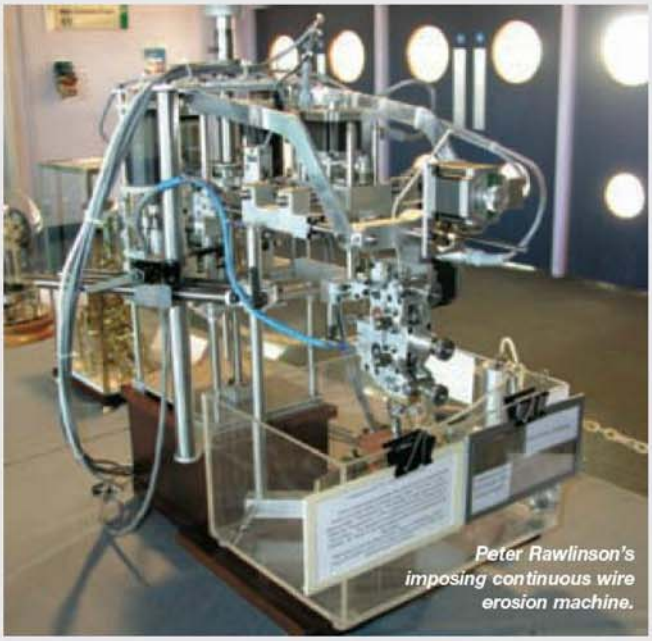
COMPETITION MODELS
AT THE 74th MODEL ENGINEER EXHIBITION

Class A5: TOOLS AND WORKSHOP APPLIANCES

Reported by Geoff Sheppard:

Dominating this year's 'Tooling section', both physically and technically, was Peter Rawlinson's Continuous Wire Eroder/Spark Eroder. Based on the machining principles of the more conventional spark eroder we saw some years ago, this device uses a continually moving wire in place of the copper electrode and is thus able to remove a narrow band of metal from the workpiece to create a slot. By moving the wire guides in a pre-determined path, profile cutting can be achieved.

A particularly ingenious feature is the mechanism, which transfers the 5000 metres (yes, 5Km!) of 0.008in. dia. electrode wire between spools, ensuring that it is 'precision' wound – that is that each turn lays next to and not on top of, the previous turn.



Peter Rawlinson's imposing continuous wire erosion machine.

Peter makes it clear that this is still an experimental machine, capable of further development, but felt that it is now in a state where it can be exhibited as a working unit. The judges decided that it was deserving of a Silver Medal and, because of the innovative design features incorporated, was worthy of the award of the Bowyer-Lowe Challenge Cup. The machine has already been fully described in *Model Engineers' Workshop* magazine (issues 95 to 99), so any reader seeking further information can find it readily.

Somewhat smaller, but also of high quality was the Stent tool and cutter grinder constructed by Peter Glenister of Buckinghamshire. This neat machine incorporated a number of modifications devised by Peter, including increased travel of the vertical slide, provision for the horizontal adjustment and 180 deg. rotation of the spindle and a grinding wheel mounting system which allows wheels to be interchanged with a minimum of re-dressing. Exhibited with a selection of accessories, this

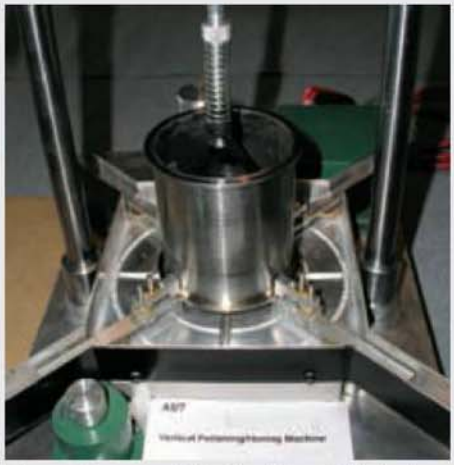
The work of the machine tool designer is not all plain sailing. Mr. Rawlinson was brave enough to show some of the results of his early experiments.

The Stent tool and cutter grinder built by Mr. Peter Glenister was well made and displayed with a range of tooling.

Entries by regular competitor Dr. Peter Clark are always well presented. This photo shows the slide rest element of his integrated lathe tooling system.

The other board in Dr. Clark's display showed how the tool holders can be used for hand turning operations.

Mr. Derrick Crossland's display of his much modified lathe tailstock and cross-slide.



The working area of Mr. Alan Wragg's Vertical Cylinder Polishing and Honing machine.

A simple pantograph engraving machine built up round a small power tool by Mr. Ian Cornish.

machine tool gained much admiration and was awarded a Bronze Medal.

Regular exhibitor Dr. Peter Clark of Southwold once again produced an attractive display of simple yet highly effective tooling, this time an integrated lathe tooling system. One element of the system was a set of individual tool holders for use in hand turning. Designed for use with a Lorch Junior lathe, these holders can, when used with raising blocks, also be employed on Lorch KD50 and Schaublin 70 lathes.

The second element of the system consists of a set of adaptors which, when used in conjunction with the tool blocks of the hand turning system, allows the use of very small section turning tools in the tool posts of a variety of lathes. Each tool is installed in its own block, providing integral height adjustment.

Dr. Clark's exhibit was displayed in the usual imaginative and informative fashion, allowing the viewer to gain a clear understanding of the purpose and operation. It was deserving of a Very Highly Commended Certificate.

A Highly Commended Certificate went to another stalwart exhibitor, Derrick Crossland of Warwick. This was for a group of modifications

A calliper type knurling tool made by Mr. G. Wooding to an **MEW** *design.*

applied to components of the popular 90 x 325mm bench lathe, which is available under a variety of brand names. One group of improvements apply to the tailstock, the original design of which is considered to have shortcomings in that it had limited access to the clamp nut and that control of the set-over is imprecise. A new clamp lever and the application of positive locking to the set-over screws have rectified the situation.

Modifications have also been made to the saddle and top slide, introducing graduated friction dials and also fitting a Dickson type toolpost. The latter improves rigidity by reducing the overhang of the top slide. The final addition is the provision of a graduated saddle stop.

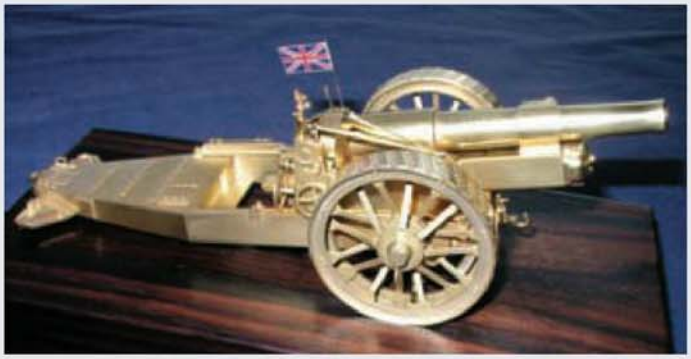
An interesting, light, special purpose machine also deserved a Highly Commended Certificate, this going to Alan Wragg of Horsham for his Vertical Cylinder Polishing and Honing Machine. Intended for use in finishing the bores of small engine cylinders, it employs one of the sprung multi-stone polishers used in the automotive trade for re-polishing hydraulic brake cylinders. Equipped with a small electric motor to rotate the polisher, it also features a system for automatically raising and lowering the stones through an adjustable range, thus allowing unattended operation. A small spray head located within the workpiece allows coolant (honing fluid) to be applied continuously.

Alan constructed the mechanical items, while a neighbour, Mike Knapp, provided the ▶

The skeleton clock built by Mr. Anthony Graham looked magnificent on its marble base.

The large balance wheel clock by Mr. Henery Penberthy was of intriguing design.

Mr. John Chantler's Anti-War clock was built to impart a message.



Mr. Esa Kaariaho's Mark VII (Vickers Mark VI) howitzer was well made but the gold plated finish was inappropriate for a model of a weapon.

Mr. Barry Glover brought this model of a Franklin Power Assisted Reverser all the way from Australia.

microprocessor and software, which control the speed of the drive motor and the reversing control of the lifting motor.

As built, the light construction and small motor capacity would preclude heavy metal removal but the same principles could be employed in a heavier version. However, this device provides a practical means of achieving the intended purpose and automates what can be a tedious task. Other items in Class A5 were a knurling tool built to the design published in issue 72 of *Model Engineers' Workshop* by Garry Wooding of Leamington Spa and a simple pantograph engraver incorporating a light power tool, built by Ian Cornish of South London.

Class A6: HOROLOGICAL, SCIENTIFIC, AND OPTICAL APPARATUS

Reported by Stan Bray:

Although the number of entries in the competition showed a considerable increase over 2004 there were only three in class A6. This follows the trend of a considerable entry one year followed by a much smaller one the next, however the lack of numbers was made up for by the quality of the entries.

Entry number one was a skeleton clock built to a published design by John Wilding and built by Anthony Graham of Gloucestershire. It was made to a standard that John would be pleased to see and was nicely set off on a marble and wood base that in itself demonstrated exceptional craftsmanship. It was housed in a glass case also built by the constructor to the same high standard and was certainly a piece of work to be proud of. The overall finish of the working parts and frame demonstrated careful workmanship and the builder had managed to impart a high quality finish and yet at the same time managing keep the wheel and frame edges square. The bell, for it is a clock that strikes the intervals, was commercially made but unlike so many of these it had a very mellow and pleasant tone, most being somewhat harsh. No doubt this was due to a prolonged period of experimentation by the builder. The standard was sufficiently high for the award of a Silver Medal.

Entry number two was yet another of the many designs of John Wilding and was built by Henery Penberthy from Surrey. It was an electric battery clock based on the Murday-Reason clock of the early nineteenth century. Unusually for an electric clock, it has a large balance wheel. The design was intriguing enough to attract a number of spectators anxious to discover the means by which it operated. Nicely made and a credit to the builder it did not however have quite the same quality of finish of the skeleton clock and in addition is a somewhat easier type to make. Not that making any clock is easy. It was awarded a Bronze Medal.

Also by Barry Glover was this Westinghouse A6ET Brake Valve and Pedestal.

John Chandler, also from Surrey, entered an exhibit described as an Anti-War Clock, unfortunately he did not supply a great deal of information other than the fact that it had been rebuilt from his entry last year. This was all very well but circumstances had dictated that a different team judged it on this occasion and had no experience of the original entry. It was basically a skeleton clock, but it was considerably embellished by a series of ladders and platforms, that gave it the appearance of a watchtower in a prisoner of war camp. These embellishments had involved a great deal of work, mainly one assumes sawing and filing heavy brass sheet. The idea was fine but probably more suited to an art exhibition than model engineering. It nevertheless showed good workmanship. It was badly let down by lack of attention to the finish, which was not of the type we expect to see on a clock, although it might be said that it was in keeping with an art exhibit. It was awarded a Commended Certificate.

Class A7: General Engineering

Reported by Stan Bray:

This class is reserved for engineering entries that do not easily fit in any other category. With the result that there are some unusual and very interesting items to be seen.

The first of the three entries was by Mr. Esa Kaariaho of Finland and was a 1:30 scale model of a Vickers 8in. super heavy, mark VI, howitzer. The model was superbly made and well detailed. Although artillery pieces such as this look like simple, if heavy, pieces of engineering, they in fact embody many fine mechanisms in their construction to enable aiming and firing to be carried out accurately and at high speed. These details appeared to be incorporated into the model with a high degree of craftsmanship. Only one point caused the judges concern. Mr. Kaariaho had chosen to gold plate his model. This resulted in the model looking, itself, like an award and tended to detract from its merit as a model of an actual weapon. Never the less the judges were sufficiently impressed to award a Silver Medal to this unusual model.

A view of the main, upstairs model hall at Sandown with splendid views of Epsom and beyond.

The other two entries were both by Barry Glover, also an overseas entrant and this time from even further away as he lives in New South Wales, Australia. Both were parts for a New South Wales Pacific Locomotive that he is obviously building, one a steam reverser and stand the other was a Westinghouse brake valve and pedestal. Such castings as were required were made from the builder's own lost wax patterns. They were made with the use of original works drawings and both items showed a high degree of craftsmanship as well as being of the utmost interest to steam locomotive enthusiasts. Both were awarded Commended Certificates.

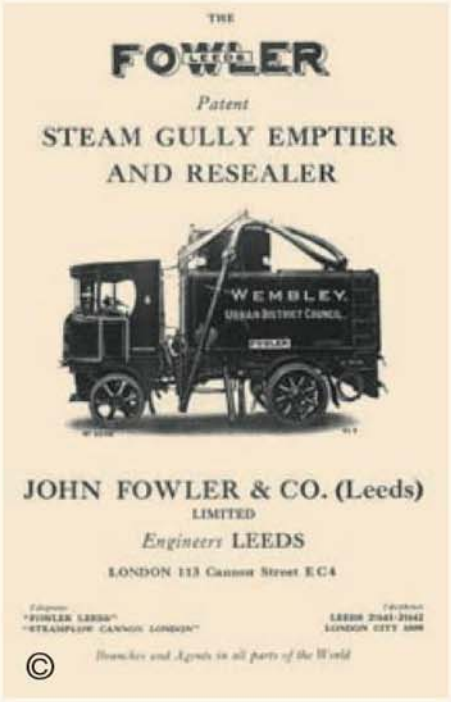
● *To be continued.*

FOWLER STEAM WAGON

Tony Webster
describes the gully emptying and tractor versions of the unique Fowler steam wagon and offers some concluding notes on his model.

●*Part XVI continued from page 203 (M.E. 4241, 18 February 2005)*

Many of the Fowler wagons were built with the company's patented gully emptier bodies. Details are given in their booklet, which is reproduced here. If you wish to build your wagon as a gully emptier this would save you some length as it would be only 4ft. 7in. long. You would be assured of a good water supply as I assume that the clean water capacity of 1,020 gallons (full-size) is also available for the boiler because there is no separate boiler water tank. The seat would be rather high and there would not be anywhere for a coal supply. I am sure that the sludge tank top could be modified to suit. The coal bunker between the seats is not very big or very convenient. Mine has coal glued to a dummy lid, which is hinged to the back of a separate inset bunker. This is then used as a very convenient toolbox.


THE
FOWLER
Patent
STEAM GULLY EMPTIER
AND RESEALER
WEMBLEY
URBAN DISTRICT COUNCIL
JOHN FOWLER & CO. (Leeds)
LIMITED
Engineers LEEDS
LONDON 113 Cannon Street E.C.4
"FOWLER LEEDS"
"STRAMPLOW CANNON LONDON"
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The three-way and the end tippers do not have room for a water tank at the rear of the chassis. As already described, these use a 'U' shaped tank between the axles, the front right corner of which provides a location for the lubricator pump, which is driven from an extension of the gearbox lay shaft. This will only be possible if the correct Fowler gear ratios are used

It is interesting to note that the pivot pin for the tipper body is well forward of the tailgate thus depositing the contents very close to the ground. Modern tippers pivot very close to the tailgate.

Last time you were able to see a list of the wagons built so that you can choose an appropriate number. I assume that those unspecified are 'standard' or long wheelbase wagons.

If you wish to build a gully emptier the appropriate Fowler drawing, number TRFCW/D01/65528, 23 April 1924, Arrangement of Fowler 'Patent Gully' Steam Wagon, can be obtained from the Rural History Centre, Reading University, PO Box 229 Whiteknights, Reading RG6 6AG.

During Dr. Brown's searches for drawings at the Rural History Museum, he came across ▶

Special Features of the Fowler Motor Gully Emptier

THE unique features of the "Fowler" Steam Gully Emptier have proved so efficient that they have been embodied in a motor vehicle.

The principal features of the "Fowler" system are :—

1—The vacuum is raised in a separate chamber. This, having a comparatively small capacity, enables the necessary degree of vacuum to be obtained in about 20 seconds. Special tests have been made to ensure the most suitable exhauster being used.

2—Patented automatic system of separating the liquid from the solid refuse, which enables a greater number of gullies to be emptied before it is necessary to discharge.

3—By the above separating system the refuse can be brought to the discharging place in a semi-dry condition.

4—The floor of the sludge tank has a very steep slope, which facilitates discharge of contents.

5—An ample supply of clean water is carried for cleansing and re-sealing the gullies.

6—With the "Fowler" system the *whole* of the contents of a gully are removed.

©

Arrangement of Tanks on the Fowler Motor Gully Emptier

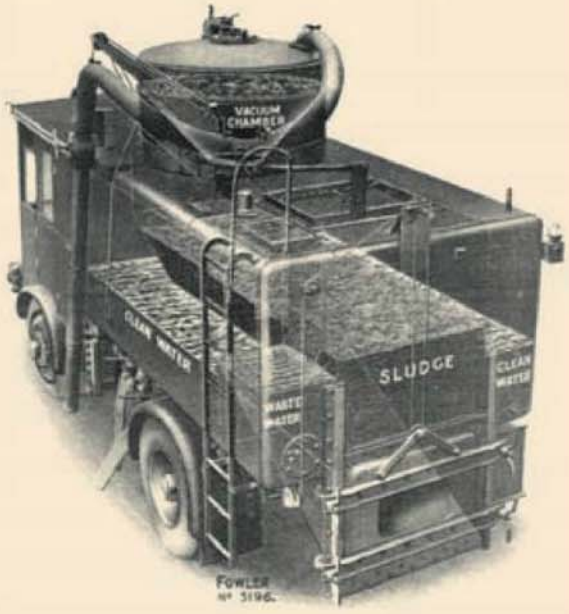


Diagram showing arrangement of sludge and clean water tanks.

Points Specially Worth Noting:—

The patented separating arrangement.
The large capacity for clean water.
The steep slope of the sludge tank floor.
The large opening for discharge of refuse.
The compact design.

General Description

THE Fowler Steam Gully Emptier has been designed after a careful study of the problem of street cleansing and is built on the chassis of the Fowler Steam Wagon which has proved so successful for all kinds of municipal work since its introduction a few years ago.

The leading features of the gully emptying body are—

1—The patented vacuum tank, placed on top of the main tank, in which a vacuum can be obtained by the steam ejector in less than half a minute at any time. This is an important advantage of steam compared to the petrol wagon, which has to obtain its vacuum slowly through a pump.

2—The patent method of drawing off surplus water from the top of the sludge tank for resealing the gullies. This at once increases the effective capacity of the wagon by leaving more room for sludge and solid matter.

3—The steep angle at which the sludge tank is set which makes the tank self emptying. As soon as the rear door is fully opened the steep angle of the floor causes the sludge to shoot out automatically without any raking or poking. The operator stands well away at the side to lift the door.

The clean water tank for resealing the gullies has a capacity of 1,020 gallons. The sludge tank itself has a capacity of 900 gallons, while the separate upper vacuum tank holds 165 gallons in addition.

The suction pipe is of 4½ in. diameter completely balanced, as shown in the illustrations, for easy handling. The steel pipe below the handles is 7 ft. 6 in. long, suitable for emptying gullies up to this depth, but longer pipes can be fitted to meet special conditions.

When required, special fittings can be provided so that the machine will empty gullies on both sides of the road without turning round, which is a great convenience in narrow streets. Special machines fitted with smaller tanks can also be supplied when desired.

The high speed of working with the Fowler Gully Emptier is obtained—

1—Through the high average vacuum which can be maintained for emptying the gullies in the shortest possible time.

2—Through the system of draining off surplus water which makes fewer journeys to the tip necessary.

3—Through quick moving from one gully to another and easy handling throughout.

4—Through quick and complete emptying at the tip.

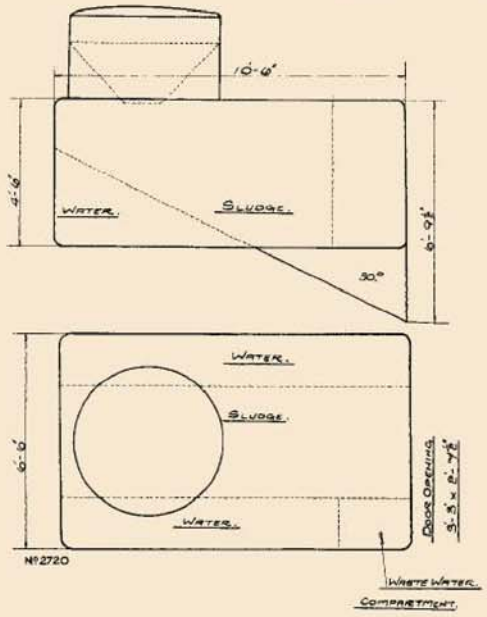


Diagram showing arrangement of sludge and clean water tanks.

drawing No. S.715 'Arrangement of Fowler patent shaft drive tractor' dated 29 October 1924. This interesting tractor was obviously offered for sale but a search through the Fowler records does not reveal any evidence of one being made.

Note the cab is longer, with the engine set further back in the chassis and the steering box mounted at a different angle. To accommodate the larger rear wheels there is a chain (or maybe gear) drive to bring the gearbox output up to the higher level of the rear axle. The axle is above the springs and there is only one set of rods to the rear brakes. This would make an interesting alternative to the standard, tipper or gully emptier versions of the wagon.

Acknowledgements

I am indebted to Dr. Jonathan Brown at the Rural History Centre at Reading University for his patience in finding Fowler drawings for me, and allowing me to use them in this series. I hope that it gives you the

Comparison

To empty 257 gullies per day 5' 0" deep (average), eight men and four horses and carts would be required at a cost of 5·09 pence per gully.

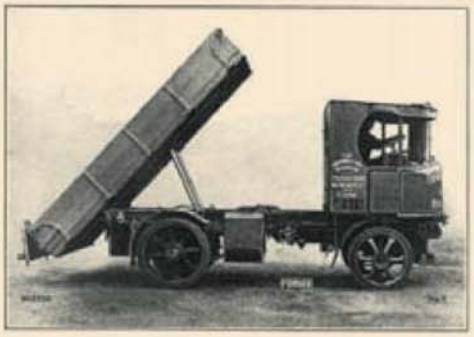
Cost of emptying 257 gullies per day 5' 0" deep (average) by the Fowler Gully Emptier would be 3·66 pence per gully, as shown on page 11.

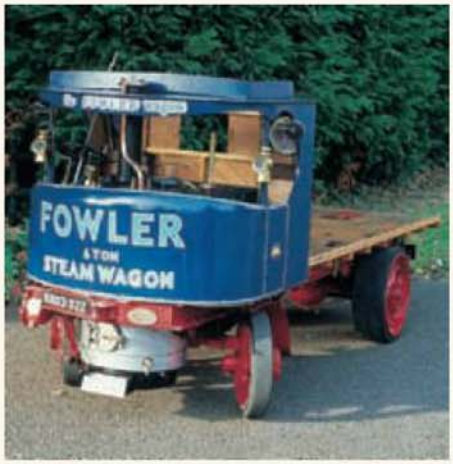
Saving per gully	1·43 pence.
Saving per annum on 61,680 gullies	£367 10s. 2d.

The Fowler Gully Emptier does not make the neighbourhood unhealthy by its presence, but is a pleasant object of interest to passers by.

Leading Dimensions

	Standard Wagon	Tipping Wagon	Gully Cleansing Wagon
Body Length ...	14 ft. 6 in.	12 ft. 0 in.	10 ft. 6 in.
Body Width ...	6 ft. 9 in.	6 ft. 9 in.	6 ft. 6 in.
Overall Length ...	20 ft. 2 in.	18 ft. 0 in.	18 ft. 4 in.
Wheel Base ...	11 ft. 0 in.	9 ft. 6 in.	9 ft. 6 in.
Height Overall ...	8 ft. 10 in.	8 ft. 10 in.	11 ft. 0 in.
Road Clearance ...	12 in.	12 in.	12 in.
Turning Radius ...	20 ft. 0 in.	18 ft. 0 in.	18 ft. 0 in.



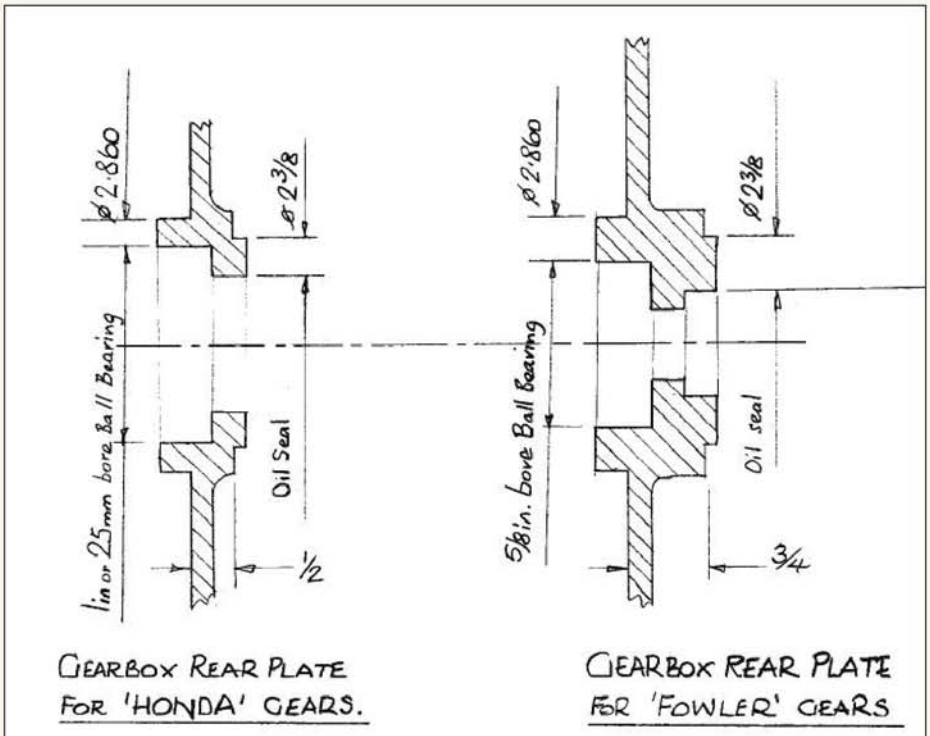


The author's Fowler wagon enjoys an outing in the sunshine.

same pleasure that it gave to me to work with the original 1920's Fowler drawings.

