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Vol. 190 No. 4190

7 - 20 March 2003 £2.30

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ISSUE 87 DECEMBER**

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IN THIS ISSUE

● Vol. 190 No. 4190 7 March 2003 ●

SMOKE RINGS

Editorial news, views and comment.
PAGE 239

POST BAG

Letters to the Editors.
PAGE 240

THE 72nd MODEL ENGINEER EXHIBITION COMPETITION CLASSES

Judges' reports describing entries for
Engineering Competition Classes A1-A4.
PAGE 242

A FERRIS WHEEL CLOCK

The series concludes with details of the
construction of a wooden base. Part XIII.
PAGE 246

NEW SERIES: EDWARDIAN ELEGANCE

Details of GWR 4-6-0 No. 100, a technically
advanced locomotive which entered
service in 1902. Part I
PAGE 248

BRAYS BENCH: THE JUNIOR

The connecting rod is completed before
we move on to deal with the piston
assembly and timing gears. Part VIII.
PAGE 252

EUROPEAN CANALS, SHIPLIFTS AND LOCKS

Continuing our Continental tour with visits
to the installations at Ronquiere and
Strep-Thieu in Belgium. Part II.
PAGE 254

PENRHOS GRANGE

A GWR 68xx 4-6-0 LOCOMOTIVE IN 5in. GAUGE
The wheel designs, axle boxes and side
rods for this handsome locomotive are
discussed and described. Part II.
PAGE 257

KEITH'S COLUMN: SAINT CHRISTOPHER

A GWR LOCOMOTIVE for 7 1/4in. gauge
Further work on the cab includes the
windows, name and number plates,
and handrails. Part XXXVI.
PAGE 261

PETES PAGE: A GLASS MARKING OUT TABLE

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marking out for your consideration.
PAGE 263



On the cover ...

Built by Norman Barber, this Vulcan beam
engine was awarded a Bronze Medal at
the 72nd Model Engineer Exhibition
in Competition Class A2.

Well presented on a wooden base shaped
and painted to simulate the stone
foundations often used with engines of
this type, this model was built without
castings, the larger parts having been
reproduced by fabrication.

(Photograph by Gary Sinfield)

EARLY DAYS

Our one-time Editor looks back and recalls
his introduction to Lord Gretton. Part IV.
PAGE 264

ROAD STEAM: SAVAGE'S LITTLE SAMSON in 3in., 4in. (and other) Scales

Choosing a prototype, a progress report
on the Savage wagon, and steering gear
for Little Samson. Part XXXIV.
PAGE 266

THE BURNT AIR ENGINE

A fascinating insight into the methods
used to machine the displacer castings
for this intriguing engine. Part VIII.
PAGE 270

NEW SERIES: A LIGHTWEIGHT CAMERA TRIPOD

An ingenious design suitable for home
construction. Part I.
PAGE 272

LEADSCREW REVERSER

A simple device to improve the versatility
of the Chester Centurion lathe.
PAGE 275

CLUB CHAT & CLUB DIARY

Recent activities and forthcoming events.
PAGE 275

INDEX to ADVERTISERS

Bruce Engineering	237	Model Engineering Services	235
Chester UK Ltd.	288	MK Metals Ltd.	281
Chronos UK Ltd.	238	Nexus Sandown Symposium	279
Compass House Tools	232	Nexus Special Interest Books	280
Engineers Tool Room	232	Parkside Electronics	235
Glendo Corp.	237	Plastow Traction Engines	234
Greenwood Tools	233	Polly Model Engineering	281
Highbury House Communications	278	Power Controllers Ltd.	281
Home & Workshop Machinery	287	Reeves 2000	236
Kew Bridge Steam Museum	235	Norman Spink	232
L. A. Services	237	Steam & Diesel Castings	281
Live Steam Models	281	Stuart Models	234
Maxtrak Ltd.	237	Tracy Tools Ltd.	235
Meridienne Exhibitions Ltd.	233	Warren Machine Tools Ltd.	230

Classified Advertisements on pages 282-286

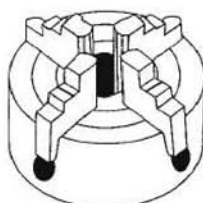
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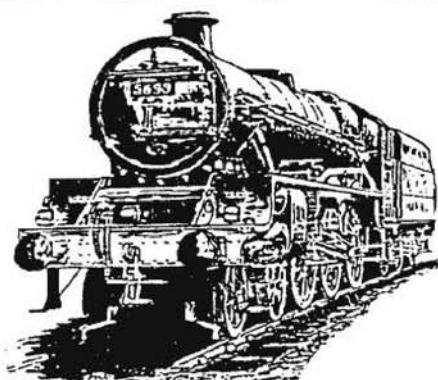
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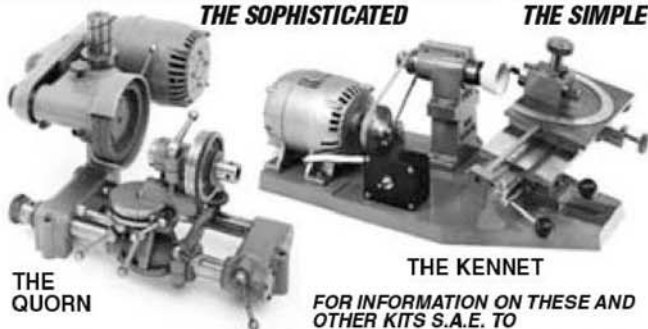
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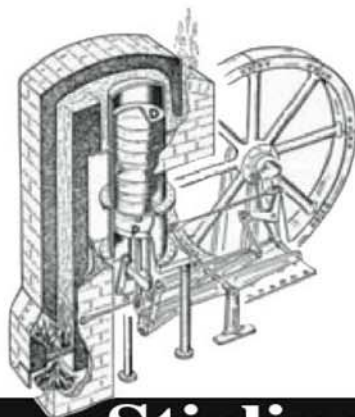
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1.	MODEL ENG TAPS & DIES SET (2 Taps each size) 1/8" x 40, 1/4" x 40, 3/8" x 40, 1/2" x 40, 5/8" x 40, 3/4" x 40, 7/8" x 40, 1" x 40, 1 1/8" x 40, 1 1/4" x 40, 1 1/2" x 40, 1 3/4" x 40, 1 7/8" x 40, 2" x 40, 2 1/8" x 40, 2 1/4" x 40, 2 1/2" x 40, 2 3/4" x 40, 3" x 40, 3 1/8" x 40, 3 1/4" x 40, 3 1/2" x 40, 3 3/4" x 40, 4" x 40, 4 1/8" x 40, 4 1/4" x 40, 4 1/2" x 40, 4 3/4" x 40, 5" x 40, 5 1/8" x 40, 5 1/4" x 40, 5 1/2" x 40, 5 3/4" x 40, 6" x 40, 6 1/8" x 40, 6 1/4" x 40, 6 1/2" x 40, 6 3/4" x 40, 7" x 40, 7 1/8" x 40, 7 1/4" x 40, 7 1/2" x 40, 7 3/4" x 40, 8" x 40, 8 1/8" x 40, 8 1/4" x 40, 8 1/2" x 40, 8 3/4" x 40, 9" x 40, 9 1/8" x 40, 9 1/4" x 40, 9 1/2" x 40, 9 3/4" x 40, 10" x 40, 10 1/8" x 40, 10 1/4" x 40, 10 1/2" x 40, 10 3/4" x 40, 11" x 40, 11 1/8" x 40, 11 1/4" x 40, 11 1/2" x 40, 11 3/4" x 40, 12" x 40, 12 1/8" x 40, 12 1/4" x 40, 12 1/2" x 40, 12 3/4" x 40, 13" x 40, 13 1/8" x 40, 13 1/4" x 40, 13 1/2" x 40, 13 3/4" x 40, 14" x 40, 14 1/8" x 40, 14 1/4" x 40, 14 1/2" x 40, 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• PISTON RINGS • BALLS • WIRE • SPRINGS • CLUTCHES • FASTENINGS •

BOILER FITTINGS • GAUGES • TUBING • HOSES • COUPLINGS & HOOKS • PACKING • SEALANTS • 'O' RINGS

**SIGHT
FEED
INDICATOR
ASSEMBLIES
NOW AVAILABLE
FROM STOCK**



2000

**THE WORLD'S
LARGEST STOCKIST
OF MODEL ENGINEERING
SUPPLIES**

**Whistle Valves
and
Blow Down Valves
now in stock**

DRAWINGS AND CASTINGS CURRENTLY AVAILABLE

UP TO 3.5" LOCOMOTIVES

1" 4-6-0 Dot LMS Tender Loco
1" 4-6-2 Diana Freelance Tender Loco
2.5" 4-6-0 Elaine SR Tender Loco
2.5" 4-6-0 Sir Ironside SR
3.5" 0-4-0 Caterbury Lamb
3.5" 0-4-0 Conway Tank Loco
3.5" 0-4-0 Georger Tank Loco
3.5" 0-4-0 Henley Tank Loco
3.5" 0-4-0 Hunslette Tank Loco
3.5" 0-4-0 Juliet Tank Loco No.1
3.5" 0-4-0 Juliet Tank Loco No.2
3.5" 0-4-0 Tich Tank Loco (large boiler)
3.5" 0-4-0 Tich Tank Loco (small boiler)
3.5" 0-4-2 Titfield Thunderbolt Loco
3.5" 0-6-0 Derby 4F Tender Loco
3.5" 0-6-0 Molly Tank Loco
3.5" 0-6-0 Rob Roy Tank Loco
3.5" 0-6-2 Mona Tank Loco
3.5" 0-8-0 Caribou Tender Loco
3.5" 0-8-0 Netta Tank Loco
3.5" 2-10-0 Evening Star Loco
3.5" 2-2-2 Jenny Lind Tender Loco
3.5" 2-2-0 Pansy Tank Loco
3.5" 2-4-0 Mable Tank Loco
3.5" 2-4-0 Petrolea Tender Loco
3.5" 2-4-4 Lucky 7 Tank Loco
3.5" 2-6-0 GW 43XX Tender Loco
3.5" 2-6-0 Marquess Tender Loco
3.5" 2-6-2 Bantam Cock Loco
3.5" 2-6-2 Betty Tender Loco
3.5" 2-6-2 Firefly Tank Loco
3.5" 2-6-2 Mountaineer Tank Loco
3.5" 2-6-2 William Tank Loco
3.5" 2-6-4 Jubilee Tank Loco
3.5" 2-8-0 Buffalo Tender Loco
3.5" 4-4-0 County Carlow Loco
3.5" 4-4-0 Derby 2P Tender Loco
3.5" 4-4-0 Rodean Tender Loco
3.5" 4-4-0 Virginia LB Tender Loco
3.5" 4-4-0 Virginia SB Tender Loco
3.5" 4-4-2 Maisie Tender Loco
3.5" 4-6-0 1000 Class Tender Loco
3.5" 4-6-0 75000 Class Tender Loco
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3.5" 4-6-0 Princess Marina Loco
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3.5" 4-6-0 St Christopher Loco
3.5" 4-6-2 Britannia Tender Loco
3.5" 4-6-2 Hielan Lassie Tender Loco
3.5" Passenger Car Bogies

5" LOCOMOTIVES

5" 0-4-0 Ajax Tank Loco
5" 0-4-0 Dolgich Tank Loco
5" 0-4-0 Dougal Tank Loco
5" 0-4-0 Gemma Tank Loco
5" 0-4-0 Hunslet Tank Loco
5" 0-4-0 Marie E Tender Loco
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5" 0-6-0 Jinty Tank Loco
5" 0-6-0 Nechells Tank Loco
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5" 0-6-0 Sallie Tank Loco
5" 0-6-0 Simplex Tank Loco
5" 0-6-0 Speedy Tank Loco
5" 0-6-2 Barnet Tank Loco
5" 0-8-0 Netta Tender Loco
5" 0-8-0 No. 136 Tender Loco
5" 2-4-0 Asia Tender Loco
5" 2-4-0 Metro Tank Loco
5" 2-4-2 Lanky Tank Loco
5" 2-6-0 BR Class 2 Tender Loco
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5" 2-6-2 GW 51XX Tank Loco
5" 2-8-0 Nigel Gresley Tender Loco
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5" 4-6-0 Torquay Manor Tender Loco
5" 4-6-2 Doncaster Tender Loco
5" Passenger Car Bogies

7.25" LOCOMOTIVES

7.25" 0-4-0 Hunslet Tank Loco
7.25" 0-4-0 Adam's B4 Tank Loco
7.25" 0-4-0 Dolgich Tank Loco
7.25" 0-4-0 Elidir Tank Loco
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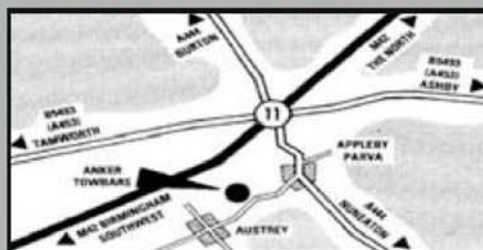
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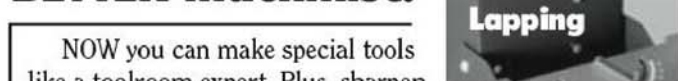
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SIZE	CODE	PRICE £
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5MM	SS50	0.85
6MM	SS60	1.40
7MM	SS70	1.60
8MM	SS80	1.70
9MM	SS90	2.20
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11MM	SS11	3.10
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15MM	SS15	5.50
16MM	SS16	5.60
17MM	SS17	6.20
18MM	SS18M	7.50
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SIZE	CODE	PRICE £
1/8	MS18	0.35
5/32	MS532	0.35
3/16	MS316	0.40
7/32	MS732	0.45
1/4	MS14	0.50
9/32	MS932	0.55
5/16	MS516	0.60
3/8	MS38	0.65
7/16	MS716	0.75
1/2	MS12	1.05
9/16	MS916	1.15
5/8	MS58	1.85
3/4	MS34	2.10
1"	MS10	3.40

SIZE	CODE	PRICE £
1/16	BR116	0.45
3/32	BR332	0.55
1/8	BR18	0.70
5/32	BR532	0.75
3/16	BR316	0.80
7/32	BR732	0.90
1/4	BR14	0.95
9/32	BR932	1.45
5/16	BR516	1.55
3/8	BR38	1.85
7/16	BR716	2.20
1/2	BR12	2.65
9/16	BR916	3.10
5/8	BR58	3.25
3/4	BR34	4.50
1"	BR1	8.25

SIZE	CODE	PRICE £
1/8	PB18	1.10
3/16	PB316	1.70
1/4	PB14	2.40
5/16	PB516	3.60
3/8	PB38	4.95
7/16	PB716	5.55
1/2	PB12	6.60
5/8	PB58	7.70
3/4	PB34	10.95
7/8	PB78	15.95
1"	PB10	18.95

SIZE	CODE	PRICE £
3/32	STS332	0.55
1/8	STS18	0.65
5/32	STS532	0.75
3/16	STS316	1.10
7/32	STS732	1.45
1/4	STS14	1.70
9/32	STS932	1.80
5/16	STS516	2.10
3/8	STS38	2.45
7/16	STS716	2.95
1/2	STS12	3.80
9/16	STS916	4.60
5/8	STS58	5.50
3/4	STS34	7.60
1"	STS10	11.95

SIZE	CODE	PRICE £
1/8	CR18	1.10
3/16	CR316	1.35
1/4	CR14	2.45
5/16	CR516	3.25
3/8	CR38	3.95
1/2	CR12	5.75

SIZE	CODE	PRICE £
3/16	AR316	0.60
1/4	AR14	0.90
5/16	AR516	0.95
3/8	AR38	1.20
7/16	AR716	1.40
1/2	AR12	1.75
9/16	AR916	1.95
5/8	AR58	2.50
3/4	AR34	3.40
1"	AR10	4.95
1 1/4	AR114	6.75
1 1/2	AR115	9.95

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8MM	PTF80	2.25
10MM	PTF10	2.95
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8MM	NYR80	1.20
10MM	NYR10	1.50
12MM	NYR12	2.20
16MM	NYR16	2.60
19MM	NYR19	3.10
25MM	NYR25	5.00
50MM	NYR50	16.00

SIZE	CODE	PRICE £
1/8	BS18	0.55
5/32	BS532	0.65
3/16	BS316	0.80
1/4	BS14	1.20
5/16	BS516	1.60
3/8	BS38	2.20
7/16	BS716	3.50
1/2	BS12	3.95
5/8	BS58	4.95
3/4	BS34	6.60
1"	BSQ1	11.00

SIZE	CODE	PRICE £
3/16	MSQ316	0.55
1/4	MSQ14	0.60
5/16	MSQ516	0.65
3/8	MSQ38	1.00
7/16	MSQ716	1.35
1/2	MSQ12	1.45
5/8	MSQ58	1.65
3/4	MSQ34	2.30
1"	MSQ1	4.40

SIZE	CODE	PRICE £
1/4	CS14	2.50
3/8	CS38	4.95

SIZE	CODE	PRICE £
1/4	ASQ14	0.65
5/16	ASQ516	0.95
3/8	ASQ38	1.30
1/2	ASQ12	1.90
5/8	ASQ58	2.50
3/4	ASQ34	3.40
1"	ASQ10	5.95

SIZE	CODE	PRICE £
5/32	MSH532	0.40
3/16	MSH316	0.45
7/32	MSH732	0.50
1/4	MSH14	0.65
9/32	MSH932	0.70
5/16	MSH516	0.75
3/8	MSH38	0.85
7/16	MSH716	0.95
1/2	MSH12	1.25
9/16	MSH916	1.65
5/8	MSH58	1.95
3/4	MSH34	2.75
7/8	MSH78	3.30
1"	MSH10	4.40

SIZE	CODE	PRICE £
7/32	SSH732	1.60
1/4	SSH14	1.95
9/32	SSH932	2.20
5/16	SSH516	2.90
3/8	SSH38	3.10
7/16	SSH716	3.30
1/2	SSH12	4.80
9/16	SSH916	6.00
5/8	SSH58	7.20
3/4	SSH34	10.50
7/8	SSH78	13.20
1"	SSH10	15.40

SIZE	CODE	PRICE £
3/16	BH316	0.60
7/32	BH732	0.85
1/4	BH14	0.90
9/32	BH932	1.20
5/16	BH516	1.40
3/8	BH38	1.70
7/16	BH716	2.30
1/2	BH12	2.95
5/8	BH58	3.95
3/4	BH34	5.50
7/8	BH78	6.95
1"	BH10	9.50

SIZE	CODE	PRICE £
0.248"	PBH248	2.95
0.324"	PBH324	4.75
0.437"	PBH437	9.25
0.562"	PBH562	13.50
0.625"	PBH625	16.50

SIZE	CODE	PRICE £
1/4x20	ST1420	1.00
5/16x18	ST51618	1.10
3/8x16	ST3816	1.20
1/2x16	ST1216	1.65
5/8x16	ST5816	2.20
3/4x16	ST3416	2.65
7/8x16	ST7816	2.95
1"x16	ST116	3.25

SIZE	CODE	PRICE £
3/32x24	CT33224	0.90
1/8x24	CT1824	0.70
5/32x24	CT53224	0.75
3/16x22	CT31622	0.80
1/4x20	CT1420	1.00
1/4x16	CT1416	1.50
5/16x20	CT51620	1.20
3/8x22	CT3822	1.95
3/8x18	CT3818	1.95
7/16x20	CT71620	1.85
7/16x18	CT71618	2.30
1/2x20	CT1220	1.95
1/2x16	CT1216	2.60
5/8x20	CT5820	2.70
5/8x16	CT5816	3.60

SIZE	CODE	PRICE £
5/16x20	BT51620	1.60
3/8x22	BT3822	3.95
1/2x20	BT1220	2.75
5/8x16	BT5816	4.30
3/4x20	BT3420	3.50
3/4x18	BT3418	2.95
7/8x16	BT7816	5.50
1x18	BT118	6.10

SIZE	CODE	PRICE £
16x16x3	SA16	1.95
20x20x3	SA20	2.10
25x25x3	SA25	2.75
32x32x5	SA32	3.85
40x40x6	SA40	5.10
50x50x6	SA60	6.95

SIZE	CODE	PRICE £
1/16x1/4	BA11614	1.25
1/16x5/16	BA116516	1.50
1/16x3/8	BA11638	1.70
1/16x1/2	BA11612	2.25
1/16x3/4	BA11634	2.95
1/8x1/2	BA1812	3.50
1/8x1	BA181	6.50

SIZE	CODE	PRICE £
3/8x3/8	AA38	0.50
1/2x1/2	AA12	0.70
3/4x3/4	AA34	0.95
1x1	AA1	1.30

SIZE	CODE	PRICE £
1/16x1/2	MS11612	0.50
1/16x3/4	MS11634	0.55
1/16x1	MS1161	0.65
1/16x2	MS1162	1.10
3/32x1	MS3321	0.90

SIZE	CODE	PRICE £
1/8x1/4	MS1814	0.40
1/8x1/2	MS1812	0.65
1/8x3/4	MS1834	0.90
1/8x1	MS181	1.05
1/8x2	MS182	1.95
1/8x3	MS183	2.85
3/16x1/2	MS31612	0.60
3/16x3/4	MS31634	0.90
3/16x1	MS3161	1.25
3/16x2	MS3162	2.50
3/16x3	MS3163	3.70
1/4x1/2	MS1412	0.85
1/4x3/4	MS1434	1.35
1/4x1	MS141	1.80
1/4x2	MS142	2.65
1/4x3	MS143	4.80
3/8x1/2	MS3812	1.40
3/8x3/4	MS3834	1.80
3/8x2	MS382	4.30
3/8x3	MS383	6.00

SIZE	CODE	PRICE £
1/16x1/4	BF11614	0.75
1/16x1/2	BF11612	1.25
1/16x1	BF1161	2.50
1/8x1/4	BF1814	0.90
1/8x1/2	BF1812	1.75
1/8x1	BF181	2.75
3/16x1/2	BF31612	2.30
3/16x1 1/2	BF316112	6.10
1/4x1	BF141	5.75

SIZE	CODE	PRICE £
1/8x1/2	AF1812	0.55
1/8x1	AF181	0.95
1/4x1/2	AF1412	0.85
1/4x1	AF141	1.95
1/2x1	AF121	2.95
1/2x2	AF122	5.15
1/2x3	AF123	7.25

SIZE	CODE	PRICE £
1/16	GP116	3.50
3/32	GP332	3.75
1/8	GP18	4.25
5/32	GP532	4.50
3/16	GP316	5.50
1/4	GP14	7.00
5/16	GP516	7.50
3/8	GP38	8.50

SIZE	CODE	PRICE £
10 SWG	CSH10	24.00
13 SWG	CSH13	19.00
16 SWG	CSH16	13.00
18 SWG	CSH18	11.00
20 SWG	CSH20	9.95
22 SWG	CSH22	8.95
24 SWG	CSH24	8.25
26 SWG	CSH26	7.95

SIZE	CODE	PRICE £
10 SWG	BSH10	24.00
13 SWG	BSH13	19.00
16 SWG	BSH16	13.00
18 SWG	BSH18	10.50
20 SWG	BSH20	9.95
22 SWG	BSH22	8.95
24 SWG	BSH24	8.25
26 SWG	BSH26	7.95

SIZE	CODE
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SMOKE RINGS

With the Editors

Apologies

We much regret the inclusion of Neville Sanderson's name in our *Club Chat In Memoriam* panel published in *M.E.* 4187, 24 January 2003. There was also some inaccuracy in the report concerning the Kinver & West Midlands 24 hour charity run which appeared in the same issue. In an endeavour to set the records straight, we print the content of a letter recently received from Kinver Secretary Mike Harrison.

"Mr. Neville Sanderson has not passed away. Due to deteriorating health, he is now permanently resident in a nursing home and is as well as can be expected."

"The proceeds from our 24 hour run for charity held over the weekend of 20/21 July 2002 were given to 'Guide Dogs for the Blind' in memory of well respected member Mr. Reg. Berry who passed away in April."

"The final total of £2,300 enabled us to finance two trainee puppies; one to be called Reg. and the other Loco."

"On a lighter note, could we please publicise our forthcoming Diesel Weekend to be held 24/25 May 2003. Trade support is invited."

"Saturday will be for members and guests only and open for anyone to run anything they please be it battery, petrol, diesel — anything except steam."

"Maybe some Competition for John Campbell's Honda 90 engined narrow gauge locomotive."

"Sunday is much the same, only members of the public will be allowed on site therefore strict health and safety rules will be enforced."

"Limited camping space is available and anyone interested should please contact either Chairman John Campbell on 01384-891244, or myself, Mike Harrison, Secretary KWMSME Ltd., on 0121-602-2019."

Ferris Wheel Clock

Part XIII, the final instalment of Richard Stephen's series describing the construction of his unique and fascinating Ferris Wheel Clock is published in this issue.

Roger Castle-Smith in Buckinghamshire is building this clock and contacted us recently with a question concerning the circuit diagram published in Part XII, *M.E.* 4188, 7 February 2003. We referred his enquiry to Dr. Stephen and feel it appropriate publish the response for the benefit of other builders.

"The circuit diagram shown as fig 48 on page 155 shows a connection of the +6V rail (top right) to the C terminal of the microswitch (top left). Halfway down on the left, the microswitch NO terminal is shown connected to pin 11 of the HEF 4528B chip. These connections should be exchanged. The +6V rail should be connected to the microswitch NO terminal and pin 11 of the chip should be connected to the microswitch C terminal."

"Similarly, the text which begins 7 lines down from the top of column 3 on the same page should read as follows:

"With the terminals uppermost, connect the left one (NC) to 0V pin (1,1), the centre one (NO) to +6V pin (1,18) and the right one (C) to pin 1,5."

We regret any inconvenience experienced by builders caused by this error and hope that no harm has been done.

We take this opportunity to remind builders that Dr. Stephen is happy to advise builders who contact him either by telephone (call: 01572-770416) or e-mail (dickstephn@aol.com). Letters will not elicit a response.

IMLEC 2002 Video

Colin Abrey, Secretary of Leeds Society of Model and Experimental Engineers, has asked us to notify readers that the video recording of IMLEC 2002 which was contested on the Eggborough track of Leeds SMEE is available for purchase.

Visit <http://homepage.nflworld.com/colin.abrey/LEEDS.htm> for further information. The results are also tabulated on this web site accompanied by photographs of each of the entrants.

You can obtain your copy of the IMLEC 2002 video by sending your cheque for £12.50 (made payable to Leeds SMEE) together with your name and address (block capitals please) and telephone number to IMLEC Video, c/o 31 Yew Tree Lane, Colton, Leeds, West Yorkshire, LS15 9JD. Alternatively, call Colin Abrey on 0113-264-9630.

The IMLEC video is in VHS format and runs for 85 minutes.

Grease, Grime and Graft

Hands-on activities to celebrate National Science Week at Kew Bridge Steam Museum, Saturday and Sunday 8/9 March 2003 11am - 5pm on both days.

Material Mayhem and *Rust Busters* are just two of the science based fun activities being organised by Kew Bridge Steam Museum to celebrate National Science Week 2003 on Saturday and Sunday 8/9 March from 11am - 5pm on both days. Aimed at children and families, the activities invite participants to solve problems, test materials and see for themselves how a 19th century waterworks workshop operated complete with shaft-driven machinery.

In conjunction with West London Museum Group Education Resource, the *Material Mayhem* challenge will invite children of different ages to identify materials around them. The under fives will be encouraged to identify natural and man-made materials such as wood and plastic.

In the *Rust Buster* challenge, children aged between 8 - 10 years will be invited to join in an activity station where they will be asked "What is rust?", "Why do some metals rust and not others?", "What causes rust?" followed by a 'Have-a Go' session of removing rust using emery cloth.

Adults will have a chance to talk to volunteers engaged in the restoration of the museum's unique Cornish 'Bull' engine, which will include a mini-tour of the work in progress. Finally, there will also be an opportunity to learn how the museum is tackling the problem of restoring and preserving 150 year-old paint from the museum's two giant Cornish beam engines.

In addition to these fun activities, the museum's giant beam and rotative engines will be in steam on both days, and the narrow gauge railway will be giving free rides around the site. The *Water for Life Gallery* will also be open, telling the story of London's water supply from Roman times, and there is a café serving hot food and snacks.

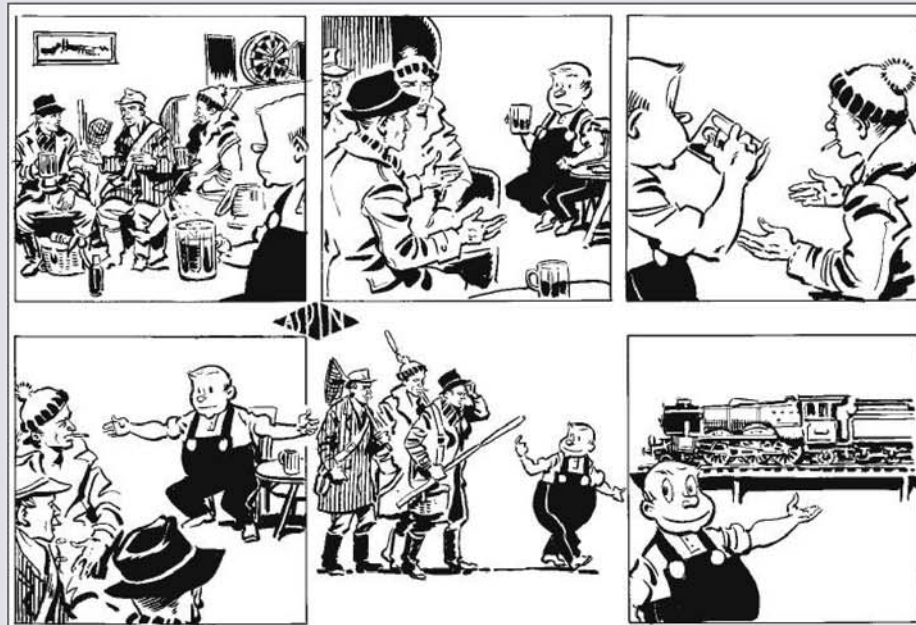
Kew Bridge Steam Museum is in Green Dragon Lane, Brentford, Middlesex, about 200 yards from the north side of Kew Bridge under the tall Victorian tower and may be reached by bus, main line rail or London Underground. The nearest motorway is the M4; leave at junction 2 and follow the signs to Kew Gardens, Brentford and Hounslow.

Admission at weekends when the engines are in steam is adults: £4.60; OAPs and students: £3.70; children (5-15 years): £2.50; family ticket: £11.95. Please note that children under the age of 13 years must be accompanied by an adult.

For more information about this event and the Kew Bridge Steam Museum, telephone the museum on 020-8568-4757 or visit www.kbsm.org

CHUCK the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

Early Days

SIRS, - In his interesting article, Martin Evans did not name any of those in the 'formal pose' photograph at the lower left of page 20, *M.E.* 4186, 10 January 2003, but readers may like to know that the face behind the locomotive and the hands on the track beam are those of the late Wenman Bassett-Lowke.

Tony Finn,
East Riding of Yorkshire.

SIRS, - Concerning the photograph of HRH Prince Philip on page 152, *M.E.* 4188, 7 February 2003, readers may be interested to know that this was taken following the official opening by the Prince of the 1952 Model Engineer Exhibition at the Seymour Hall. The model shown in the photograph was not a destroyer as captioned, but was of the frigate *HMS Magpie*, the ship commanded by the Prince during his naval career.

Following the opening, the model was presented to the Prince who later had it installed in his study on the Royal Yacht *Britannia*. Since the royal yacht has now been decommissioned, it would be interesting to know the present whereabouts of this model.

W. Laing, Northumberland.

Lubricating oil

SIRS, - In reply to Mr Heppenstall's request for information, may I offer some facts and suggestions concerning the maze of lubrication products available?

First viscosity, defined typically as an SAE number (Society of Automotive Engineering, I think). The higher the number the 'thicker' the oil, whose viscosity is dependent upon temperature, but this is only the tip of the iceberg. Broadly speaking, viscosity is increased in hydrocarbon oils by increasing the molecular weight, which is achieved at the refining stage.

Each application for a lubricant has its own requirements, hence the development of unique properties and the proliferation of oil types on the market. Consider first the needs of the motor car: a petrol engine runs hot and the products of combustion in the cylinders tend to contaminate the oil. So, additives are put into the oil:

- 1: To control the variation of viscosity with temperature (the so called viscosity index).
- 2: To stabilise the oil at high temperature and prevent it from breaking down.
- 3: To keep the system clean with a

so-called detergent effect. The additives tend to be complex organic compounds which are quite stable and ideal for the purpose for which they are designed. If they should be used in a machine tool the hydrocarbon oil tends to evaporate very slowly, leaving the additives as a sticky mass. Hence the discolouration of lubricator jars!

Oils for other purposes contain other additives, for example gear oils contain an extreme pressure additive, designed to avoid squeezing the oil out from between teeth under heavy operating conditions. Cutting oils tend to contain sulphur additives to enhance their performance, and so the list goes on.

From this you will see that it is extremely unwise to use any of these oils for machine tool lubrication, since sooner rather than later you will end up with a sticky mess, stained components and poor lubrication. What you require for a spindle oil is a plain hydrocarbon oil with no additive. Follow the manufacturer's recommendations. For lubricating slide ways (and gearboxes) you should have a slightly thicker oil which has a 'sticky' additive that makes the oil adhere to vertical slide ways and gear teeth.

Each of the lubricant manufacturers can supply his own equivalent product and I have had success with my local Shell industrial oil depot (nothing to do with garages or heating oil supplies). Simply ask them if they can supply two or five litres of their equivalent product. If Shell cannot oblige ask Esso, etc., and you should be able to buy a fairly small amount. For example, Shell pack Tellus 37 in boxes containing four 5-litre bottles and in a fast moving product such as this they will often have an odd bottle available. Otherwise, how about combining forces with your friends?

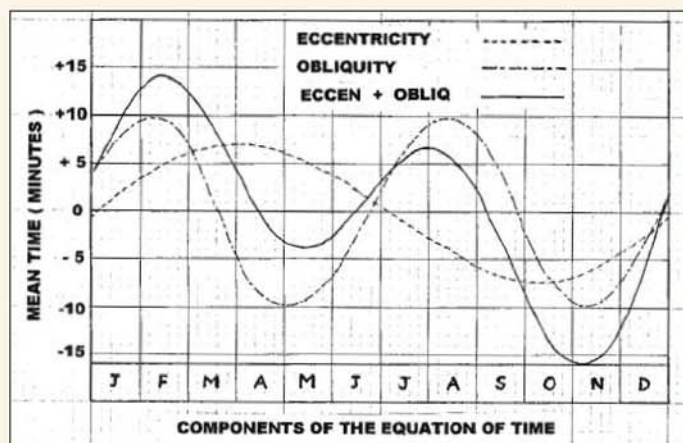
D. A. G. Brown, Rutland.

Motor torque

SIRS, - Assuming I have assessed the implications correctly, why don't manufacturers of small machines for model engineering purposes give torque ratings along with the wattage of motors as a guide to metal removal capacity? As it is commonly understood that metals of different hardness require different power ratings for cutting, tables would be useful.

Where does one go for such figures or a graph that plots torque and power ratios?

G. W. Gowan, Leicester.



Portable universal armillary sundial

SIRS, - David Wilcox has presented us with another fine sundial to construct (*M.E.* 4182, 15 November 2002). Unfortunately, it has been described as "usable anywhere in the world" and some modifications are required for it to be readable at all in the Southern Hemisphere.

In the Northern Hemisphere you see the sun in the southern half of the sky. Down under, we see it in the northern half. The compass must therefore be re-orientated through 180 degrees. You see the sun travel across the sky from left to right; we see it traverse the sky from right to left, so the time scale needs to be reversed left to right.

I do not have the expertise to comment on the necessary correction for the graph for the Equation of Time. Could this graph require displacement by 6 months to make it suitable for use by us in the Southern Hemisphere?

Perhaps the Author or other readers could reassure us on this point. The modifications mentioned also apply to his portable sundial (*M.E.* 4134, 1 December 200) which I have built. My thanks to Lieut. Col. Wilcox for his innovative designs.

Geoff Oakes, Victoria, Australia.

David Wilcox replies:

SIRS, - I am grateful to Mr. Oakes for pointing out that my Portable Universal Armillary Sundial is 'Universal' only in the Northern Hemisphere. As he says, for the Southern Hemisphere, the compass card must be turned around through 180 degrees and the hour scale reversed. I have to say that among all my many books on sundials, not one of them mentions use in the Southern Hemisphere.

With regard to the application of the Equation of Time in the Southern Hemisphere, I have discussed this with someone more expert than myself and we have concluded that the Equation of time applies identically as in the Northern Hemisphere.

The Earth's orbit around the sun is eccentric and the Earth's equatorial plane lies at an angle of 23deg.

26min. to the ecliptic plane, i.e. the plane of the Earth's orbit around the sun. In consequence, the Equation of Time is made up of two components: eccentricity and obliquity, as shown in the figure above.

In the case of eccentricity, the Earth moves more swiftly when it approaches perihelion, i.e. when it is closest to the sun in January, and more slowly when it approaches aphelion in July, so the length of the solar day varies accordingly. In the case of obliquity, combining with the effects of eccentricity, on four days of the year (16 April, 14 June, 3 September, and 25 September) there is then no difference between the length of the solar day and the mean time day. At other times of the year, there is a difference.

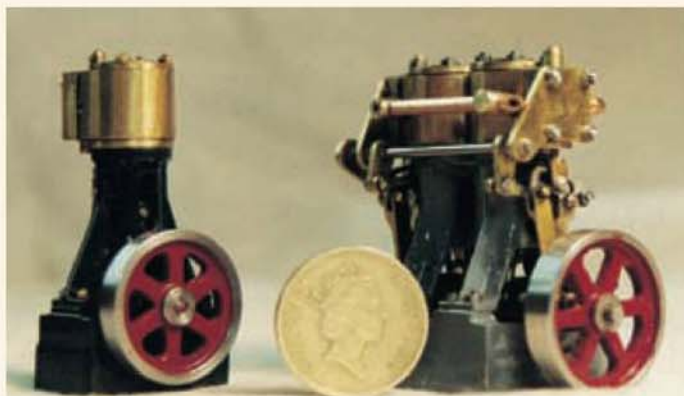
The effect of these two components, eccentricity and obliquity apply equally and identically in both Hemispheres. To argue otherwise would be to imply that as one stepped across the equator, the Equation of Time would suddenly change.

Scale rules

SIRS, - I was recently working on a CAD General Arrangement drawing of a Fowler locomotive, the original of which was printed from a microfiche copy to an odd scale.

After using a scale rule and a calculator for a while, I realised that the CAD program could be used to create a scale to measure the original drawing and convert dimensions directly to the 'model scale' drawing. On the original, a dimension of 3ft. 0in. was represented by a distance of 80mm; the scale of the model was 60 mm to 1ft., so an actual distance of 80mm on the drawing represented 180mm. Put another way, 1mm on the scale rule is represented by a distance of 0.444mm.

I drew a horizontal line across my CAD screen and a 10mm vertical line downwards from one end. I then used the offset command to copy this line at 4.44 mm intervals, for the full length of the scale rule. This gave me my 'tens' scale. I repeated the process with 5mm verticals spaced 2.22mm apart for my 'fives' scale and 2.5mm verticals at



Two of Mr. Bernard Walker's miniature slide valve steam engines.

0.44 mm intervals for a 'ones' scale. Choosing the one which was not too cramped I then used the text function to mark the 'tens' scale and, as a final touch, again with the text function, I identified the drawing number and scale.

The scale was printed full size on a sheet of thin card and cut out. It could have been printed on normal paper and glued to a length of card. The idea has worked well and saves a lot of time.

The idea can of course be used even if the drawing has a 'normal' scale and one does not have the appropriate scale ruler. These card rules are surprisingly durable; I have in my possession a set of Eyre and Spottiswoode cardboard scales which were my Father's, used by him when he was an apprentice back in 1927. They are a little dirty but still useful.

A final point: imperial scale rules are becoming very difficult to obtain, so if you have them, cherish them.

Peter Glanville, by e-mail.

Miniature power plants

SIRS, - Please find herewith a photograph showing two of my miniature steam engines.

To begin at the beginning, I built the single cylinder vertical slide valve engine about five years ago. It has now run on air for some 80 hours at the National Model Engineering and Modelling Exhibitions at Harrogate, and the annual West Riding Small Locomotive Society two day Rallies at Skopos Mill when the full size compound engine *Sarah* is steamed. A card is always displayed with the engine, enquiring "Is this the smallest vertical slide valve engine in the country?" Some have challenged me but all but one of the challengers turned out to be oscillating engines. The odd one out had a smaller bore and stroke but was assembled by soldering and could not therefore be stripped down and rebuilt as is full size practice.

Some weeks ago I decided to build a twin-cylinder version complete with Stephenson's reversing gear; this also runs very well on air. Both my little engines are 0.234in. bore x 0.234in. stroke and the small single

cylinder engine fits in a box just 1 x 1 x 2in high. The photograph includes a 0.886in. diameter £1 UK coin to give a sense of size.

A disabled old age pensioner now 78 years of age, I started model engineering in 1986 when I retired. I have two fairly large steam launches and a steam drifter all equipped with engines, boilers and burners of my own design. All the engines are twin cylindered with feed pumps and exhaust feed water heaters. They are all radio controlled and very good performers. I also have an LMS 'Black Five' in gauge '1' and an LNER 'J39' plus a further twelve stationary engines, pumps, etc, all of which perform at the previously mentioned events.

As a member of West Riding SLS, I have also built and regularly run an LNER B1 and GWR 15xx locomotives, both in 5in. gauge.

Bernard Walker, West Yorkshire.

Nameplates

SIRS, - Although the article on nameplates by D. A. G. Brown (*M.E.* 4183, 29 November 2002) was full of good advice, it failed to explain how one needs to vary the space between capital letters for best appearance. If you squint while holding the example at arms length, *Tony* appears spread out while *Priest* appears squashed up, especially in the middle.

Open letters like C, G, O, V need minimal space against adjacent letters (sometimes negative space with LO, TO and the like) while vertical-sided letters (particularly H, I, M, N) require increased spacing where two verticals are adjacent.

Sign writers and draftsmen know exactly what to do, but amateurs need a few trials to get an even density. Movable letters simplify this greatly.

Michael Verney, Sussex.

6-cylinder Roesch engine

SIRS, - It has been suggested that readers of this magazine may be able to help my research which concerns the Swiss designer of the London-built Talbot cars from 1916 to 1938, by name Georges Roesch.

Among 'Roesch' documents

acquired some ten years ago by the STD Register (the club for Sunbeams, Talbots and Darracqs) is a drawing (undated but most likely from 1928/29) of a marine version of the Talbot six-cylinder, 1666cc, 14/45hp car engine. We have no knowledge of the engine having been produced, or even of it having been built as a prototype.

There is a suggestion that it might have been designed to meet the specification for a tender for the RNLI, but we have no proof.

Is it possible that one or more readers might be able to throw some light on the matter? If so, I would love to hear from them!

John Gray, Oxfordshire.

Safety

SIRS, - Readers of part I of my article on *Faceplate Dogs* (*M.E.* 4184, 13 December 2002) should note that the small screw dogs shown in photo 1 cannot grip work strongly like a normal 3 or 4-jaw chuck. Therefore, to avoid accidents when starting work on turning or facing a workpiece, tailstock support must be provided.

The best method is to set the work hard up against the faceplate and then adjust the dog screws. From the tailstock, very carefully drill a centre hole. Then use a lubricated dead centre or a rotating centre to support the work. Thus supported, the dogs simply drive the work. Take light cuts.

This form of chuck is useful if you need to convert a rough, uneven piece of cast bar into something round in section and parallel along its length. Such a rough piece is difficult to grip in normal chucks.

Peter Spenlove-Spenlove, Leicester.

Colour blindness

SIRS, - Stan Wade's letter in which he pleads against CAD drawings in colour on the grounds of colour blindness is echoed by myself and probably about 1 in 8 (12.5%) of your predominately male readership. This is a very large proportion. Women are only affected to the extent of about 1 in 200, but 1 in every 8 men are affected, handing down their defective genes to their grandsons,

but only through their daughters.

My condition seems common to many; I have blue cones and green cones that work, and red cones that do not seem to work at all. In order to see red, my brain has to reprocess the signals from the blue and green, and perhaps by elimination, show me the object as the true red. Most of the time in everyday life this processing has already been done before, and I believe I immediately see the same red as most people. But confronted at a distance by a red rose bush the whole thing will at first appear green (or something dark.)

A REMAP assignment really proved this. A teenager sought advice on a career in electronics. His sister suggested we each count the number of roses on a bush about 15 yards away. On the first count he got to five, I got to seven. Then we started to see more and more up to around 14 each. His sister laughed and said there were 19. When we walked up the garden we could both see them all. It needed a clear visual distinction between the leaves and the petals, not possible at a distance. I advised him of the joys of mechanical engineering!

I have a string of funny stories about what has gone wrong over the years, fortunately none with serious or fatal consequences. The Health and Safety Euro-Gang have at last realised that red/green might not be the best stop/start colours. A few expensive mistakes in industry working from indiscriminately coloured prints might make that design office think. Even workshop wiring makes me hesitate. I always do a double-take over the 'o' in *Homepage* and it was years before brown and red tops for Nescafe jars were pointed out to me!