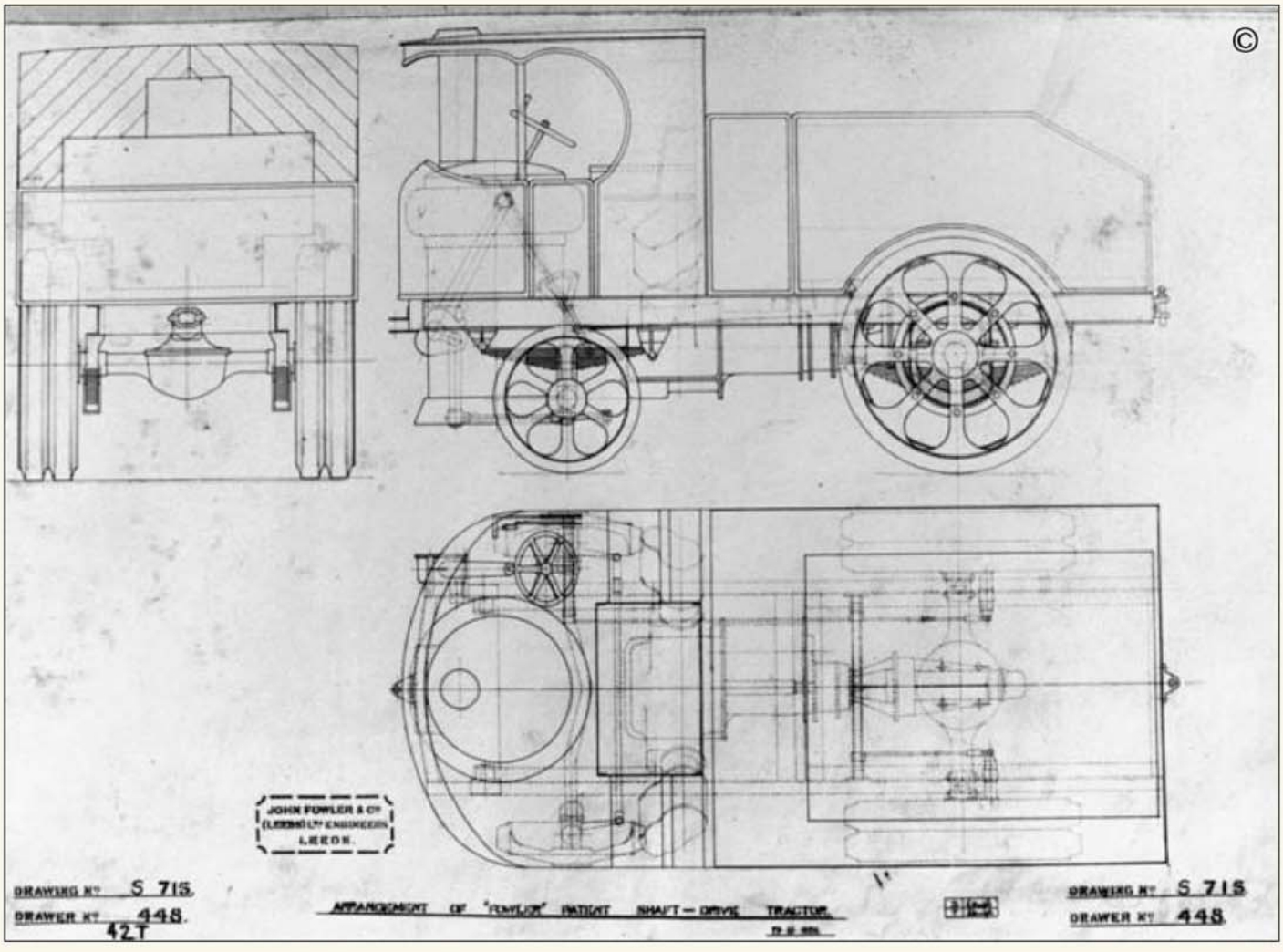
My thanks also go to Frank Strange who administers the Road Locomotive Society's Portfolios on Road Steam subjects. I also thank the chairman, Richard Willcox who gave his permission for me to use information from books and Fowler literature in the Fowler wagon portfolio. Brian Hutchings sent me the 'Fowler Wagon Parts List' for which I thank him. I have sent a copy for inclusion in the RLS Portfolio. I would also like to thank my wife and daughter for deciphering my writing and typing the manuscript.

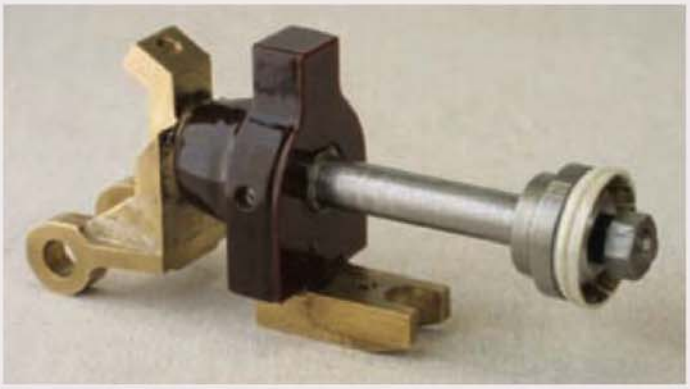
●*To be continued.*



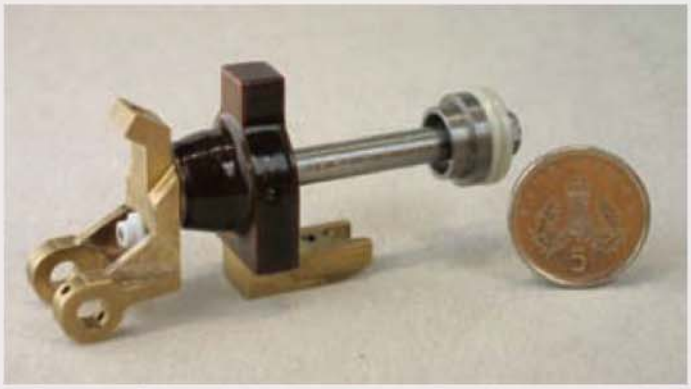
GEARBOX REAR PLATE

The author has asked that we include the revised drawing of the gearbox rear plate. It should be examined in conjunction with that published on page 35 of *M.E.* 4225, 9 July 2004. Different rear plates are required depending on whether the gearbox is built up around a Honda motorcycle gearbox or scratchbuilt.





The main operating piston and piston seals. The seals have a brass spreader which can just be seen behind the seal securing nut.



The operating spring for the contactor sits over the tapered retainer on the piston shown in this view.

ELECTRO-PNEUMATIC CONTACTORS

Colin Beckwith

looks at further details of the construction of these items starting with the piston rod guide.

●*Part V continued from page 211 (M.E. 4241, 18 February 2005)*

The stability of the piston rod as the piston moves up and down is important for correct main contact orientation. Misalignment must be avoided and it is the piston rod guide that ensures that this is minimised. It is basically a linear bearing with a large aspect ratio. In other words it is a long bearing with a small diameter. The shaping of this part also ensures that there is sufficient surface to limit the effects of wear during operation. The part is pressed into the cylinder body against a shoulder, which locates it axially. This is sized to act as the stabiliser for the upper end of the main opening spring. Again, this part can be removed if and when it wears out or becomes defective in some other way. This part is shown in fig 10 (*M.E.* 4241, 18 February 2005).

The piston rod guide allows the cylinder to be self-contained, as far as being a positive guide for the main contact alignment. Other ways of doing this were examined at the design stage. These can also be arranged to accommodate the anti-rotation feature mentioned in the cylinder construction. This can be possible if the main contacts are supported elsewhere by means of rotary bearings. In this way the duty of the cylinder can be reduced as far as contact alignment is concerned. The simplification of the cylinder arrangement is, of course, offset by the more elaborate main contact support. I much prefer the self-contained approach, hence my use of it here. It is neater, easier to produce and, more importantly, minimises the vertical height of the contactor. The cross over point, if I can put it that way, is when you need to provide a large contact gap. The separate hinge will then enable the cylinder height to be minimised. For my low voltage application the contact gap is not large enough to warrant the complication of exterior support.

The piston rod guide is manufactured from bright mild steel, which is turned to profile. The first operation is to generate the 5/16in. nominal diameter feature. This being a nominal diameter as it has to be adjusted up by about 0.001in. to create sufficient interference. The 25/64in. diameter for the spring stabilisation flange is then turned down. Still in the same set up, by necessity of concentricity, the 3/16in. diameter piston rod guide feature is drilled and reamed through the blank. The part can now be turned around to complete the remaining detail. The overall length of 5/8in. is the only critical dimension left as the 2.5deg. taper and 1/32in. radius are only really cosmetic features. Cosmetic features should not be taken for granted because, after all, that is what gives the finished article its character. In industry these little niceties are all too regularly left out in order to reduce cost. Absolutely everything has to be there for a reason and if it cannot be justified, it goes. That is what I really like about model engineering, the 'products' actually portray something of the builder.

Piston seals

These items are, even if I say it myself, quite an innovation by way of the material used. The full-sized contactor of this epoch used shaped leather piston seals, which were made from hide about 1/8in. thick. From early on I had seen the difficulty with using this material for the contactor I am making. The thickness of available leather is far more than the scaling will allow for this application. Having said that, I have seen some high quality gloves that are made of very thin hide of some sort, possibly of porcine origin. This unavailability of material started me looking for alternatives. Some people, including me, would naturally turn to neoprene O-rings. I found these to exhibit a lot of drag at this size and became unwilling to use them. Seeing that I wanted to keep friction losses low I started looking at more and more obscure materials albeit mainly plastic. This led me to the material that I have used ever since, which I found whilst looking through my bicycle 'bits box'. The material is actually handlebar tape for racing bikes, which was in roll-form. It might have been used on bikes of the Eddy Merckx epoch. The material is plastic and very pliable, just wide enough to cut out suitably sized discs for the seals. I have made numerous seals with this material and it has performed faultlessly under extensive testing. This design utilises two seals of different sizes formed into layers so as to rub against the cylinder bore. They are stabilised with a thin spreader and washer then secured

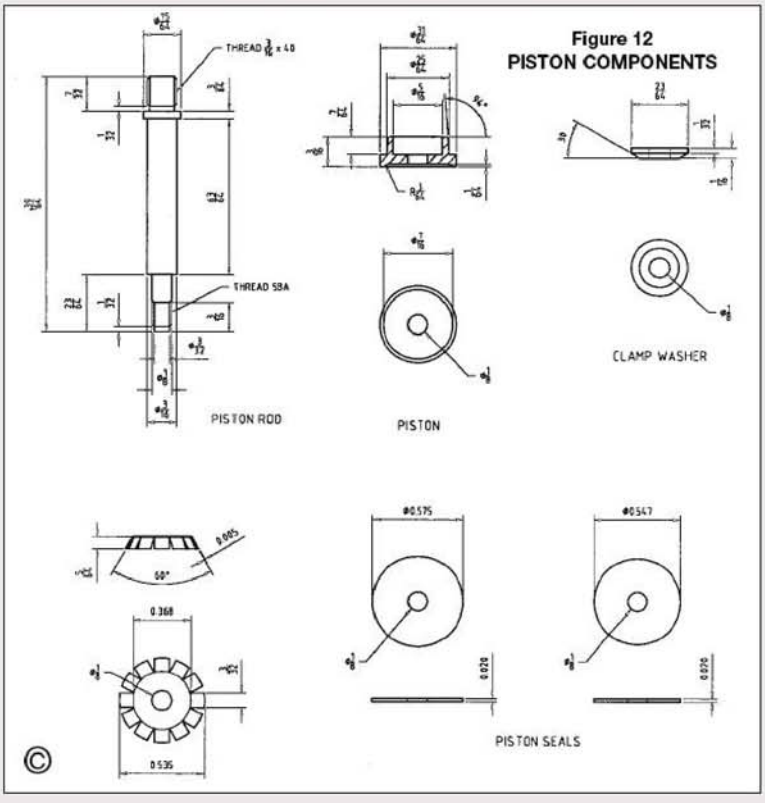
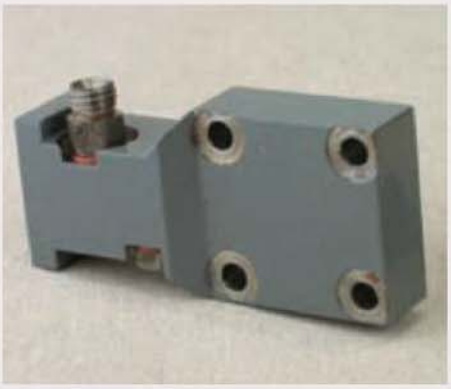


Figure 12
PISTON COMPONENTS



The bottom view of the cylinder cover. Note the air connection detail with adaptor.

The top view of the cylinder cover. The piston stop can be seen in position.

with a 5BA nut. Reference to fig 9 will illustrate the layout (*M.E.* 4241, 18 February 2005). The details are shown in **fig 12**.

Piston

The piston is mainly used to hold the seals already discussed. There is a recess on its underside to accommodate them. The recess has a radius at the outer edge to facilitate good seating and avoid chafing. A paper washer is placed between the piston and the rod to stop any air leakage. The top side of the piston is shaped to ensure that the opening spring is firmly retained in position. The piston material is bright mild steel turned up in the lathe to the profile shown in fig 12.

Piston rod

The name of this part speaks for itself really (see fig 12 for details). One end is threaded 3/16in. x 40 to go into the auxiliary contact carrier. The other is threaded 5BA for securing it to the piston. The main sliding surface is 3/16in. diameter. At the upper end there is an abutment where the rod screws into the auxiliary contact holder. This gives a square seating for the rod once it is screwed up tight. At the lower end of the rod a stop is provided by way of a turned stub. When the contactor opens, this stub bottoms out on the cylinder cover so that the inertia is passed to a defined area.

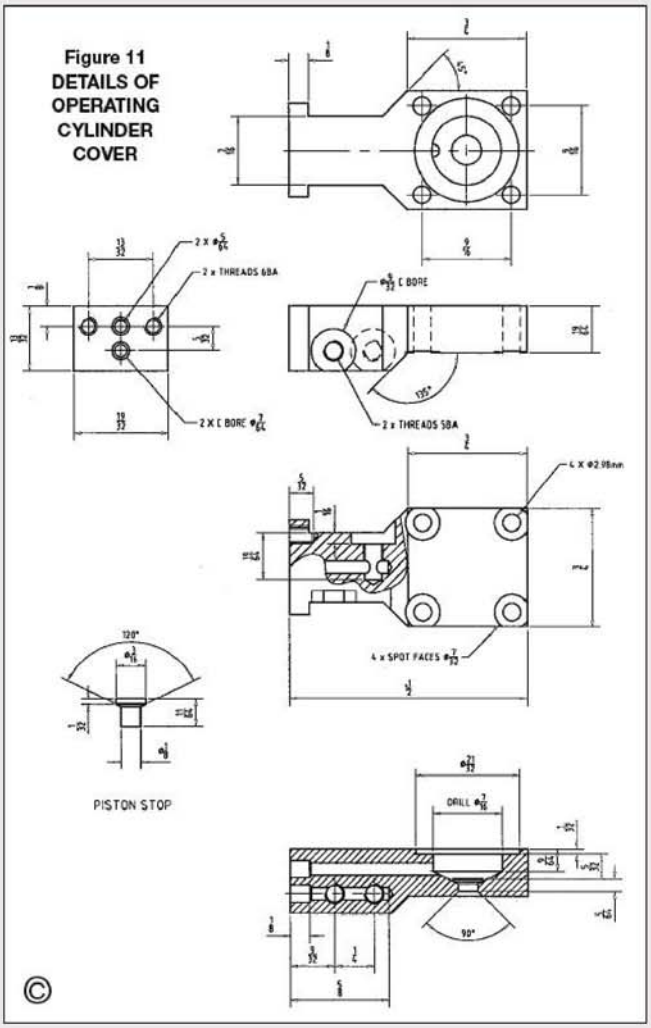
The piston rod is a simple turning job, no special jigs or gauges are used in its manufacture. It is made from silver steel to ensure the required toughness is provided. Care is needed to generate a suitable finish on the running surface of the part. The relatively long overhang of this feature makes the machining process somewhat protracted.

Cylinder cover

This part encloses the piston and seals the chamber against leakage. It also serves as a mounting for the solenoid valve and carries all the air connections. As implied from the piston rod description, it also stops the downward travel of the piston assembly (see **fig 11**). The main air seal consists of a circular recess machined into the cover. The cylinder liner spigot fits into this recess and clamps a paper gasket in place. Four 6BA screws secure the cylinder cover. There is a raised platform that the piston rod seats against when the contactor is opened. This platform is located inside a chamber formed to accommodate the piston and seal assembly. The solenoid valve mounts on a flat face at the other end of the cover. The valve mounts with the aid of two removable spigots, which take most of the vertical loading from it. This ensures that the shear forces on the two 6BA mounting bolts is kept to a minimum. A paper gasket is used to seal the solenoid valve to the cylinder cover. The cover is drilled to allow the air to get to the cylinder when the valve operates. The air supply for the contactor is fed in through the cylinder cover into counter bored connections threaded 5BA. These are arranged so that the air for the subsequent contactors feeds through these connections. Therefore, only one connection to the actual air supply need be provided for any particular bank of contactors. The contactors are thus connected in series as far as air supply goes.

The platform mentioned above is a point of interest in that it is a separate part. The joint is made by rivetting it to the cover. This makes the cover far easier to produce, in that complex profiles are eliminated at the machining stage. The piston chamber is just drilled to approximate depth with the hole for the stop providing a pilot hole. This pilot hole is drilled right through the cover and countersunk on the reverse side. The stop is then inserted and rivetted over. The bottom of the cover is then filed flat and the evidence of any rivet disappears. The platform is then faced to the correct depth, using the seal recess as a datum. This has been successful in operation and no air leaks have been detected at this location.

Figure 11
DETAILS OF OPERATING CYLINDER COVER



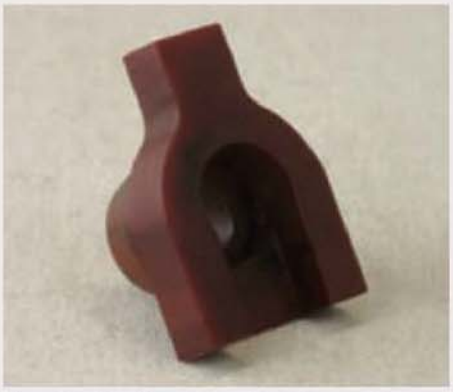
Notes on gaskets

I have tended to use normal paper and card for the sealing gaskets with some enlightening results. Patches of corrosion were found on some joint faces of parts assembled for a period. Some joints suffered worse than others and it just happened that different materials were used in these locations. Donning my deerstalker hat in true Sherlock Holmes fashion I deduced that the paper and card used as gaskets were responsible. Elementary, I hear some of you say. The fact is that I reckon that the bleaches used in the manufacture of paper and card are the root cause. Residual amounts react with the metal to cause the corrosion evident on the joint faces. I know that this may be obvious to someone involved in paper manufacture, but it is a lesson learnt for me.

Main Insulation - support bars

The two support bars are made from 1/4 x 1/16in. bright mild steel section and form key structural components in the contactor assembly. They join the operating cylinder at their lower end to the top, mounting block at the upper. In so doing, they form the vertical seating for the fixed contact holder. This is held on to the bars with the aid of two bright mild steel clamps each affixed with two 6BA screws. For this reason the support bars need to be insulated which ensures that the fixed contact holder is not earthed.

The support bar insulation consists, at the moment, of heat shrink sleeving that is shrunk on to the bar against a layer of epoxy resin. Epoxy gives more stability to the heat shrink and renders it far less liable to deformation during the clamping operation described above. This heat shrink method was not the first preference for the support bar insulation. I originally wanted to mould epoxy-loaded paper or some other similar material. This was one of those things that, being a bit of a problem to an engineer, seemed to get overtaken by an easier and quicker method. I still want to use the original method ▶



The piston insulator has cut outs to permit fitment of the auxiliary contact carrier. The projection helps confine the arc to the arc chute.

Another view of the fragile insulator. The hole in the top of the insulator will take the moving contact assembly.

eventually, prompting a solution to the production problem mentioned. This is because the same type of component is required on many other items of traction equipment.

Moving contact components

Moving Contact Insulator

This component forms the mechanical connection between the operating piston and the moving contact carrier. It is made from insulating material. This being due to the requirement to provide ground insulation for the moving contact. The insulator ensures that the mechanical structure of the contactor including the cylinder and fixing points can be earthed. Most electro-magnetic contactors will have some live structural components in order to minimise weight. The electro-magnetic contactor design does not lend itself well to the insulation of the main structure. For this reason, the supporting framework will have to include all the necessary ground insulation, unlike in the electro-pneumatic unit. The electro-magnetic contactors are mounted on special insulated supports that add to the complication of mounting and containment of the units. The electro-pneumatic contactor, by virtue of its on board insulators, can be bolted directly to the earthed support frame work.

The insulator is made from Tufnol section of Carp Brand designation. The material machines and files extremely well, so the part is not too much of a challenge to produce. There are a number of features on the insulator worthy of note. Reference to **fig 20** will help to identify these. The upper 1/4in. dia. bore is the register for the moving contact carrier spigot. The lower 11/32in. dia. bore and 5/16in. slot are provided for the auxiliary contact carrier to sit in. The 1/4 x 3/16in. extension on the left serves to create a barrier and assist the arc chute with arc containment.

The material is mounted in the lathe to drill the 1/4in. dia and 11/32in. dia holes in the one set up. This ensures that the holes are parallel, which is of critical importance. A mandrel was made up on which to mount the part for further machining. The outer profile being non-critical, relatively speaking, was accomplished with the aid of this mandrel. The tapered boss and flat surface were generated in this operation. Next, the plan profile was sawn and filed to shape the marking out being done with the aid of a template. The most protracted part of the making of this part was the hand finishing of the 5/16 x 5/32in. slot. This receives the extension of the auxiliary contact carrier and it has to be 'fitted' so to speak. This ensures that the correct amount of gap exists around the mating part. Another reason for this hand fitting is the difficulty in mounting and securing if the part was to be machined. This area is a weak spot until the whole shooting match is assembled later on. You get so much more feel with a file, anyway. The only operation left is to drill the two 5/64in. dia. holes whose purpose will become apparent later. This is done with the aid of yet another drilling jig, which has two uses, more on that later as well.

Knuckling Feature

All switches will have some sort of contact 'wipe'. That is, the actuator will still be moving after the contacts actually touch. This wipe can be up to 20% of the actuator stroke for this class of switch. This feature has great significance when it comes to the action of the auxiliary contacts and more will be said about this later. The L-shaped contact tips are made with a radius on the contact face toward the toe of the tip. **Figure 13** shows the three stages of contact knuckling. The first view shows the contacts fully open. The second view shows the initial contact of the tips at the toe, and the third shows final closure. Notice how the lower, moving contact appears to roll around the top, fixed contact. This happens as a result of the contact holder and hinge geometry and this characteristic is crucial to efficient contact operation. The rolling causes a cleaning action to be imparted on the tips and so help remove blobs of melted copper. These may have accumulated on the contact tips as a result of previous operations and arcing. In this way the contacts are more likely to seat together properly. However, the most important reason for this feature is the fact that the toes of the contact tips always touch first and break last. This confines the arc roots to the toe portion of the tip leaving the heel part smooth and free from the arc damage. In this way the heel can be kept in a condition that will maintain good contact.

When the contacts separate under load, the arc forms at the toes of the contact tips as mentioned above. For reasons described later the arc will tend to travel off the ends of the tips and on to the arc horns. The lower arc horn is mounted on the moving contact carrier. The result of this is that during opening and arcing, the current will pass through the hinge, but being only temporary it can be tolerated. The knuckling spring, however is not a great conductor of high currents so it is mounted on a small insulator in order to block current for this albeit short period. Figure 4 shows this characteristic more fully than it can be explained (*M.E.* 4237, 24 December 2004).

Another important aspect of the knuckling feature is the presence of two mechanical stops. These stops are incorporated into the moving contact carrier and holder. They are also shown in fig 4 duly labelled. One of them allows the moving contact holder to rotate up a set amount. The other allows the moving contact holder to rest on the carrier when the contactor operates. This transmits the force from the operating cylinder directly to the main contact tips. The presence of the stops only enables the moving contact holder to rotate through 9 degrees. The knuckling spring is set so as to bias the contact holder in the upward position. When the contactor operates the contact holder is forced to rotate down against this spring. It does this until the lower stop is reached.

●*To be continued.*

Figure 13
THREE STAGES OF KNUCKLING

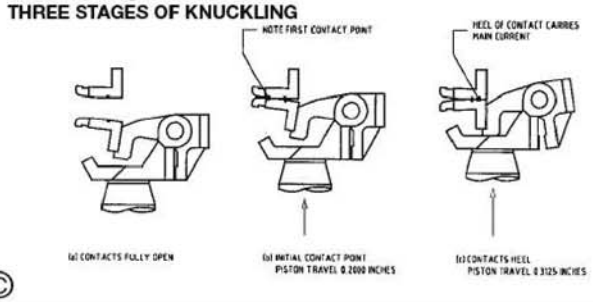
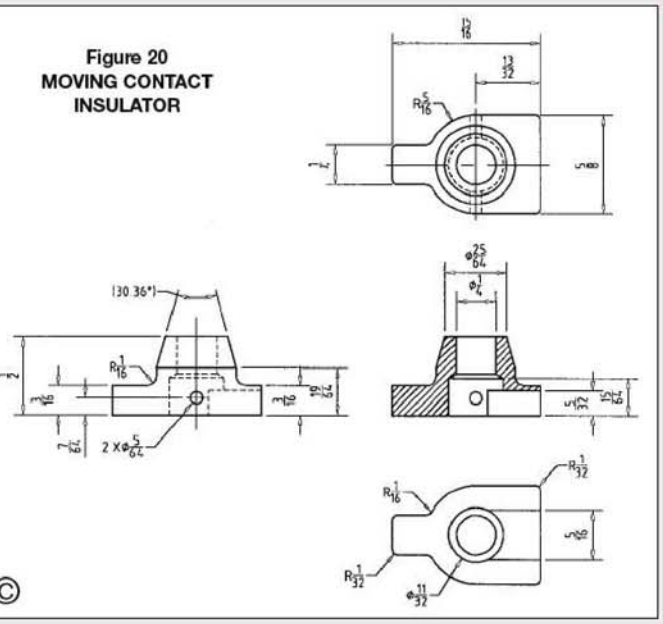


Figure 20
MOVING CONTACT INSULATOR



Three-quarters back view of the part assembled remontoire train with the temporary connecting link.

JOHN HARRISON'S H3 SEA CLOCK
BUILDING A REPLICA

Don Unwin
concludes this fascinating series on a famous clock.

●*Part V continued from page 214 (M.E. 4241, 18 February 2005)*

Now the movement was essentially completed it was possible to see if it was likely to work mechanically. Of course, all the movement was running on plain bearings so this was a limited test for clearances and any other obvious problems. The balances, pulleys and connecting wires were not fitted so, to give the rotation in opposite directions necessary to try the grasshopper escapement, the two arbors were connected as per the temporary set-up seen in **photo 71**. By driving the train with a weight hung on a string from a spoke of the great gear wheel and turning one of the balance arbors the remontoire and grasshopper escapement could be seen to work - surprisingly! After several other details had been corrected it was decided to press on and make the anti-friction wheels. Great care had to be taken to ensure that the registering surfaces of their lignum vitae bosses were perfectly concentric with the bores for the small diameter brass axles. To turn the wheel blanks a stub mandrel was held in the collet chuck (**photo 72**) the wheel blank clamped by a nut and turned (**photo 73**), until they just 'kissed' the arbor to give the correct diameter (**photo 74**). The wheels were crossed out after being turned to size using the sequence of operations shown in **photo 75**. My marking on the blank enabled me to identify where the wheel was located. After all the anti-friction wheels had been sized in this way the holes in the plates into which the arbors were temporarily located were opened out.