The problem needs more attention. There is a mass of information on the internet. Maybe via this medium, colour-blind people could make a plan of action to heighten awareness. Say we complete a printed page to point out to government and commerce where they are missing out or disadvantaging us, in each specific case? Contact: DALMANC@aol.com

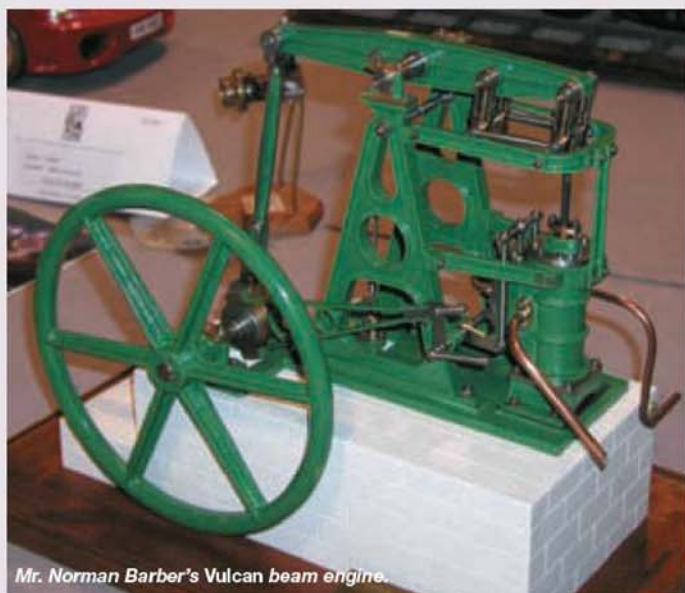
David Dew, Norfolk.

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Publication is at the discretion of the Editor. The content of letters may be edited to suit the magazine style and space available. Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.



Mr. Norman Barber's Vulcan beam engine.



Mr. Herbert Stumm's hydraulic engine.

COMPETITION CLASSES

AT THE 72nd MODEL ENGINEER EXHIBITION

Class A1:

Hot air engines

Julian Wood reports

The Hot Air Engines Class only attracted one entry this year. Thus continues the steady decline in entries over recent years. Originally, in about 1975, the Hot Air Engine Competition was for engine power output as measured by a brake. This attracted up to a dozen or so engines each year and resulted in many interesting and quite powerful engines. This competition declined some seven years ago and no entries have been received for the last three years. It seems that the present A1 class in which engines are not required to run is no longer attractive to engine builders.

However, a visit to any club stand will reveal that there is no shortage of engines available. Hot air engines of all sorts are highly popular as construction projects and some really novel, interesting and beautiful models are being built. Why cannot the builders of these engines put them on display, provide inspiration to others and, by so doing, obtain free admission to the exhibition?

The sole entry this year was a vacuum engine sometimes known as a flame eater. Beautifully made by Mr. James Douglas with a polished, finned aluminium cylinder and attractive flywheel, it was mounted on a polished brass base plate fixed to a wooden plinth and was awarded a Highly Commended certificate. This engine uses a slide valve on the side of the cylinder which is closed by a cam on the crankshaft. The valve is opened by a spring.

The vacuum engine is only one of several types of hot air engine which include the better-known Stirling engine, the Ericsson engine, the 'Manson' engine, and a more recent design, the Thermal Lag engine. Of these, the Stirling and Thermal Lag engines are closed cycle types; the same air inside is continually re-used: the other three all contain valves and at least some of the air is expelled and replaced each cycle. Comparisons regarding efficiency, power available, thermodynamic operation advantages and disad-

vantages, etc., are fascinating but complex, and the subject of several books. In particular, the Stirling has been developed to a high level of efficiency and power output.

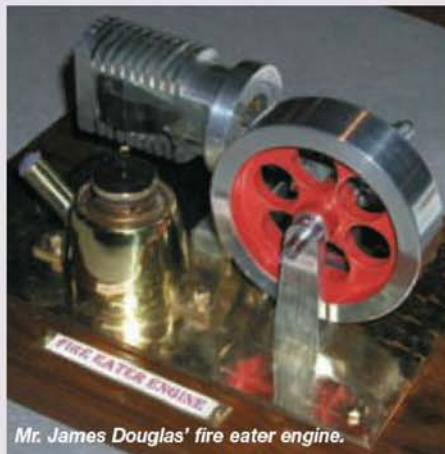
The vacuum engine has a limited output but examples were used up to about 1900 for small power applications. The operation is basically simple. A flame is continually present near the valve opening and is drawn in when the valve is opened. This occurs as the piston travels towards bottom dead centre (BDC). The valve closes at about BDC and the entrapped hot gases cool by contact with the cylinder wall. This produces contraction and a low vacuum, and atmospheric pressure acting on the 'back' of the piston forces it towards top dead centre (TDC) producing the power stroke.

The vacuum can only be quite low and the resultant power is limited. A much better vacuum would have been produced in the early atmospheric or Newcomen steam engine. The small vacuum engine is capable of around 1000rpm although lower speeds are usual. Valve sealing and flame type and position are critical. The engines make a pleasing popping sound when running. They also have a tendency to blow their own flame out with the exhaust gases and a separate lightly

sprung exhaust valve is a useful modification. Valve design and operation is a fascinating and rewarding field.

The success of the vacuum, and incidentally the Ericsson engines, is largely due to the direct heating of the air with the flame, or furnace in the Ericsson case. This ensures rapid and fairly complete heating of the air in contrast to the closed cycle designs in which the heating takes place through a thin metal casing. This metal 'casing' is the subject of much development work in Stirling engines and takes the form of fine tubes or fins in an effort to obtain complete high temperature air heating, relatively easily obtained by flame contact. This heating is essential to obtain high expansion and pressure changes on which the engine power depends.

A similar but less severe problem exists to produce rapid and effective cooling for the cold end of these engines. However, external heating removes the need for valves and avoids combustion products inside the engine. This issue and several others are all the subjects of various compromises in these engines; finding the most advantageous compromise is a major part of the fascination of hot air engines.



Mr. James Douglas' fire eater engine.



Mr. Ian Cornish's twin cylinder oscillator.



Mr. Bill Connor's Matchless G50 engine.



Mrs. Cherry Hill's Gilletts & Allatt traction engine.

Class A2: General Engineering Models Anthony Mount reports

On being handed the Judges notes I was disappointed to find that only four engines had been entered for this year's competition. Hundreds of engines are being built, surely a dozen or so could make it to the competition each year?

The first entry was a *Vulcan* beam engine built by Norman Barber. The design was originated by Edgar T. Westbury in 1954. The nameplate on the model gave 1820 as the period represented. The beam is supported by A-frames and the whole engine is self-contained, requiring no support from the engine house walls as was often the case with early beam engines. The original design incorporated castings for the larger components, but Mr. Barber used fabricated construction throughout, and supplied photographs of the construction of the fabricated parts. I do urge entrants to give the Judges as much information as possible about their model. It is a great help. The A-frames in particular were a very good representation of castings.

The foundations appeared to be of wood, but were carefully painted to represent stone as was often used in full size work. The pipework was nicely done with clean bends and proper flanged and studded joints. The engine turned over very smoothly. Painting an engine is one of the most difficult jobs on a model and a little extra time spent on this aspect would have improved an otherwise excellent model. It well deserved its Bronze Medal.

The second entry was from Ian Cornish who

has entered a number of engines in the past. The model was of an inverted vertical twin cylinder oscillating engine with reversing gear. It appeared to represent a large engine as the entablature was surrounded by a catwalk reached by two ladders. It was constructed mostly of brass with an iron flywheel. Some parts were not prototypical of the full size engines of this type, and the reversing box could have been modelled more on the lines of a casting. The model was unfortunately not painted and no Judges notes had been submitted. However, it was a nice little engine and gained a Commended Certificate.

The third entry was also from Ian Cornish and was a freelance design for a boiler feed pump to be attached to a Stuart 10V or 10H engine. It was of a fabricated design. Driven through spur gearing, it had disk crank webs, with a bronze valve box of silver-soldered construction. Again the model was unpainted.

The fourth entry was from Herbert Stumm of Germany who entered an hydraulic engine by Mayer from the 1880s. These engines bear a superficial likeness to a horizontal steam engine, but the working fluid is a column of water. The pressure can be up to 54bar (800psi). The model is of a light industrial type using water at mains pressure. It was scratchbuilt except for the flywheel which is an iron casting.

Source material for the model was from a technical encyclopaedia showing in main the cylinder, so some of the parts had to be extrapolated from similar engines and practice of the period. The fabricated cylinder did indeed look like a casting, and was surmounted by some nicely shaped air

vessels. The valve gear was very nice and of interesting design.

Workmanship was superb with scale size nuts and studs, and the finish excellent. Some of the details were very fine, for example the eccentric strap was only about 3mm thick, and there were no external flanges on the sheave. Pipework had flanged and studded joints, except those to the small expansion chambers which inexplicably had nutted connectors. The engine was mounted on a simulated brickwork foundation and was itself on a polished oak base. The paintwork was very nicely done; a lovely engine, it gained a Gold Medal.

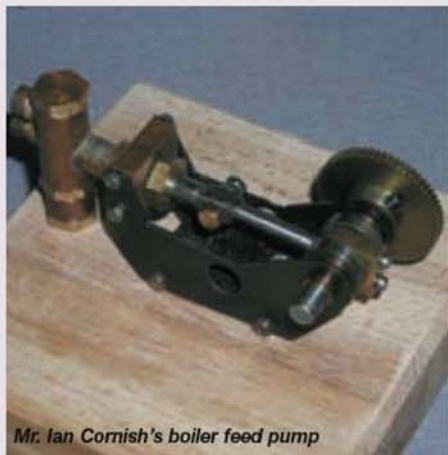
Class A3: Internal Combustion Engines David Boote and Neil Read report

Two entries were received in this class. The RGB XL engine entered by Mr. William Downes was an interesting development of the RGB motor, described in these pages (commencing in *M.E.* 4105, 22 October 1999). We understand that the engine is approximately 5 times the size of the original design and has a 20cc capacity. It was fitted with a neat recoil starter. All the main components for the engine were machined from the solid. Aluminium alloy (HE30) was used for the main body, EN8 steel for the crankshaft, cylinder sleeve and connecting rod. As the original design does not use piston rings, a ringless, lapped cast iron piston was preferred.

The cylinder head of the RGB motor was designed for the restricted airflow to be found in the confines of a radio controlled model racing car. It was generously proportioned to dissipate heat. At the increased scale the cylinder head appeared even more exaggerated and a substantial counterbore was needed to reach the glow plug.

Induction of the fuel charge is via a port cut in the crankshaft journal to the crank chamber. In the original RGB engine the designer had found this to be a weakness and, following a breakage, the journal diameter was increased. No such difficulty had been encountered with this larger version of the engine. The crankshaft is supported by two ball races with an intermediate plain bearing to hermetically seal the crank chamber. The carburettor for the engine was not a commercial item and had been machined from the solid like the other main parts.

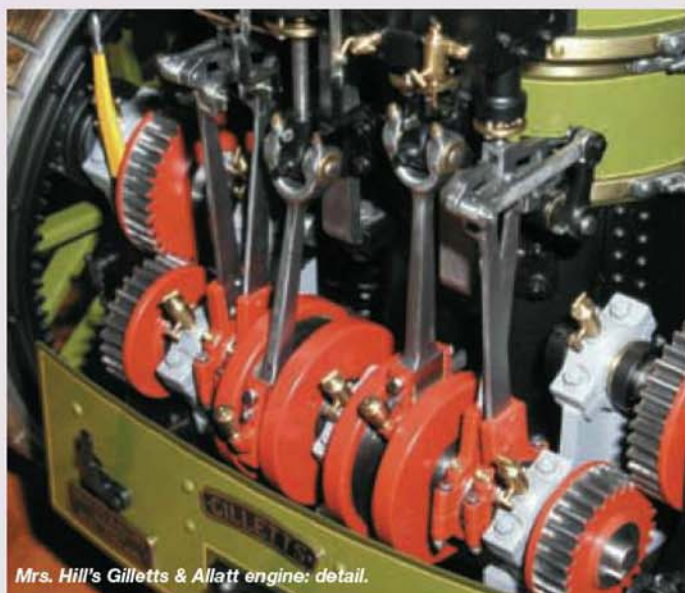
Mr. Downes is to be congratulated for producing this enlarged version of the RGB engine and for retaining the features that interested him while



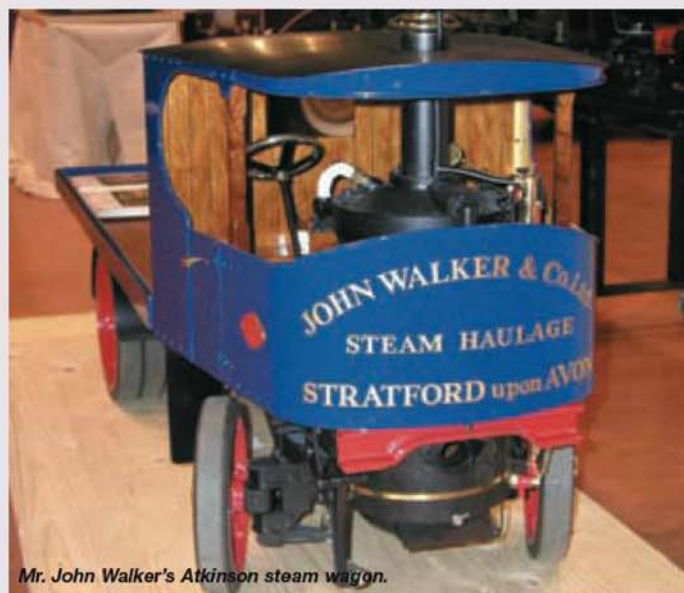
Mr. Ian Cornish's boiler feed pump



Mr. William Downes' 20cc RGB XL engine.



Mrs. Hill's Gilletts & Allatt engine: detail.



Mr. John Walker's Atkinson steam wagon.

incorporating some of his own ideas. However, the Judges felt unable to make an award for this model.

The half size Matchless G50 engine entered by Mr. Bill Connor has featured in these pages before when it was seen (and heard) at the 35th Guildford Model Steam Engine Rally and Model Engineering Exhibition last year. This is an excellent model of a famous racing engine. We understand that the main 'castings' were machined from solid billets of material but care had been taken to achieve an 'as cast' look. The case containing the drive chain to the overhead camshaft was particularly well done as befits what is probably a trade mark feature of this engine. This model was awarded a Gold Medal and the Edgar Westbury Memorial Trophy.

The 500cc Matchless G50 engine was really a stretched version of that fitted to the 350cc AJS 7R racing motor cycle. This statement probably warrants some explanation for those not steeped in motor cycling history. During 1931 the famous and long established motor cycle manufacturer AJS fell on hard times and ceased trading. The company was bought by Matchless Motor Cycles (Colliers) Ltd. and production re-commenced at the Matchless factory in Plumstead, London. Some seven years after this, the company name changed again and they became known as Associated Motor Cycles Ltd., or AMC for short, and some readers may remember them trading under this name. For a time production of the two ranges of machines carried on in parallel, however before long they became virtually identical with only the name on the tank, the colour scheme and a few minor differences to distinguish between them. This was in fact an early example of badge engineering.

However, it seems that Matchless/AMC were quite content to learn from AJS. During the 1920s AJS had introduced an overhead camshaft, single-cylinder model into the range. The unusual thing about this engine was that, where most designers used a shaft to operate the camshaft via bevel gears, AJS used a simple, fully enclosed chain fitted with a Weller tensioner. This feature distinguished the AJS 7R when it was introduced in 1948 and was a characteristic feature of this very successful racing motorcycle. The 7R remained in production until 1961 and dominated the 350cc racing class so it was not surprising that the owners of the marque would want to capitalise on its success and build a 500cc version, albeit under the Matchless banner. What is perhaps surprising is that it took them so long to do so.

The G50 was introduced in 1958 and faded out sometime in the early 1960s.

Another feature of these engines was the use of hairpin valve springs instead of the more usual helical compression type. The valve travel used on these engines caused problems with conventional springs and double springs of the hairpin type were found better able to cope. This feature is faithfully reproduced in the model. Even the sparking plug was made by Mr. Connor, a material called Cortan being used for the insulator. Ignition is via an induction discharge unit with a contact breaker and an advance and retard mechanism housed in the dummy magneto. Incidentally, the paint finish on the main castings was to protect them from atmospheric attack as they were cast in magnesium based alloy.

Class A4: Road Vehicles

Ron Heugh and Harry Paviour report

There were four exhibits in the A4 competition class. These were located on the ground floor at one end of the main hall opposite the SMEE stand. The other competition model in this class was located on the upper floor level. Complementary to the standard of models in this class, they were displayed together with the entries for the Duke of Edinburgh Challenge Trophy.

Before commenting on the various entries, the Judges feel there is a need to comment on the expectations for an exhibit to be considered for Medal and Trophy awards.

One of the five criteria assessed by the Judges is 'Complexity'. Allocated according to the additional effort and contribution made to the model to present it complete and comprehensive, this includes extent and quality of lettering and lining, lamps, headlights, number plates, etc., and even a set of tools and associated equipment which one would expect to find on a full size engine. A little more in-depth research would provide the builder with this information. It is all these additional items, including the finer points of construction and painting detail, that will gain the builder additional marks.

The Judges felt that two of the three engines exhibited were somewhat wanting in this respect for which they therefore forfeited potential marks. For example, had one exhibitor presented the additional items and equipment and waited another year before exhibiting, a higher award would have been obtainable.

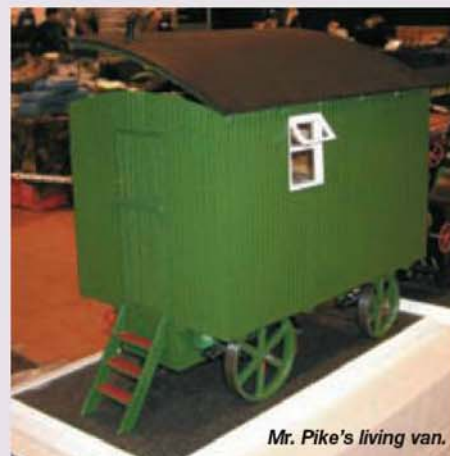
The nomination and award of Trophies is very much at the discretion of the Judges. A Trophy can accompany any of the three levels of awarded medals or commendations.

Mrs. Cherry Hill of Worcestershire entered a 1:16 scale model of a Gilletts & Allatt Traction engine, circa 1862. This very much followed the standards and expectations associated with the builder's previous exhibits and was presented and displayed in a fine cherry wood and glass case. Including the research and design stages, the model had been built over a period of 10 years. It depicts a double tractor unit design, provided with a 4-wheel drive system with two steering axles. Each drive unit is provided with its own vertical boiler. Both drive units are capable of being disconnected to form a self-contained unit.

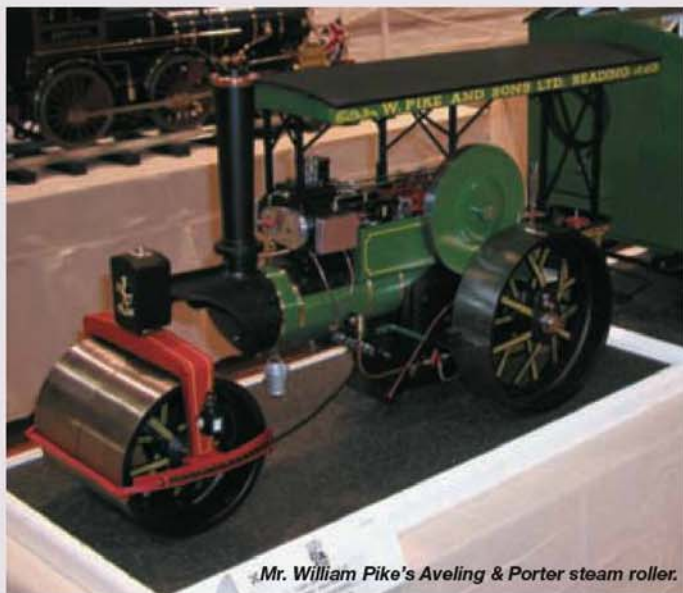
No castings were used; all the components for the model were machined from solid, even the fastenings and rivets were individually made. The fine scale steam fittings, plumbing and moving parts clearly demonstrated good eye and close attention to detail.

Painting a model of this calibre must have presented the builder with many problems. The motion gear was of an orange shade of red, this was set against a satin black for the two boilers and other hot parts. Olive green wheels and plate work was complemented with very fine orange/red lining.

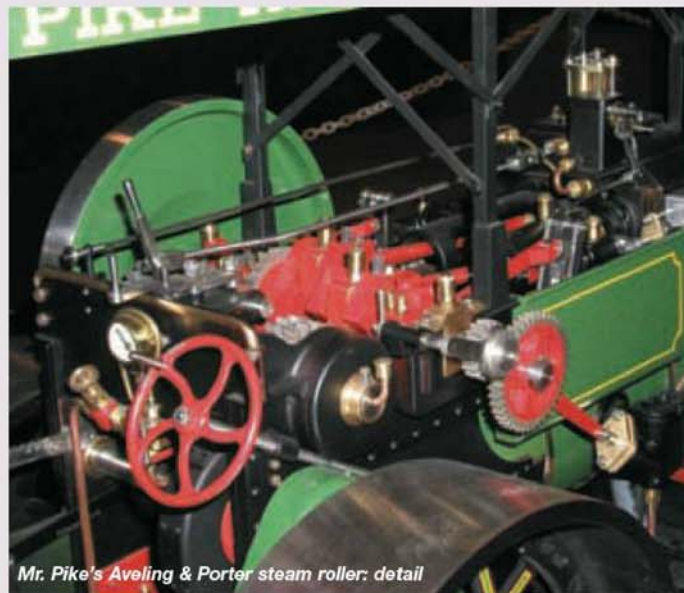
For the Judge's information, Mrs. Hill had provided a set of very comprehensive research and construction notes to accompany the model together with an interesting set of photographs illustrating the stages of construction and materials used. Accompanying the model was an example



Mr. Pike's living van.



Mr. William Pike's Aveling & Porter steam roller.



Mr. Pike's Aveling & Porter steam roller: detail

of an incomplete and unpainted road wheel, including a number of the wooden blocks fixed to the rim. A Gold Medal and the Bradbury Winter Memorial Challenge Cup were awarded.

Mr. John Walker of Warwickshire, provided considerable interest for visitors with his 3in. scale Atkinson 6-ton 'Standard' steam wagon. This model was built and described by Ray Prime in *Engineering in Miniature* magazine. This sizable model is some 5ft in length, 20in. wide, 22in. high and weighs in at a substantial 200lb. Not an easy model to display on a table, it therefore had to spend its exhibition time standing on a wooden plinth on the floor!

While the boiler fittings, sprockets, gears and chain were commercial items, the remainder of the workmanship, construction and paintwork demonstrated the builder's very high level of ability, the more so when the flat bed was lifted off to expose the cylinders and chassis detail.

The Judges were particularly pleased to have sight of a very comprehensive set of notes illustrating the background history of the prototype vehicle, including all the research for building information. The notes also included a set of interesting and informative photographs on the setting up and machining of the various components.