After this work was completed attention was turned to the back section which included the balance wheels, pulleys, escape wheel and pallets. The front movement was removed, the balance arbor holes in the centre and back plates opened out and the balances assembled with the anti-friction arcs. With the connecting wires, the balance spring together with the escape arbor and wheel were fitted. The temporary pulley with a string and weight pan was fitted to the escape arbor enabling it to be driven with a uniform and measurable torque. The grasshopper escapement pallets were adjusted, a slow and far from easy task. Things did not go well, a considerable weight was needed in the pan to keep the balances swinging. Gould, in his paper about repairing the original clock published in 1932, said that if deflected 10deg. the balances would continue to swing for 9 minutes. With all attachments to the escape arbor removed and the pallets lifted clear mine swung nearer 9 seconds than 9 minutes! To identify which of the top or lower balances was at fault the connecting wires were removed. After going up several blind alleys a screw in the centre plate was discovered to be protruding through and touching one of the anti-friction arcs. Shortening it made a difference but not enough. However, fiddling with the balance spring fixing did improve things a lot so the wires were replaced. It still behaved badly so back to square one! It was not possible to try the bottom balance independently as the spring was on the top balance only. The period of swing of the top balance only was measured carefully then a flat torsion spring rigged up on the lower balance and its length adjusted to give the same period of swing (**photo 76**) and guess what, it was still swinging slightly at 10 minutes! Back to the top balance and closer attention was given to the positioning of the arcs in their slots in the arbor. One was twisted slightly and the other out of position causing them to press on the sides which when corrected improved the top balance to 10 minutes. With the connecting wires replaced it still ran for 10 minutes. Tension of the connecting wires is very critical. If too tight the lower balance could be lifted up from the anti-friction arcs whilst any slackness allows the lower balance to lag slightly which resulted in a shortening of the swinging period. Whilst it has only taken a paragraph to relate the work it took about 35 hours spread over six days and involved taking it to pieces and reassembling several times.

Having got the balances swinging properly the grasshopper escapement had to be set up correctly again. By varying the weights and noting the angle of swing of the balances, the setting of the pallets was determined that gave an angle of swing of about 12deg. at minimum torque (**photo 77**). During these experiments the effect of the isochronism correction mechanism was tried. It did not seem to have much effect on the setting but the downward force it exerted on the lower arbor made the adjustment of the wire tension less critical. To reach this stage took quite a long time, then the remontoire train was reassembled and the spring connected by the fusée chain to the great wheel.

No means was provided by Harrison to rotate the spring barrel for the set-up tension so a strap wrench was made and is seen in use in **photo 78**. In fact many special 'tools' were devised to assemble and adjust the clock, **photo 79** showing a selection of these.

When the remontoire springs were connected to the escape wheel cam, not easy until a special tool was devised, the tension provided insufficient torque to keep the balances swinging. If the tension was increased the train torque was insufficient to wind it up! To measure ▶

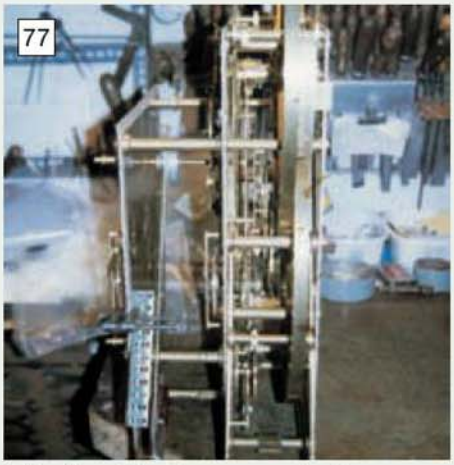
The stub mandrel for turning the anti-friction wheel diameters.

Turning an anti-friction wheel to size on the stub mandrel.

Checking the anti-friction wheel diameter in the assembly.

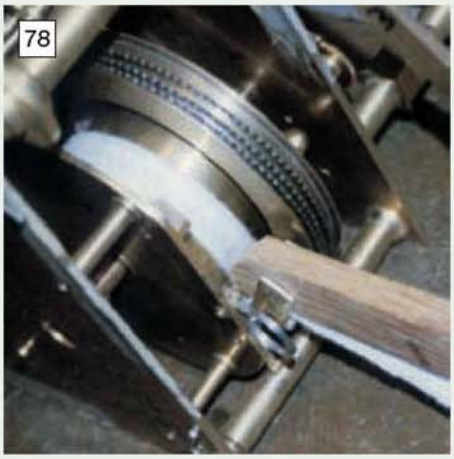
The sequence of operations for crossing out the anti-friction wheels.

The rig with a torsion spring designed to test the lower balance independently.



Set-up for setting the escapement using a weight, string and pulley.

the torque at various levels in the train torque gauges were made. At the top of **photo 80** is the spring balance used on the great gear wheel spoke, in the centre the torque gauge to fit onto the winding square and at the bottom a gauge to measure the torque at any gearwheel, seen in use on wheel 9 in **photo 81**. The pin was inserted in a tooth and then gradually loaded by means of the knurled adjusting screw on the surface gauge until the force to just balance the gear torque was indicated on the scale. I had calibrated it in grams and knowing the radius of the wheel the torque was estimated. From this work it was revealed that the spring would never be strong enough to keep the balances swinging even with much more initial set-up tension! So a new wider spring barrel was made and a stronger spring fitted. This helped but I was worried that the chain may not be strong enough, however doing some sums indicated that it should be adequate. This stronger spring made quite a difference so at last I saw the balances keep swinging and the remontoire winding up every 30 seconds – but not for long! It only kept running for a few minutes. To overcome this involved painstaking investigations taking several months and taking it to pieces and reassembling many times. As each defect was isolated another became apparent. To relate all of these problems, even if I could remember them, would be long and tedious! However, a typical example was on wheel 9, watching it stop I noticed that it always occurred at a certain point and by careful observation of the action spotted a slightly wide tooth! Removing the wheel and lightly re-cutting the tooth flanks



The strap wrench used to set the initial tension of the spring barrel.

using my rotary table, that has a larger indexing wheel than the dividing head used originally, cured the problem (**photo 82**). Another discovery was the occasional lifting of the escape arbor from the anti-friction wheels. This was found to be caused by unequal tensions of the two, remontoire springs. To avoid this rates and tensions of the springs had to be absolutely matched. If they differ then as the stronger one passes over the top position it overcomes the lower one and lifts the arbor during that part of the rotation of the remontoire gear. Many other problems had to be resolved, each of which involved taking to pieces either the drive train, the back section with the balances or both. I did this scores of times so got very good at it, able to take it down in about half an hour and reassemble the whole in about an hour although adjustments usually took longer.

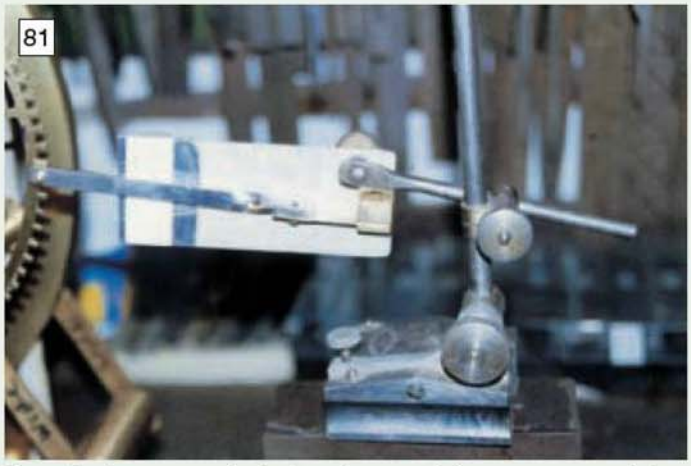
Eventually it would run for quite long periods so I took it completely to pieces, grained and cleaned everything up, engraved the dials (**photo 83**) then silvering them, finally giving all a coat of lacquer, carefully avoiding any bearing surfaces. It was at this time that I was able to count the number of parts, 620 made-up parts, 335 commercial screws, most of which needed modification and 30 taper pins at the final count, a total of 985 bits.

Re-assembly did not go without problems and it took several weeks to get things right. Although I attempted to note the settings of the pallet assemblies both had to be taken to pieces for cleaning and the settings could not be recovered so resetting the grasshopper escapement was particularly difficult. However we got there in the end and I took it to the Harrison display at the BHI Open Weekend in 2000 where it ran well. As the balance wheels weigh about 3kg each any jerking of the clock in transit could cause them to jump up from the anti-friction arcs with the risk of indentation of the mating surfaces. To avoid this I made some transit clamps shown in position in **photo 84**.

When returned home it ran for a time but gradually became less reliable, stopping at random intervals, sometimes long, sometimes short. Determining the cause was not easy as the random nature of the stoppages made it difficult to actually see it as it stopped. After a while I learned to spot symptoms that indicated if the

A photograph showing some of the specially designed and made tools needed to assemble the clock.

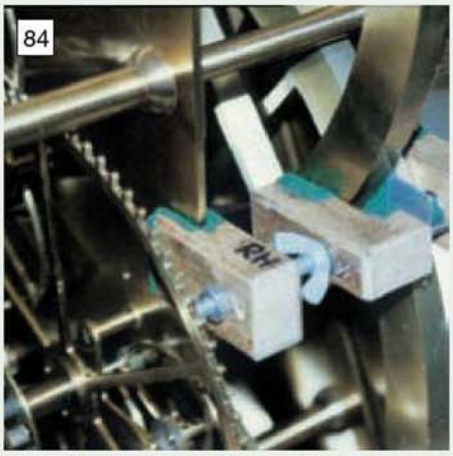
Three of the tools used to measure torque during the assembly phase of working on the clock.



Measuring torque on a wheel using a home made torque gauge mounted on a universal surface gauge.

Re-cutting the flanks of the gear wheel teeth. This was found to be necessary when faults were found during assembly.

Engraving the minute scale on the dial plate. Indexing was achieved by using the rotary table.



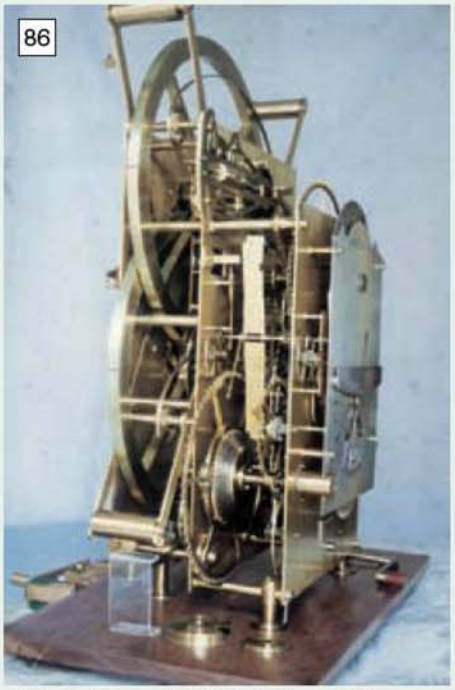
To avoid damage during transportation these balance weight clamps were devised and fitted.

balances or the train had stopped first. Mostly it became apparent that the fault was in the train but a series of torque measurements did not help much! The balances were removed so that the gear train could be examined in detail. Eventually one major cause was discovered, I had made too good a job of the fit of the lignum vitae rollers on their spindles and many had shrunk very slightly and did not rotate freely. They were all taken out and the bores opened out to give greater clearance. The lignum vitae bosses of the anti-friction wheels were also checked at the same time and some opened slightly. However, as the outside diameters are much larger care had to be taken to avoid excessive clearance which could allow them to wobble. Once this was corrected other faults were revealed, often only occurring at even longer intervals. Again, whilst it does not take long to describe the faults took months to trace and correct. Eventually the intervals between stopping became much longer but nevertheless it still stopped, sometimes caused by the train and sometimes the balances, although following no discernible pattern. Close examination after one of the balance stoppages it was noticed that one of the anti-friction arcs had worked its way until the arbor was rolling against one end of the arc. Their positions are controlled by a curved spring strip that can be seen at the top of photo 1 and in photo 53. This must have been slightly incorrectly set so the direction of migration was noted and the clamp moved a little. It took a couple of goes to get this correct and of course several weeks before it recurred. However there were also occasional stoppages attributable to the train the cause of which I was unable to trace. The main problem was actually seeing it at the moment of stopping. After the anti-friction arc problem was solved things became a little easier as there was only the train to watch. Even so there were random intervals between the stops. After several frustrating weeks, watching it every time I passed it by, I spotted it just as it was about to stop. When the detent arm released the stop arm on the fly the train failed to start immediately, only starting after the slight vibration caused by the detent falling back. This was just sufficient to overcome the static friction preventing the train from starting. The time interval between the release and the train starting to run, although short, was sufficient for the claw to miss the pin on the escape wheel so allowing the remontoire to run down. As the condition depended on minor variations in the whole of the train the fault occurred only at irregular intervals. However, once I had discovered the reason the remontoire was running down I was able to repeat the condition at will by lowering the drive torque. At first I thought that the fly was out of balance but proved this idea incorrect by trying with the fly vane at different angular positions relevant to the stop arm. Next a careful examination of all the tooth/pinion interfaces revealed a very slight tight spot between the remontoire gear and fly pinion. It was observed that the angular position of the remontoire gear had no effect, the train could be made to hold up at any position. An even closer examination of the tooth engagement at the point where the stop arm is at rest on the detent arm and released revealed that the pinion roller was *just* touching the top of the next engaging gear tooth! The offending tooth was marked, the fly arbor removed and the diameters and radii of the trundles checked. One tooth was found to be at a few thou greater radius than the others. Murphy's Law had predicted that the stop arm was at just the wrong position. Had the bad tooth been at any other position the train would have been running so the kinetic energy would have overcome the tight spot. Why the pin should be misplaced is a mystery as great care was taken when drilling the pinholes but they are only 1.1 mm diameter so the drill must have wandered slightly. After remaking, the pinion was refitted and the clock started. It ran, but not for long, for after two weeks it stopped. The symptoms were the same but this time a spindle of the lantern pinion had worked out from one side flange allowing the roller to become misplaced. At first I was unable to see why this should have happened, then the penny dropped. The spindle that had worked out was the one that supported the roller that took all the shock when the stop arm was brought to rest by striking the detent arm! The repeated shocks had caused the spindle to work out. It was pushed back into place with a drop of retaining fluid on the end without any dismantling and the clock restarted to run faultlessly for six months, then it stopped. After spending several hours searching I spotted that one end of an anti-friction wheel spindle had worked out of the plate allowing the maintaining gear arbor to run metal to metal on the plate. A picture of the anti-friction wheel forced out of position by the torque on the maintaining arbor is in **photo 85**. Fortunately, I was in luck again and it was possible to replace the pin without any dismantling and the clock re-started satisfactorily. It has taken eight months research, 13 months to construct and 18 months to iron out the bugs but I suppose I cannot grumble, it took Harrison 19 years!

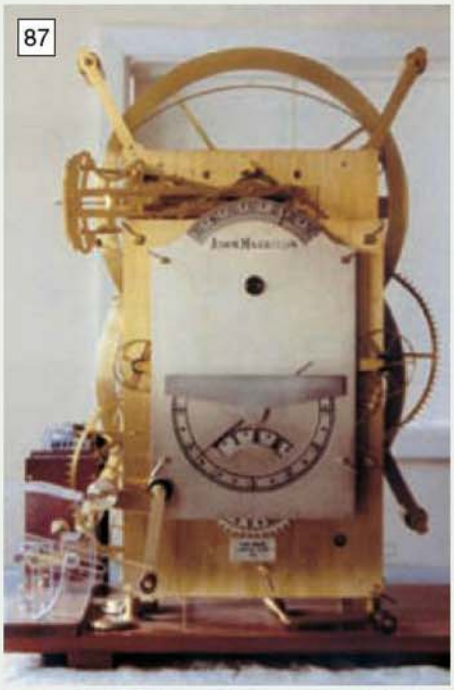
The front of the completed clock is shown in photo 1 whilst **photo 86** shows the fusée side. The acrylic bracket on the baseboard in the foreground is to protect the isochronism correction arm from being accidentally touched as it easily dislodged and very difficult to reposition. Also on the baseboard are two covers for the roller bearings, left uncovered to enable them to be seen.

As the clock running time is only about 30 hours I realised that there was a real risk that it would be allowed to run down and stop. Restarting is not easy, because in addition to winding the mainspring the remontoire has to be reset. To overcome this I decided to make and fit ▶

The misplaced anti-friction wheel caused by the end spindle working out of the plate.



The virtually completed clock. Shown is the three-quarter front view, fusée side.



The front of the clock with the electric winding remontoire fitted.

an electric winding mechanism. However, I was anxious that it should be as unobtrusive as possible and also able to be easily removed and replaced for occasions when the clock was to be on display for a day. **Photograph 87** shows it in position. To remove it the link is unhooked from the handle, the two knurled screws in the base removed and the unit lifted away.

It has been a fascinating project but at times so frustrating that I was tempted on occasions to throw it on the floor! One cannot help but admire Harrison for his ingenuity and determination. However, to judge from the correspondence that I am getting, I think it will be having some 'pups' in the future, one I know of is in Australia.

Most of the operations illustrated are those using my milling machine and its attachments. Whilst a great deal of work was also done on the lathe most of these operations involved straightforward turning and would be quite familiar to readers.

LEADSCREW REPAIR

John L. Littler
describes how to get more life out of a worn leadscrew.

I wonder if readers would be interested in the radical action that I recently took on my elderly lathe? This is a 5in. centre height Atlas, dated on its headstock as 1942, and came to the UK from the US as part of the 'lease-lend' programme of the 1939-45 war. It had been misused and sadly neglected when I came across it on the floor of a damp cowshed on the recently closed-down dairy farm of an old friend. I was told it was destined for the scrap man, and replied that I would impersonate said scrap man, and acquired it in return for past services rendered when the farm was operational, and because it would be put to good use by me, not scrapped.

Spares are still available for these machines and, after lots of de-rusting and the fitting of new feed screws and nuts to the slides, all seemed well. Until, that is, my first attempt at screw cutting! The leadscrew thread was so badly thinned at the point of maximum use just before the chuck area, that the thread I produced varied in pitch from start to finish, and was totally useless! However, the price of a new one would need a second mortgage, and where does one stop?

It occurred to me that the other end of the leadscrew, up by the tailstock, had probably never ever seen the half nuts, and was unworn; would it be possible to reverse the leadscrew? I removed it and temporarily re-fitted it into the half nuts the other way round, getting a shake free smooth action, any wear on the half nuts seemed to be even over their relatively short length. Thus encouraged, radical action was taken, each end of the leadscrew was hack sawed off! The cut ends of the screw and drive end were faced, drilled and reamed for an axial mild steel dowel, with some 3/4in. on each piece, turned to a firm push fit. An 1/8in. spacer was put between the screw and the drive end to replace the metal lost in the cutting and facing of each end, in order to restore the component to its original length.

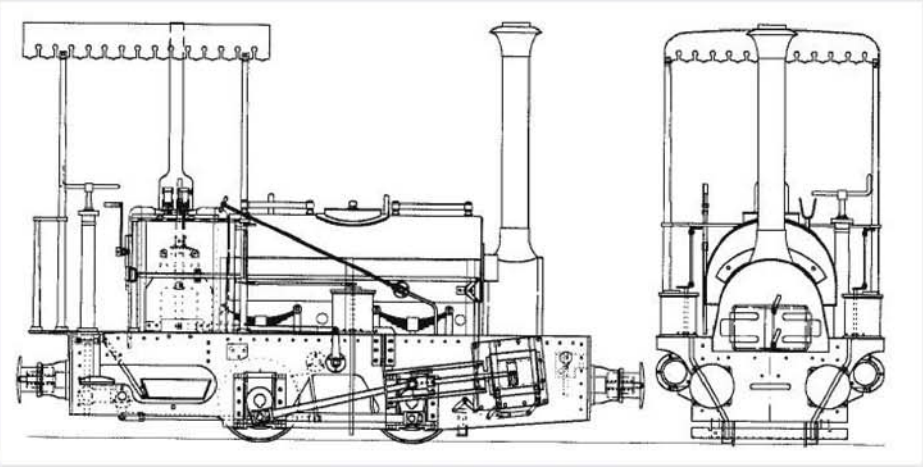
The worn end, now at the far end, was similarly machined. The piece beyond the thread at the tail end was originally just a plain shaft in a plain bearing, with a short thread and a couple of nuts to adjust end float. This was replaced with new longer shaft in order to fit a dial and hand wheel beyond the end of the bed.

My original intention was to chamfer the end of each piece at the joins, and fill the chamfer with arc weld to unite the sections but, after picking the brains of a respected personage at the Model Engineer Exhibition at Sandown, I was advised that I risked distortion, and would be better off to fit shear pins through the dowels to effect the join; which is what I did, using 5/32in. silver steel; thank you, Mr. Derek Brown.

And did it work, yes, like a charm! My threads are not quite perfect, but that's me, not the equipment, but at least they are now the same pitch all the way along, and I can now do what the pundits advise, and screw cut, rather than just use a die. And if, and it's a big if, I ever need a thread long enough to need the worn end, I'll buy some studding!

Example of a worn leadscrew.

Example of an unworn leadscrew.



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

D.A.G. Brown and Mark Smithers commence with notes on finishing the boiler before dealing with an assortment of other parts.

● *Part XIII continued from page 208 (M.E. 4241, 18 February 2005)*

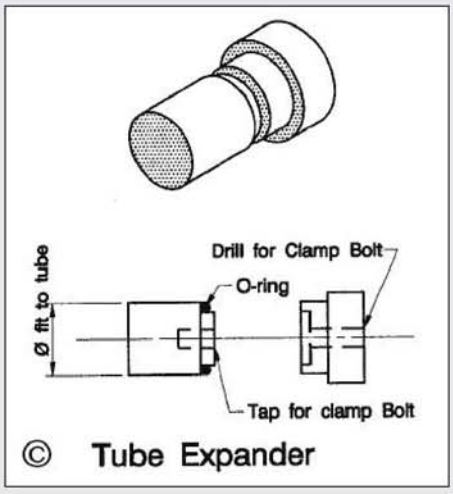
The last two parts of the series have dealt with manufacture of the various components for the boiler assembly. It is, of course, necessary to join them together and here one can decide either to do the job oneself or to get it done within the trade. I favour the former route, but I will confess that it does require a large heat input and, for the final operation, I have the use of both the largest Sievert blow torch and an oxy-acetylene set, albeit quite a small one. Silver-soldering is quite therapeutic, but you must have somewhere of adequate size to avoid setting fire to the house and a supply of firebricks and/or insulating sheet material to avoid overheating the floor of your work-space and to conserve heat on the job. For pickling, you need a large enough 'tank' of very weak battery acid to dunk the boiler to at least half its depth. Any sturdy plastic container should be suitable. A plastic dustbin is not too expensive to buy, but I am lucky in that our local cement works supplies the church with a Christmas tree every year, potted in a very large white plastic drum bearing their logo. Once used for such a purpose, the container is just scrap, so one has come my way. Keep your eyes open and you may be surprised what turns up!

The whole assembly can be done using Easyflo No. 2, the slightly greater expense being worth it for the sake of easy running. For many of the larger joints be prepared to use the large diameter (2.5mm) rods; they are easier to control than the normal 1.5mm variety. There are several areas of especial interest for holding the parts in place, with which I shall now deal.

Tubes

Having drilled the tube-plates an easy fit on the tubes, they will fall through if given half a chance. So, a good ploy is to make a small local deformation to keep them in place and here I am indebted to Stan Bray during one of his all too rare visits to my workshop. A mandrel is a good fit in the tube, into which it enters by, say, 3/4 inch. Its end is tapped, say, 1/4in. BSF and reduced for a suitable O-ring. The mating piece is bored to fit over the mandrel end and turned down also to fit the inside of the tube. This spigot can be adjusted in length so as to determine the position of the bulge which is formed near the end of the tube. It is obvious how the device works, but the tube must be annealed before the O-ring is squeezed, thereby deforming the tube locally. One further piece of gilt on the ginger-bread: if you form some flats on the register which takes the O-ring, the tube will not bulge at these positions. This allows flow paths for the solder to both sides of the joints.

That stops the tube nest from having a mind of its own, but it is essential to provide accurate transverse location for the bundle while it is being fixed into the firebox tube-plate. Use any length of steel bar, say 1 1/2 x 1/4in. section and 2ft. 3in. long. Pick up the location of two crown stay holes from the Inner Firebox Wrapper, ensuring that the holes are located parallel with the axis of the bar. A simple bracket at the far end of the bar will then locate the Smokebox Tube-plate using two of the 5/16in. dia. stay holes. It is prudent to fit small bushes between the Wrapper and the bar, to reduce any heat drain during the soldering process. This device enables the tubes to be held accurately parallel to the boiler axis.



Stays

The large numbers of 3/16in. dia. rivets also need some restraint during the heating process. A straight knurl placed just under the head does exactly what is required, allowing a light drive fit to be used to keep the rivet in its correct position, without reducing its cross-sectional area. Such a knurl can be expected to increase the diameter locally by around 0.010 inch. All rivets are correctly made from 1in. long commercially available snap-head rivets. The larger stays can be similarly treated, after first deforming one end to prevent them from passing right through their locating holes.

Bushes

All bushes should be located and fixed as the process proceeds, securing if necessary by means of the odd small centre-pop to prevent movement until they are soldered into place. Make sure that there is a good fillet of solder around the bushes, especially the Dome Bush. I am sure that the order of fixing the various components will become fairly obvious. Do not be tempted, however, to fix the Smokebox Tube-plate and its associated stays until the whole of the firebox end has been completed. While on the subject of the bushes, do not forget the fixing pads for the boiler mounting on the sides of the Firebox Wrapper, nor the bits to hold the Firehole Door.

The bits that got away

Mainly due to space constraints on the printed page, a number of components have almost 'got away'. Luckily, however, the CAD filing system does not lose them altogether and we shall have a round-up of various pieces that complete the boiler saga, ready for the steam and water fittings.

First the odd stay, that one which enables the regulator to be assembled into the top of the shell. It is made from phosphor bronze rod, threaded 5/16in. x 40 at both ends. The threads are picked up by blind nipples with the matching internal thread and 7/16in. x 40 on their outside surfaces. Hopefully that makes sense of the two special bushes of that pitch which were specified for fixing into the sides of the Firebox Outer Wrapper. ▶

A stay made from a 3/16in. dia. rivet with a knurled shank to aid retention during heating.