The Royal Bue livery was set off by red wheels and, at the front of the cab, the builder's name and home town was presented in gold leaf. That said, the Judges felt that the model would have benefited from some fine lining and filigree around the contours of the cab sides and front. Additional items, including number plates, lamps, tools and even a tarpaulin or two, including the rope hooks



Mr. Pike's water cart

under the flat bed, would have gained additional marks to obtain a higher award. Nevertheless, the Judges were pleased to award a Silver Medal and the Aveling and Barford Trophy.

Mr. Pike of Berkshire exhibited a very interesting display of three models in 2in. scale consisting of an Aveling and Porter Road Roller, a Water Cart and a Living Van, all to the designs by John Haining. Each of the models was painted in a light shade of green and were presented on their own individual plinths. From a distance all three exhibits looked a very impressive collection worthy of showing at any show, rally or exhibition.

Closer examination of the Roller revealed that there were several matters upon which the builder could have improved to have earned additional marks. A main concern was that the flywheel seemed to be loose on the crankshaft to the extent that the gib head key could be easily pulled out. With a taper of $\frac{1}{8}$ in. per foot length, this key should of course have been driven in but was found to be almost parallel. (Note for future builders: a full size roller like this model would have had a crankshaft of about $3\frac{1}{2}$ in. diameter. The key would therefore be $\frac{7}{8}$ wide x $\frac{5}{8}$ high x $4\frac{1}{2}$ in. long).

The steering chains were obviously from a commercial manufacturer and of a too light a gauge. If, or when the model is steamed, these links will certainly part. The smokebox door was not quite as found in full size practice; in terms of scale, it was considered too thick. In full size practice these doors were hung with top hinges and secured with dogs around the edges. No doubt the builder has used a central screw fixing for ease of cleaning the smoke box and tubes when steaming on the rally field. Also, the brass clips holding the drainpipes around the side of the boiler were too thick for the scale. One of the brass boiler bands was found to be loose around the boiler. Finally, the Judges were sure that with a full size engine, curved rainwater bars should have been fitted to the top sides of the roof; these were missing.

To gain valuable marks in any competition, attention to detail must also include the paintwork. It was thus disappointing to see a number of scratches and chips to the paintwork. Exhibitors need to spend time with what is known as a '3-whisker brush', going around touching up any little defects in the paintwork. The Judges were surprised to see that the lining around the tender had not been extended to either side of the boiler bands. Another disappointment was that there were no tools or firing irons with the model.

Despite the above comments, the Judges recognise the amount of work and effort that goes into the building a model of this type, including the machining, lining up of the cylinder, crankshaft assembly, etc., and were therefore pleased to award a Bronze Medal.

The construction of a living van will really test any model engineer's ability to work in wood, with only a limited amount of the familiar metalwork involved. Mr. Pike's model was no exception. Another interesting model, its roof was propped up to enable the inside to be viewed, but closer examination revealed areas that should have been addressed before exhibiting. The potential to gain a higher award had unfortunately been missed.

One of hinges to the lower stable door had come off the doorframe. While steps were provided for persons to gain entry from the ground, there appeared to be no provision for them to be stowed beneath the van or carried on brackets at the rear, when travelling. The overall quality of workmanship to the woodwork was good, though normally the van sides would have been of double thickness to include a form of insulation. Difficulty was found in operating the brake gear to check the working of the wheels.

The inside of the van presented a pair of bunk beds with some very thick warm bedclothes. No doubt this was a contribution by the builder's wife, demonstrating her needlework skills! Also inside the van was a stove, table, wall cupboard and a storage chest, though regrettably no chairs were present. To complete this domestic scene, a paraffin hurricane lamp was hung from the inside of the roof. The Judges were pleased to award the builder a Highly Commended Certificate.

A water cart is always an interesting model to make, although quite simple it still requires the builder to address many skills. The Judges noticed that the offside wheel had a very pronounced wobble when spun around, a clear indication that the driver at some time, had cut the corner a bit tight when turning right! An interesting spray bar attachment was fitted to the rear of the cart. The water lifting hose for the water cart was similar to the water lifting hose provided on the roller, both hoses appeared to be of commercial manufacture. To enhance the model, the builder could have provided leather straps to the hose, a set of wheel chocks, etc., all helping to finish the model off. The Judges were pleased to award a Commended Certificate.

●To be continued.



The wooden base constructed for the clock. It is constructed from veneered plywood and hardwood mouldings.



A drawer to the front houses the dry cells which supply power to the Archimedes screw drive motor.

A FERRIS WHEEL CLOCK

Richard Stephen

concludes this series of articles with a description of the base.

●Part XIII continued from page 155
(M.E. 4188, 7 February 2003)

Figure 50 shows the base I made for my clock. The carcass was made of 10mm birch faced marine plywood covered with rosewood veneer. The mouldings around the base were also covered with veneer. The only solid rosewood used in the base was the edging around the top. The base could be made from solid timber rather than using veneer on plywood but I would not recommend this since it will make the job a lot more difficult, particularly when it comes to making the mouldings. Don't be put off by the thought of veneering; it really is much easier than you may imagine and you can choose from a huge range of lovely veneers. Frankly, I find wallpapering is a lot more difficult! When choosing the veneer,

be sure you can obtain sufficient solid timber to match for the edging around the top.

It may be that some readers do not have a great range of woodworking tools. Although I have done a lot of woodworking in the past, and still have all the tools, I used very few of them when I made the base for this clock; in fact I only used a chisel and a small plane. Most of the work was done on my milling machine using end mills and a slitting saw. All the mitres were cut by milling with an end mill; by which means it is so easy to cut mitres which are absolutely true.

The following materials will be required:

- 1: 1 piece 300 x 500mm of 10mm birch faced marine ply.
- 2: 1 piece 100 x 300mm of 6mm birch faced ply.
- 3: 1 sheet 300 x 1000mm of veneer.
- 4: 1 roll of veneering tape, (old fashioned brown paper adhesive tape).
- 5: 1 200mm length of 10 x 20mm solid wood for the top edging to match the veneer.
- 6: 1 sheet of 'iron on' veneer glue sheet.

7: 1 small bottle of aliphatic pva wood glue.

8: 1 length of 20 x 20mm concave moulding.

9: 1 small box of 20mm long panel pins.

Suppliers

Birch faced plywood is generally available in small quantities from most good model shops. The thickest which I was able to obtain was 6mm so I glued two pieces together to get the 12mm I required. Please note that if you have to follow suit and end up with 12mm ply, the dimensions shown on the drawing (fig 50) are for a base made with 10mm material. Model shops also supply aliphatic pva adhesive which seems not to be generally available from the average DIY store. Aliphatic pva glue is superior to the ordinary variety in that it sets hard and can be easily sanded.

Veneers in a very wide variety of exotic woods are available from Art Veneers Co. Ltd., Chiswick Avenue Industrial Estate, Mildenhall, Suffolk IP28 7AY; tel: 01638-712550. Readers may wish

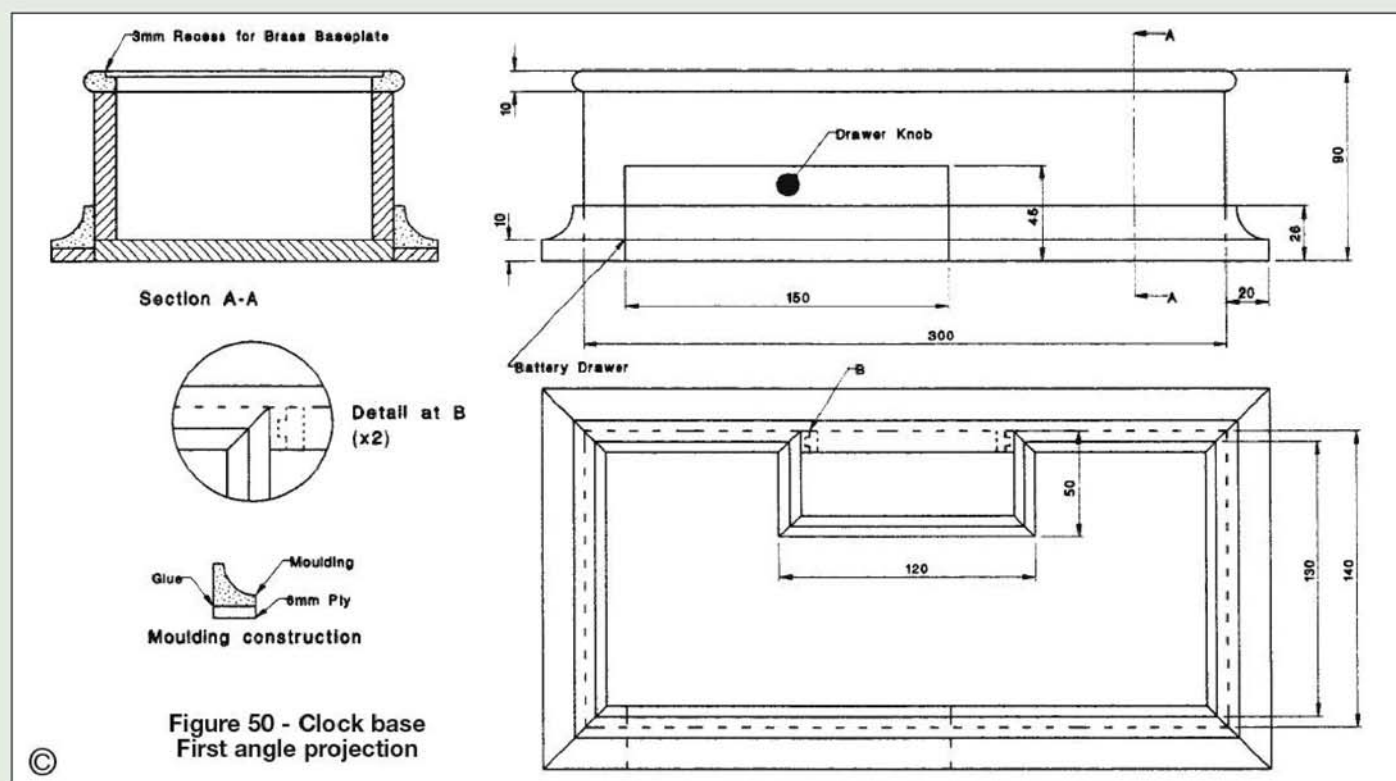


Figure 50 - Clock base
First angle projection



Top: The sandpaper file was made from a scrap length of Perspex.

Left: The mitres at the corners were cut using the milling machine and an end mill.

Right: The recess provided for the pendulum with its cover removed.



to visit the comprehensive and informative Art Veneers Co. website at www.artveneers.co.uk. For suppliers outside the UK the Internet should provide other suppliers. Art Veneers Co. Ltd. can also supply glue sheet and veneering tape.

Suitable mouldings are available from most good DIY stores. If you can get it, the best mouldings are machined in Ramin which is quite hard, straight grained and easy to work.

A cover for the clock is essential. In my opinion these are items that are best purchased. Recently, I had a Perspex cover made by Engineering and Design Plastics, 84 High Street, Cherry Hinton, Cambridge; tel: 01223-249431. The cover was superb and the price very reasonable. I can recommend them.

Constructing the base

The dimensions of the base are shown in fig 50. Cut the sides and the base from your piece of 10mm birch plywood. Make sure that the sides and edges are all absolutely square. The sides will be glued and pinned but before doing so, drill holes for the pins just a fraction smaller than the diameter of the panel pins you aim to use.

Prime the edges to be joined with a small amount of glue and allow it to dry. I find the glue straight from the container is generally a bit too thick and add a little water to thin it down to the consistency of pouring cream. Glue and pin the sides together checking that all the corners are square. When the glue has set, pin and glue the sides to the base and allow to dry thoroughly.

Using a suitable punch, the heads of the pins must be hammered at least 3mm below the surface of the ply. If this is not done, the heads of the pins may rust at some time and this rust will eventually stain the veneer to spoil the base. The holes left after punching are filled by gluing in lengths of wooden cocktail sticks. When the glue is quite dry the sides of the base must be sanded absolutely flat and smooth.

Applying the veneer

Applying veneer using glue sheet is extremely easy. You will need to borrow a household iron; if you have an old one about the place, I suggest you avoid domestic strife by using this. If not, you can assure the 'powers that be' that it will come to no harm.

Begin with the two sides of the base. Cut a piece of glue sheet just a little larger than the side to be veneered. Wipe the surface of the side with a damp sponge and place the glue sheet, glue side

down, on the surface. Run over the paper backing with a warm iron until the glue adheres to the surface and then peel off the backing paper. The iron should be hot enough to just melt the glue.

Using a sharp craft knife and a steel rule, cut off a piece of veneer just a fraction larger than the side. Damp both sides of the veneer with the sponge. Iron on to the base in the same way as the glue sheet. Don't worry at this stage if the veneer lifts a bit on any of the edges. Veneer the other side and allow the veneer to cool. Wherever the veneer has lifted, poke in a little pva glue using a thin strip of scrap veneer and hold it in place with a piece of veneering tape. When the glue has set the tape can be easily removed by wetting with a damp sponge.

The edges of the veneer must now be rubbed down flush with the front and back; . A sandpaper file is a useful tool for this job; I made mine from a 300mm long scrap of 8mm Perspex 40mm wide with one end shaped to form a handle. Strips of 120 grit aluminium oxide paper are stuck to the surface with double sided adhesive tape. When sanding the edges of the veneer, always sand towards the base, never away from it.

Complete the veneering of the sides of the base. You may not find it easy to get the iron into the recess for the pendulum at the back of the base; I used a length of 25 x 6mm thick brass previously heated with a blowtorch.

The solid wood edging can now be glued around the top of the base. I cut the mitres on the milling machine using an end mill, always working the wood with the grain, never against it. The advantage of cutting mitres with the mill is it is easy to shave off a 'smidgen' for a perfect fit.

Begin by cutting the mitres and gluing on the front edging strip. Work your way around the top, fitting and gluing in each piece individually. You may have to adjust the angle of the mitre slightly. The edges of the opening in the front for the battery tray can also be veneered now.

The mouldings fitted around the bottom are made next. Cut off two lengths of the moulding for the front and back with a little to spare, and two lengths for the sides. The moulding as purchased is not quite tall enough and an extra piece had to be added. Cut strips of 6mm ply and glue these to one side of the moulding as shown in fig 50. Before veneering the mouldings check that the cross-sectional dimensions of all four pieces are the same and that all the edges to which the veneer is glued are absolutely flat.

Begin by veneering the concave surface. Find a piece of bar with the same radius of curvature as the concave surface of the moulding and as long as the piece of moulding. Cut off a piece of veneer wide enough to cover the concave surface with a little to spare. Cover the length of bar with cling film. Apply glue to the concave surface of the moulding. Dampen both sides of the veneer with water. Assuming domestic approval, put the piece of veneer in the microwave for 20 seconds

at full power. While it is hot, the veneer will be quite pliable and bend easily around the concave surface without splitting. Using the length of bar as a former, bind string around the bar and the moulding to keep the veneer in place. Set aside for a couple of hours until the glue has set.

Veneer the concave surfaces of the rest of the lengths of moulding. Sandpaper the edges of the veneer flush with the remaining edges to be veneered. I used glue rather than glue sheet to attach the veneer to the edges of the moulding and a length of flat wood covered with cling film and bound with string to hold the veneer in place while the glue set.

Before gluing the mouldings around the bottom of the base, sandpaper the surface of the mouldings, finishing with flour paper. Cut off a length of moulding for the front of the battery tray and put it to one side. Start gluing the moulding around the base with the piece to the right of the battery tray opening. Cut off one end square and sandpaper it smooth. Size the end grain with glue and allow to dry. It may be necessary to repeat the sizing to get a suitable surface on which to glue the veneer. Glue a piece of veneer on the sized end, sandpaper the edges flush and finish sand the surface. Cut the mitre with a milling cutter and glue the moulding in place. If the two surfaces in contact are smooth and perfectly flat, the glue will grip adequately to hold the moulding in place until the glue dries. Fit and attach the rest of the mouldings.

The battery tray and cover for the pendulum recess are all that remain to be made. Readers should have no difficulty making and fitting either of these parts.

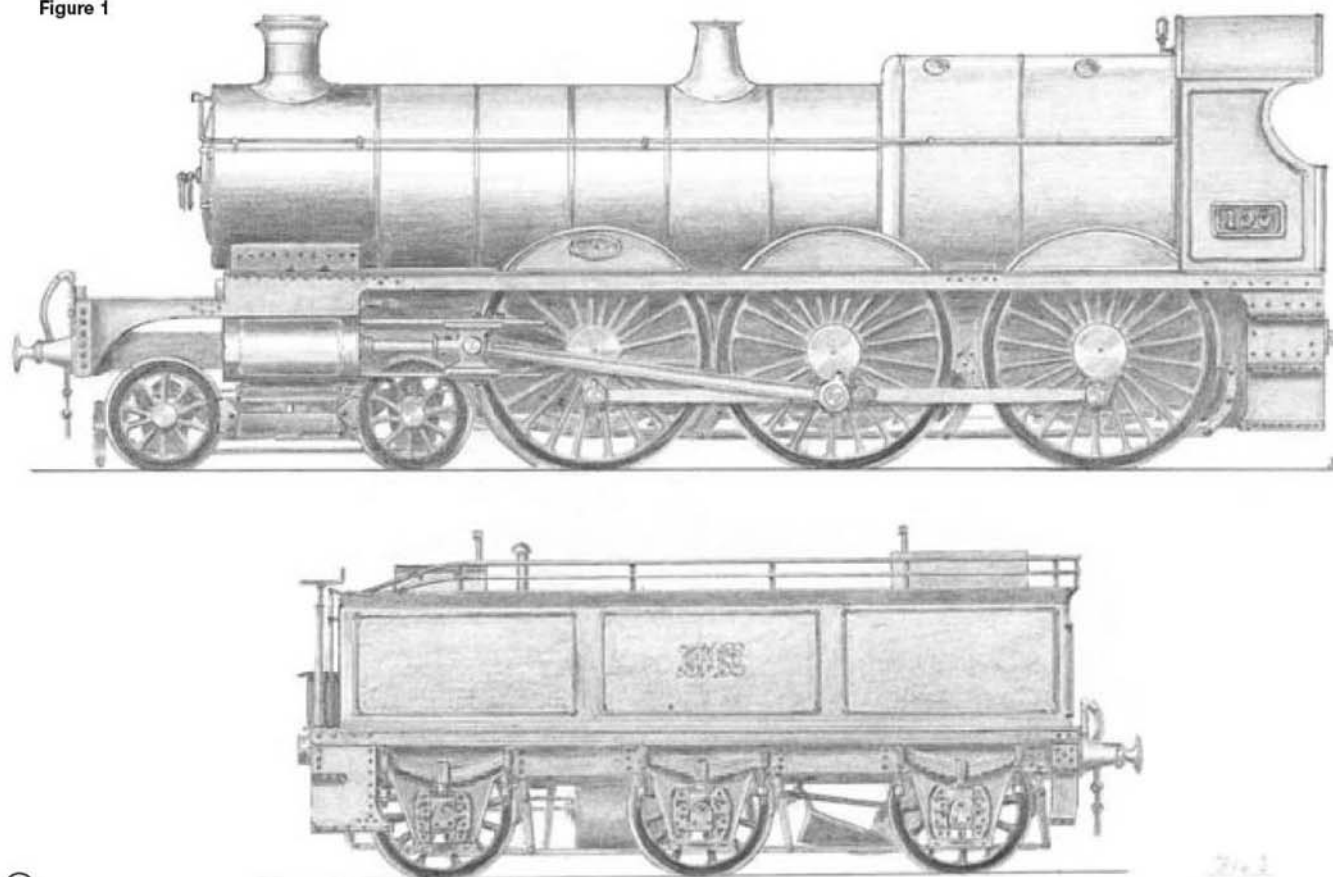
The final task is to cut the recess in the edging around the top of the base for the brass base plate. The recess is not essential and if cutting it poses a difficulty it may be better not to bother. I machined the recess on the milling machine with little difficulty.

Finally, attach the two brass brackets to the inside of the base. Position the brass base and mark the positions of the holes for the 3mm screws which secure the clock to the base. This completes the base except for final sanding and polishing. To polish my base I treated the veneer with several coats of sanding sealer, sanding lightly between each coat until I obtained a dead smooth surface. To obtain a final shine I used French polish.

All that remains is to fully assemble the clock and test it for several weeks before polishing all the brass parts.



Figure 1



EDWARDIAN ELEGANCE

Ron Isted

introduces his new series with a description of an ideal subject for the modeller: GWR 4-6-0 No. 100.

●Part I.

We tend to think of galloping technology as a recent phenomenon, but just over a century ago in February 1902, there emerged from the Great Western Locomotive Factory at Swindon an engine which really was an amazing leap into the future and a spectacular contrast to what had gone before. Just consider that three years earlier, this same works was still turning out the classic Dean 'singles', considered by many, including the late J. N. Maskelyne, to be the epitome of locomotive grace and elegance. In his beautiful book *Locomotives I Have Known*, he stated categorically that "he would not argue on this point" and produced 'proof' in the shape of the 'considered opinion of a student of aesthetics.' On the other hand, he described the subject of this article as 'seemingly uncouth' and 'a profound shock.'

Well, I guess I've always been a rebel, but I much prefer the sleek simplicity of the engine of the new century to the — dare I say it — brassy and exuberant appearance of the Dean engines, excellent performers though they were. No. 100 was built while William Dean was still in charge at Swindon, but there is little doubt that the design was the work of his assistant, E. J. Churchward, who became Locomotive and Carriage Superintendent on Dean's retirement in June

1902. Dean had always been a great enthusiast for experimental engines, so it is likely he gave his assistant every encouragement.

If I may digress for a moment at this early stage, I am well aware that several writers have stated that William Dean was suffering from a form of dementia and in later years had little idea of what was going on. This is definitely not borne out by contemporary reports in the *GWR Magazine* of farewell speeches made by him in February and June 1902, in which he displayed complete lucidity and a splendid impromptu wit: hardly the symptoms of senile dementia.

To return to the subject of this article, the major difference between Dean's experimental locomotives and Churchward's new brainchild was that the former generally had very short lives, not to mention a marked reluctance in some cases to stay on the track, while No. 100 with all its novel features, at least as far as the GWR was concerned, spent 30 years in top link service.

After undergoing Indicator trials, the engine began her revenue earning service in June 1902 and two months later was allocated to Bristol shed. In that same June, she (or he?) was named *Dean*, changed in November to the rather more personal *William Dean* and put to work on the heaviest expresses of the day, mainly between Bristol and Exeter or Newton Abbot. Coal consumption averaged about 33½/2lb. per mile, Whitehall summit included, a good figure in the days before superheating, but probably no better than the 4-4-0s and 4-2-2s on the same duties.

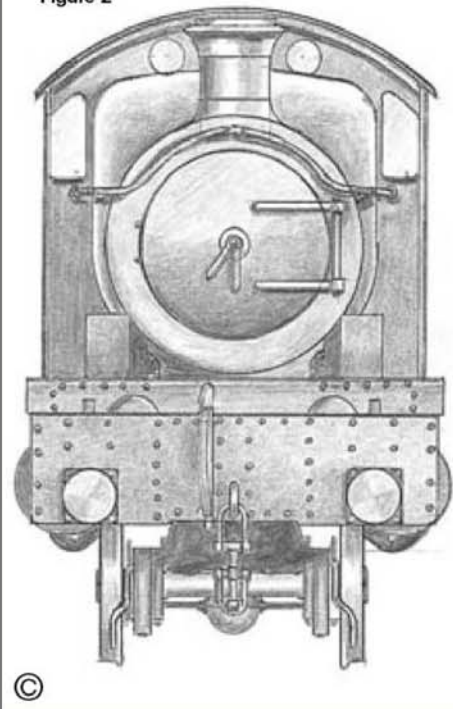
Throughout its career, the engine was kept up-to-date, conforming as far as possible to the later '29s'

or 'Saints,' being fitted with the later No. 1 standard taper boiler, Swindon superheater, top feed and other detail alterations including substitution of side plates for the coal rails on the tender. After 30 years of hard work, the latter part of which had been spent at Landore shed, still on top link duties, the non-standard cylinders had reached the re-boring limit and this truly ground-breaking locomotive, which really was the grandfather of all modern British locomotives, was ignominiously consigned to the scrapheap in June 1932.

Pros and cons

Apart from the importance as a historical landmark, I feel that No. 100 in her original form (figs 1 and 2) would make an excellent working model for several purely practical reasons. First and foremost, she was built with the only parallel version of what was later developed into the GWR No. 1 standard taper boiler, allied to a Belpaire firebox with a (nearly) flat top and straight sides. Both are very much easier to build in small sizes than the later Great Western boilers, particularly the fireboxes which seem to taper in all directions at once and are so difficult to get right as far as appearance is concerned. On the prototype, incipient cracks in the joints between the barrel and firebox led the Swindon design team to develop the highly efficient but complex-shaped boilers which lasted until the end of steam traction in this country. However, given our normal safety factors there is no reason why such problems should arise in a miniature version and I very much doubt whether any difference in steaming capacity would be noticeable.

Figure 2



Another advantage of No. 100's angular appearance is that there are no curves to reproduce and 'blend in' in the footplating: it's all straight lines and right angles. Even more important, as far as sheer physical effort is concerned, the main frames are plain rectangles of steel plate, apart of course from the horn block apertures and some small cut-outs in the lower edges. In other words, there are no curves over the wheel centres, unlike the Brighton Railway tank engine I am building, the frames of which have more curves than a 1940s Hollywood film star!

There are, however, certain problems with the frames of No. 100 which I will discuss later, but for the moment let us continue with the advantages of building this particular locomotive. The cab is very short indeed, 4ft. 3in. full-size and spartan even by the standards of 1902, but that makes life much easier for our out-of-scale fingers, while the tender is very low-sided compared to later standards, and reasonably short. Both characteristics are an aid to firing and driving a miniature version.

The engine was reversed by the large Churchward style lever, colloquially referred to as the 'pole', which is more convenient when running on an up-and-down track, and I have to admit I find this type much easier to make than a screw reverser; but then I am no Bill Carter or Fred Cottam. A detail unique to No. 100 among GWR outside cylinder 4-6-0s, at least those with straight footplating, is that the cab footsteps were solid-backed, with no fancy cut-outs as applied to later engines. Apart from being a fiddling job to get right, they leave the finished item very vulnerable to mishap or just plain clumsy mis-handling.

The big-ends on No. 100 were the first example on the Great Western of the solid eye type which later became standard not only on that railway, but was widely copied elsewhere. Again, they are simpler to make and replace in miniature than the adjustable type.

Technical details

Before discussing the 'cons' of building a working model of No. 100, a few technical details of the full-size locomotive would be useful. The most

Figure 3

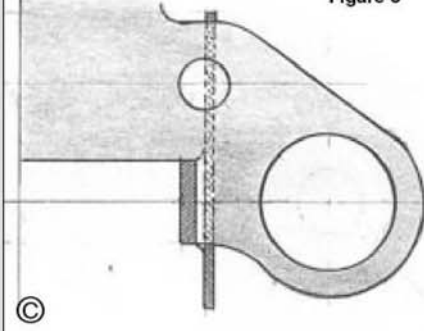


Figure 5

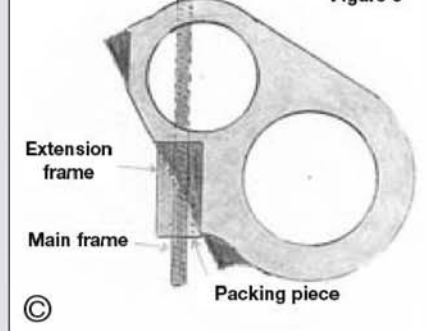
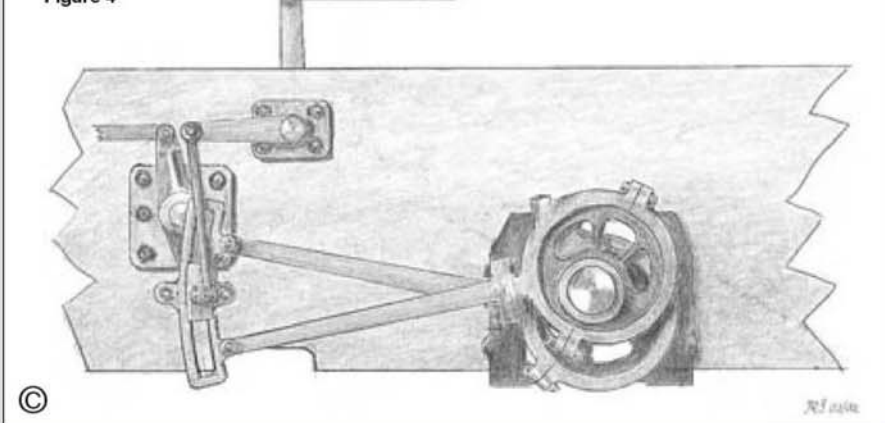


Figure 4



obvious difference between this engine and the later '29s' lay in the disposition of cylinders and valve gear, while the cylinder dimensions of 18in. diameter by 30in. stroke became a GWR standard, the piston valves on this prototype, which were double-ported, were initially only 6 1/2in. dia., giving a port area to piston area ratio of about 1:10. This was considered good practice around the turn of the century, but was a far cry from the 1:7 of the 'Saints' with their 10in. piston valves. Those on No. 100 were later opened out, first to 7in. dia. and finally to 7 1/2in., presumably the limit for the casting.

Port dimensions were 20 1/2in. x 1 5/8in. steam and 20 1/2in. x 2 7/16in. exhaust, lap 1 3/8in. with the valves set to give a lead of 5/32in. at 25% cut-off, line on line, i.e. no exhaust clearance. As a matter of interest the corresponding figures for the 'Saints' were 1 3/4in. wide for steam ports, while exhaust ports were no less than 4 1/4in., lap 1 5/8in. and a lead of 1/8in. at 25% cut-off. No wonder they 'barked' when getting away! The eccentric rods on No. 100 were 4ft. 0 31/32in. long compared to 3ft. 10in. on the '29s' and the throw of the eccentrics was 6 1/4 inches.

The main visible difference, as is evident from fig 3, was that the centre line of the piston valves on No. 100 was offset inwards from the cylinder centre line by no less than 1ft. 4 1/2in., compared to just 5in. on the later engines; or to put it another way, approximately 47deg. to the vertical compared to 18deg. on the 'Saints.' This brought the valve centre line dead in line with the inner edge of the main frames which, as in all GWR 2-cylinder 4-6-0s built before the 1940s, terminated just in front of the leading coupled wheels. The valve-rod was therefore off-set horizontally and was driven by a vertical rocking shaft with unequal length arms as shown in fig 4, quite different from the horizontal rockers on the later engine.

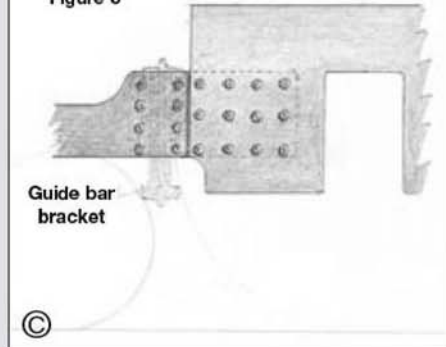
In our miniature version of No. 100, this extra 'tilt' of the valve/cylinder centre line poses problems

if trying to utilise commercial castings such as LBSC's 'Hall' or Don Young's *County Carlow* in 3 1/2in. gauge, Martin Evans' *Torquay Manor* in 5in. gauge or Keith Wilson's 'Saint' in 7 1/4in. gauge. Figure 5 shows a possible solution, taking *County Carlow* castings as an example, but I must emphasise I have not tried it myself, so, unlike LBSC, I am unable to guarantee the 'words and music'.

As mentioned above, the main frames on the full-size locomotive cease altogether in front of the leading coupled wheels and a steel framework with 11 x 2in. side members is bolted on to carry the front end of the engine as shown in fig 6. I am aware that other writers, including no less an authority than Harold Holcroft, have stated that No. 100 had plate frames throughout, but the 'Frame Plan', Swindon drawing No. 18742 dated November 1901 for Lot 132, which can only refer to No. 100, definitely shows a separate 'extension frame.' In any case, the full depth main frame could not have extended as far as the front buffer beam since, as already mentioned, the centre line of the piston valve is in line with their inside edge. By no means can the valves be described as 'inside the frames' as has frequently been asserted and this is obvious from frontal photographs.

Now, I have to say this form of construction appears to me, as a non-engineer, an incredibly flimsy arrangement, but as it survived until the end of steam over 60 years later, it could not have been that bad. One point of interest, however, is that the Great Western '28' 2-8-0s and most of the 2-6-2 and 2-8-0 tank engines were fitted with a pair of struts from the smokebox saddle to buffer beam, which may indicate weakness in that area. Presumably express passenger and mixed traffic tender engines were expected to lead a rather more sheltered life when it came to front end shocks, so were not thought to require this rather unsightly, not to say crude form of reinforcement.

Figure 6



In 'our' sizes, as is so often the case, an exact scale equivalent of the full-size job would produce a hopelessly flimsy result and if I were building this engine, I would continue the main frame forward to the buffer beam, but reduced in depth to the scale equivalent of 11 x 2in. and incorporating cut-outs for the bogie wheels. I would then reinforce it on the inside with a matching piece of steel, producing in effect a bar frame, which in 3 1/2in. gauge would be 1/4in. thick. By setting the cylinder casting at an angle of 29deg. (i.e. 47 - 18deg.) the shaded areas shown in fig 5 can be milled away so that the finished job sits squarely on top of the doubled-up frame extension. A packing piece, as shown in my drawing, will be needed between the cylinder bolting face and frame in order to keep the 'between cylinders' dimension correct. If the bore for the piston valve is cast in, obviously a fairly substantial liner will have to be inserted, as can be seen by comparing figs 3 and 5.

Castings

It is perhaps worth pointing out that commercially available castings for locomotives other than GWR prototypes are unlikely to be suitable for No. 100 due to the long piston stroke of 30 inches. This necessitates an overall minimum length for the cylinder block of approximately 2 1/2in. for 3 1/2in. gauge, 3 1/2in. for 5in. gauge and 4 3/4in. for 7 1/4in. gauge, otherwise you end up with wafer thin pistons! On the prototype, the overall length of the cylinder/valve together with one half of the smokebox saddle was cast in one piece, steam and exhaust passages being cored in. I imagine this is completely impractical in miniature, but perhaps one of Terry Aspin's disciples will prove me wrong.

Yet again, other writers have claimed that No. 100 did not have the one-piece casting, but the Swindon cross-section drawing No. 19261 dated November 1901, Lot 132 which can only apply to No. 100 shows a one-piece job similar in principle to the later engines.

One detail of the full-size engine as originally built which I would hesitate to reproduce in a working as distinct from a glass-case job, is the American style swing link bogie, as its riding and guiding properties have been shown to be inferior to the spring-controlled Adams type. This deficiency is even more crucial in small sizes due to the relative roughness and sharper curves of even the best of our tracks. I have come up against this same problem with the swing link Great Northern style bogie on the Brighton Railway tank engine I am building, and have re-designed it with spring control, but retaining as far as possible the appearance of the original. Swindon obviously had second thoughts about swing links after the arrival of the superbly engineered French compounds in 1903/4 and produced a sort of 'conversion kit' to change the existing design to spring control, an outline

Main Dimensions GWR No. 100

Note: these are intended specifically for use in producing a miniature version of No. 100, so 'internal' measurements such as heating surface and diameter of boiler barrel sections are omitted. The figures for 3 1/2in. gauge and 5in. gauge have been calculated to the nearest 1/64in., using 3/4in. to the foot and 1 1/16in. to the foot respectively. For gauge 1, halve the 3 1/2in. gauge figures, for 2 1/2in. gauge, halve the 5in. gauge figures, for 7 1/4in. gauge, double the 3 1/2in. gauge figures. Figures prefixed by = are approximate only

Description	Full-size	3 1/2in. gauge 3/4in. scale	5in. gauge 1 1/16in. scale
Overall length over footplate	36ft. 4 1/2in.	27 9/32in.	38 21/32in.
Overall length of frames, including 'extension'	36ft. 2in.	27 1/8in.	38 27/64in.
Height to top of chimney as originally built	13ft. 2in.	9 7/8in.	13 63/64in.
Height to top of cab roof	13ft. 1 1/2in.	9 27/32in.	13 61/64in.
Width over cylinders (max. width of engine)	8ft. 11in.	6 11/16in.	9 15/32in.
Width over footplate	8ft. 6in.	6 3/8in.	9 1/32in.
Width of cab (outside)	7ft. 10 3/8in.	5 29/32in.	8 23/64in.
Length of cab	4ft. 3in.	3 3/16in.	4 33/64in.
Radius of cab roof	5ft. 9in.	4 5/16in.	6 7/64in.
Width over splashers	6ft. 0 3/4in.	4 35/64in.	6 7/16in.
Height of footplate above rail level	5ft. 9 1/2in.	4 11/32in.	6 5/32in.
Height of cylinder centre line above rail level	3ft. 6 3/4in.	2 43/64in.	3 25/32in.
Width of cylinder centre line	6ft. 10in.	5 1/8in.	7 1/4in.
Width of piston valve centre line	4ft. 1in.	3 1/16in.	4 11/32in.
Length of cylinder casting	3ft. 4 1/2in.	2 17/32in.	3 19/32in.
Pitch of boiler	8ft. 6in.	6 3/8in.	9 1/32in.
Diameter of smokebox and barrel over cladding	5ft. 3 1/2in.	3 31/32in.	5 5/8in.
Length of smokebox (external measurement)	=4ft. 10in.	3 5/8in.	5 1/8in.
Visible barrel length (Smokebox to front of firebox)	=14ft. 8in.	11in.	15 37/64in.
Visible firebox length (front of cladding to cab front)	=7ft. 4 1/2in.	5 17/32in.	7 27/32in.
Height of firebox top above rail level	=12ft. 0 1/2in.	9 1/32in.	12 51/64in.
Width of firebox cladding	=5ft. 10in.	4 3/8in.	6 3/16in.
Cylinders: bore x stroke	18in. x 30in.	1 1/8in. x 1 7/8in.	1 11/32in. x 2 21/32in.
Piston valve diameter as originally built	6 1/2in.	13/32in.	37/64in.
Driving and coupled wheel diameter (22 spokes)	6ft. 8 1/2in.	(5 1/32in.)	(7 1/8in.)
		see text	see text
Throw of crankpin	1ft. 3in.	15/16in.	1 21/64in.
Bogie wheel diameter (10 spokes)	3ft. 2in.	2 3/8in.	3 23/64in.
Locomotive wheel base, total	27ft. 2in.	20 3/8in.	28 55/64in.
Divided into	7ft. 2in. +	5 3/8in. +	7 39/64in. +
	5ft. 3in. +	3 15/16in. +	5 37/64in. +
	7ft. 0in. +	5 1/4in. +	7 7/16in. +
	7ft. 9in.	5 13/16in.	8 15/64in.

drawing of which can be found in Holcroft's *Outline of G.W. Locomotive Practice* (see bibliography). No. 100 was certainly 'converted,' but I have been unable to discover the exact date. There is no doubt, however, that it was after the engine was named and fitted with a taper boiler, so if you are a relative or friend of LBSC's *Inspector Meticulous*, you have a pretty little problem!

A rather less intractable difficulty in producing a working model of this locomotive, and one which applies to the GN Atlantics, is that the leading coupled and driving wheels, nominal diameter on tread when new, 6ft. 8 1/2in., are spaced at 7ft. 0in. centres. Translating this to 3 1/2in. gauge for example, gives a diameter of 5 1/32in. at 5 1/8in. centres, resulting in what may euphemistically be described as a severe interference fit for two 0.110in. flanges! Two alternatives, or a combination of both, suggest themselves for getting round this; one is simply to lengthen the wheelbase, in the case quoted by 5/32in., equivalent to 2 1/2in. in full-size, or approximately 3%, quite a substantial amount. The second, which I would prefer, is to work to scale diameter over flanges and reduce the tread diameter by the difference between the exact equivalent of the full-size flange depth and the standard depth of flange in the scale you are working to. In the 3 1/2in. gauge example quoted above, the wheel castings for *County Carlou*, the finished size for which is up to 5in. on tread, would be ideal if turned down to 4 15/16in. and the wheelbase extended by 1/16in. (1in. full-size).

These castings of course allow for the 15/16in. between centres of axle and crankpin required of the 1 7/8in. piston stroke. So far I have been unable to discover from various catalogues a suitable 'off the shelf' wheel for 5in. gauge (diameter approximately 7in., axle to crankpin 1 21/64in.), but Keith Wilson's 'Saint' wheels, available from Jim Vass, would obviously be perfect for a 7 1/4in. gauge version.

A niggling nuisance, rather than a technical difficulty, arises in the coal rails on the tender, which will be extremely vulnerable, especially in small sizes, if they are not to look clumsy. On the full-size locomotive, they were replaced by the much more substantial sideplates some time before Summer 1904, but again after the first half-coned taper boiler was fitted, so Inspector M raises his ugly head again. While on the subject of handrails, a minor oddity is that the horizontal rail on the cabside appears on neither the 'official' nor other photographs taken when the engine first emerged from Swindon, but had definitely been fitted by June of that year when No. 100 was first named.

Non-existent

I mention these minor details as a reminder that it is all too easy to produce an engine which never actually existed in a particular combination of characteristics. This has happened frequently in full-size restoration projects, the classic case being No. 100's illustrious contemporary *City of*

Figure 7



Figure 8



Truro, which re-entered service in the 1950s carrying its original number, 3440, and the intricate double-lined colour scheme with Indian red splashers, wheels and frames current until about 1906, combined with its 'modern' boiler complete with top feed, which did not become standard until six years later, by which time the engine had been renumbered 3717!

Pursuing the argument to its logical conclusion, the only advice must be: do not trust anyone or anything, particularly official photographs and 'works' drawings. Believe me, I speak from bitter experience, having suffered from many heinous crimes committed by the old railway companies against unsuspecting ferro-equinologists.

To quote a really blatant example of the confidence tricks perpetrated by those no doubt amiable rogues who used to inhabit railway drawing offices and photographic departments (and who probably still do), let us betake ourselves in our imagination to that sacred shrine of Great Westernism in Wiltshire. It is the month of December in the year of grace 1903; No. 100 is busy strutting its stuff down in Somerset and Devon, while here at Swindon, the third Great Western outside cylinder 4-6-0, No. 171 *Albion* has this very morning emerged from the stygian gloom of the 'Factory'. Specially painted matt grey, lined out in black and white, this magnificent machine is carefully posed for the railway company's official photographer. This worthy gentleman sets up his massive 14 x 10in. plate camera, presses the shutter and produces a perfect portrait of Mr. Churchward's latest masterpiece for future railway historians to drool over. Or does he?

Close scrutiny of the result of the photographer's efforts, which has been published hundreds of times without question, reveals that the name and its plate have been 'painted in', and pretty badly too, while the cabside number plate bears very obvious signs of having been doctored. Further investigation reveals a quite remarkable similarity to the 'official' photograph of No. 98, the second outside cylinder 4-6-0 built nine months earlier. Every detail (except name and number plates!) is identical: same viewing angle, rods in precisely same position and identical lighting conditions in spite of being a different time of year. My final piece of evidence lies in the rail joints — in exactly the same position in both photographs. I rest my case.

In the case (sorry!) of the drawing office, I suspect that simple human error rather than deliberate falsification is the source of most incorrect information. I had almost completed this article when three excellent Swindon works drawings arrived from the National Railway Museum, which have proved very useful for confirming dimensions which I had painstakingly scaled off various photographs to produce the illustrations. Included in this NRM trio was

drawing No. 19161 dated October 1901 showing the motion details of No. 100, almost identical to a drawing of which I have a part, except that the wheels have been drawn in one foot too small, i.e. at 5ft. 8in. diameter. In order to compensate for what I can only imagine was a draughtsman's error, the rear bogie wheel has been drawn 6in. above its correct position in order to bring it to the same rail level! Both the other works drawings, dated November 1901, show No. 100 fitted with the plain cast iron chimney (similar to that fitted to the 'Aberdare' 2-6-0s), whereas the locomotive was in fact turned out with a narrower version of that later fitted to the 'Saints' and, of course, carrying the famous copper cap. To be fair, this is a relatively minor detail alteration which could have been made after the drawing was completed, but it does demonstrate the need to find corroborative evidence for virtually everything when possible. All three drawings are countersigned by three or four people, not to mention the little confirmatory ticks against major dimensions, and carry the identification 'Lot 132,' which can only refer to No. 100.

So, dear reader, next time you spot an error in a drawing published in *Model Engineer*, please remember a: they are made by human beings, even if through the medium of one of these new-fangled computing devices, and b: the original source material is often suspect.

What of the colour scheme for No. 100? I believe it initially conformed to the GWR 1894 standard, in which splashers, wheels (except tyres) and everything below the footplate outside the main frames apart from the actual motion work was painted Indian Red, lined with orange chrome edged in black. The wheel tyres were also black, an unusual but striking touch. The green bits, i.e. boiler, cab etc., were middle chrome green (not Brunswick) lined in orange chrome and black; at this period I think the orange and black were contiguous i.e. no green between them, but it is difficult to be certain as the photographic emulsions of those days were very insensitive to the red end of the spectrum; those dreaded photographers again. I include illustrations of the works plate, fig 7, and the monogram decorating No. 100's tender, the drawing of which has resulted in the loss of several of my few remaining head whisks. The story goes that only one man at Swindon was capable of executing this, in pure gold leaf of course, and when he left, they had to change the design! I rather fear this story is as genuine as No. 171's 'official' photograph, but painting a representation of it on a 3 1/2in. gauge tender should keep anyone out of mischief for an hour or two and would be a more accurate test of their sobriety than any breathalyser.

In conclusion, I would like to acknowledge the kind assistance from Keith Moore at the library of the Institution of Mechanical Engineers.