The machining of the Fusible Plug from Bronze hexagon bar needs no elaboration. A 1/8in. dia.. hole is filled with Comsol soft solder, which melts at 300deg. Celsius. The correct flux for this material is Bakers Fluid, which I personally hate using, since if you are not careful its vapours induce a layer of rust on anything in the vicinity. Do not be tempted to use tinman's solder, as our affable pattern-maker Paul Lingard did, to his complete embarrassment a couple of years ago. He had just got steam up and was enjoying the first lap of the Club track when there was an almighty wooooosh-ing noise and the whole firebox area was enveloped in steam. *"Oh Dear!"* he said, and had to be pushed into the steaming bays to collect his thoughts. The technical reasoning is quite simple: soft solder melts at 170deg. C, and steam at 90psig has a temperature of around 166deg. C, leaving no room for stable operation.

Firehole Door

Mountings for the door are already on the boiler backhead and the door itself is quite simply made from 3mm material, my own preference being for 3Cr12, which will not rust with the effects of the acid fumes from the fire. The 3mm parts are available in laser-cut form, with holes positioned. The Latch rises and falls into a Latch Block, the Latch end being bent round to taste, a good idea being to provide a small nick so that it can be opened by the coal shovel. For this reason the latch is being left extra long for trimming after bending. Alternatively you can fit a small brass handle near the end of the latch and neatly round the end of the lever itself.

The various hinge components are fabricated from steel, preferably the same as the main bits of the door. They are silver-soldered into place with the objective that, when the door is closed, it will just bear onto the Firehole Door Ring on the boiler itself. You may need some minor adjustment to achieve this state. Set out from the Door by 3/8in., and an easy clearance within the Door Ring, is a heat shield, from 1/16in. material. The secondary air holes in the Door allow air to be sucked in by the draught while the engine is running. This air escapes into the Firebox around the heat shield, which it also cools. More to the point, the Firebox Door keeps cool enough to allow the latch to be eased open even by quite delicate hands. I feel that this sort of design detail is vital to the well-being of the whole operation.

The option of mounting the door either way round is available in the design, but no doubt some clever fellow will pronounce on the reason for right or left hinging. Certainly on a two-man footplate, placing the hinge on the driver's side affords some protection from radiation and glare.

Firegrate and Ashpan

The Firegrate is made from a pair of identical iron castings. These have turned out really well, the firebars being tapered to deter blinding, and having a serviceable open area and gap to retain the fire and provide a clear draught passage. I have not found it necessary to depart from cast iron for firebars. In the case of the Hunslet, with nine seasons and over 600 miles on the clock, the grate sections are nearly as good as new, so why change? You will already have noted the remarks about setting the grate through the Firehole Door. However, it must be machined on its ends and sides to make for an easy fit within the firebox walls, aiming to provide 0.040 to 0.060in. of clearance; although the firebox will grow with temperature, so will the grate, only to a larger extent.

Problems arise with cast iron grates only if the air circulation is faulty, or if ash builds up beneath the grate itself, stifling the air supply, which normally cools the grate bars. Several years ago I went out from my house to see a full sized traction engine which had failed 3/4 mile away, on its way home from a local rally. Its grate was a sorry sight, the middle section having melted out, so that the fire was no longer being supported. The rally authorities had provided an inferior house coal for the day, which had a high ash content and low ash fusion temperature. In their enthusiasm the drivers had made over-zealous use of the poker to try and break up the clinker; consequently the far end of the ashpan was full and there was also a hot fire-bed under the grate. With a fire below and clinker insulation on top, that was a perfect recipe for destruction of the grate. Beware of cheap house-coal!

The grate sections rest on the Ashpan, fore and aft, so there is no contact with the boiler itself. Pull out the pin and the whole lot drops! The ashpan itself is another fabrication from 2mm. 3Cr12, which is vital to avoid rusting over the years. It is best assembled by MIG welding, although silver-soldering may be used if you only have those facilities. The rear of the pan is just a narrow piece of metal, to support the Damper door over its entire length. The two short platforms for supporting the grate sections need to be welded into place exactly level with the top of the pan, so that the whole assembly is located by the eight small pins sticking down from the bottom of the foundation ring. The damper door must be an easy fit on its hinges, avoiding any gaping holes around the metal; not that it needs to fit like a Chippendale sideboard drawer, nevertheless the better the fit, the better it will control the draught when needed (and incidentally the more carbon monoxide it will cause to be generated!)

Outboard of the ashpan damper door, a small angle section rivetted to the bottom corner is connected to the Damper Lever, preferably using an easily removable pin. This, of course, is taken out when it is time to drop the grate and thrown away into the hot, wet ash pit, never to be found again. Seriously, if you want to avoid a swearing match at the ash drop, fix a knurled-headed pin with a length of chain, anchoring it to the Damper Lever for safe keeping. Drill a cross-hole in the end of the pin and fit it with a split-pin, similarly attached to the Damper Door. The Damper Lever has three notches in its lower edge, which are best left for positioning until final assembly, at which time they will be found to engage with the 1/8in. dia. pin called up on the right hand Sunken Rear Footplate Bracket in part VIII of the series. The Damper Lever also has a tension spring fitted about 2 1/2in. from its top end, to encourage contact with the pin, but I shall leave location of this pin to your good selves! It also makes sense to fit a buckle around the Damper Lever, near its lower end, to keep it in place when the ashpan is not there.

Next, the Ashpan Retaining Pin fits in prepared holes in the Main Frames. The long cross pin eases the job of dropping the assembly after a run. If you have stuck to the drawing, you will find that the Ashpan Locator fits as drawn, but press the Ashpan into place and measure the distance between it and the Retaining Pin. Adjust the 1 1/4in. dia. spigot to suit. Eventually I am going to recommend painting the whole of the outside of the Ashpan black and finishing the Retaining Pin, Locator and Damper Lever by chemical blacking.

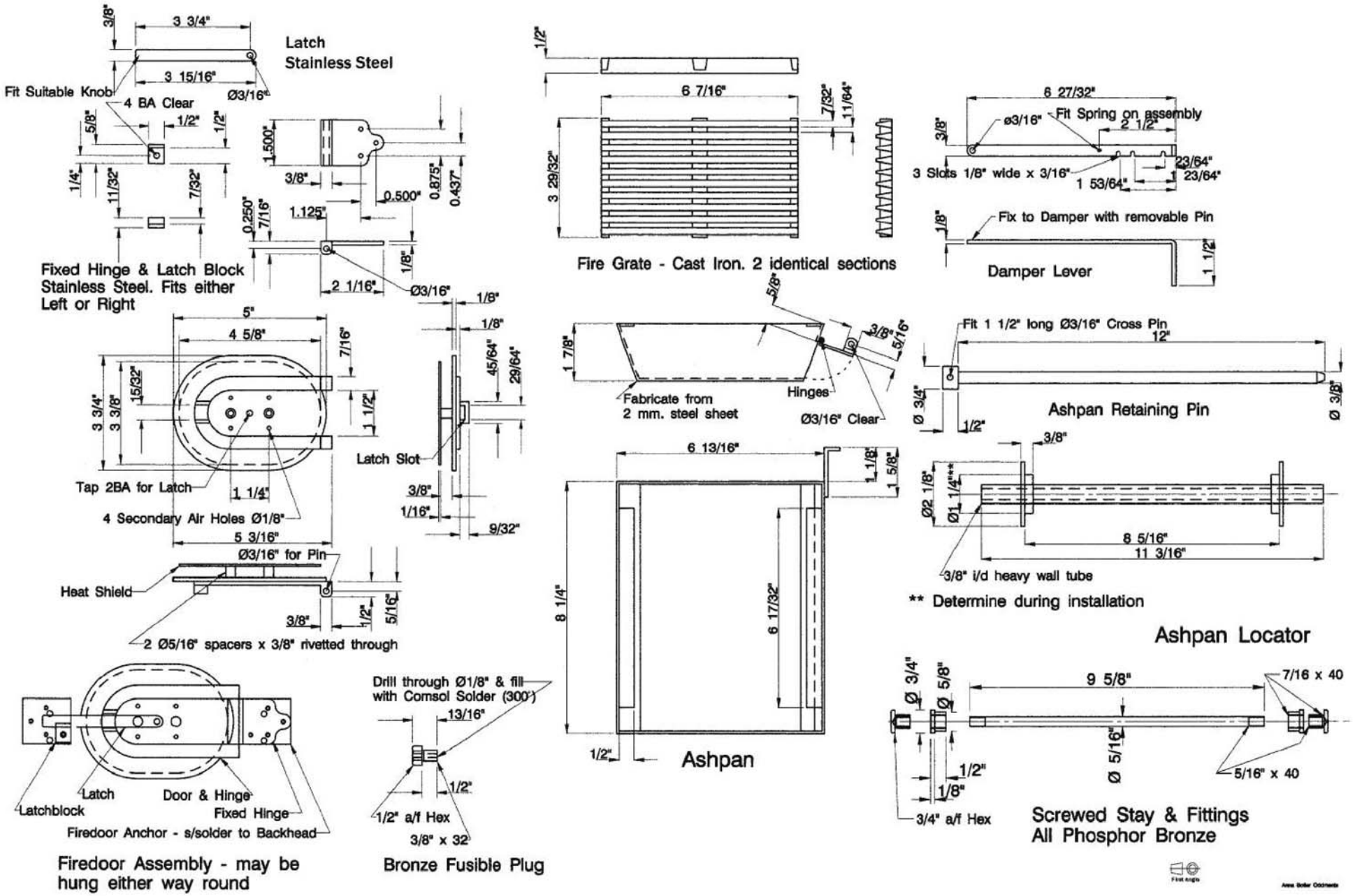
Following the original design by Manning Wardle, the ashpan and grate come to rest on the brake linkage, which fits between the wheel sets. The hot embers, clinker, chestnuts and all are then withdrawn sideways through the large odd-shaped hole in the Main Frames. I do not like this arrangement and will probably generate a modification to the brake gear, to allow the assembly to drop into outer darkness between the rails. For the time being, however, the design is as specified and true to prototype. That is a job for the tidying up process.

"And now for something completely different"

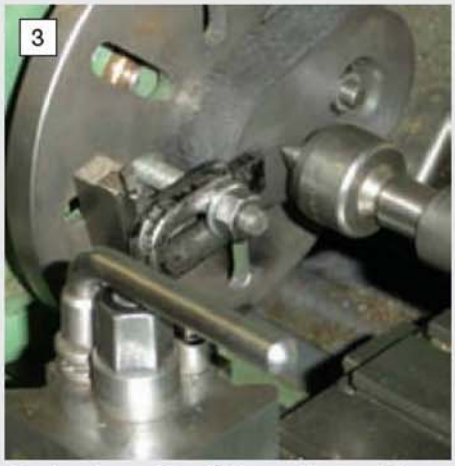
Having got the boiler out of the way, I should like to take a step backwards and share some of my experiences of accuracy with other builders of the Anna project. Looking back over the past issues and talking to one or two of you who have embarked on the job, it seems worthwhile to examine again the work centred on the wheel sets and running gear. I realise that when describing the machining of the Axles and Fly Cranks I rather glossed over the importance of accuracy and the use of toolmaker's buttons. So here is some photographic evidence of the work in progress in my own workshop.

First consider why it is necessary to get things accurately in line. The Fly Cranks are opposed mutually at 90deg. to each other, that is to say if you look on the face of the right side crank pointing to the right of the picture, the left crank will be pointing downwards and you will be seeing its backside. There should be a straight line between the axle centre, the centre of the key and the crankpin centre. In the accompanying sketch this is represented by the left-hand view. Let us suppose now that the keyways in the axle have been cut truly at right angles, but that there is a 2deg. angular error in placing the keyways in the cranks in relation to the crankpin holes, as depicted in the right-hand view. This brings about an equal and opposite error in the set-up on the other side of the engine - not a happy state of affairs.

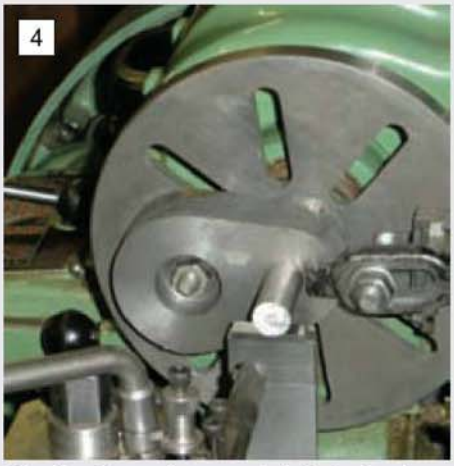
So let us see what can be done in the amateur's workshop to achieve an acceptable state of affairs. First, how to ensure that the crankpin centres are accurately placed. In **photo 2** a button is machined to a good fit in the axle bore of the Crank and this button is bolted lightly to the 7in. faceplate of the Myford. The clock gauge is set at centre height and arranged to a deflection reading of, say, 5 as the button passes its spindle. Next, the mandrel is rotated 180deg. and the cross-slide advanced by 3.250in., i.e. the stroke of the engine; it does not take many attempts to arrange that when the button passes the clock gauge in this position ▶


Latch
Stainless Steel
Fit Suitable Knob
4 BA Clear
Fixed Hinge & Latch Block
Stainless Steel. Fits either
Left or Right
Tap 2BA for Latch
4 Secondary Air Holes Ø1/8"
Latch Slot
Heat Shield
2 Ø5/16" spacers x 3/8" rivetted through
Ø3/16" for Pin
Latchblock
Latch
Door & Hinge
Fixed Hinge
Firedoor Anchor - s/solder to Backhead
Firedoor Assembly - may be
hung either way round
Drill through Ø1/8" & fill
with Comsol Solder (300°)
1/2" a/f Hex
3/8" x 32
Bronze Fusible Plug
Fire Grate - Cast Iron. 2 identical sections
Fabricate from
2 mm. steel sheet
Hinges
Ø3/16" Clear
Ashpan
Damper Lever
Fix to Damper with removable Pin
Fit Spring on assembly
3 Slots 1/8" wide x 3/16"
Fit 1 1/2" long Ø3/16" Cross Pin
Ashpan Retaining Pin
3/8" i/d heavy wall tube
** Determine during installation
Ashpan Locator
Screwed Stay & Fittings
All Phosphor Bronze
3/4" a/f Hex
5/16" x 40
First Angle

Clocking an offset button mounted on the faceplate of the lathe.

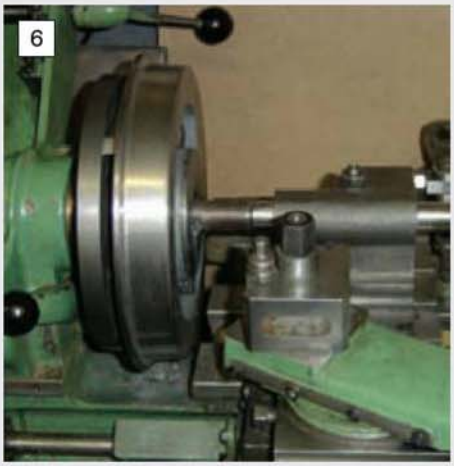


Aligning the crank for drilling and boring of the 5/8in. dia. crankpin hole.



Checking the gap between the lathe bed and a plug gauge inserted into the 5/8in. dia. bore.

Cutting the internal keyway in the crank with a hand operated slotting tool.



Cutting the keyway in one of the wheels. Note the packing between the faceplate and work.

the same reading of 5 is obtained. It is just judicious use of a rubber mallet before the fixing screw is finally tightened.

In **photo 3**, the Crank is being aligned for drilling and boring to 0.625in. dia., while its main hole hangs on the button. Since its perimeter is a cast surface, accurate location merely means getting the hole closely by eye on the centre-line thrown out from the axle centre. So the running centre of the tailstock is aligned with a pencil marked centre-line before the faceplate dog is clamped up solid. In these circumstances the crank throw is fixed by that of the button and the holes in all four cranks will be identically placed. The pilot hole was next drilled 1/2in. dia. and the hole bored until a gauge just entered at 0.624in. diameter.

Now look at **photo 4**. The plug-gauge is still in the hole, no wiggle, and a length of gauge plate has been placed over the lathe bed, tail end just visible sticking out of the left side of the picture, beyond the tool post. A stack of slip gauges has been inserted into the gap between the underside of the plug gauge and the gauge plate, to find the precise value, it being quite easy to measure to 0.0005 inch. In my case the centre-height worked out precisely at 3.500in., good show for Myford!

Let us say that we are going to cut a keyway 0.250in. wide, the bottom of its cutting edge must be 1/8in. below centre line or 0.187in. higher than the bottom of the crank pin gauge. So, add this amount to the slip gauge stack and use this enhanced stack to set the slotting tool to the correct height. In **photo 5** you will see the slotting tool, which has already been described in *Model Engineer* in the past. Its centre-height was bored from the lathe headstock, so its spindle is set up for this job without further adjustment, other than rotating the tool holder as just described.

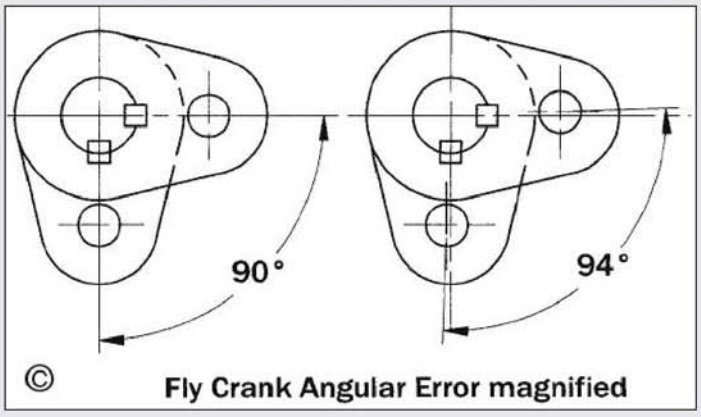
The next operation entailed remounting the Crank with its main bore running true, thereby preparing to cut the keyway. To get it to run true it was clocked in its bore, while being held in the 4-jaw chuck. Again, as before, my ritual with the 4-jaw is to recite: *"loosen 4 and tighten 2; loosen 3 and tighten 1"*, etc., until it is within 0.0005in. total indicator reading. The bore is now true and ready for the keyway.

In photo 5 that same stack of slip gauges as above is placed on the same piece of gauge plate on the bed, the (isolated) lathe is put into slow back gear and the gears pulled round until the plug gauge meets the slip gauges. Slight effort is applied to keep everything in place whilst the keyway is cut. This design of keyway cutter is good for the biceps and I certainly appreciated that I had done some physical work at the end of eight keyways (four in the Cranks and four in the Wheels).

I suppose I have written on the assumption that everybody has a set of slip gauges, which is clearly not true. A suitable alternative is a length of, say, 3/4in. dia. bar machined to such a length that it just fits the gap filled by the slips – slightly more work, but just as effective at fitting the purpose. If you determine the length of the first piece you can repeat it with a second bar 0.187in. longer for setting the tool to the correct height.

Now I will confess to having made a departure from my own drawings, in that I reduced the size of all the keys and keyways from 5/16 to 1/4 inch. I deemed that there is more than enough strength in the job to allow this to happen and it probably halved the amount of effort expended on keyway slotting. I have modified the master drawings, so those of you who purchase them in the future will have a smooth passage and those who already have them will be issued with amendments.

The final picture (**photo 6**) depicts the slotting operation on one of the wheels, which was done immediately after that described above. Noteworthy in this shot is the packing between the faceplate and the wheel casting, which enables the slotting tool to run out without clobbering the faceplate or mandrel. The wheel was rotated until the balance weight was vertical at the rear of the machine, at which point the back gear was locked up solid and slight effort maintained to take up the backlash ready for the slotting operation to begin. The position of the slot is clearly indicated on the drawing. One other aid to easy work was my decision to increase by 0.001in. dia. the part of the axle onto which the wheel is keyed. This means that it is easier to apply a slight interference fit between wheel and axle at the place where it matters, without hazarding the surface of the journal portion. My thanks for this suggestion must go to one of our constructors, Paul Tattersall, who mentioned it in passing.



●*To be continued.*

LETTERS TO A GRANDSON

M. J. H. Ellis
imparts some wisdom through humour followed by a review of the Atkinson Differential engine.
●*Part LXXIV continued from page 197 (M.E. 4241, 18 February 2005)*

Dear Adrian, I have continually urged you to cultivate the virtues of resource - fullness, ingenuity, and lateral thinking. I have even given you one or two examples, and after the recent rather heavy going, I shall now endeavour both to instruct and to entertain you with a few more. Some may be fiction, but I think that some could well be true.

As he was passing an asylum, a motorist suffered a puncture and stopped to change the wheel. He went to fetch the spare, and while he was doing so his little boy dropped the wheel-nuts down a drain. The motorist could not think what to do. An inmate had seen this happen through the asylum railings, and shouted *"Take one nut from each of the other wheels and use them to bolt it on!"*. The motorist *remarked "To think that I, who am sane, could not think of that, but you, who are in an asylum could"*. *"You see"*, came the answer, *"I am here because I am mad, not because I am stupid!"*

An inmate of an asylum climbed up onto the roof, and one of the staff was sent to fetch him down. The patient grabbed him, saying *"Come on, let's jump down!"* The attendant saved the situation by saying *"Any fool can do that. We'll walk down, and show them that we can jump up!"*

King Louis XI of France was very superstitious. An astrologer made a prediction which so displeased the king that he decided to put him to death. He summoned him to his presence in a chamber high up in his palace. *"Tell me"*, asked the king, *"how long do you think you have to live?"* *"I do not know that"*, the man replied, *"but I do know that I shall die three days before your Majesty"*. Two servants were waiting to throw him out of the window; but the king had changed his mind, and did not give the signal. Instead, he invited him to live in the palace, where he took special care of him.

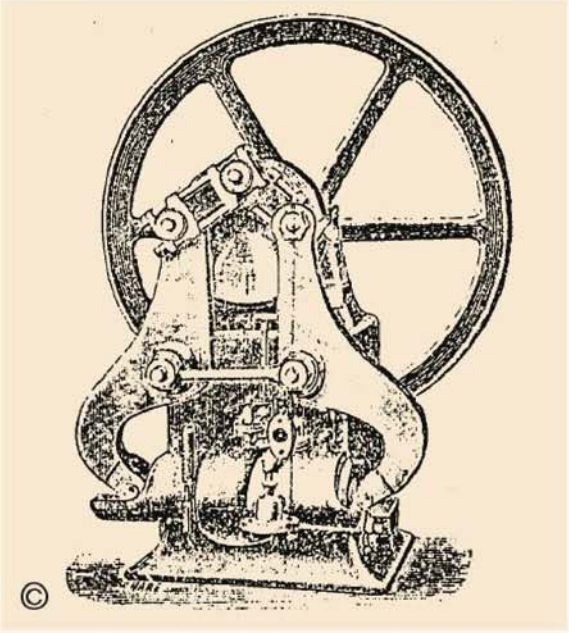
I don't think that this final story could have been made up. This is how the Chinese are reputed to catch ducks:

The fowler makes himself a head-dress which looks like a duck. Donning this, he enters the water on which ducks are swimming, and crouches down so that only the head-dress is in view. Walking leisurely to and fro, he makes his way close up to one of the ducks. He does not make a grab for it, but waits until the bird upends itself with its head beneath the water. Then he seizes it by the neck and gently pulls it under the surface, where the duck drowns. The fowler wears a belt, to which he fastens the duck out of sight, and proceeds to take further ducks by repeating the same procedure.

The Science Museum in London is a marvellous place, and it is quite impossible to take stock of all its treasures in a single visit. Nowadays, rather than browse aimlessly, I go there to acquaint myself thoroughly with some specific subject, for example; the various processes used for spinning yarn. I still recall the impression the place made on me when I first saw it on the occasion of a visit by a school party. We were accorded our own guide, and the first question he asked us was, had we ever seen a gear wheel with only one tooth? The boys were non-plussed, but Ellis, in typical pushing fashion, did venture the suggestion that he might have a worm-wheel in mind. Actually, that was not the answer he was looking for, for he proceeded to produce a beautifully made model of a pair of helical gears, of which the pinion in fact did only have one tooth, which was wrapped round its whole circumference.

I shall have more to say later about some of the little-known mechanisms to be found in the Science Museum, but having started my letter with an exhortation about originality of thought, I now want to tell you about another very ingenious design of prime-mover, the Atkinson gas engine. This was a four cycle engine, which accomplished the seemingly impossible feat of firing once for every revolution of the crankshaft. I found the Atkinson engine in the Discovery Museum at Newcastle-upon-Tyne, where it was on loan from the Science Museum in London. Its full name is the Atkinson Differential Engine.

The engine was patented in 1885 by James Atkinson. Its action depends on the motion of the links which connect the two opposed pistons to the crankshaft. As the cycle begins, the pistons almost meet at the right-hand end of the cylinder. The left-hand piston then withdraws, sucking in a charge of air and gas. The right-hand piston then follows it, so compressing the charge. At the end of its stroke, the left-hand piston uncovers a passage leading to the hot tube used for ignition. The right-hand piston is now driven backwards, while the left-hand one scarcely moves at all. At the end of the power stroke, the exhaust port is uncovered by the right-hand piston, and the other (left-hand) piston now moves towards it, so expelling the exhaust gases.



Atkinson's Patent Differential Compression Gas Engine.

A virtue of the engine was that the expansion ratio exceeded the compression ratio, while the burnt exhaust gases were also very efficiently scavenged.

As I see it, the Atkinson engine is a shining example of ingenuity in achieving the desired end with the minimum of moving parts, and in the most elegant of ways. Give the inventor full credit for that, but it then has to be added, that the engine did have its weak points. The cylinder had a bore of 7in. and the 'stroke' of the pistons was about 10 inches. Yet the engine only developed one horse power, presumably, because its working parts were so bulky that it was governed to no more than 180rpm. For its modest power output it was, moreover, inordinately heavy, weighing, as it did, close on three quarters of a ton.

All the same, it seems to me that the basic concept was open to considerable development. In particular, the cast-iron links and rocking levers, the weight of which (I assume) limited the speed at which it ran, could have been greatly lightened, had they been made of steel. The same goes for the main body casting. If the engine then ran faster, it could have had a lighter fly-wheel.

In view of the ruggedness and reliability of 'open crank' farmers' engines, I was surprised to learn that the engine was *"susceptible to breakdowns"*, and speaking from memory, I have the idea that there were lubrication problems. Perhaps these could have been cured if the engine had been lightened and made to run faster; its size could perhaps then have been reduced to the point where the whole of the moving parts could be enclosed.

Assuming that these changes were possible, the performance of the engine could then have been further enhanced by replacing the automatic inlet valve by one mechanically operated.