References

- 1: *Railway Engineer*, November 1902 (Supplement), courtesy I. Mech. E. Library.
 - 2: *Locomotive Magazine*, June and November 1902, courtesy I. Mech. E. Library.
 - 3: *The Engineer*, 28 February 1902, courtesy I. Mech. E. Library.
 - 4: *A Pictorial Survey of Great Western Locomotives Vols. I and II*. Jim Russell, pub. O.P.C.
 - 5: *Locomotives of the G.W.R. Parts 1, 8, 12*. Various authors, pub R.C.T.S.
 - 6: *An Outline of Great Western Locomotive Practice, 1838-1947*. H. Holcroft, pub. Ian Allan.
 - 7: *G. J. Churchward, A Locomotive Biography*. Col. H. B. Rogers, pub. Allen and Unwin.
 - 8: *Livery Register No. 2: G.W.R.* Editor J. N. Slinn, pub. Historical Model Railway Society.
 - 9: Works Drawings NRM ref. 3/GW/680, 3/GW/9205. Obtainable from National Railway Museum, Leeman Road, York, YO26 4XJ.
- Photographs with useful detail can be found in the following:
- 10: *G.W.R. 'Saint' Class 4-6-0*. O. S. Nock, pub. Patrick Stevens.
 - 11: *Churchward Locomotives*. B. Haresnape and A. Swain, pub. Ian Allan.
 - 12: *Pregrouping Railway Scenes No. 1: G.W.R.* O. S. Nock, pub. Ian Allan.
 - 13: *Names and Nameplates of British Steam Locomotives No. 2: GWR*. G. Coltas, pub. Heyday.
 - 14: *Great Western Railway Journal No. 14*; Spring 1995. Pub. Wild Swan.
 - 15: *Railways in Camera 1860-1913*. Robin Linsley. Pub. Alan Sutton.

For anyone wishing to build a model of No. 100, the most useful technical drawings can be found in Nos. 1, 6 and 9, while the best photographs appear in Nos. 4 and 15. Photographs from No. 15 are available for purchase from the Public Records Office, Kew, while the NRM drawings (No. 9) are particularly recommended for prospective 'live steam' builders: 3/GW/680, Swindon drawing 18742 is a 'Frame Plan' giving side elevation and plan, similar to a 'General Arrangement' drawing, but lacking details of motion work. These can be found on 3/GW/9174 (Swindon No. 19261) while 3/GW/9205 (Swindon No. 18261) consists of six half cross-sections, also very useful. There is also an outline weight diagram, NRM ref No. 3/GW/15 which would be useful to builders of 'mechanical mice' (electrically driven small gauge locomotives.) Yet another caveat not mentioned in the main text is that these drawings are printed up from microfilm of the originals and are available only up to A0 size. The results of this are a: they are not to the original scale of 1 1/2in. or 3in. to the foot, and more seriously b: the scale is not uniform across the whole drawing as I found out the hard way!

●To be continued.



THE JUNIOR

A STATIONARY

INTERNAL COMBUSTION ENGINE

Stan Bray

completes the bearings for the connecting rod before moving on to the piston assembly.

●Part VIII continued from page 133
(M.E. 4188, 7 February 2003)

The small end bearing is simply a piece of bronze drilled and reamed to size and pressed into the hole in the rod, or it can be held with retaining compound if preferred. The big end bearing will of, course, need to be split. This is best done using the method used to produce the bearing brasses for model steam engines. Start by machining a flat on a short length of $\frac{3}{8}$ in. dia. phosphor bronze rod to exactly half its diameter. Cut off a piece and soft solder it back onto the remaining length to get a round or nearly round bar. Mount the embryo bearing in the lathe with the solder line on centre. Drill and ream $\frac{1}{4}$ in. dia. and turn the outer diameter to $\frac{5}{16}$ inch. Part it off to a length of $\frac{3}{8}$ inch. Melt the solder, separate the two halves and clean up.

Normally the bearing would be made with lips to hold it in place but there is little room for such niceties in this case and so, on assembly, we will resort to sticking it in place with an epoxy resin adhesive. The original drawings also show a nice circular section $\frac{1}{32}$ in. long either side of the



The completed con-rod with pressed in small end bush and big end shells awaiting fitting.

bearing surface, the only purpose served being to make the rod end look nice; since it is not going to be seen the job will be much easier with the circular registers left off. If their presence is important to you, they can easily be turned with the con-rod mounted on a mandrel.

The big end bearing can now be fitted to the big end eye with epoxy resin.

Piston

Material for the piston was not supplied so a short length of 1in. dia. aluminium alloy was pressed



The piston and rings. The rings shown are bronze but cast iron is a better choice of material.

into service. Making it should hold no terrors, as it is mainly a simple turning and boring exercise. Some milling is also required to create the internal shape between the gudgeon pin bosses.

Start by roughing out the outer diameter and then open up the bore with a $\frac{3}{8}$ in. dia. drill. Turn the $\frac{1}{2}$ in. and $\frac{3}{4}$ in. internal diameters with a suitable boring bar. Finish the outer diameter and cut the ring grooves using a parting-off tool ground with a square end. The piston has to be cross-drilled and reamed for the gudgeon pin and care must be taken to ensure that the hole is exactly central across the diameter and also at precisely 90deg. to the main axis of the piston. Aim to make the gudgeon pin a very light press fit in the piston walls. Final fitting with a reamer should be left until the gudgeon pin is made.

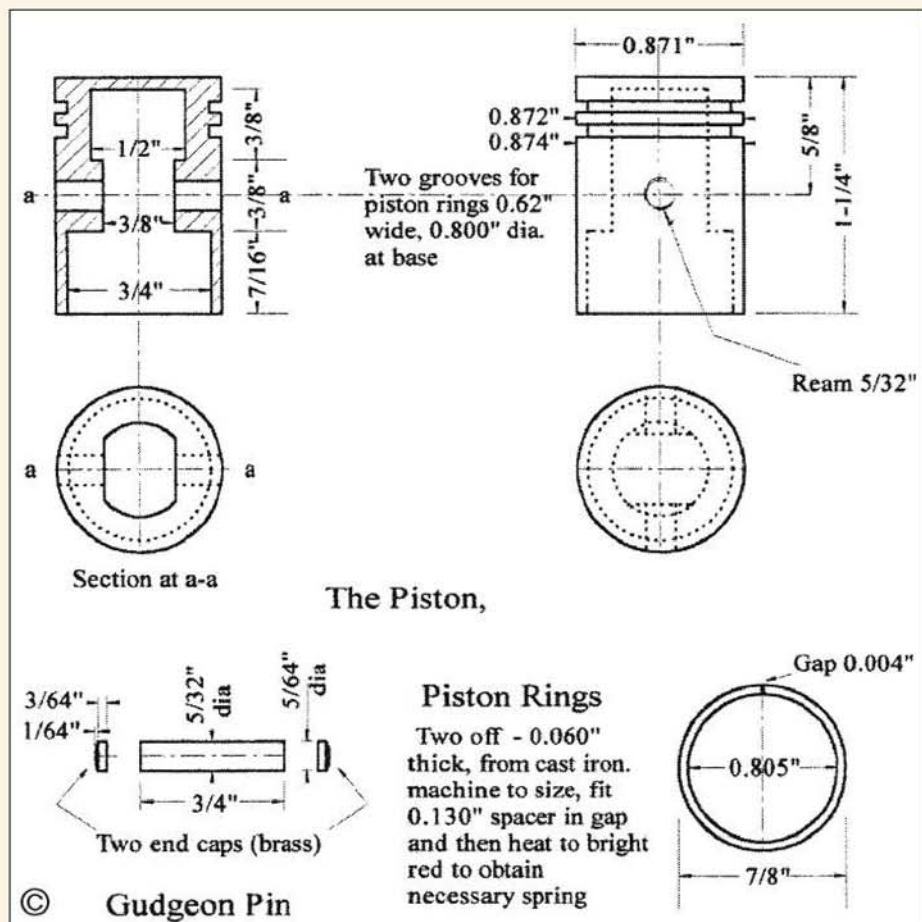
The internal piston shape adjacent to the gudgeon pin bosses, which gives clearance for the swing of the con-rod, is cut by milling and judicious filing. Set up the piston on a rotary table, open end upwards, taking due care to protect the finished surfaces from damage. Using a long series cutter, mill in the flat cheeks and the radiused ends using a combination of the main axes of the milling machine and the rotary table.

The operations could also be carried out on a vertical slide equipped with a small rotary table if a milling machine is not available. If the radii left by the cutter in the corners are unacceptable to you, they can now be removed by filing.

Piston Rings

Much has been written about making piston rings and possibly the most thorough treatise was that by *Tubal Cain* and serialised in these pages beginning in M.E. 3961, 21 January 1994. Those readers with access to these articles may care to read up the subject before embarking on these items. For the rest of us, the following notes should provide a guide through the various stages of manufacture.

First turn a length of cast iron bar to a good fit in the cylinder, and bore it out to the dimension shown on the drawing. Part off the two rings plus a couple of spares to a width slightly greater (0.001 to 0.002in.) than the ring grooves. The rings now need to be split. This can be done by sawing but it is then almost impossible to maintain the suggested 0.004in. ring gap. A wider gap should not make a





61
The timing gears in position in the timing chest. Note the larger, bronze gear is on the camshaft.



62
Marking the position of the timing cover fixing screws in the crankcase by spotting through.



63
The cover temporarily attached to the crankcase with one screw.

great deal of difference to the performance of the engine so use the thinnest slitting saw in your collection. An alternative is to split the ring by driving it over a tapered mandrel. However, if you do this, weaken the ring at the point where you want it to split by filing a notch on the inside to a depth of $\frac{2}{3}$ the thickness. If you do not do this, the ring will be very heavily stressed by the splitting process and may fail in service.

The rings are given their springiness by means of heat treatment. First make the rings up into a stack and introduce a spacer into the ring gaps. Theory dictates that the width of this spacer should be 0.14in. but you may care to experiment and make it less. Any width between 0.09in. and 0.14in. should be okay. Clamp the stack between two plates with a through bolt and bind the rings with soft iron wire. Rub soap into the wire to seal them and exclude air. Heat the complete stack to red heat; hold for 15 minutes and then leave to cool as slowly as possible.

On removing the plates you should find that the rings have taken on a permanent set and have to be sprung into the cylinder bore. To fit the rings to the piston grooves they should be rubbed on fine abrasive paper placed on a flat surface and lightly abraded until they can be rolled round the piston grooves without any trace of tightness or undue play.

Gudgeon pin

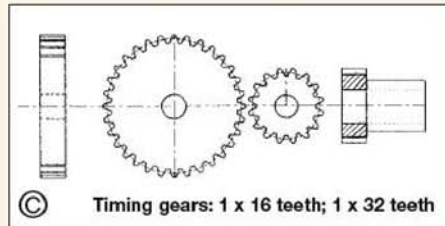
The gudgeon pin is another very straightforward item but the two small brass end caps should be a good fit in the gudgeon pin hole, although the liner walls will prevent their movement.

It should now be possible to assemble the crankshaft, connecting rod, piston, etc., together in order to try them and ensure they run freely.

Timing gears

No great mention has so far been made of the timing gears as it is anticipated that most builders will wish to buy them; they are available from the suppliers of the castings. However, we should spare a thought for those who will want to cut their own. There is nothing at all difficult about gear cutting, it is simply a case of mounting a piece of metal of a suitable diameter and gashing the required number of slots in it.

The slots can be made in several ways. The most expensive, although it must be agreed it is the easiest, is to buy a proper cutter and use that. The trouble is that such cutters are very expensive and to cut one pair of spur gears the price is not easy to justify. The alternative is to make your own either in the form of a simple, single point cutter or one of the more elaborate multi-tooth types. It is not proposed to detail the methods that



can be used as these have been previously described in these pages, but basic details of the gears required are shown in the drawing. One major snag to making one's own gears for this particular model is that of finding a suitable means of dividing by thirty-two. This is an awkward number as it is unlikely you will have a change wheel with that number of teeth or one with a number of which thirty two is a factor. Certainly there will be no problems for anyone with a geared dividing head, but for simple division work, most people seem to use change wheels, the standard range of which does not include 32 teeth. For Myford owners such a gear is available as an extra. It is not beyond the ability of some model engineers to cut the gears using a hacksaw and files. There are a number of people who are quite well known in the hobby who have perfected this technique, although this will not solve the problem of getting thirty two divisions. The gears required are:

- 1: 1 off (bronze) 32 tooth, 32DP, $\frac{1}{4}$ in. dia. bore (to suit camshaft) x $\frac{3}{16}$ in. wide.
- 2: 1 off (steel) 16 tooth, 32DP $\frac{1}{4}$ in. dia. bore (to suit crankshaft) x $\frac{3}{16}$ in. wide with boss $\frac{3}{8}$ in dia. x $\frac{7}{16}$ in. long.

The suggestion for fixing the gears shown on the original drawings is to hold them in place with a retaining compound. This is probably ideal for the larger of the two as it can be secured thus to the camshaft but it will still be possible to dismantle the engine if required. Fitting the other gear to the crankshaft by this means is a different proposition for once it is fixed it will no longer be possible to take the shaft out. The best answer therefore is to secure it with a grub screw for initial setting up and then fit a taper pin once it is set in position. If it does become necessary to remove the shaft at any time, it will be possible to do so and the taper pin will locate it in the same place on reassembly.

Back to the timing cover

Work on the timing cover was mentioned early in this series but was left incomplete so that when a later stage was reached, use could be made of the finished components as an aid to the necessary drilling. We are now at that stage and should have to hand a machined cover with six tapping sized holes which will eventually be used for the bolts to secure it to the crankcase, and nothing more.

Holes are needed for the crankshaft and camshaft and we also have to drill the fixing holes accurately into the crankcase.

Start by carefully measuring the position of the hole for the crankshaft bearing and when satisfied as to its accuracy, drill and ream $\frac{1}{4}$ in. diameter. Put the crankshaft into the case using two bearings and bolt the other cover to the crankcase, using two or three bolts. Slip the timing cover over the crankshaft and align it with the boss to be drilled for the camshaft pin set vertical. Stick the cover to the case but do not use a glue that is likely to be permanent. An ordinary clear adhesive was used for the one shown, but almost any such adhesive will do, alternatively hold it in place with three or four good blobs of Bluetack.

Using a tapping size drill through three or four of the holes in the cover, spot through for drilling. The method will depend on what equipment is available; the drill can be held in a pin chuck or in a mini electric hand drill if one is available.

Remove the cover and drill and tap holes where the indentations have been made. Open out the matching holes in the cover to clearance size, bolt the cover in place and repeat the operation for the other holes. Bolt the cover back in place and pass a drill through the tapped hole for the camshaft in order to make an indentation in the cover. An extra long series drill will be necessary for this. If you do not happen to have one, put a point on a piece of steel, pass this through the tapped hole and strike it with a hammer. Although this is now a punch there is no need to harden and temper it, the aluminium alloy in the case is soft enough to give way under the steel.

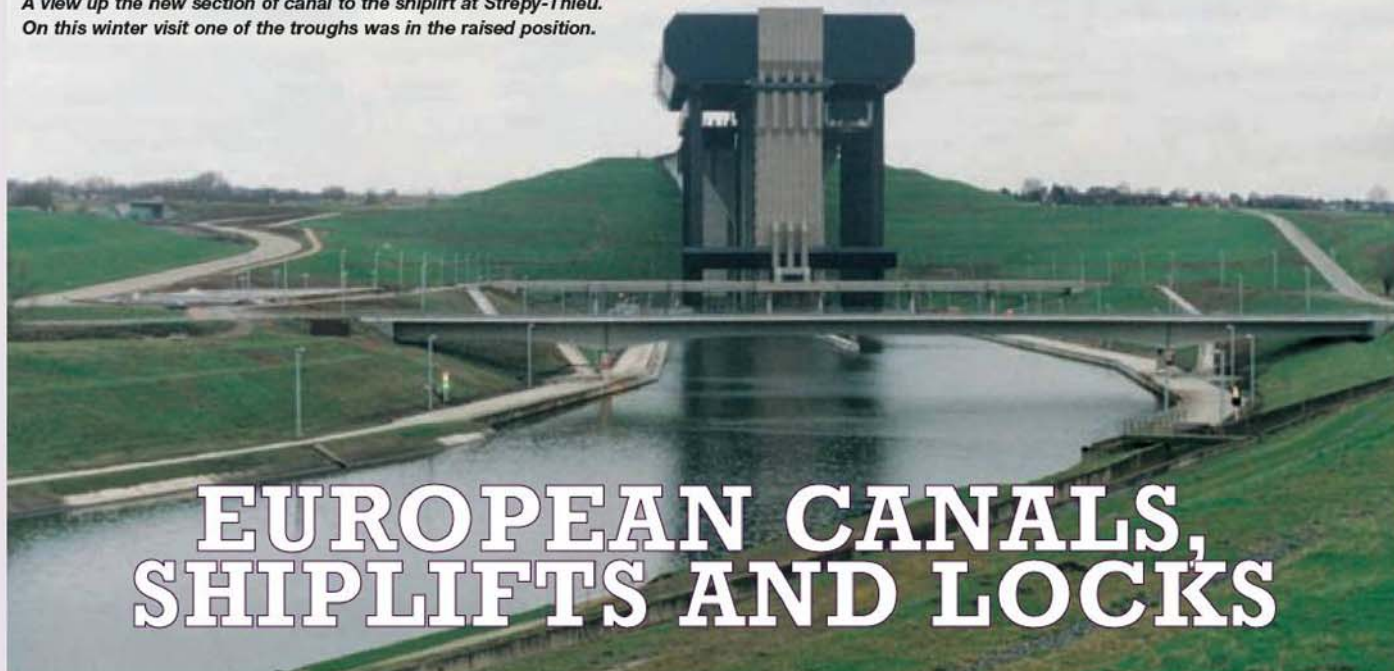
Remove the cover, drill through clearance size for 7BA, reassemble the crankshaft and camshaft into the case and slip on the cover. It is a near certainty that it will all be a perfect fit. However, it is extremely unlikely that the final hole will be in the exact centre of the boss and while this does not matter, if one wishes to do so the cover can be set in the 4-jaw chuck and the boss finished concentric to the hole.

What happens if it has not worked out right? Open the hole out and tap it 2BA, get a short length of $\frac{3}{16}$ in. aluminium alloy, thread it 2BA and screw it in so that it fits tightly. File level with the surfaces of the case and try again with the punch and 7BA clearance drill.

If you have not already done so, two holes are needed in the cylinder block to line up with those in the valve cages. They act as ports and the drawing shows the exhaust port tapped $\frac{1}{4}$ in. x 40 threads per inch. Some readers may feel inclined to fit a silencer and this thread is provided for that purpose.

●To be continued.

A view up the new section of canal to the shiplift at Strepy-Thieu.
On this winter visit one of the troughs was in the raised position.



EUROPEAN CANALS, SHIPLIFTS AND LOCKS

John Olsen

visits the Ronquieres and
Strepy-Thieu shiplifts in Belgium.

●Part II continued from page 136
(M.E. 4188, 7 February 2003)

In my last article it was mentioned that a new shiplift is to replace the four at La Louviere. This is located at Strepy-Thieu, quite close to the lower of the four shiplifts. Canal works in general can be a little difficult for the visitor to find since they tend naturally to be low and hence not easily seen from afar. This does not apply to either of the works discussed in this article. The new shiplift at Strepy-Thieu stands up high and proud and so is difficult to miss. The second work we will cover, the inclined plane at Ronquieres, is provided with a tall tower, and so also stands out from the Belgian countryside.

At the time of my visits in 2000 and 2001, the shiplift at Strepy-Thieu was not yet in service. The shiplift itself appeared to be complete, externally at least. There is a large aqueduct a few kilometres to the east near La Louviere, and it appeared that this was the holdup. The concrete was in place over the major part of the span, but did not

appear to be linked to the earthworks at either end. By the time this appears in print, the shiplift may well be in service. The new lift has a total lift of 73 metres and replaces the four earlier lifts and two locks further down the canal. The structure is a reinforced concrete tower with steelwork on the top. A trough is suspended on each side. The troughs are 112 metres by 12 metres and the new canal works will permit self-propelled barges up to 1350 tonnes. They will also accommodate a 2000 tonne barge with a push tug up to 23 metres long. Each trough weighs 8400 tonnes including water.

The free standing tower structure is linked back to the main canal by an aqueduct 200 metres long. The civil engineers had to carry out investigations before building to ensure that the subsoil could carry a structure of this height and weight. Dewatering was necessary to lower the water table before earthworks were carried out.

A paper by H. Brouet (ref. 1) gives a comparison of the capital cost, installed horsepower, and energy required for different solutions considered. Summarising a few of the details, the lift as built will require 50kW per transfer, a 10% inclined plane would require 140kW per transfer, and a series of three locks would require 11,700kW per

transfer. In many places where locks are used, there is no direct expenditure of power since the water used is taken from the flow of the river. This still represents an opportunity cost, since if the lock were not using it the water would be available to generate that amount of power. In the present case, there is no large river on the summit level, although there was sufficient to operate the canal in its earlier 19th century form.

The power required to operate the lift would normally be drawn from the national grid. A small hydro-electric station is included in the works to permit operation during a power outage. Emergency gates protect the aqueduct and the earthworks at the top of the canal against failures of the earthworks or the gates. These emergency gates close if a failure occurs. The earthworks for the whole project total 4 million cubic metres.

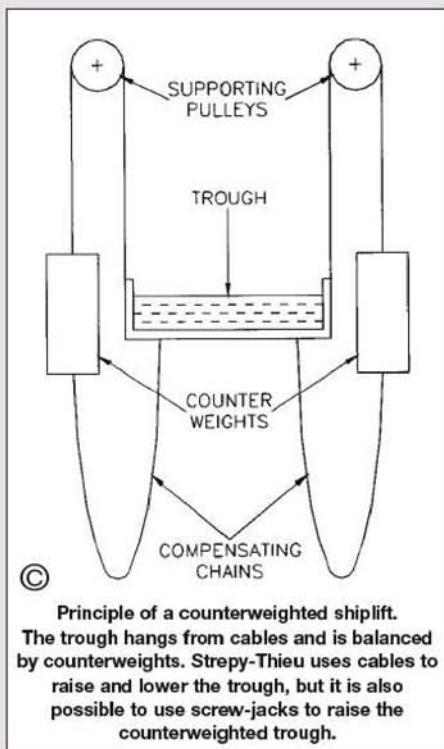
The troughs each move independently and are counterbalanced by weights suspended from cables like the Anderton lift. Each trough is suspended from 144 cables each 85mm in diameter. There are 112 suspension cables that pass over a pulley to the weight, and 32 control cables which pass around a drum driven by the motors. There are four motors of 500kW rating. Shafts are provided to permit the four motors to be linked together.



The new shiplift at Strepy-Thieu as seen from the approach road.
The entrance to the visitor centre is seen on the bridge at the right side.



The new shiplift at Strepy-Thieu seen from the embankment.
The old canal runs along the line of trees in the left distance.