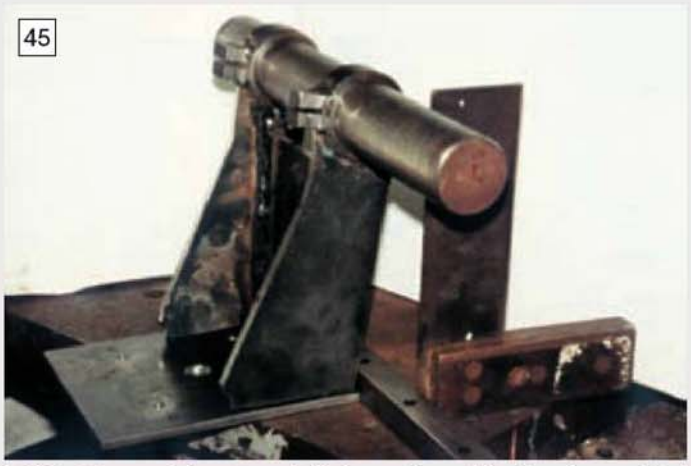
Actually, the Differential engine was not the only product of James Atkinson fertile imagination. He appears to have had a gift for thinking of simple but ingenious linkages, and he also devised an engine of more conventional appearance, in which the expansion ratio was also greater than the compression ratio. I don't think that I should start to describe this engine at this late stage in the present letter, but perhaps it will whet your anticipation of joys to come.

Writing about my first visit to the Science Museum has certainly awakened echoes of joys past. Much of the return journey from London was spent in pleasant dalliance with some young ladies from a neighbouring girls' school, at the end of the corridor. News of this came to the ears of Mr. Phillips, the young and popular physics master who was in charge of the party.

"Well," he was reported to have remarked dryly, *"Ellis can only benefit from the influence of a little feminine refinement!"*

Your affectionate, now reformed hobblede-hoy, of a Grandpa.

●*To be continued.*



Initial setting up of the cutter spindle frame. The uprights have been welded to the gusset plate and the arbor is being set parallel to the base plate.

Setting up is helped if wedges are used to obtain the necessary alignment which can be checked by means of an internal micrometer.

CAMCUTTER

A. J. Aldridge
deals with the fabrication of the cutter spindle frame.

●*Part IX continued from page 217 (M.E. 4241, 18 February 2005)*

This is another welded fabrication and another where it pays to get the measurements accurate at the start even though the plate work has an open tolerance.

Cut up the plate or get your friendly steelyard to do it, which probably pays if one has not got a band saw. The uprights are shown on **fig 31** with a simple shape suitable for assisting fabrication. They can be shaped like those on the assembly drawing after welding if you wish. The base plate needs to have the centre hole machined into it and four holes disposed around it at exact 90deg. steps, which can be done on any dividing attachment available. I use a divider of very simple form that bolts onto the back of a tool post for my quick release tool holder. It only requires a boss to be made to get into business.

The fully welded assembly. Here a special test arbor is shown but you could use the boring bar needed to bore the collars fitted with suitable spacers.

The clamping rings shown on fig 31 can be cut from solid or built up from brazed assemblies to finish 44mm dia. in the bore, which is the diameter of the spindle body. They should be bored to size after welding and the best way to align the rings for welding capitalises on the need for a boring bar that will carry the cutting tool at a later stage. This boring bar can be any convenient size, say, 30mm dia., with two rings machined to fit it that are a push fit to the roughed out clamping rings. This boring bar has to be machined parallel for its full length. Note that the clamps are not cut through until

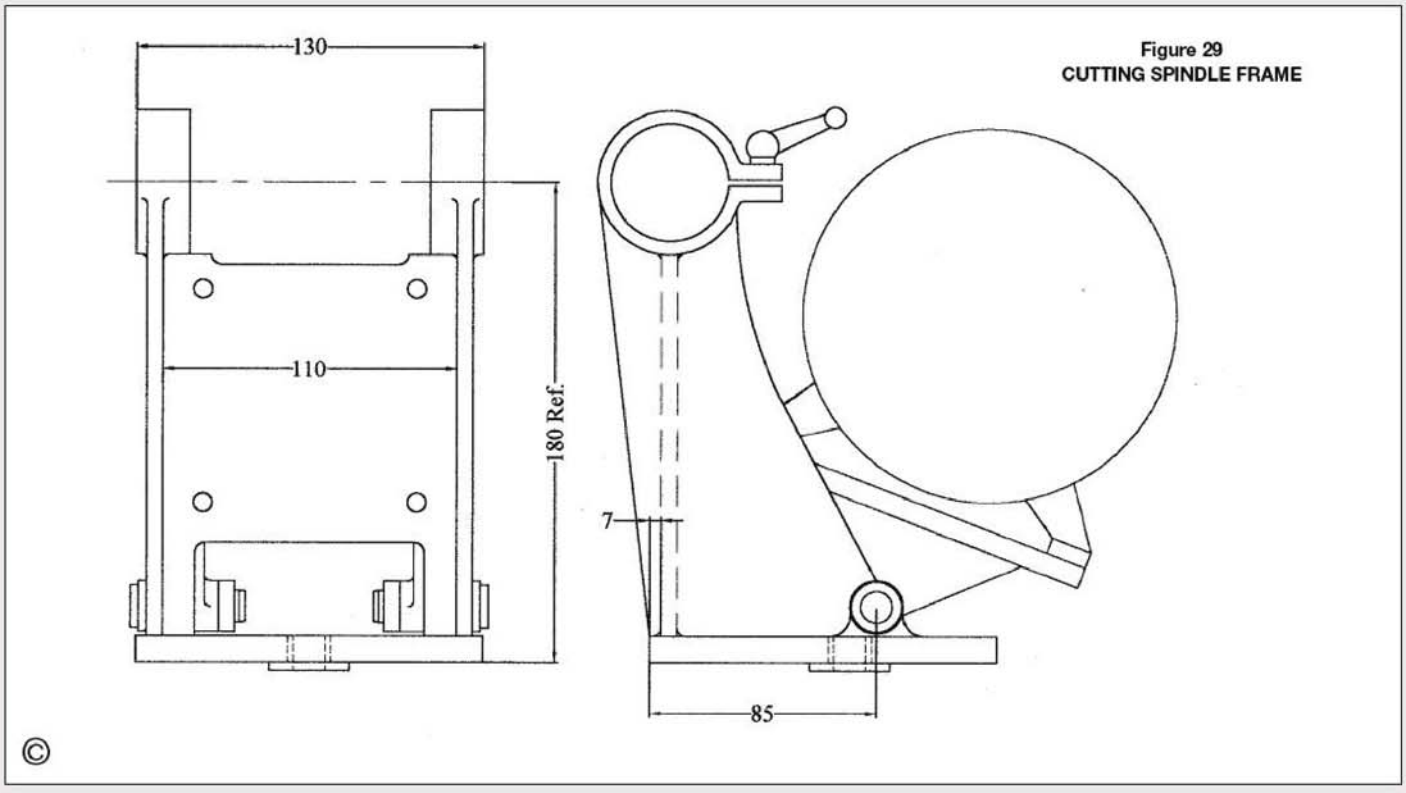


Figure 29
CUTTING SPINDLE FRAME

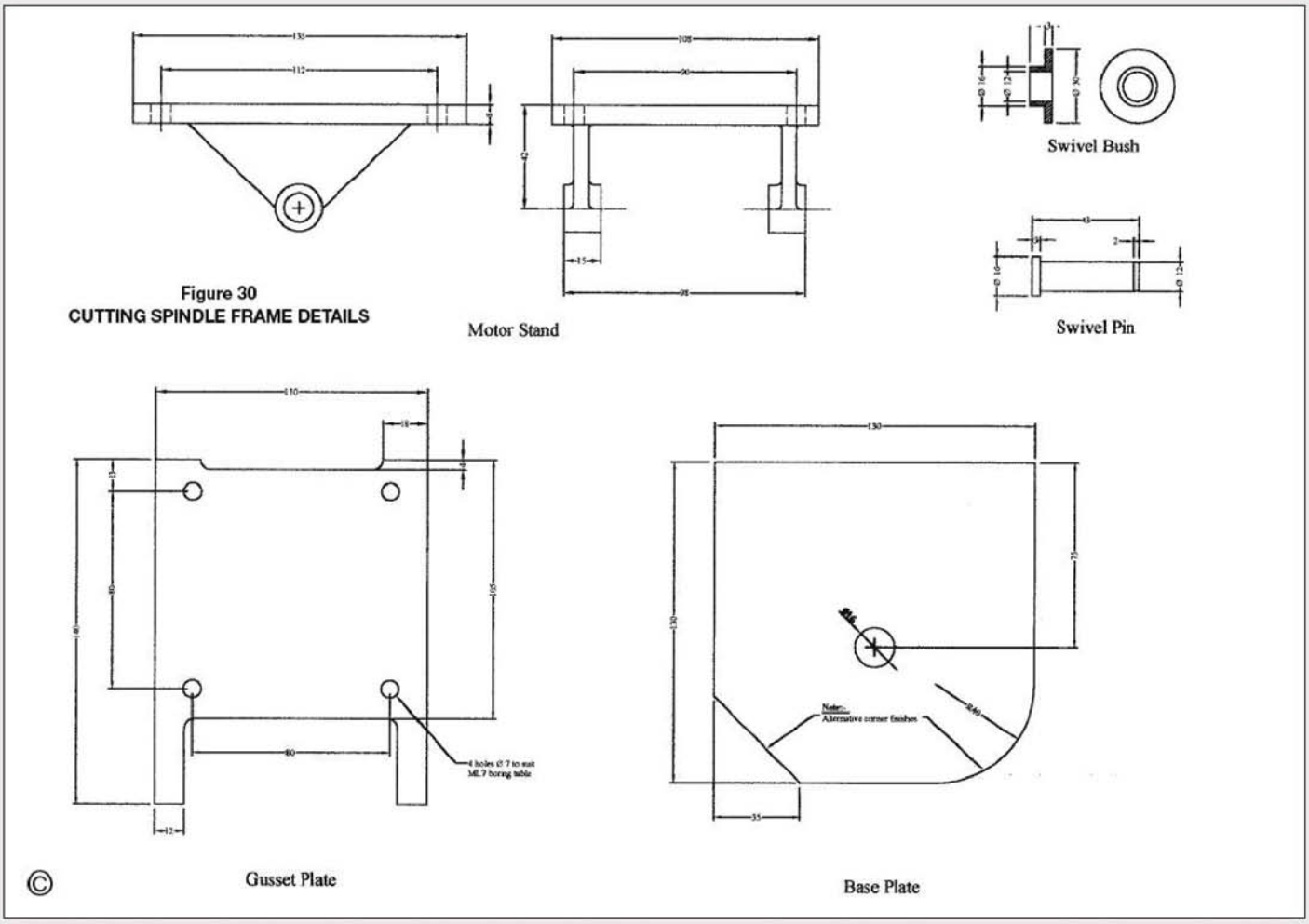


Figure 30
CUTTING SPINDLE FRAME DETAILS

©

after they have been welded into position and bored to size.

Photograph 45 shows the initial setting up of the side plates. **Photograph 46** shows alignment tests being made. It is important to make sure the arbor lies parallel to the base and in the photograph a bore micrometer is being used to check each end of the test bar.

One can see wedges being used to pick up the plate end to get the alignment required and a spacer to get the correct width and parallelism of the sides. Tack the base and sides ▶

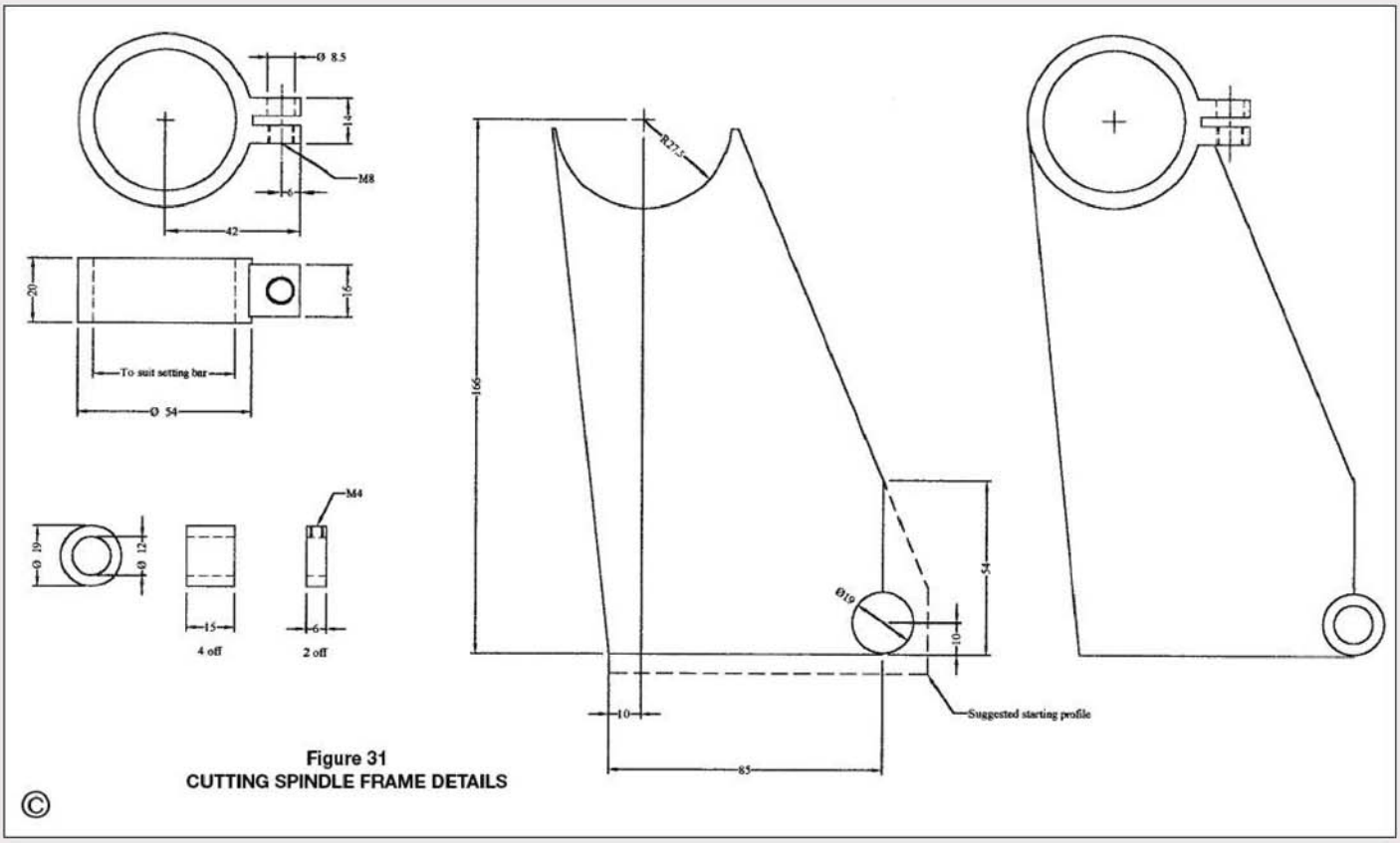


Figure 31
CUTTING SPINDLE FRAME DETAILS

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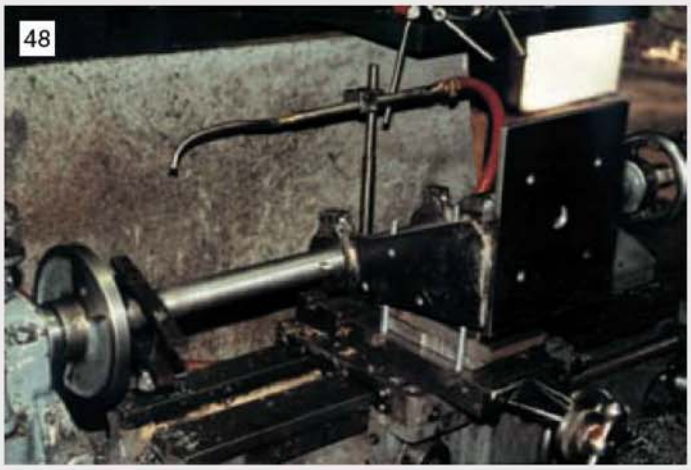
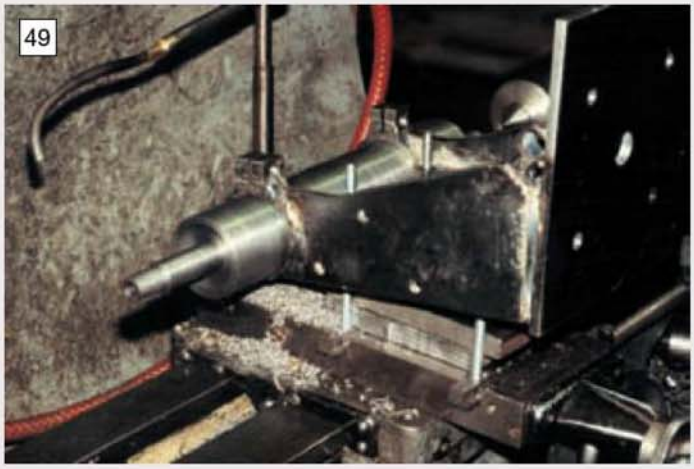


Boring the clamping collars to their final diameter ready to accept the spindle. The boring bar, fitted with suitable spacers, can aid setting up.



Testing for final size using the actual machine spindle. The boring bar can be removed and replaced without loss of setting.

heavily and with all the wedging out of the way full weld all the joints.

Final work on the spindle frame

We now need the boring bar used for checking alignment for its original purpose. It is time to bore out the clamping rings to final size even though this might only be a lick so accurate has our work been. Use the boring bar and spacer collars to set the work up on the lathe boring table of the lathe. This is done by placing the boring bar between centres (**photo 48**). The frame is then tightened down on to the saddle. Note the reason for the holes in the gusset plate.

My boring bar is not a good example of what is needed as the tool pokes out at 90deg. but would be so much easier to use if the tool was set at 45 degrees. A little arithmetic will give the degree of overhang required. Final size should be checked by using the spindle housing itself as a gauge (**photo 49**).

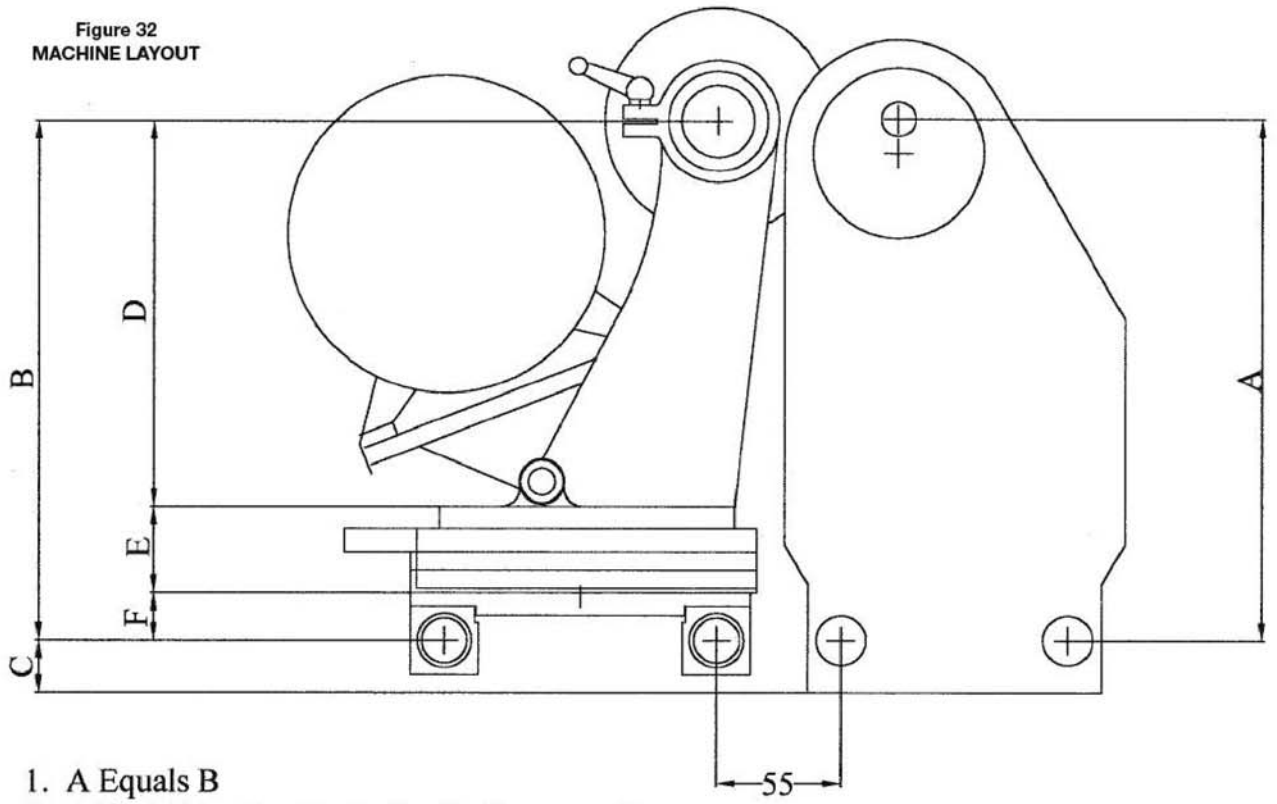
The base of the frame can be given a very light skim to give an all over witness by swinging the frame around and aligning the arbor at its ends to an inside micrometer to fine limits.

After all the machining is finished and as a final operation cut through the small amount of metal left in the bottom of the slots of the rings and tap the holes for M8 screws. Clean up the welds and surfaces of the plate and your cutter spindle frame is now ready to be painted to match the other fabricated parts (**photo 50**).

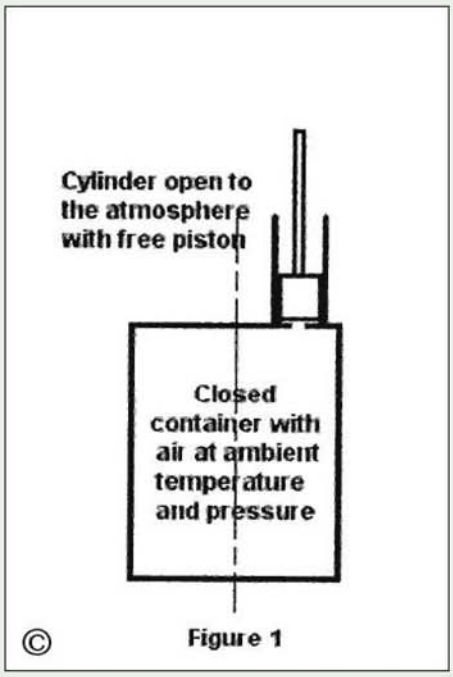
●*To be continued.*

Left: The completed frame ready for painting. Do not forget to cut through the collar slots.

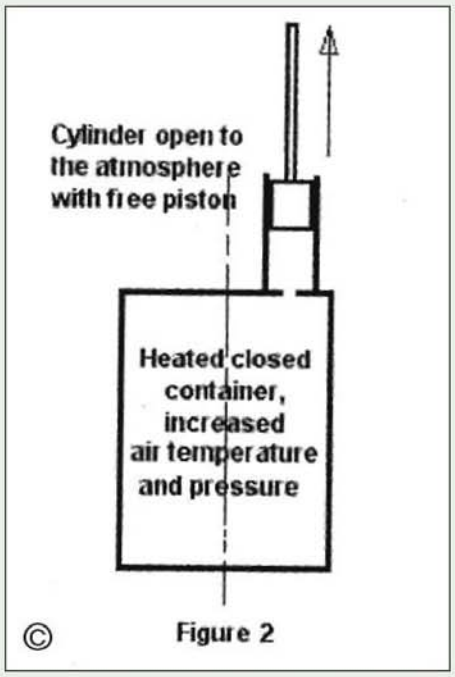
Figure 32
MACHINE LAYOUT



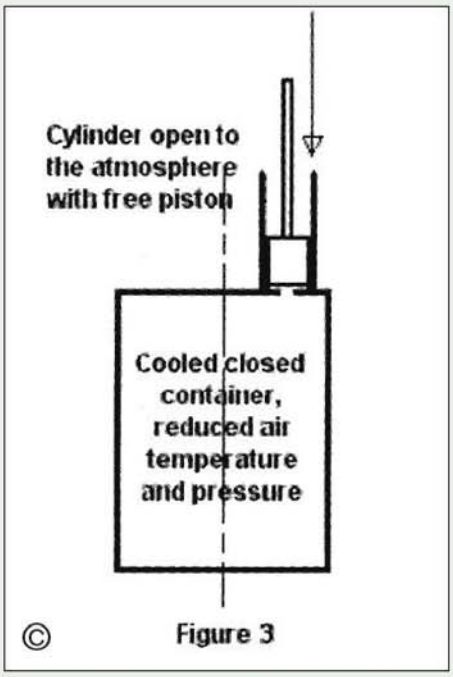
1. A Equals B
2. Adjust C to give Centreline in the same plane
3. D + E + F = B (Adjust either E or F or both)



© Figure 1



© Figure 2



© Figure 3

HOW HOT AIR ENGINES WORK

Mike Thurgood

explains some of the basic operating principles harnessed by these engines.

The principle of the hot air engine was first propounded by the Rev. Robert Stirling in the early 19th century. In retrospect, the basic principle is very simple. The real ingenuity arose in the mechanical mechanism that Robert Stirling invented, and the many variations that were subsequently invented, to translate his principle into a mechanical concept for the purpose of obtaining useful work output. The Stirling cycle, as it came to be known, was based on the knowledge that was available to Robert Stirling at the time, viz the physical principle that air expands when heated, and contracts when cooled.

How this phenomenon was first discovered I do not know, but even the old alchemists must have been well aware when heating their retorts that the contained air bubbled from its orifice when held under water – or mercury - and water or mercury was sucked back into it when the source of heat was removed.

The possibility of getting work from this phenomenon must have come as a sudden insight to Robert Stirling, namely that when air is contained in a closed vessel - its expansion and contraction being thereby constrained - the pressure rises and falls as the container is alternately heated and cooled. Therefore there has got to be some mechanical means to translate these phenomena into useful work.

The principle of the hot air engine is as follows:

1: We start with a closed container filled with air and with a cylinder and free piston attached, with an orifice between the cylinder and the container – see **fig 1**. One end of the piston is open to the atmosphere. It is set up with the air in the container at atmospheric temperature and pressure, and the piston at the bottom of its cylinder

2: When the container is heated, the temperature of the entrapped air increases. Therefore so does its pressure increase. This increase will cause the piston to rise and consequently provide a work output – see **fig 2**.

3: Next the container is cooled and as the temperature of the entrapped air falls so does its pressure fall. Therefore the piston will travel back down its cylinder, a process which can also provide a work output – see **fig 3**.

That's the basic principle of the hot air engine – the Stirling cycle - which can be translated into a closed graph.

In order to obtain a useful work output, alternately heating and cooling a volume of air in a large container is obviously not going to result in a quick exchange of heat between the heating and cooling cycles. Something considerably more efficient was required.

To overcome this problem Robert Stirling invented the crucial component for success, namely the displacer cylinder and piston, in which there is an annular space between them – no close fit or piston rings. Thus, as the piston is moved up and down within its cylinder, the contained air is displaced from one end to the other. Heating one end and cooling the other therefore assures a good rate of heat exchange as the air flows through the narrow annulus.

Having devised this rapid heat exchanger, now the heating and cooling cycles could be used to provide a useful work output through a suitable mechanical mechanism.

Robert Stirling was not only the first person to define his cycle, but he was also the first person to devise a mechanical system for making use of his cycle, and thus provide a useful work output. Later, during the 19th and early 20th centuries, quite a number of inventors devised mechanical improvements and variations for hot air engines, many of which were patented. But not all of them were translated into hardware.

Typical 19th Century hot air engines had their power pistons open to the atmosphere – hence 'atmospheric' hot air engines. The Rider compression engine made an attempt to increase the internal pressure of the system, and one patent even shows a 'make-up' air pump, although this wasn't included in the Rider engines advertised in the 1906 catalogue of the Rider Ericsson Inc company. But both its power and displacer piston heads were open to the atmosphere.

For the atmospheric hot air engines the work output was purely a function of the difference between the internal and atmospheric pressures. Their power outputs were, as a result, invariably limited, engines of a few horse power in power output being relatively large in comparison with internal combustion engines that were coming on to the scene towards the end of the 19th century.

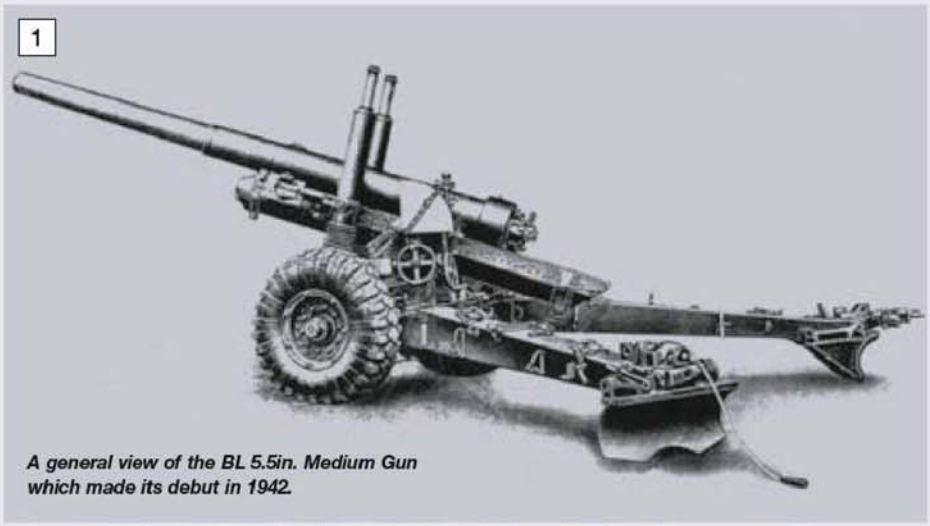
During World War II, experimenters at the Philips factory in Eindhoven, The Netherlands, introduced the first really major breakthrough in power output from hot air engines. Obviously some engineer must have asked himself the simple question: *"Why not totally enclose the engine except for its displacer cylinder and output shaft, and pressurise it?"*.

Suppose you construct a hot air engine with this principle, and start it without pressurising it. Its power output will be a function of the pressure difference (internal – atmospheric). Now pressurise it, say to ten atmospheres, and use the same heating source. Although heat transfer properties of the pressurised gas will complicate the heat exchange properties of the displacer, effectively the same temperature differential will now result in about ten times the pressure differential, therefore the power output will be increased by the same factor, for the identical engine.

For reasons which aren't entirely obvious, modern Stirling engines, as they are now referred to, haven't yet 'taken off', although companies in the USA and New Zealand are offering a range of Stirling engines off the shelf.

Chrysler did try out a hot air engine powered motor car, but it was never developed to a marketable stage. The only major use of which I am aware is the substitution of hot air engines for diesel engines for underwater running of the Swedish Navy's submarines. Their silence is their greatest advantage for this use. Presumably they are electrically heated from batteries charged by the diesel engines when on the surface.

David Wilcox
fires the opening salvoes in a fascinating new series.
●*Part I*


1

A general view of the BL 5.5in. Medium Gun which made its debut in 1942.

THE BL 5.5 inch MEDIUM GUN

In the 1930s it was decided to develop a new, medium, artillery gun to replace the aging 6in. gun dating from the First World War. In 1939, an Operational Requirement was issued for a 5in. gun capable of delivering a 90lb shell to 16,000 yards with a weight of less than 5½ tons. Development and early manufacture were beset with many problems and it was not until May 1942 that the first guns went into action in the Western Desert.

The equipment which emerged, and which is depicted in **photo 1**, had a calibre of 5.5in. and could fire either a 100lb shell to 16,200 yards or an 80lb shell to 18,100 yards. The gun and carriage weighed just over 6 tons. The gun had an Ashbury breech mechanism operating a Welin, interrupted thread, breech screw (similar to the Naval 6in. gun) and the carriage was a two-wheeled split trail pattern, which carried the gun in a trough cradle. The trunnions were set well to the rear of the barrel centre of gravity so as to allow recoil at maximum elevation of 45deg. and hence balancing springs were mounted vertically, bearing on the cradle, giving the equipment the characteristic 'horns' alongside the barrel. When in action, the trail legs sat 60deg. apart, permitting a top traverse of plus and minus 30 degrees.

The 5.5in. gun survived in British service until the 1960s and, during its time, several variants of both gun and carriage existed. Original carriages were of rivetted construction but later, a welded, lighter weight version appeared. My copy of the 1956 user's handbook describes the welded version but I have never seen one. All the equipment that I have seen (Fort Nelson, Fareham, The Firepower Museum, Woolwich, Royal Military College of Science, Shrivenham and Hohne Barracks in Germany) are all rivetted and the differences from the welded version are quite minor. The diagram figures in the text are taken from the 1956 handbook.

Having previously completed about two dozen different artillery models, the 5.5in. gun presented a real challenge, since to my knowledge no sensible drawings existed, and because as guns go, it is quite complicated. As a retired member of staff of the Royal Military College of Science at Shrivenham and living close by, I was fortunate to have access to an example almost on my doorstep. My first act then, which took several weeks, was to measure the equipment in great detail, take numerous photographs and understand how it all fitted together. Back at home in the evenings, with half an eye on the television, I prepared drawings to a scale of one inch to the foot. Then, using a copying machine, reduced these to 1:15 scale or 0.8 inches to the foot, the scale I have used for all my artillery models. Completed the model measures overall 18in. long, 11in. wide and 7in. high. The model described in this article was awarded a Silver Medal in the 1998 Model Engineer Exhibition at Olympia.

Since my drawings are rather amateur, I would urge anyone attempting a model of this gun to examine and photograph an example of the real thing. There must still be quite a few around apart from those that I have mentioned; perhaps in the hands of gunner Territorial Army units dotted round the country. The Firepower Museum at Woolwich should be able advise.

Artillery modelling, I find, provides scope for most model engineering skills - turning, milling, rivetting, silver-soldering and sheet metal forming. My main lathe is a Myford ML10 and this is supported by a Sherline milling machine and an Emco Unimat 3. A wide variety of materials was used - brass, copper sheet where awkward shapes have to be bent over formers, aluminium alloy and, notably, boxwood.

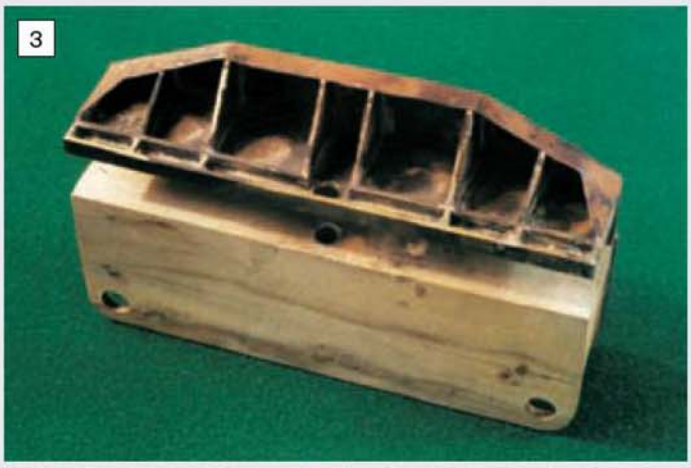
I am fortunate in having an old boxwood tree growing in my garden and when well seasoned, boxwood can be turned and milled like metal, leaving a metallic smooth finish, but more on this later.

The 5.5in. gun may be divided into a number of major sub-assemblies and the modelling of each of these will be described in turn. The main elements are:-

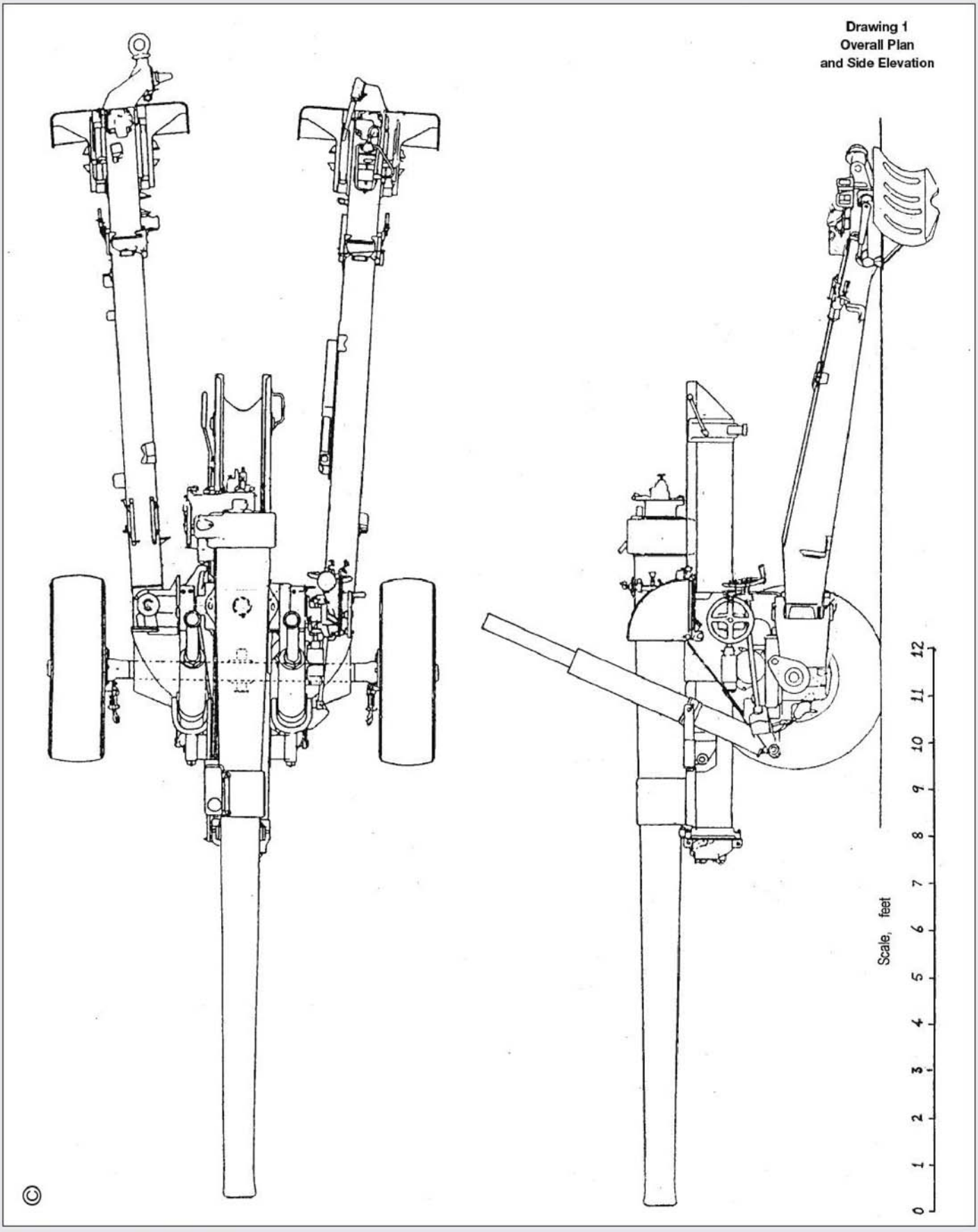
1: Gun barrel and breech mechanism.
2: Cradle to hold the barrel and recoil system.
3: Saddle to take the cradle, elevating and traversing mechanisms.
4: Saddle supporting bracket and axletree.
5: Carriage legs with their fittings, spades, etc.
6: Wheels.
7: Balancing gear.
8: Quick loading gear.
9: Sighting system.


2

Top view of the saddle supporting brackets showing the bearing ring and leg hinge recesses.


3

Bottom view of the saddle supporting bracket showing the ribbed front apron, axletree pivot and recess for the axletree.

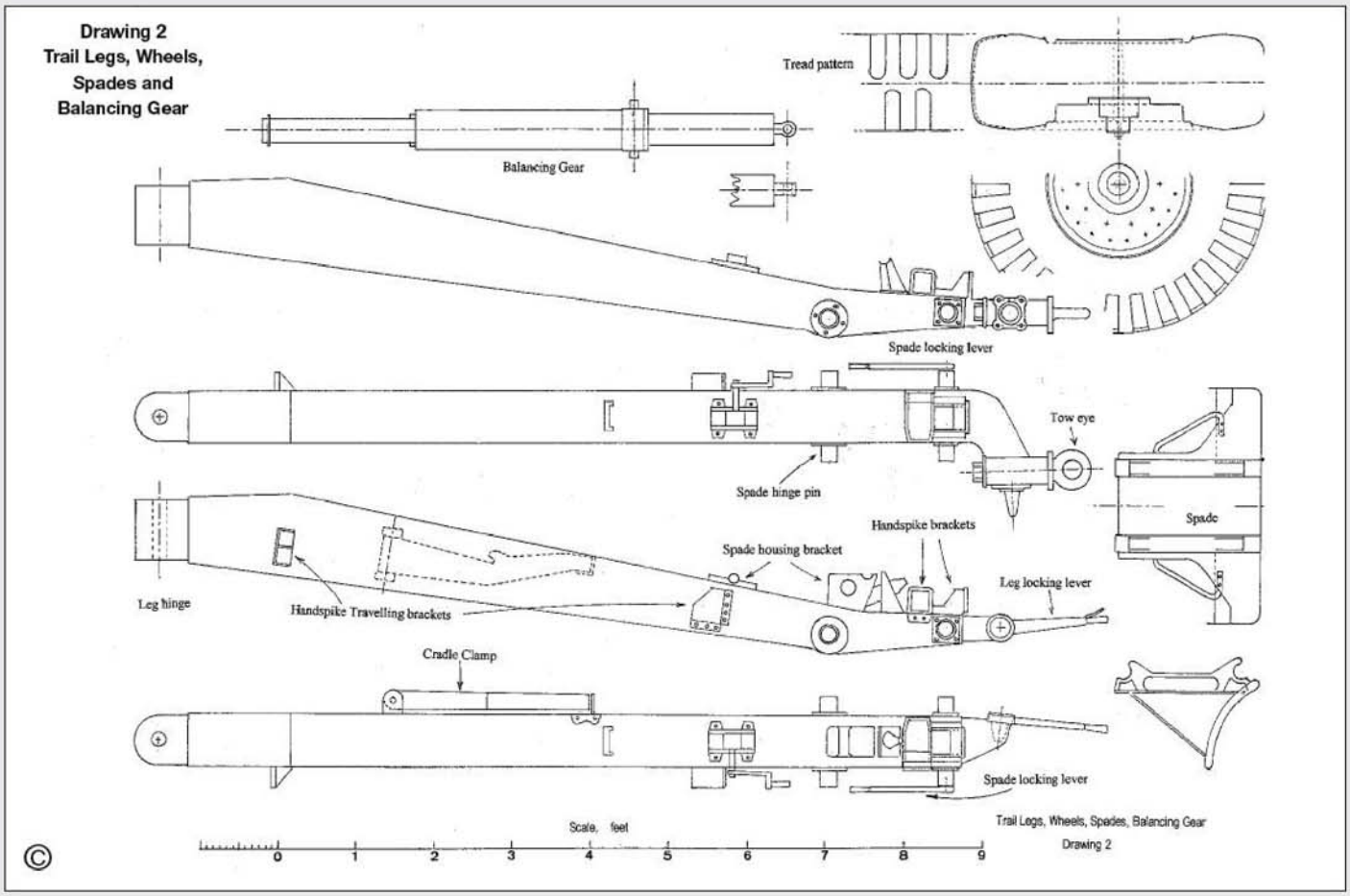


Saddle Supporting Bracket

It seemed most logical to start with the saddle, supporting bracket since this is the fundamental part of the carriage. As it is effectively a box structure, boxwood (no pun intended) was selected for its construction. The bracket has the following function:-

1: It supports the saddle, enabling it to traverse plus and minus 30 degrees.
2: It provides the hinge points for the trail legs.
3: At the front, it is recessed to accommodate the axletree, enabling it to tilt over uneven ground.

The saddle supporting bracket is depicted in **drawing 3** whilst **photos 2** and **3** show top and bottom views of the rectangular block of boxwood to which is affixed the top plate. The top plate is made from 0.015in. thick copper sheet to which is rivetted the traversing ring (brass) and at the front, an overhanging ribbed skirt which with the block provides the recess and hinge pin location for the axletree. The rear corners of the



boxwood block are milled out and drilled to provide the hinge points for the trail legs. The ribbed skirt was built up from 0.015in. thick brass sections silver-soldered using self-fluxing silver solder paste. The ribbing is best seen in photo 3.

Axletree

This is dimensioned in drawing 3 and depicted in **fig 12** and **photo 4a**. The axletree consists essentially of a pivoting beam to the ends of which are welded an offset reinforcement to support the protruding stub axles and the anchorage plates.

In the model, this was once again built up from brass sections milled, turned, drilled and silver-soldered as appropriate. The axletree is designed to swivel plus and minus 10deg. in the vertical plane to cater for towing or positioning the gun over uneven ground. There is of course no suspension as such. Once the axletree has been set in place in the inverted channel in the saddle, supporting bracket, a cover plate should be secured across the gap. In case the model needs to be taken apart, I suggest that 12BA bolts are used, tapped and screwed into the saddle supporting bracket.

Wheels and Brakes

The wheel dimensions are shown in **drawing 2**. These were turned and milled in all their detail including hubs and the tread pattern from 3in. dia. boxwood.

Photograph 4b shows the milling out of the tread pattern. When complete, the 'tyre' is painted matt black and looks most realistic.

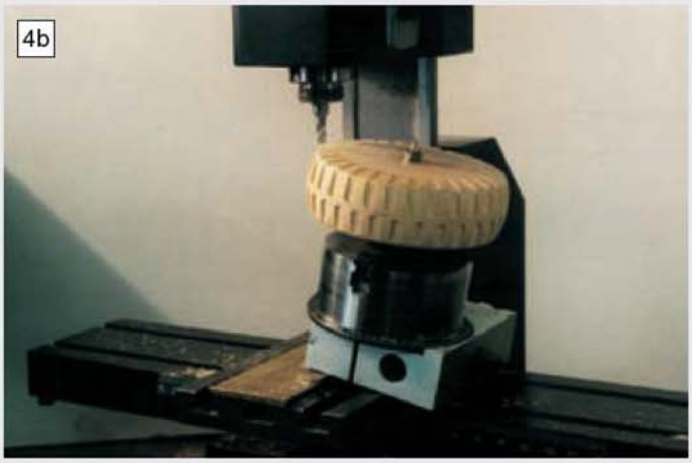
Photograph 4a shows the wheels mounted on the axletree. Each anchorage plate is bolted to a 7-sided plate and this, in turn, to the circular brake hub backing plate. Handbrakes operate independently via ratcheted levers on each wheel and are attached to the 7-sided plates. The plates are bolted together using 14BA bolts with hexagonal nuts. **Photograph 4c** shows the axletree fitted into the channel in the saddle, supporting bracket.

Saddle

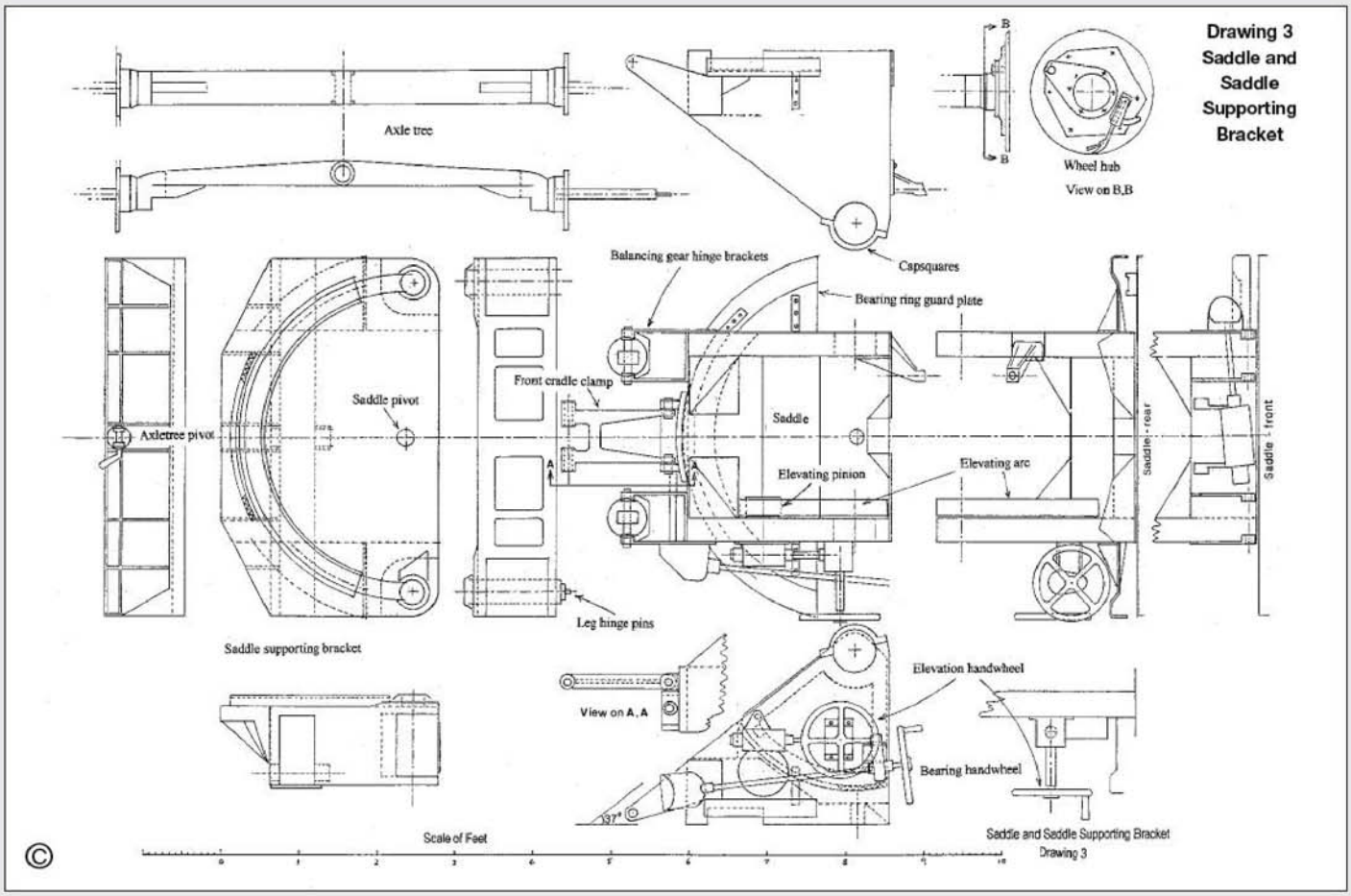
The saddle as detailed in drawing 3 was tackled next. As seen in **photos 5** and **6** the basic structure is of boxwood pieces glued together with PVA glue. Underneath, a circular channel is milled out, centred on the saddle pivot so as to match the roller, traversing ring fixed to the top of the saddle, supporting bracket. A small recess has to be allowed for the elevating pinion, which meshes with the elevating arc - see **photo 7**.

●*To be continued.*

The axletree anchorage plate and wheel hub backing plate with the hand-brake attached.



Milling out the tread pattern in the boxwood tyres. This material machines well when properly seasoned.



A view showing the axletree fitted in the channel provided in the saddle supporting brackets.

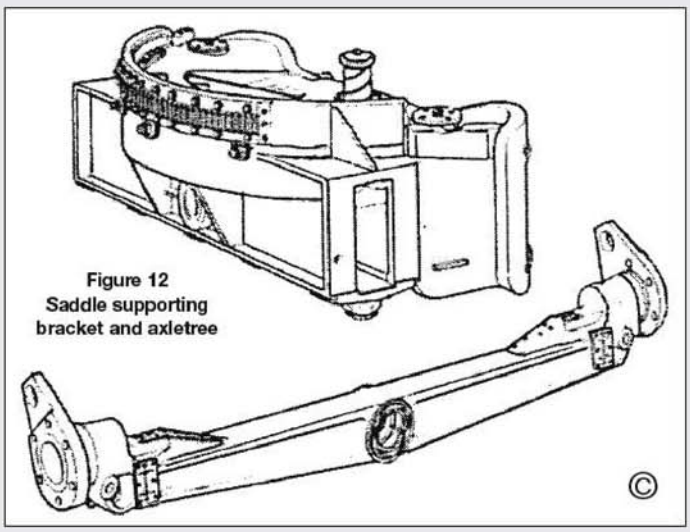
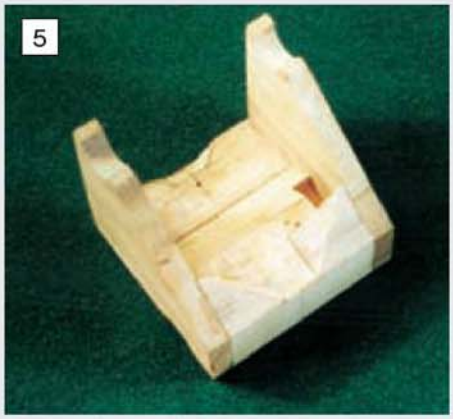
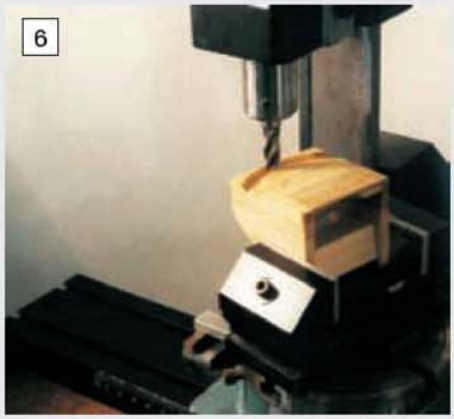


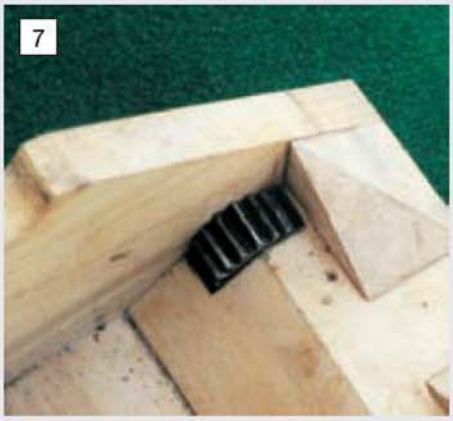
Figure 12
Saddle supporting bracket and axletree



Top view of the saddle. Like a number of the gun's structural parts this was fabricated from boxwood.