However, it appears that it is not the intention that they should all be permanently linked. Normal braking is done by the electric motors. There are also large disk brakes on the gear reductions and emergency brakes on the drums. The safety brakes are intended to be capable of stopping the trough even if it loses up to 2700 tonnes of water.

The base of the tower contains a visitor centre; tours of the machine room were available. Regrettably, my own visit was at the wrong time of day for me to avail myself of this. Even if all you have time for is a look around the outside you will not be disappointed, especially if the lift is operating.

Getting there

From Brussels, Liege or Mons E19/E42 exit 21. Direction Strepv-Thieu. Since construction work was still being carried out at the time of my visits, it is difficult to give detailed instructions and be sure that they will still be correct, but the lift is well signposted and is prominent. I do not have pricing details for the visit but the contact details are as given later for Ronquieres.

It is worth mentioning that our experience was that few Belgium tourist attractions were equipped to take credit cards or Eftpos, so it pays to find out prices and take enough cash to cover costs. The opening season is from June to October. Once at the lift, the lower of the four Victorian era lifts is visible on the other side of the canal, and may readily be included in this visit if you have not already seen them.

Ronquieres

On the other side of the same high country the canal descends towards Brussels, not very far from the field of Waterloo. Originally this descent was accomplished by a long series of locks. During the 1960s these were replaced by a shiplift on the inclined plane principle. This amounts to a pair of railways, each transporting something very like an Olympic size swimming pool. It is a spectacular piece of engineering. At the summit end, the two inclined planes rise above the ground level so that the gate structure and winch room are high above ground level.



In this winter view of Ronquieres the troughs can be seen in the lower position.

These link back to the canal via an aqueduct supported on a forest of concrete pillars. An additional touch is a tall tower between the two gates. This has no functional purpose but does provide a spectacular view out across the Belgian countryside.

The weight of the two troughs is counterbalanced by concrete masses supported on a separate set of rails between the main carrying rails. These masses pass under the troughs during an ascent or descent. The inclined plane ascends 68 metres in a distance of 1432 metres, giving a gradient of about 5%. The troughs can accommodate 1350 tonne barges and are 91 metres long by 12 metres wide. They weigh 5500 tonnes. The passage takes 40 minutes. Despite being there twice, I have never managed to properly watch the lift in action, only once seeing a trough in transit from a distance of several miles. For those who decide to make a group trip, it is possible to arrange to make the transit of the lift. Normally the barge, called the *Scaldis*, makes a trip a few kilometres down the canal towards Brussels and return, which is pleasant in itself, but not so interesting as a trip on the inclined plane would be, at least to an engineer.

The 125 metre tower which is such a prominent feature of the site was built in a remarkably short 34 days. There is a lift that takes you to a level just below the top, then a flight of stairs to the viewing room. A very worthwhile display has also been built into the space in the lower tower and gate structure that is not required for machinery. It is called *Un bateau, une vie* (A boat, a life.)

This is a display of the life of the bargees and their families. It uses full size reconstructions of parts of a barge and video programme material to give an effect that is almost as good as if you could spend time on an actual barge. Part of this visit enables you to see the machinery in the winch room. Not many technical details were provided, but the plant appears to be based on the Ward-Leonard principle frequently used for building lifts. Naturally, however, this plant is on a somewhat grander scale.

A Ward-Leonard set uses an AC motor to drive a generator that provides a DC voltage for the motor driving the actual load. The advantage of this somewhat convoluted approach is that the voltage applied to the DC motor can readily and efficiently be controlled by controlling the excitation of the generator. It is possible now to accomplish control of either AC or DC motors very efficiently with solid state controls, but there are still many Ward-Leonard sets in service.

It is also possible to see the top gates and the mooring area on the aqueduct. You even get to visit a reconstruction of the pub the bargees drink at, although regrettably, none of the excellent Belgian beers were actually being dispensed. The charges are listed at the end. Infra red headphones are provided with multiple language commentaries, including English, being available.

This display makes this shiplift one of the most interesting to visit for any non-engineering members of the family, since it gives an insight into life on the canals. For anyone needing additional reasons to persuade their families to visit this area with



The substantial aqueduct leading from the summit section of the canal to the Ronquieres gate structure is supported on a forest of columns.



An interesting perspective showing the Ronquieres viewing tower framed between the raised part of the inclined planes.

them, perhaps some mention of Belgian chocolate or lace might be helpful. All the shiplifts described so far are handy to Brussels, which has many attractions including the Grande Place, the Atomium, and Mini-Europe.

The bottom gate is readily viewable for no fee, and will normally also give a good view of the troughs, which seem to be parked here when not in use. A kiosk near here sells tickets for the boat ride or a combined ticket including *Un bateau, une vie*. Tickets are also sold at the top gate. There is plenty of parking at the top and the bottom. A single lock near the bottom gate structure gives access to a level of the old canal, now used

to accommodate house-barges. A pleasant walk is possible along the towpath of the old canal, which is still filled with water, although the gates have been removed in all locks above the first. They have been replaced with concrete to maintain the water level.

Getting there

Autoroute E19 Bruxelles exit 20, or Autoroute E42 Liege-Mons exit 18. The incline is signposted from both exits. It will be to the north. Watch for the name Ronquieres and a graphical representation of the inclined plane. Follow the N534 until you come to it. It might seem trite to say that you can't miss it, but since the tower can be seen from up to 20 kilometres away, it is certainly prominent!

Prices

The following prices were current in 2001, but will give an indication of the likely current costs. They may by now have been rounded to the nearest Euro price. The family price is per person for each member of a family group. Tickets for the combined trip are not sold after 3:45pm, and you should indeed start earlier than that if you wish to have time for both.

Un bateau, une vie:

Adults 6.94 Euro, student and pensioners E5.45, families E4.71 per person, under 5 years old free.

Boat trip on lower canal:

Adults 2.48 Euro, students and pensioners E2.23, families E1.86, under 5 years old E1.24.

Combined:

Adults 8.18 Euro, students and pensioners E6.82, families E5.95, under 5 years old E1.24.

The boat trip is available from May to



The gate at the top of the incline. The extra gate in the raised position is used to permit work on the working gates when required.

September, while *Un bateau, une vie* is available from April to October.

Contact

Voies d'Eau du Hainaut ASBL, Rue de Clercs 31, 7000 Mons, Belgium; tel ++32-65-360464; Fax ++32-65-335732.

Reference

Ref. 1 *The Shiplift at Strepv-Thieu, Canal du Centre, Belgium*, Proceedings of the Institute of Civil Engineers, Transp., 1997, 123, August, 178-185 Paper 11260.

●To be continued.



Looking down the inclined plane from the tower. This is railway engineering on a grand scale. There are two sets of rails on each side, one for the troughs and the other for the equally heavy counterweights.



The Ronquieres aqueduct and summit section seen from the 125 metre viewing tower. The aqueduct also acts as a mooring area. Don't forget to visit the fascinating 'Un bateau, une vie' display within the tower.

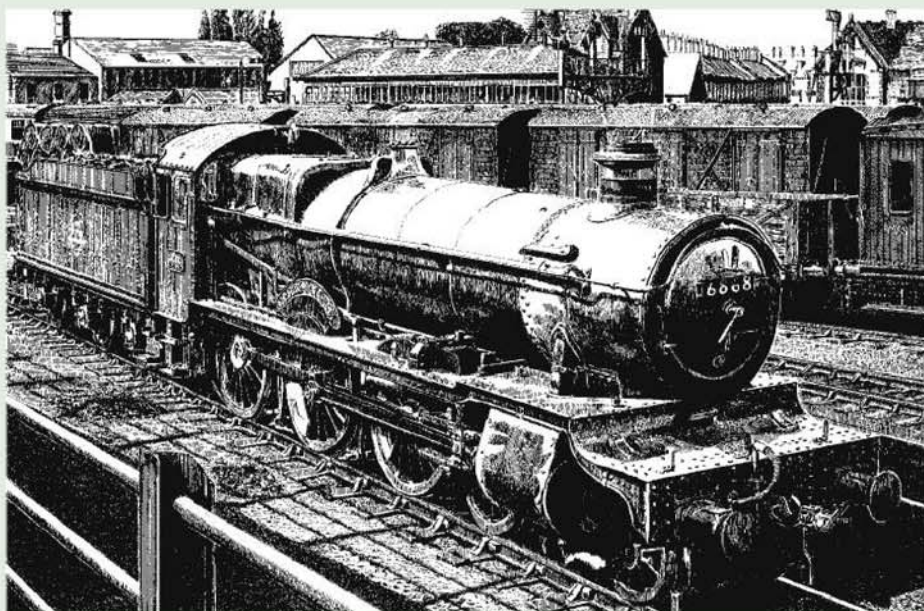
Neville Evans

discusses wheel variations and their turning before describing the axle boxes and side rods for this fine GWR 68xx locomotive.

●Part III continued from page 388
(M.E. 4180, 18 October 2002)

The GWR 5ft. 8in. wheel comes in two basic types, as well as a large variety of sub-species. The earlier wheel was used for the 'Moguls' (the 4300s) the 5ft. 8in. 2-6-2 tanks, and the huge 4700 mixed traffic 2-8-0s. You can find them with large or small bosses and detail variation in the spokes. As it was a standard wheel, I suppose quite a few different patterns were used, as they got worn out and damaged in the foundries. This was the wheel that was used on the 'Granges', which of course used many wheel and motion parts from obsolete 4300 'Moguls'. It was also used on the first batch of 'Manors'. The later 'Manors' built after the war were fitted from new with second generation wheels; these later wheels can easily be recognised because the crank pin boss bisects the two bottom spokes. These spokes are filled in by a web, and the two adjacent spokes are also webbed, but with an open centre. This later design concept was applied to most of the larger GWR outside cylinder locomotives and had the advantage of greater strength.

We are lucky in that Reeves 2000 (01827-830894) for instance, can supply representative castings for both wheels. The older type was made for *Torquay Manor* and the later for Trevor Shortland's lovely 6100 2-6-2 tanks. I spent many weeks trying to find a photo of a 'Grange' with the later type of



PENRHOS GRANGE

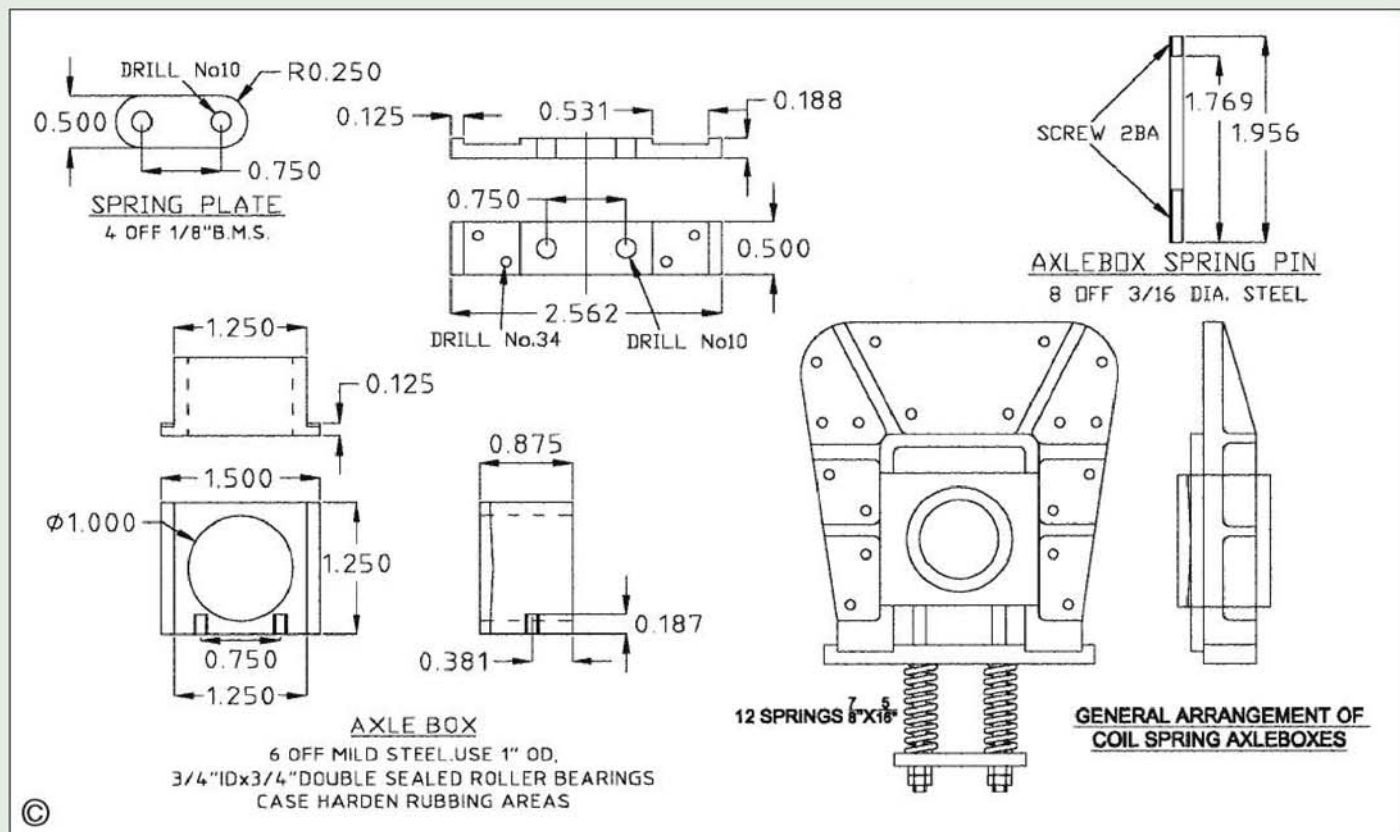
wheel, until at last the ever resourceful John Hill came up with a photo of *Houghton Grange*, which had them fitted. Most, if not all, of the Earlier 'Manors' were retrofitted with the later wheels and it would seem that we will be quite justified in using them on the 'Granges' as well.

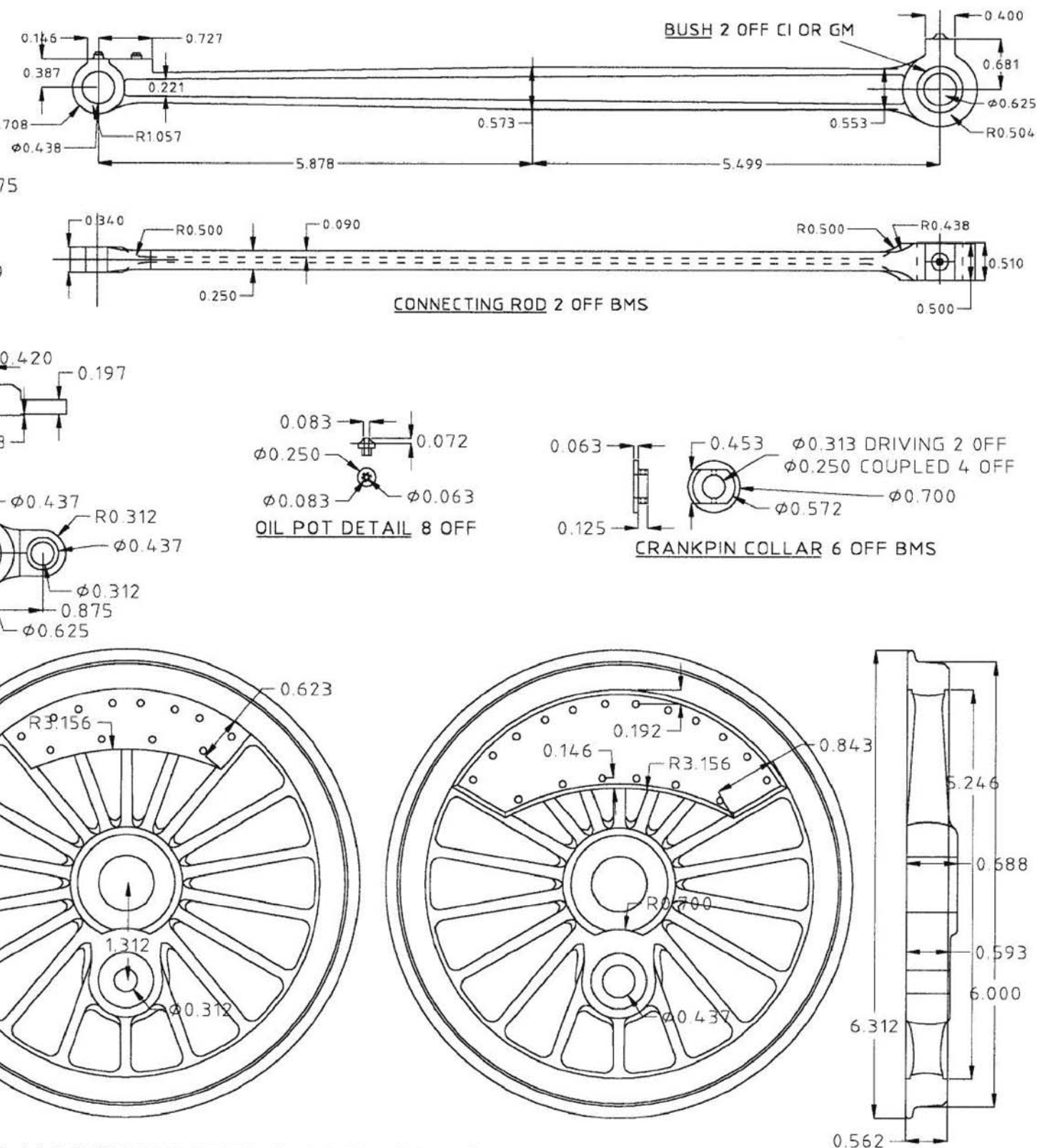
As to methods of machining wheels, I dare say that there are as many ways of doing this job, as there are people turning them. My preferred method is to hold the offending item by the flange in the 4-jaw independent chuck, face outward, with the face standing out as far as possible so that you can get a nice long cut on the tread. Set the inside of the rim to run true. If the central

boss is wobbling too much relative to the inside of the rim, don't be afraid to return the casting from whence it came.

Face off the outside of the boss and drill and bore the axle hole to whatever dimension suits you, about half a thou' or so interference for a press fit, or size plus 0.002in. for Loctite.

Turn the front of the wheel to size and shape and please, study the photos first to get a really good idea of what this particular wheel looks like, then try to get the same effect. Remember that the appearance of the wheels has a profound effect on the whole engine. For the smaller coupled wheels such as the 'Grange' you can now use a





"RANGE" WHEELS AND OUTSIDE MOTION

6100, and allowed no play at all. Both locomotives run perfectly.

The bushes can be made of gunmetal, phosphor bronze or best of all cast iron. Most metal stockists keep Meehanite in various sizes at ridiculously cheap prices, try some, you'll be amazed at how good it is. The crankpin bushes are detailed on the drawing, only the trailing coupled and the conrod bushes

protrude to any extent, the rest are flush with the rods.

Connecting rods

The GWR long con-rod as fitted to the 4-6-0s is possibly the most difficult piece on the engine. While I can see the elegance of the big-end design, combining as it does maximum strength and rigidity with minimum weight, it's still a

right pig to make properly. In fact, even in full size, they don't even attempt it any more! If you don't believe me, go and have a look at *Earl Bathurst* one of the 'Castles' at Didcot. Those big ends were never made at Swindon. Help is at hand in the form of W.O.M Models of Wells, Somerset, who turn out some really authentic GWR connecting and side rods on their tame CNC machines. Contact them on 01458-831565. ►



Manx driving wheel, note cut-away spokes.



Note the shape of the coupling rod oilbox.

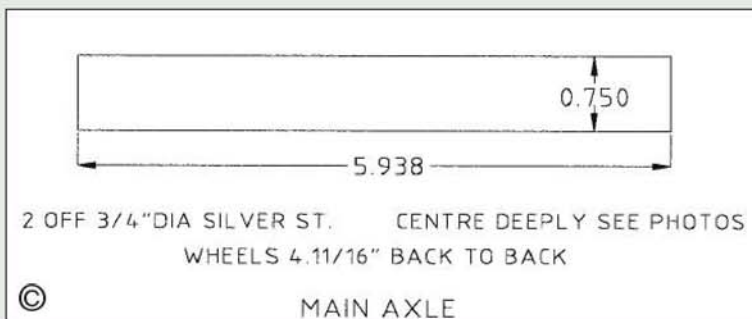


Small end detail



Left side trailing big end.

If you decide to make them yourself (and why not?), then I would suggest that a rotary table is an essential, the root radius being cut with a fly cutter. The join where that radius meets the oil box will have to be finished with one of those little abrasive cylinders that the tool peddlars now sell. These little devices are one of the most useful tools that I have ever used ... hours of



harmless fun and all that. One piece of earnest advice however, is to do this job as early as possible; no, I don't mean at 6 o'clock in the morning, but before you gouge out the fluting and cut the fishbelly. Yes Mr. Bignell, these rods are fishbellied. That way you don't feel too suicidal, the first time you cock one up. It may not be the last!

●To be continued.



Typical late coupled wheel.



Left-hand Manx driver, note balance weight detail.

KEITH'S COLUMN

Keith Wilson

deals with the cab windows, name and number plates and handrails.

●Part XXXVI continued from page 151
(M.E. 4188, 7 February 2003)

Franksly, the windows are blighters to make, very finicky, yet I can see no better way than as shewn, mostly fine (fairly tight toleranced) milling or turning jobs.

A method which has given me some reasonable results is to silver-braze four bars together, each $\frac{1}{4} \times \frac{3}{16}$ in. and cut to appropriate shape. Clamp this onto a somewhat larger 'blank' sheet for which I keep a 6in. square piece of $\frac{1}{2}$ in. 'aluminium' alloy with some 2BA holes tapped in it. Some little dog-clamps all help to hold the frame, and if it be mounted on a rotary milling table under a vertical milling attachment then careful handle-juggling will enable all one side of the frame to be machined.

Do the inside first, then clamp downside-up and do the outside, leaving the corners to be done by filing or linishing. To clamp upside down, fit some little pieces of steel or brass as packing pieces beneath the flanges of the frames. Take light cuts at this stage, and it is well to use a brand new slot drill for the whole job.

Although I do not have dimensioned drawings of the windows for Saints and 47s, they scale to such closely similar sizes that they must surely have been standard sizes — obvious when you think of it. It is by no means easy to get dimensions accurately from full size general arrangement drawings, the more so when they are not direct

SAINT CHRISTOPHER

A GWR LOCOMOTIVE for $7\frac{1}{4}$ in. gauge



GWR 47xx in $10\frac{1}{4}$ in. gauge. A substantial trailer is required for transportation in this scale.

prints but micro-filmed reproduction to suit 'about' $3\frac{1}{2}$ in. gauge, which is not always consistent all across the sheet.

I had thought that some windows were a little narrower, for the space between the boiler cladding and the cab side for the bigger locomotives is not infinite. It is easier to make the window frames first and then to match the spectacle plate to them.