Saddle showing the recess for the bearing ring being milled out on the Sherline milling machine.



Saddle showing the position of the elevation gear pinion, which meshes with the elevating arc.

KEITH'S COLUMN

LILLIAN
A NARROW GAUGE LOCOMOTIVE
for 7 1/4in. gauge

Keith Wilson

describes the crossheads and guide-bars for this attractive locomotive.

● *Part VI continued from page 221 (M. E. 4241, 18 February 2005)*

The crossheads can be cast iron castings (?) or can be fabricated from chunks of mild steel silver-brazed together. I chose the latter, mainly because of the interesting task it offered. Machining from one fat lump is possible, but it is a hell of a pile of swarf, energy, etc.

So an obvious choice is out of one piece 1 1/2 x 2 1/4 x 3/8in., one piece 6 5/16 x 1 3/8 x 3/4in., and a piece 1in. diameter. Machine them up in any order you choose.

Starting with the biggest job, reduce the 6 5/16 x 1 3/8in. etc. to just 0.6875in. thick (alright then, 11/16 inch). Square off the ends (milling preferred) and do a bit of marking out. I find that a good way of coating the surface for marking is to spray it with an old aerosol can of paint – you've probably got one somewhere. I find it far better than copper sulphate solution as the copper rubs off very quickly. There are special solutions on the market, but I always seem to have a few spray-cans handy so have yet to try them. Degrease first – white spirit will do, plus a paper towel.

An easy way to machine is to deal with the holes first, reaming or tapping them before milling the profile, then mount the bit on a rotary milling table. It is then easy to cut the taper bits. Incidentally, why is it that as soon as I get to the last operation on a given task, I notice that there is a far easier way to do it?

I first set the angle correctly and took each taper down in turn. However, as I started the last cut I realised that it was better to machine the bits parallel, and just to take off the angled portions last. The curved bits are done with the main hole mounted on a spigot in the centre of the rotary table. Note that life is easier by making the two 'end-on', this automatically makes them one to each hand. It is also easier to hold the whole unit down. After parting, you can file (ugh!) linish (ah!) or mill the ends round.

To do the main spigots or bosses (what else should they be called?) make the threaded end first, screw-cut the threads, for the spigots must line up with centre lines, etc. Then turn the taper and part off. If screwed into a threaded bush mounted in the chuck (I keep a small drawer of these in a good range of sizes, they are made out of hexagonal material) the drilling through and reaming out to a 10deg. (included angle) taper is straightforward, for which I use a home made D-bit.

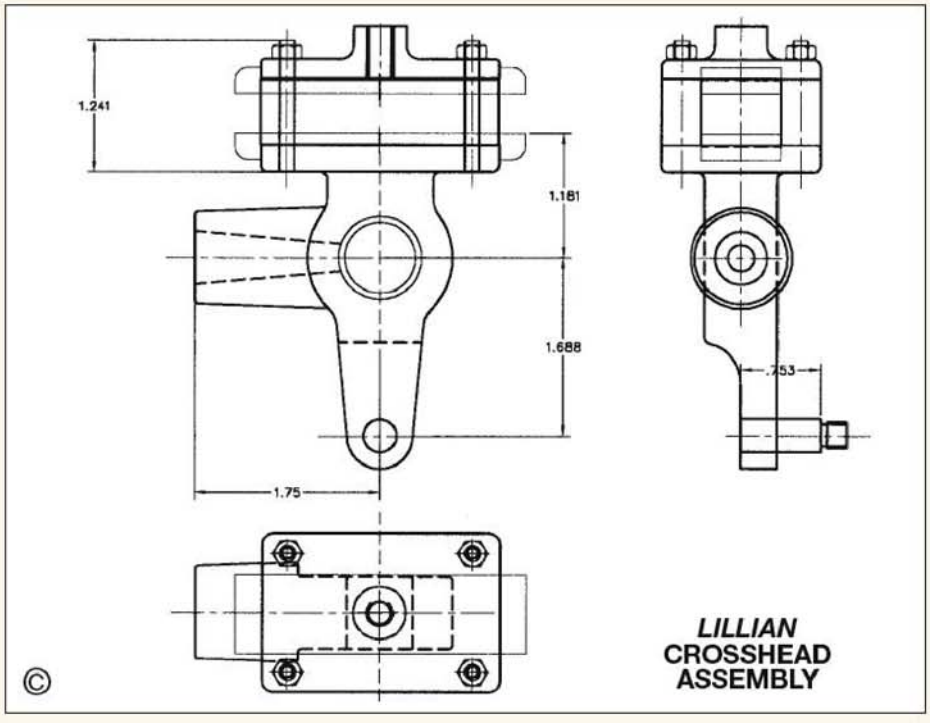
For the guide parts or tops, mill out a slot 11/16in. wide x 3/32in. deep along the 1 1/2 x 3/8in. piece, cutting it in half afterwards. If the main body is pressed against one side of this slot (if it is not a perfect fit – is it?) it will end up parallel to the spigot bit and at right angles to the main bore. In my case I had a few 1/4in. BSF countersunk screws handy so used them through the top tapped into the main bodies to hold them firm. Assembling the three parts of each crosshead with a supply of silver-braze flux, a few minutes work with an oxy-acetylene torch will glue them together for keeps. Do not forget a bit on the screw heads.

Incidentally, it is perfectly easy to apply the flux to the hot joint if you are dealing with copper, brass, or bronze, but don't try it with steel. Flux must be applied in liquid form before heating. Mixing the flux up with some water ere applying it is okay. About the consistency of medium cream is correct, don't omit to make sure that machined steel bits are grease and oil free. Contrary to some beliefs, grease or oil will not boil off and leave a clean surface.

To machine the tops of these items dead square to the main bore and dead parallel to the piston rod (take it from me, 'tis most important) turn a 10deg. included angle taper on a piece of bright mild steel 1/2in. dia. about 10in. long. Drive this into the taper in the spigot part of the assembly and rest the rod on two matching blocks whilst gripping the main block in the machine vice under the vertical milling machine (or equivalent). Then the top can be trimmed back, to the measurement of 1.063-0.25in., or 13/16in. (0.8125in.) from the top of the piston rod. I know of no better way of getting crosshead accuracy. Speak now or forever hold your piece!

The various other parts that make up the crosshead are relatively simple milling or turning jobs. If you are using needle roller bearings, then 'tis best to harden the crosshead pin (shown on the connecting rod drawing) if using a bronze bush then it is not worth the trouble, for the steel pin will wear badly whilst the softer bronze bearing will not. Reason: any grit getting into the bearing will be pressed into the bronze, which will then become a grindstone. Several years ago I gave a 'heavy general' to my '1366'. I planned (amongst other things) on renewing the main connecting rod bearings. However, on 'miking' the 1/2in. and 3/8in. dia. silver steel pins (crankpin and crosshead) and found them worn about 0.025in. on diameter, oval in the case of the crankpin. I applied reamers to both bearings, and said reamers fitted tightly all round. I had not omitted oiling either. Any questions?

A view of the crosshead assembly. A little more work with a file might be appropriate.



Chewing out the crosshead bodies on the milling machine. The parts are set up on the rotary table.

Lining up the crosshead using suitable blocks of equal height. The cutter is held in the horizontal spindle of the milling machine.

To deal with the pin-hardening, drill a short hole in the 'small end' of the pin (No. 34 drill), tap a few threads 5BA. Now I know perfectly well that this is not the correct tapping size drill, but it saves a bit on taps and it is not likely to be used again after the hardening process. To harden, screw a piece of 1/8in. dia. steel with a few threads on the end (5BA, how did you guess?) into the end of the pin – this to act as a holder. Heat up the pin as fast as you can (fairly large oxy-acetylene jet recommended) and directly the centre reaches bright red, dunk into cold water. The theory is, only the outside reaches hardening temperature, therefore only the outside gets hard. This theory may be good or not, but it works. If the pin gets hardened all the way through, it will be as brittle as – never mind. I've had a 1/2in. dia. steel crankpin snap like a rotten carrot, with quite a minor shock.

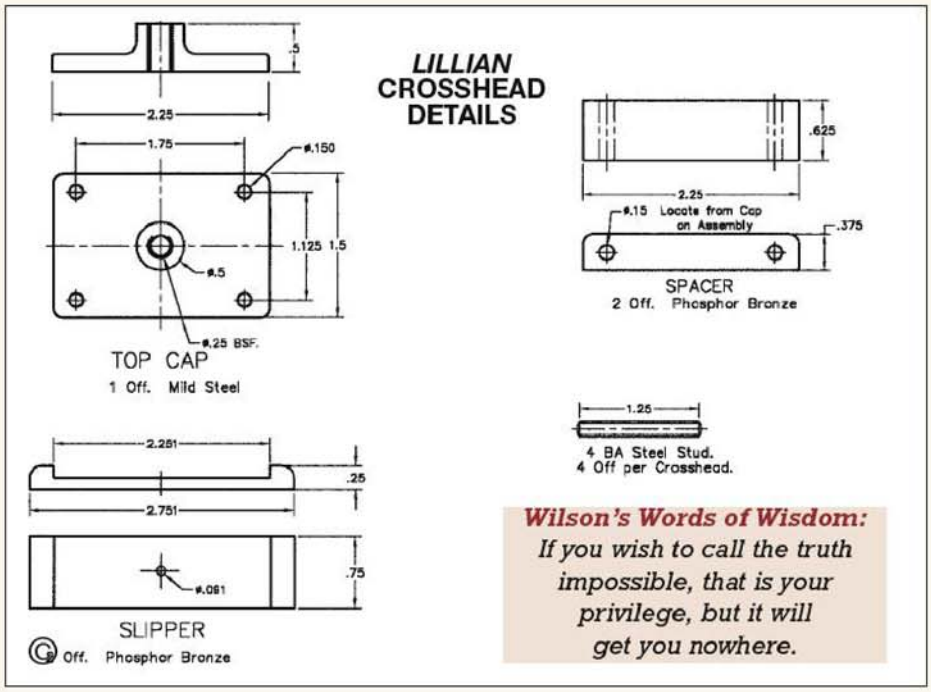
There is no great reason for using bronze for the side guides, brass will do, but bronze is better. The main slippers, however, must be hard bronze, for 'tis them that carries the load.

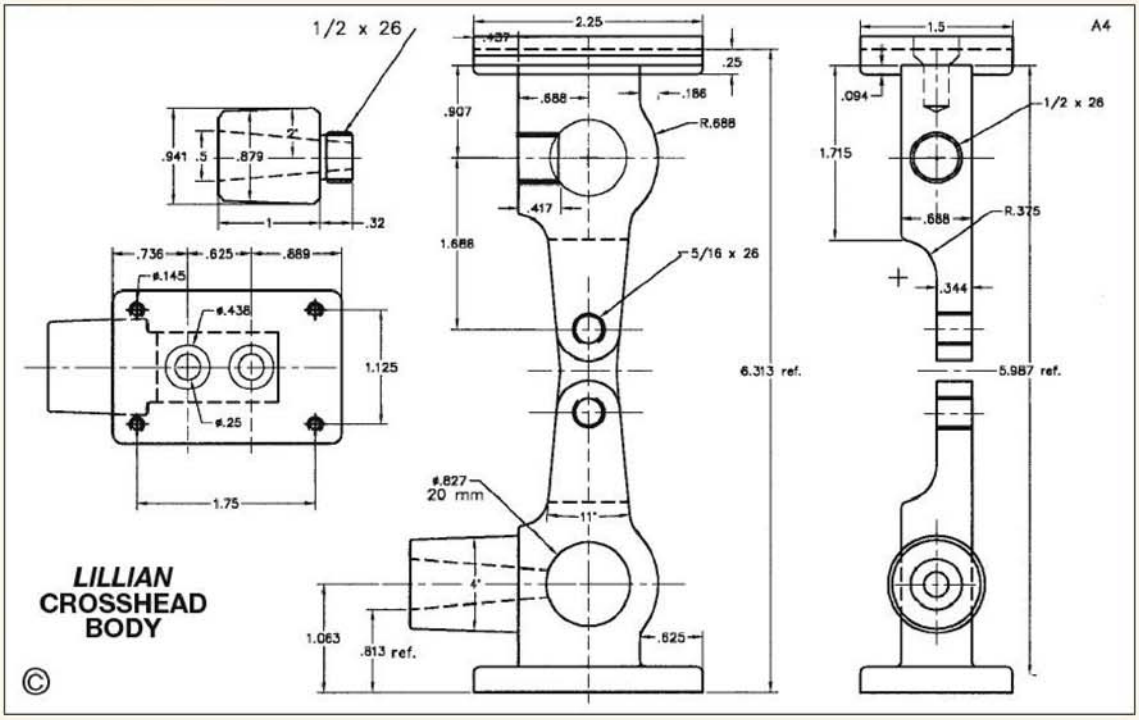
Running forwards, wear is confined almost exclusively to the lower slipper, backwards the load bears on the upper slipper. Incidentally, this is so only for power output, 'coasting' (technical term, drifting) then the situation is reversed.

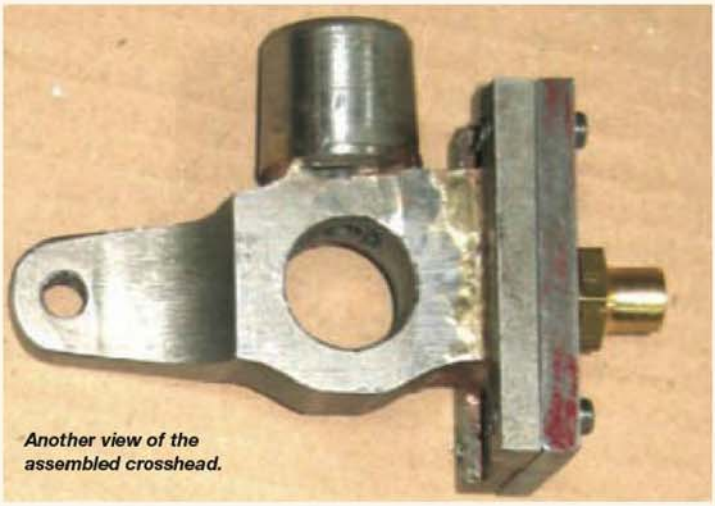
The top cap material is unimportant, cast iron or mild steel. As can be seen, I used the latter with a brass oil cup. Since many of the patterns cannot be made until I am satisfied as to accuracy of the drawings, it pays me to fabricate many items that I would otherwise make from castings – time being somewhat of the essence etc. Closely allied to crossheads are the

Guidebars

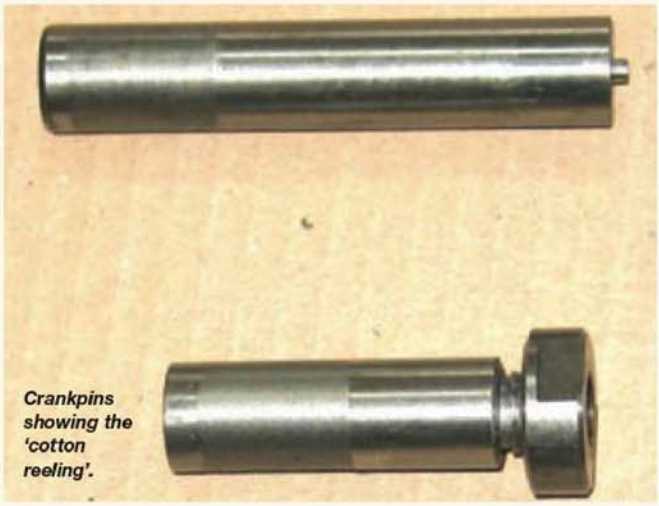
I have not been able trace any suppliers of 3/4 x 3/8in. silver steel, but I see no reason for not using two bars of 3/8in. square. Closely and carefully bonded together, they should last as well as the







Another view of the assembled crosshead.



Crankpins showing the 'cotton reeling'.

solid stuff. Laid flat side-by-side on the lathe bed (if you haven't got a plane table) they can be clamped together tightly. I suggest cleaning with acetone, anointing with Loctite 601, and clamping together on the surface plate or its equivalent. Tap them down (they must be flush) possibly on a sheet of newspaper, and allow to set. Then deal with the screws, making sure that: -

1: The heads are sunk or at the most flush, and
2: Put on the inside when assembling onto cylinder covers and expansion link brackets. Do not omit the same Loctite on the screws; the last thing you want is for them to show their little selves on the outside! Klonk, klonk, klonk.

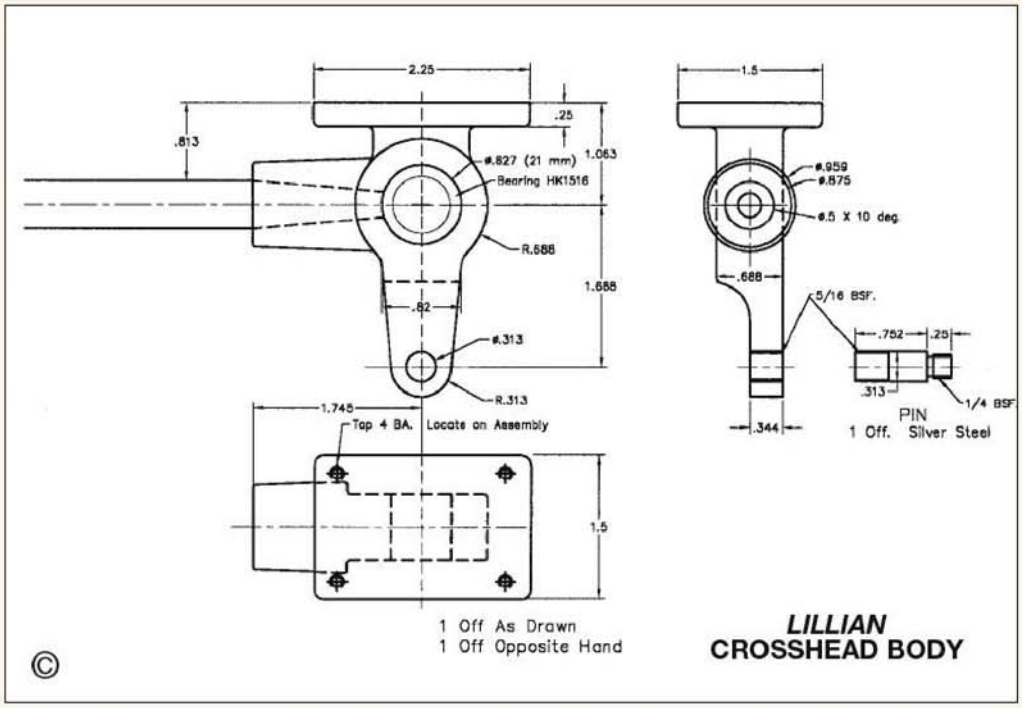
It has been suggested that hardened bars are best for this, but first, they will surely leave the straight–and–narrow, and secondly just how would you cook up only the outside without getting the centre hot?

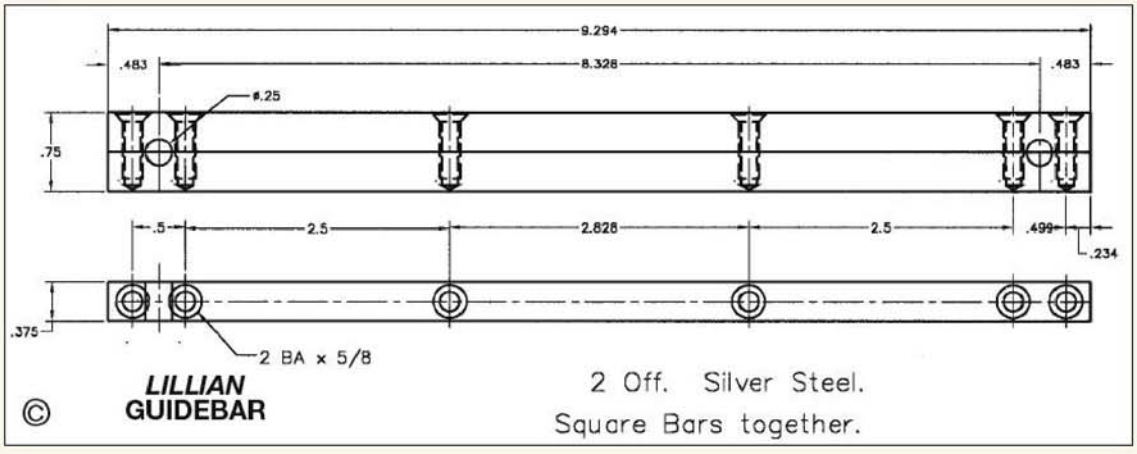
A matter that dear old Curly did not seem to mention much – if at all – was the use of shim steel to line up a guidebar perfectly. It is no light matter. Not only must they be dead parallel to the piston rod but the correct distance above it. About the only way is by trial and error. It is not too tricky this way. But, if you have a supply of several thicknesses of shim, get the final set-up with as few as possible pieces. In full-size practice, to the best of my knowledge and belief, the required thickness was measured very carefully and a solid block ground down to this size. Makes good sense.

Note, incidentally, that the process of shimming can also be applied to the crosshead slippers if necessary. Note, also, that these shell-type needle roller bearings should not be 'miked' without care, for in the 'raw' state the outer shell is not necessarily perfectly cylindrical; they rely on the firm support of an accurate housing. So, take care to get the housing bores reamed to size, wash them out (acetone) and wash off the outside of the bearing. Then anoint with Loctite 601 and push the bearing into its housing. This has always proved satisfactory. The tolerances on housings for these bearings are quite tight, certainly beyond my capabilities, and I suspect out of the question for most of us amateurs - occasional pronounced hammer-chewers!

The firm of **Steam and Diesel Castings, 59 The Foxholes, Kidderminster, Worcestershire DY10 2QR,** has agreed to supply castings for this puffer. I have met and discussed matters with him and given him my driving wheel pattern. He knows his stuff, so good castings are to be expected. I think he would probably prefer customers to call and collect their castings where it is convenient to do so, for 7 1/4in. castings are not by any means lacking in mass (and therefore weight). For example, driving wheels weigh about 18lb. Each, as cast. Quite a parcel!

● *To be continued.*





HOBBYMAT MILLING HEAD REPAIR

Douglas Reid

describes how he repaired his trusty milling machine.

Having successfully used a Hobbymat BFW 300 mill for about 11 years, I recently noticed that the gearbox had become more noisy than usual and it was difficult to select the different speed ratios. I decided to investigate and, expecting to just re-lubricate the mechanism, I was surprised to find that the trouble was much more serious.

Having removed the drill feed handle and the right hand side cover plate, it appeared that the upper pair of nylon gears which are engaged by the dog clutches had parted from and were now running on their central bronze bushes which had seized to the shafts. When not engaged in the drive train the upper pair of gears were falling down and causing the gearbox to seize on certain speeds.

It was clear that the gearbox needed a complete strip down and rebuild. The left side cover plate was removed, together with the selector levers. The motor was removed and the cover plates on the lower bearing housings underneath the gearbox removed by unscrewing the grub screws and jacking them out by screwing in longer M4 cap screws. The circlips on the upper bearings and ends of the shafts were removed. The selector shaft was tapped out and the selector forks were removed.

The dismantling of the gearbox is a bit of a puzzle and the following method is how I overcame the problem. Some simple tools need to be made up and these are shown in the drawings. The upper bearing on the shaft nearest the front was partially removed by tapping the bottom bearing upwards using the tool shown in **fig 1**. At this stage the bearing could not be fully removed due to fouling of the gears. It was necessary to drive the shaft down by tapping the shaft out of the inner part of the bearing, using a short length of 3/8in. dia brass rod. This allowed a split collar (**fig 2**) to be inserted between the top steel gear and the bearing. The bearing could then be removed by tapping from the bottom. It is not necessary to remove the lower circlips from the upper bearing housing. By tapping the shaft back down, the upper gear, its shaft key and the upper nylon gear can be lifted out. The lower bearing can be tapped up clear of its housing and the remainder of the gear train then removed. Before further dismantling this gear train, mark the upper side of the dog clutch, as it is slightly wider on one side than the other and needs to be replaced the same way up. Once this shaft is removed the other shaft can be removed more easily in a similar manner.

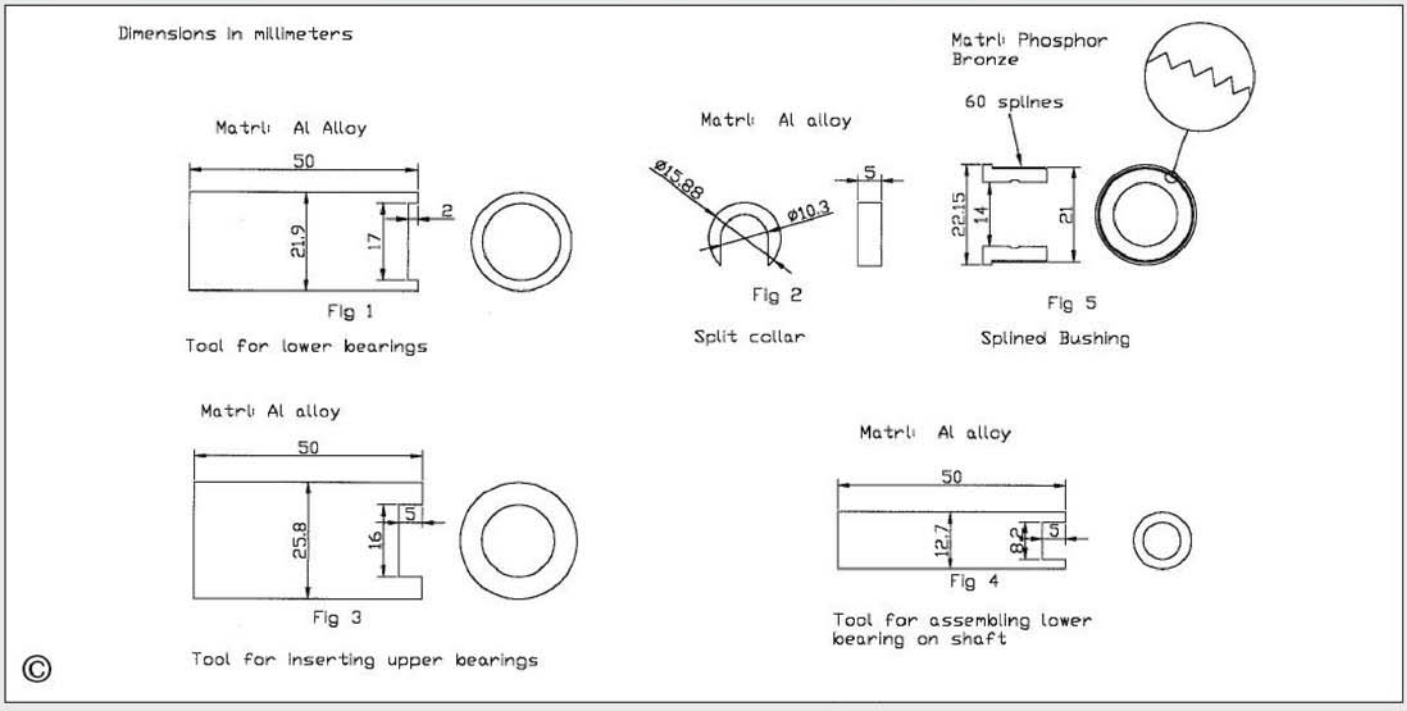
On examination it was found that all four nylon gears were rotating on the outer part of their bronze bushings, which had seized on the shaft due to lack of lubrication. Here it is worth noting that these bushings are lubricated for life at the time of assembly and there is no means of lubricating them during their service life. My machine was manufactured in 1992 and has been in regular use since it was purchased. It has occurred to me that there must be a fair number of these machines, which might be suffering from the same problem, in the hands of other model engineers.

There are two solutions to the problem. Replace all four nylon gears with new ones or re-bush the existing gears. I chose the latter route.

The worn bores of the nylon gears were trued up and bored concentrically to a suitable larger diameter, in this case 20.5millimetres. New bushings were machined from phosphor bronze. Note that although the bore of the four bushings is 14mm, there are two widths of bushings in this machine (14mm and 12mm). The outer diameter of the bushings was turned to 21mm, 0.5mm oversize on the diameter of the bore of the nylon gear. On this oversize diameter 60 splines were cut to a depth of 0.3mm, using a tool with a 90 deg. angle and the lathe set up as a shaper. The indexing can be achieved in a number of ways, such as a 60-tooth gear or even an old clock face. I used a cardboard division plate drawn on a computer controlled plotter. This was attached to the main drive pulley of the lathe (Emco Compact 8). The splined bushing was pressed into the nylon gear thus ensuring that it could not rotate. The final bore of the bushing was machined concentrically with the gear. This bore was machined to be a free spinning fit on the shaft using a carbide (Sumitomo T12A) tipped boring bar. This gave a mirror finish on the bore. The bushing also incorporated a groove in the centre of the bore, as shown in **fig 5**, to retain lubricant. The bushings were packed with molybdenum disulphide grease and the machine re-assembled, using the tools shown in **figs 3** and **4**.

So far it is running well but I am still not happy that there is no provision for lubricating the bushings. If it gives trouble again, I propose to drill the shafts from the top and fit grease nipples at the upper ends, cross drilling the shafts at the bushings. These grease nipples would then be accessible by removing the motor.

I would be interested in hearing if any reader has had a similar problem with this machine and how they have solved it.



CLUB CHAT
With Malcolm Stride

UK News

David Boughen, Editor of *Criterion* the **High Wycombe MEC** newsletter has just realised that he has been Editor for 20 years. At the time he had only been in the club for seven months so was obviously caught early. Can we congratulate David on this achievement which all you other Editors out there will particularly appreciate. David also makes a plea for contributions for this year, a plea which I suspect he has made many times in the past! The society had a talk by George Ray on the development of the steam catapult used to launch aircraft from carriers. George said that they could be considered as the largest steam engines ever built with a stroke of 150ft. and consuming a ton of steam at 400lb/sq.inch every minute when operating. The hit of the November video evening was the driver's eye view of a circuit of the Homer Green track behind John Matthews' *Dart*.

Following a decision by **Rugby MES** to relay all of the original 1980s track in the far field of their site, 1,000 Sleepers were delivered to the site on Wednesday 17 November, 5,000 Screws are on order, Fishplate bolts and nuts will be required. Up to 30 tons of 14mm Ballast will be ordered and plastic sheet needs to be laid under the alignment. The society is calling for "*help from all fit and younger members under 80...to complete this essential work which is already under way*". The 7¼in. gauge carriage building team rolled out of the carriage workshop the last of the five vacuum braked carriages of the building programme on Wednesday 29 September. These new carriages are reported as running well, looking good and their braking capacity has added an extra safety level to the operation. Work on the club locomotive *Dr. John* has also commenced with among other things new connecting rods and blast nozzle.

Saffron Walden & District SME have sent us details of their programme for the year which includes an open day with barbecue on Sunday 19 June which is *"open to all clubs"*.

Members of the **St. Albans & District MES** are looking forward to a trip on the sailing barge *Hydrogen* from Maldon in June. The note in the newsletter points out that the vessel has a bar on board which piece of information brought to mind a chorus of *"what shall we do with the drunken sailors"* but I am sure that all members will be well behaved and we hope they enjoy their trip. The boating section are holding regular monthly meetings at the lakeside for *"anyone who wants to have a go"*. The newsletter carries an article on Fred Bearton's fine model steam crane which many readers will have admired on the society stand at the Alexandra Palace exhibition.

Stockholes Farm Miniature Railway report that work has started on the north tunnel portal and the style is based on a photograph of Primrose Hill tunnel. The second workshop has also been *"sorted out"* and now boasts a 16ft. long workbench down one side. And even a *"new bit of carpet"*. Members of the railway attended the rally at the **Great Cockcrow Railway** in September. Ivan Smith described the event as a *"fascinating three days"*.

Members of the **Wigan & District MES** enjoyed a presentation by Dr. Bailey (his third visit to the society) on Robert Stephenson. Because it is impossible to cover the whole of Stephenson's life in one evening Dr. Bailey covered the time from Stephenson's birth in 1903 until his appointment to the London & Birmingham Railway in 1933. Dr. Bailey informed the members that Stephenson took *"a gap three years"* from 1824 and went to Columbia. During this three years Stephenson took on several engineering tasks. Carl Mayhew described a dream trip on the Himalayan mountain railway which included the fact that sand is applied to the rails by two crew members perching on the front buffer beam who apply the sand by hand. As Carl comments *"for me this is still a pipe dream but it does exist, a real railway doing a real job of work for 100 years. All it would take is around £2,000 and a like minded companion and it could become reality."* All volunteers names and donations to the editorial office please!

The **Society of Model & Experimental Engineers** report a successful show at the Midlands Exhibition organised by Dennis Monk. There were also two talks at Marshall House, one by Harry Paviour on Judging of Models and another by Brian Perkins on building IC engines with components machined from the solid. The society also reports gaining some new members at the Sandown Exhibition. This brings to mind a question I was asked at my local club recently. A member enquired whether anyone could join the SMEE? The answer is emphatically yes and membership secretary Peter Dennis would be pleased to hear from anyone interested. The society can be contacted on 020-7733-4309 or via the website at **www.sm-ee.co.uk** Work is continuing at the Marshall House Headquarters with the new building complete and the new grinding shop and test room redecorated. The newsletter also reports the very pleasing news that Cherry Hill has been made a Companion of the Institution of Mechanical Engineers. The institution report carried the comment that "*Cherry Hill is regarded as the greatest living model engineer*". Few would dispute that and can we add our congratulations to Cherry on this well deserved accolade. Items at the competition day in December last year included several items of tooling including (among others) a micrometer indexing tool and a topslide turret stop for the Myford, both by Dennis Monk, accessories for a rotary table by Roger Woollett and a retracting screw cutting tool by none other than our own Technical Editor, Neil Read.

Keith Roper of the **Sutton MEC** comments on the popularity of 'Bits and Pieces' evenings, even going so far as to mention this column in the process. At this point we all go round in circles for a while reporting each other busy reporting each other! Keith also quotes a report in the *Daily Telegraph* which stated that the *"all-consuming passions of 'geeks, nerds and anoraks' may actually be beneficial to society"*. Apparently a think tank has decided that ourselves and similar hobbyists *"promote community cohesion and should possibly be subsidised"*. Two things come to mind, the first that stating the obvious seems to be the role of think tanks and their highly paid (by us) members and secondly, where is the end of the queue for the subsidy? Keith finishes by an exhortation to all of us to present our work at our next club 'Bits and Pieces' evening thus doing our bit for community cohesion! Another thought has occurred to me, should I now be called a 'Community Cohesion Facilitator'?

Whilst looking at the **Victoria Model Steamboat Club** stand at Alexander Palace, I picked up a leaflet listing the various tethered hydroplane speed records for 2004. The one that interested me particularly was the flash steam record held by Bob Kirtley at a phenomenal 119.50mph. Not bad for a steam boat!

York City & District SME are having two Saturday afternoon practical sessions this year. These are 'Hands on CAD' in June and 'Practical Sheet Metal Working' in August. This is in addition to the normal Saturday evening programme. Further details can be obtained from Pat Martindale on 01262-676291 or e-mail at **honsec@yorksme.org.uk** 'Otto' describes how he researches and generates working drawings for large models of diesel or electric prototypes where the drawings are not available from places like the National Railway Museum. This lack of information is usually because the locomotives in question were built by private concerns and the drawings remain outside the public domain. The writer often starts by purchasing a 'Skinley' print of the general arrangement in Gauge 1. This is then used to prepare workshop sketches for the cross sections and longitudinal profile of the main body. Other details are gained from examination or photography of preserved prototypes.

World News

Australia

Members of the **Hornsby Model Engineers** celebrated their 31st Anniversary over the weekend of 8-10 October last year. The weather was excellent over the three days and the event saw record numbers of visitors from other clubs as well as members of the public. Friday and Saturday were devoted to inter-club running and Sunday was the normal public running. The static display of models organised by Alan Fern was again a major attraction. The track replacement program now has the new mainline track extended down from Hill Top almost to the club house, including the siding at Hill Top. The points to both the Hill Top siding and the Martin's Place sidings are now connected to new signals around Hill Top for safer operation. Extensive general maintenance of the rest of the main line track and sidings has been carried out to ensure smooth and safe running. The curved brick wall around the steaming bay turntable has been completed and a powder

Steam Locomotive Society of Victoria Public Running.

Ivan Smith with Roger Sully's A4 at Great Cockrow.

coated loop top fence has been erected on top of it to meet safety requirements.

The new mulcher at the **Steam Locomotive Society of Victoria** is proving its worth. Provided that the tree refuse is not left for a long period to dry out the mulcher handles material up to about 3in. or more, resulting in some good product with which to mulch the garden beds and help keep water evaporation and weed growth to a minimum. The refurbishment of the Elevated Track is temporarily in abeyance while professional advice is being obtained on the soil mechanics and support design. The sub-committee responsible for this work has decided that the replacement construction shall be of a post-and-beam type which will lend itself more readily to future adjustment should the ground continue to move (as is expected it will). Filled swamps do! I have included a photograph by Stephen Gaal from the society newsletter. The weather at the time was nice and sunny so we in the UK can see what we have to look forward to.

New Zealand

The President of the **Auckland SME**, Gary Farquhar reports that there are several projects under way at the society including replacement of the Punga retaining wall and Coat Hanger railway bridge. Also improved fireproofing for the archives room and improved monitoring and security for the clubrooms and facilities has been done. Member Alan Pritchard has donated 20 beer glasses to the club as a thank you for the use of the club room for wife Edna and his 50th Wedding Anniversary. All it needs now is someone to donate the beer!

At a recent meeting of **Hutt Valley MES** member Bill Yemm brought along some collets and showed the differences in use between the 'Sparey' and 'Myford' types. At the same meeting the members viewed a railway video produced by the late Fred Dibnah. The society organised a carpenter for the fitting of a new roller door on the end of the clubhouse which now just requires a small amount of trim work.

Members of **Maidstone MES (NZ)** have had the first few days this year of real spring weather; in fact the temperature reached 27deg. C on one weekend. Because of this good weather members have been able to complete some necessary repairs to Council owned buildings they use. The power cable that supplies electricity to the station and clubhouse has also been repaired and the break rejoined with assistance from Upper Hutt city Council. In November, a group of members enjoyed a visit to the **Wellington Vintage Machinery Club** at Mangaroa. A variety of items were seen including a Tangye ▶

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.

MARCH

18 **Canvey R&MEC.** *Alan Bone: Railways I have visited.* Contact Brian Baker: 01702-512752.

18 **North London SME.** *David Mitchell: The Talyllyn Railway.* Contact David Harris: 01707-326518.

18 **Rochdale SMEE.** *Annual Models Competition.* Contact Mike Foster: 01706-360849.

18 **Romford MEC.** *Keith Catchpole: Longmoore Military Railway.* Contact Colin Hunt: 01708-709302.

18 **Romney Marsh MES.** *DVD Evening.* Contact John Wimble: 01797-362295.

19 **Bristol 2005 Model Trams & Buses** at Newman Hall, Grange Court Road, Westbury Road, Bristol. Contact Graham E. Warner: e-mail kidbux@lineone.net

19-21 **Centurion SME.** *National Steam Meet 2005.* Contact Rudy Du Preez: 012-9986780.

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

19 **SM&EE.** *Rummage Sale.* Contact David Boote: 01202-745862.

19 **Steam LS of Victoria.** *Club Run.* Contact Graham Plaskett: (03) 9750-5022.

19 **York City & DSME.** *Members' Talks.* Contact Pat Martindale: 01262-676291.

20 **Bedford MES.** *Boiler Test Day.* Contact Ted Jolliffe: 01234-327791.

20 **Bristol SMEE.** *Boiler Testing Day.* Contact Trevor Chambers: 0145-441-5085.

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

20 **Model Steam Road Vehicle Soc.** *Boiler Testing Day.* Contact Geoff Miles: 01869-247602.

20 **Northampton SME.** *Boiler Testing Day.* Contact Pete Jarman: 01234-708501 (eve).

20 **Portsmouth MES.** *Bugs out Run.* Contact John Warren: 023-9259-5354.

21 **Leicester SME.** *AGM.* Contact Raymond Wallis: 0116-285-8824.

21 **Model Steam Road Vehicle Soc.** *Grand Auction.* Contact Geoff Miles: 01869-247602.

21 **Peterborough SME.** *Mike Wickham: Woodturning.* Contact Tony Meek: 01778-345142.

23 **Birmingham SME.** *AGM.* Contact John Walker: 01789-266065.

23 **Guildford MES.** *AGM.* Contact Dave Longhurst: 01428-605424.

23 **Harrow & Wembley SME.** *Mark Hamlin: Hovercraft.* Contact Dr. Roger Greenwood: 020-8427-2755.

24 **Cardiff MES.** *John Styles & Mike Jones: CNC Machining Pt. 2.* Contact Trevor Jenkins: 029-2075-5568.

24 **Sutton MEC.** *Models Old & New.* Contact Mike Dean: 0208-657-5401.

24 **Worthing DSME.** *Bits & Pieces.* Contact Bob Phillips: 01903-243018.

25-28 **British Columbia SME.** *Easter Meet.* Contact Sean Laurence: (604) 931-1547.

25-27 **Furness MRC.** *FMRC Easter Exhibition.* Contact Bob Watson: 01229-831937 or Bob Reeves: 01229-838088.

25-28 **Leighton Buzzard NG Rly.** *Easter Fun.* Enquiries: 01525-373888.

26 **Brighton & Hove SMLE.** *First Trackday of The season.* Contact Mick Funnell: 01323-892042.

26/27 **Guildford MES.** *Maintenance Weekend.* Contact Dave Longhurst: 01428-605424.

26 **Hornsby ME.** *Family Day & Boiler Inspection.* Contact Ted Gray: 9484-7583.

26 **Stockholes Farm MR.** *AGM and Wakey, Wakey Day.* Contact Ivan Smith: 01427-872723.

26 **Steam LS of Victoria.** *Working Bee & Barbecue lunch.* Contact Graham Plaskett: (03) 9750-5022.

27 **Amnerfield Miniature Railway.** *Public Running.* Contact David Jerome: 0118-9700274.

27/28 **Bedford MES.** *Easter Bank Holiday Running.* Contact Ted Jolliffe: 01234-327791.

27 **Canvey R&MEC.** *Operating Refreshers from 11am.* Contact Brian Baker: 01702-512752.

27/28 **Cardiff MES.** *Open Days.* Contact Trevor Jenkins: 029-2075-5568.

27 **Birmingham SME.** *Easter Locomotive Parade.* Contact John Walker: 01789-266065.

27/28 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.

27/28 **Elmdon MES.** *Easter Eggstravaganza.* Contact Chris Giles: 0121-458-1291.

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

27 **Leyland SME.** *Boiler Testing Day.* Contact Mark Entwistle: 01772-422411.

27 **North London SME.** *First Running Day.* Contact David Harris: 01707-326518.

27 **Maidstone MES (UK).** *First Public Running Day.* Contact Martin Parham: 01622-630298.

27/28 **Oxford (City of) SME.** *Running.* Contact Chris Kelland: 01235-770836.

27 **Peterborough SME.** *Start of Running Season.* Contact Tony Meek: 01778-345142.

27 **Portsmouth MES.** *Start of Running Season.* Contact John Warren: 023-9259-5354.

27 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.

27 **Romney Marsh MES.** *Easter Track Evening.* Contact John Wimble: 01797-362295.

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

28 **Brighton & Hove SMLE.** *Trackday.* Contact Mick Funnell: 01323-892042.

28 **Canterbury DMES (UK).** *AGM.* Contact Granville Askham: 01227-463295.

28 **Frimley & Ascot LC.** *Bank Holiday Run Easter.* Contact Bob Dowman: 01252-835042.

28 **Hornsby ME.** *Meeting.* Contact Ted Gray: 9484-7583. ▶

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.

Phil Bevan	*Rugby MES*
John Dowdeswell	*SMEE*
Ron Moffatt	*Auckland SME*
Peter Wright	*Stockholes Farm Miniature Railway*

single cylinder engine, farm tractors, sheep shearing equipment, Villiers petrol engines and large Blackstone stationary engines.

South Africa

We have a correction from the **Rand SME** who pointed out that the types of engine described as a 'calorific' engine in these columns (*M.E.* 4233, 29 October 2004) should really have been described as 'caloric' engines as per the maker's description. Apologies for that slip, I can't blame the computer since it recognises both terms! For those unaware, a caloric engine is an open cycle (as distinct from the Stirling closed cycle) hot air engine which takes air from outside via a furnace. The expanded air is then passed to a power piston and finally exhausted to the atmosphere. I am indebted to Tom Campbell for that information. The cover picture of the latest newsletter is of the LNER 0-10-0T *Decapod* which will be familiar to many readers. This locomotive was designed for accelerating heavy suburban rush hour trains on routes out of Liverpool Street station in London. The Editor comments that when the Holden designed locomotive appeared in 1902 it was the most powerful locomotive on the planet. Track improvements include rock gardens sloping down to the track where it curves to the left before entering Woodside station. There is also a new stairway down to the track and station from just a little along from the Quarterdeck. Arthur Prescott continues his description of his visit to the UK and in particular the National Railway Museum at York and the Forncett Industrial Museum. Arthur comments "*if you should happen to go to Norwich, be prepared for impossible traffic conditions but the local folk are nice and friendly*". All our readers in Norwich are no doubt feeling very pleased with themselves now!

Lots on the table at Bay Area Engine Modellers.

United States

Bay Area Engine Modellers report that the fine rectilinear steam engine by Dave Palmer won "*Best of Show*" at the first GEARS meeting in Portland. The club had a good collection of engines on the table at their December meet which also included the annual December 'Pot Luck Holiday Party' with a selection of food brought by members which was enjoyed by all.

George Parsons, President of the **New Jersey Live Steamers** recounts the reaction when he inadvertently left the driving seat of his Hudson locomotive on a picnic table at the club when setting off for a trip to another club. His locomotive was rolled out and provided with a new seat fashioned from a toilet seat and a whoopee cushion. The seat was complete with a New York Central railroad emblem and other accoutrements. After everyone had stopped laughing, the new seat was given pride of place in the club house. On a more serious note, George reports on a very successful 2004 season and reflects that the real enjoyment of our hobby *"is to be able to take advantage of the camaraderie and friendships that continue to grow and become stronger with each and every event that we hold"* Many of our readers will agree and it makes me wonder why the largest percentage of our readership are lone modellers and thus missing out on the benefits that George commented on.

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28 **Northampton SME.** *Easter Running Day.* Contact Pete Jarman: 01234-708501. (eve).
28 **Saffron Walden DSME.** *Running Day with Barbecue (public running after 2pm).* Contact Jack Setterfield: 01843-596822.
28 **Stockholes Farm MR.** *Easter Monday Open Day.* Contact Ivan Smith: 01427-872723.
28 **Taunton ME.** *Public Running.* Contact Don Martin: 01460-63162.
29 **Stafford DMES.** *AGM followed by a presentation on Bombardier.* Contact Chris Dobbs: 01889-270533.
30 **Birmingham SME.** *Spring Running Evening.* Contact John Walker: 01789-266065.
30 **Hull DSME.** *Ian Cornwall: Building a Duchess.* Contact Tony Finn: 01482-898434.
31 **Bradford MES.** *Tony Harrison: Trains Around the World.* Contact John Mills: 01943-467844.
31 **Brighton & Hove SMLE.** *Workshop Evening.* Contact Mick Funnell: 01323-892042.
31 **Cardiff MES.** *Bits & Pieces.* Contact Trevor Jenkins: 029-2075-5568.
31 **Leyland SME.** *Discussion about Pumps.* Contact Mark Entwistle: 01772-422411.
31 **Sutton MEC.** *Dr. Paul Newman: All About Timber.* Contact Mike Dean: 0208-657-5401..

APRIL

1 **Aylesbury (Vale of) MES.** *Photo Competition.* Contact Andy Rapley: 01296-420750.
1 **Canvey R&MEC.** *Meeting.* Contact Brian Baker: 01702-512752.
1 **Maidstone MES (UK).** *Bring and Buy.* Contact Martin Parham: 01622-630298.
1 **North London SME.** *Our Section: Modelling in 00-Gauge.* Contact David Harris: 01707-326518.
1 **Portsmouth MES.** *Derek Lock: Pharmaceutical Machinery.* Contact John Warren: 023-9259-5354.
1 **Rochdale SMEE.** *Bits & Pieces.* Contact Mike Foster: 01706-360849.
1 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
2/3 **Dockland & E. London MES.** *Opening Weekend Belhus Woods.* Contact P. M. Jonas: 01708-228510.
2/3 **Model Railway Club.** *London Festival of Railway Modelling Exhibition* at Alexandra Palace. Advance booking (to 18 March 2005): Adults: £7.50, Children: £3.50, OAP: £6.50, Family (2+3): £20. Information and Ticket Hotline: 01778-392089. www.brmodelling.com
2 **Ickenham DSME.** *Public Running.* Contact David Sexton: 01895-630125.
2 **Isle of Wight MES.** *Track & Pond.* Contact Ken Stratton: 01983-531384.
2 **SM&EE.** *Brian Woodward: Refurbishing a NGG 16 Garratt Locomotive.* Contact David Boote: 01202-745862.
2/3 **Taunton ME.** *Exhibition.* Contact Don Martin: 01460-63162.
2 **York City & DSME.** *Alan Westby: Railbus – simple, quick railways.* Contact Pat Martindale: 01262-676291.
3 **Canvey R&MEC.** *Start of Sunday Running.* Contact Brian Baker: 01702-512752.
3 **Cardiff MES.** *Steam-Up and Family Day.* Contact Trevor Jenkins: 029-2075-5568.
3 **Frimley & Ascot LC.** *Public Running.* Contact Bob Dowman: 01252-835042.
3 **Guildford MES.** *Boiler Testing Day.* Contact Dave Longhurst: 01428-605424.
3 **Kew Bridge Steam Museum.** *Stirling Hot Engine Rally.* Information: 020-8568-4757.
3 **Northampton SME.** *Boiler Testing Day.* Contact Pete Jarman: 01234-708501 (eve).
3 **Plymouth MSLS.** *Start of Running Season.* Contact John Brooker: 01752-671722.
3 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
4 **Leicester SME.** *Pete Jordan: Half Way to Heaven.* Contact Raymond Wallis: 0116-285-8824.
4 **Peterborough SME.** *Bits & Pieces.* Contact Tony Meek: 01778-345142.
5 **Oxford (City of) SME.** *PC Bob Clewley, Air Support Unit.* Contact Chris Kelland: 01235-770836.
5 **Romney Marsh MES.** *Highlights at Rolfe Lane during the past 15 years.* Contact John Wimble: 01797-362295.
5 **Taunton ME.** *Quiz Night.* Contact Don Martin: 01460-63162.
5 **West Wiltshire SME.** *AGM.* Contact R. Nev. Boulton: 01380-828101.
6 **Bradford MES.** *Bits & Pieces.* Contact John Mills: 01943-467844.
6 **Guildford MES.** *Derek Fisk: The Story of London Transport.* Contact Dave Longhurst: 01428-605424.
6 **Leeds SMEE.** *Video Evening.* Contact Colin Abrey: 01132-649630.
6 **Tyneside SMEE.** *Bits & Pieces.* Contact Ian Spencer, 0191-2843438.
8 **Brighton & Hove SMLE.** *Peter Hill: Pills, Potions and Patients - Reminiscences of a Pharmacist.* Contact Mick Funnell: 01323-892042.
8 **Colchester SMEE.** *Richard Thomas: Royal Gunpowder Mills.* Contact L. G. Hammond: 01376-511686.
7 **Cardiff MES.** *Boiler Testing.* Contact Trevor Jenkins: 029-2075-5568.
7 **South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.
7 **Sutton MEC.** *Bits & Pieces.* Contact Mike Dean: 0208-657-5401.
9 **National 2^{1}/2in. Gauge Ass'n.** *South Eastern Area Get-Together.* Contact Clive Young: 01233-626455.
10 **Bristol SMEE.** *Public Running.* Contact Trevor Chambers: 0145-441-5085.
10 **Canterbury DMES (UK).** *Public Running Day.* Contact Granville Askham: 01227-463295.
10 **Cardiff MES.** *Open Day.* Contact Trevor Jenkins: 029-2075-5568.
10 **Harlington LS.** *Public Running.* Contact Peter Tarrant: 01895-851168.
10 **Leeds SMEE.** *Running Day.* Contact Colin Abrey: 01132-649630.
10 **Model Steam Road Vehicle Soc.** *Boiler Testing Day.* Contact Geoff Miles: 01869-247602.
10 **Sutton MEC.** *Track Day.* Contact Mike Dean: 0208-657-5401.

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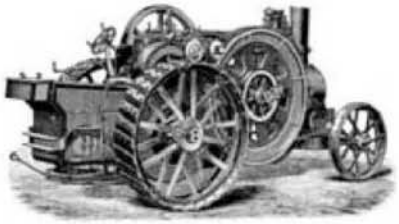

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