Another way — pay your money and take your choice — is to start with a solid piece of brass $\frac{3}{16}$ in. thick, clamping this to the aforementioned 6in. square alloy plate. It will be as well to locate the four 'corners' of the window by jig-boring methods; your time spent on making careful notes of the readings for these co-ordinates, including the angular reading of the rotary table, will be amply repaid. These window frames appear to be a standard size.

The backing-plates, to be attached by 10BA

brass studs and nuts, are made from 20swg sheet brass. Although the silver-brazed basic frame may beseech a more difficult proposition than $\frac{5}{32}$ in. sheet, the drawn brass is easier to machine. During machining, an air-jet kept handy is useful for blowing off chips but mind your eyes, as fine brass chips are the very devil to get out, being non-magnetic.

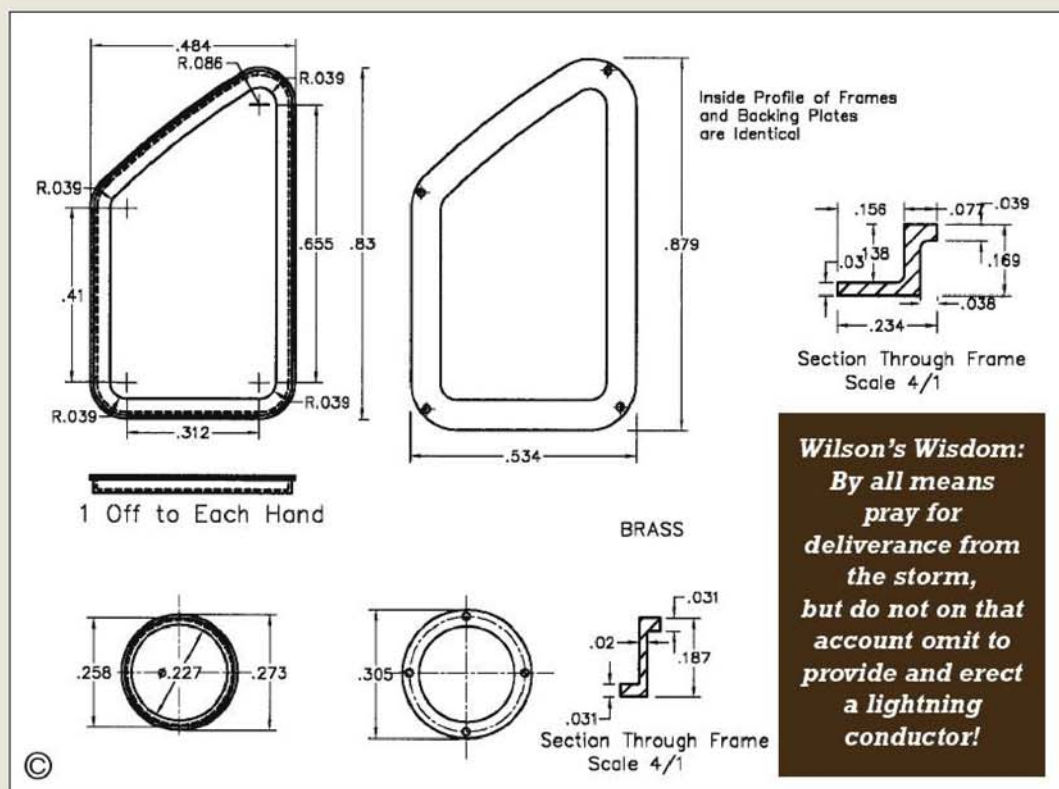
Note that I shew the spectacle-plate holes dimensioned in two different ways, you may find one easier than the other. Although the top edge of the larger window frame is curved, when scaled down this is virtually impossible to notice, and I certainly haven't bothered.

The frames are soft-soldered into their respective apertures, and the studs located from the backing plates. If these studs are soft-soldered and neatly trimmed off flush on the outside, they will be completely invisible under the paint.

Now, I am fully aware of the fact that the front cab windows were made to open, presumably so that they could be cleaned when the locomotive was 'doing the knots', as under these conditions the rush of air inside the cab was somewhat preferable to climbing outside it, duster in hand. But although some have made such windows, even in smaller gauges, I'm sorry but I ain't one of 'em!

The two round windows are only shewn for completeness, they were omitted in later life, sometimes they were blanked off with steel plates. There is of course the age-old tale of these windows being abolished after the demise of the broad gauge, as narrow gauge drivers' eyes were too close together, but I think this unlikely as they were still applied to engines not even designed at the time.

For those of an evilly masochistic disposition, the full-size round backing-plates are each affixed with eight studs and nuts, but I know not of what size. They are extremely small on the Swindon drawing, ▶



Wilson's Wisdom:
By all means
pray for
deliverance from
the storm,
but do not on that
account omit to
provide and erect
a lightning
conductor!

possibly 2BA, however if anyone wants to work with approximately 0.024in. dia. studs, etc., then the best of luck, and don't trouble me!

Handrails

Unlike windows, these are easy to make. However, one or two tips may be useful. It is perfectly possible to make these from 1/4in. dia. stainless steel but to machine most of this away to leave a parallel smooth finish is not a matter to be taken lightly. Even if taking light cuts and working between centres it will whip like no-one's business — there are easier ways.

As I shew, the small handrails can be made while retaining the original surface of the stainless steel, which helps. On full-size, the handrails were of mild steel and painted to match the plate colour behind them, however this for us introduces another snag. Ours are far more likely to get knocked, and paint on sharp radii (the plural of radiusses) has a short life as regards flaking away. Also, cleaning is more stressful than full size. This being so, I submit that bright stainless (which incidentally is not of quite the same hue as bright mild) looks far better than chipped paint. I am of course writing in respect of a working locomotive.

The ends are turned down and threaded as shewn. All that remains is to get the two bends in the right place; for this make a couple of adaptors. These are pieces of 1/4in. mild steel, one end of each tapped 6BA about 5/16in. deep. Strictly speaking, plain clearance holes are okay but tapped holes are better. To bend the parts at the correct places is now easier, but another dodge is very important. With oxy-acetylene torch in hand (smallest jet) and one 'adaptor' in the vice bending is the proverbial piece of cake. It is unbelievable until you have tried it for yourself just how much a bit of red-hotness aids bending — and unbending!

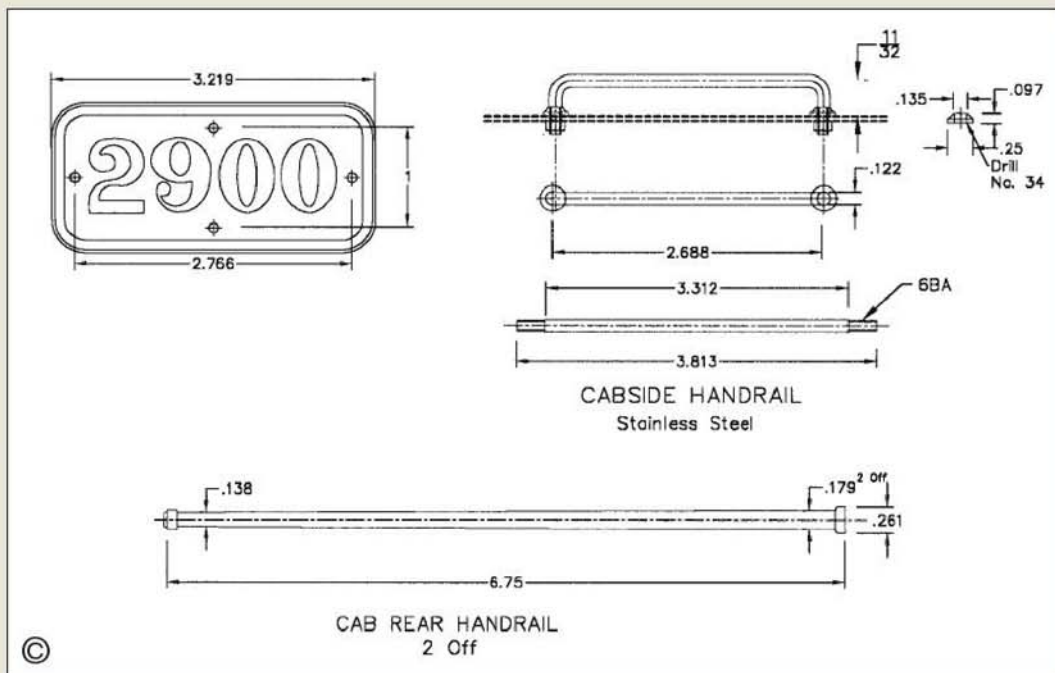
You probably won't get the bends dead right first go, but with the torch it is not impossible to partially straighten the errant bend and persuade it to go in the right place.

Then it is easy to polish off the heat-marks with fine abrasive material (emery or corundum paper) leaving bright bent specimens.

When these are threaded into a: the bosses and b: the cab sides and the nuts tightened, then you have splendid handrails.

The other cab handrails — the vertical ones at the back — also present problems, albeit of somewhat different character. It is far easier to turn these between centres* from one piece. If (understandably!) you fight shy of this, then having encountered this problem many years ago when doing '00' gauge telegraph poles!, my eldest son devised a clever way of getting the long taper required.

He got two coarse 15in. files and fitted them into a wire clip at the ends so that the tang of one corresponded with the 'far end' of the other. Putting this contraption around a piece of steel gripped in the chuck, running the lathe and squeezing the two unconnected ends of the file contraption together, a long taper was quite rapidly produced. It was a bit rough, but attention



with some 'enry clorff' with a drop of oil cured this. I seem to recall that he made some 20 telegraph poles in one session.

In the case of the later cab types on the Great Western (the Collett cabs) this vertical handrail continued up to the roof, but with the Churchward cabs this was not so. Collett cabs? Kings, Castles, Halls, Granges, Manors, Counties (4-6-0), 93xx and 38xx generally. Churchward cabs? *Great Bear*, Stars, Saints, 28xx, 47xx, Counties (4-4-0), Cities, 43xx, 53xx, 63xx, and 73xx generally.

The bottom of these handrails rests in a little footblock bolted to the footplate; the top is fixed to the cab special beading as described recently.

*For 'between centres' in this case, a method by which instability can be reduced is to grip the wide end of the handrail (before cutting to dead length) in the chuck, with the outer (eventually thinner) end supported by a slightly off-set tailstock center, about 1/64in. off-set being a good start. Using a sharp tool with a barely visible tip radius, and by taking light cuts at fine feed and a high rotational speed of the lathe mandrel, a good result should, er, result. Theoretically all wrong, but the method seems to work. The taper may not be dead true, but it won't be far out.

Finish off truly between centres if you wish, but be careful, for the slightest dig-in will ruin the job irretrievably. Once again, fine abrasive materials will make all well.

Name and number plates

Name and numberplates are largely beyond the powers of the average model engineer and are probably best purchased. I did try milling out a nameplate once by 'plotting' methods but soon realised I had 'dropped one' and wasted a couple of day's work so I shifted to photo-engraving methods. The trouble here is getting the lettering correct; I have not even yet discovered stencils of the correct font. I spent some time checking through some 100 fonts in various sections of my computer with zero success.

So I spent a few days loading GWR style letters and figures into a computer program, I now have the lot and can get correct nameplate and numberplate drawings, but it takes time.

Probably the easiest all-round way is to purchase them ready-made from Dianne Carney (0141-

557-1948). They may not be cheap, but from my own experience I can confirm that they are extremely good.

Useful truss

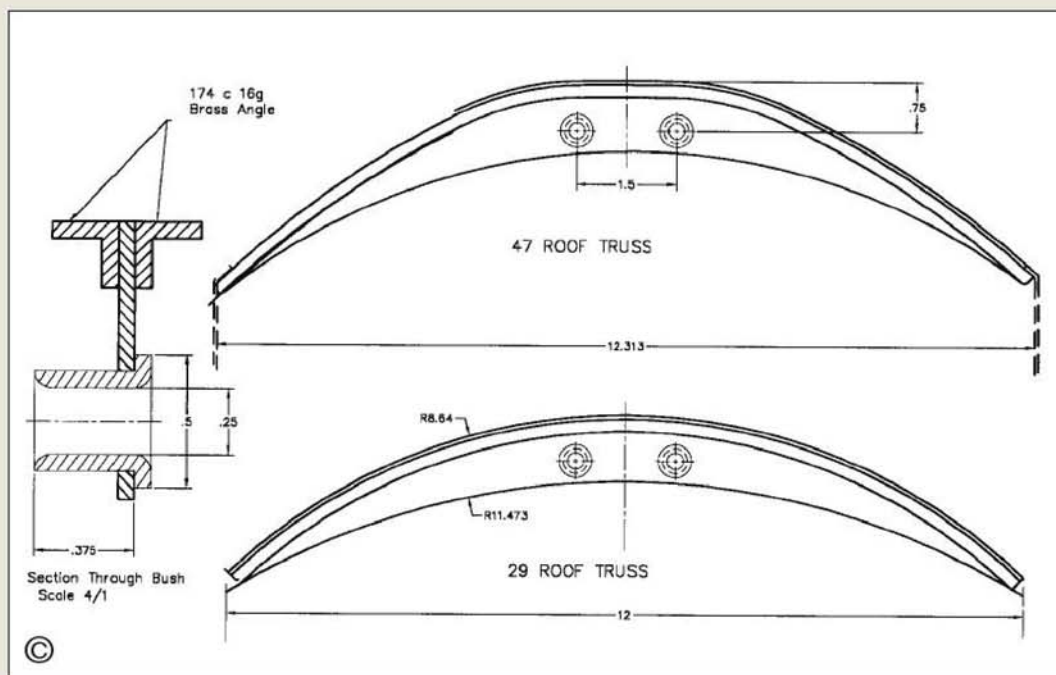
The full size cabs are generally made from 3/16in. steel sheet riveted to a framework; anyone building a working locomotive and who wants to make theirs out of 0.024in. thick material will regret it. Unless my mathematics is sadly at fault, the rigidity of a sheet of metal varies at least as the cube of the thickness thereof. In the case of a bar, it varies exactly as the cube, but plates are a different kettle of fish. Although I have the strength formulae for plate thickness, plates can behave somewhat differently from bars, and the deflection formulae are not over simple.

The cab assembly is rather flimsy as is shewn, for side pressure on cab sides or leaning on the cab roof will cause distortion of the whole cab. The roof will move downwards (upwards in the case of side pressure) spreading out sideways, and the sides will move outwards, and in the event of excessive or prolonged pressure, the nice neat 'squareness' of the cab could be most difficult to restore. A brace across the roof will very greatly negate this, and will serve two other very useful purposes.

One is to act as a rear edge to a roof cut-out. Not 'scale' but it aids driving tremendously, and is not too obtrusive. The second is a support for the whistle chains, which otherwise dangle right across the backhead controls, leading to trouble — and how! for if you reach for the brake valve in a hurry, as can easily happen! and your finger catches in the chain, then repeat after me "Kerrruunch!" It interferes even more with access to the injector steam valves, although need for this is seldom quite so urgent.

The whistle chains pass through two little brass bushes. Note that both ends of the bores of these bushes are radiused, this is important as the links of the whistle chains will otherwise get caught on the sharp edges.

Chain? There are at least two good versions of this. One is ordinary brass bath-plug chain which is strong enough and fits easily through the bushes. Trouble is, it looks rather like bath-plug chain. Surprise! A better chain is that fitted to cuckoo clocks. Many clock repairers stock it or can get it;



in fact I contacted a department store in Wolverhampton and they promptly sent me about 4 metres free. It looks pretty good, which is important, and does the job well, which is even more important.

In full-size, of course, there were two whistles, one (the alarm or warning whistle) which could be sounded by driver or fireman, and the other, a lower-pitched brake whistle, only by the driver. However, there is little point in trying to arrange this for to grope around in the cab for the correct chain would be most difficult for us. So, one chain to each whistle, one each side of the cab is best for us.

●To be continued.



A GLASS MARKING OUT TABLE

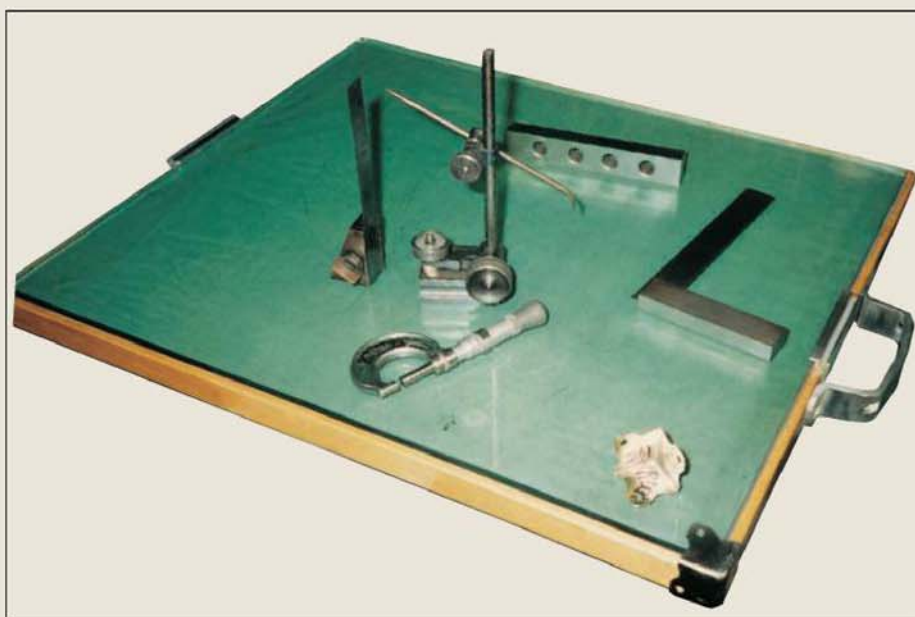
Peter Spenlove-Spenlove describes a useful and inexpensive aid to accurate marking out.

While collecting some goods from a local glass merchant, I spotted some offcuts of very thick glass left over from a shopfitting contract and originally supplied for shelves. About 24 x 18in. and nearly 1/2in. thick, a 'fag paper' and straight edge showed them to be flat within 0.001in. or so. While in the shop I placed one piece of glass on another in various positions, and could not detect any rock or hollowness. Having bought a piece, I donned leather gardening gloves and smoothed the edges with abrasive and rounded the corners sufficient to remove any sharpness.

A board of 3/4in. thick wood veneer faced chipboard was cut 1/8in. longer and wider than the glass and chosen because it remains fairly flat. All around the board, using glue and panel pins, I secured a wooden lip made from 1 x 1/4in. moulding with a rounded corner on one side obtained from my local DIY store. This tray-like assembly was lined with a piece of green baize.

A clip at each end stops the glass from falling out when hung up or carried by the D-handle screwed on one end. The photograph shows a suitcase type reinforcing corner piece placed on one corner of the marking out table but I did not use these as I had enough material to make two clips (1 x 1 x 3in. long) from aluminium alloy angle.

I use this plate for marking out purposes only. For carrying out flatness testing using marking blue I prefer a scraped, cast iron surface plate.



Since the flatness of the supporting chipboard is critical, neither the handle nor clips should be attached with thick wood screws which could swell the surface so that the glass sits on high spots despite the cloth lining. Readers who do a bit of DIY and have assembled and fitted 'flat-packed' household furniture will have noticed that the wood screw holes are pre-drilled to the core diameter of the screws. The screws themselves are special parallel chipboard screws threaded right up to the head and with no plain shank. These screws should be used if possible, especially for the lifting handle and should be long and thin rather than short and

thick. This will reduce the chance of reliance being put on a screw in a void or soft area within the chosen piece of chipboard. As the assembly is heavy, I suggest the handle or hanging hook be fixed with at least two screws, 2in. or more in length. Cheap, weakly bonded chipboard will require special care.

A firm hold may be obtained in very soft chipboard by fitting a coarsely knurled piece of 3/8in. diameter aluminium alloy or brass rod, pre-drilled and tapped for a fixing screw, and secured deep into a drilled hole in the soft chipboard with plenty of epoxy resin adhesive.



EARLY DAYS

Martin Evans

reminisces about times with *M.E.* and his meetings with Lord Gretton.

●Part IV continued from page 153
(*M.E.* 4188, 7 February 2003)

Returning to the previous parts of this short series, a few further points have come to mind. I hope readers will permit me to revisit some of them here. I have already commented on the pleasure of meeting visitors to Noel Street who came to discuss our great hobby and possibly to purchase books or drawings. It was not unusual to welcome readers from Australia, New Zealand, South Africa, and even from places as far away as Tasmania who would also be keen to see the *M.E.* workshop. When Robin Riddles, the last CME of British Railways, came to see us he did me the honour of descending to the workshop where we had a most interesting discussion, not only about full size railways but about our 3½in. and 5in. gauge locomotives, too.

In recalling our regular contributors to *M.E.*, LBSC comes immediately to mind. This *nom-de-plume* was derived from the initials of the well-known South Coast Railway by which he was employed for many years. He was also known as 'Curly', from the mop of golden hair with which he was blessed from his youngest days despite the later disapproval of the Railway authorities!

I have already given an account of the manner of LBSC's departure from these pages owing to a disagreement with the then Editor Leslie Howard. The news of this clash soon reached the public domain and many members of model engineering clubs and societies condemned Howard. Circulation fell quite dramatically as LBSC's writings were very popular at the time. Some blamed me for the trouble, but my previous account reveals the reality that I had nothing whatever to do with the affair.

My concern about the financial position of the

HRH The Duke of Edinburgh with the late Prof. D. H. Chaddock and Jim Crebbin.

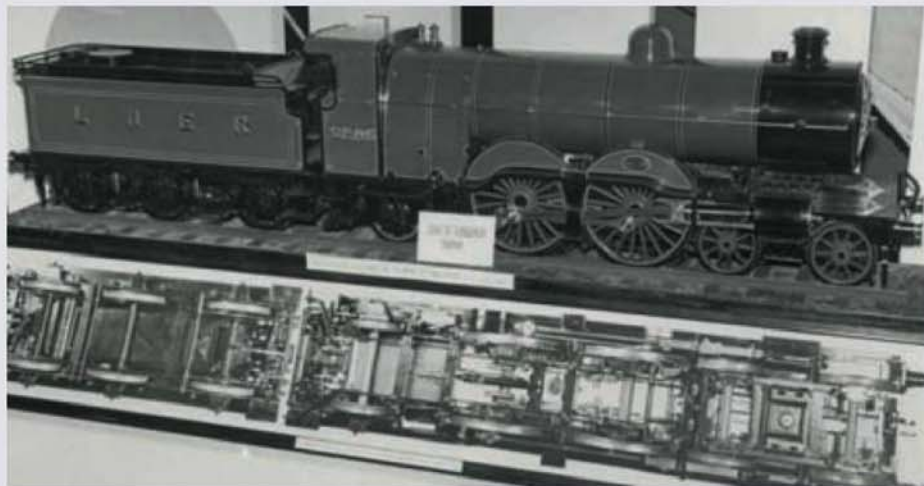
company, after I had been with *Model Engineer* for about four years, has also been mentioned earlier. It seemed to me that the free and easy attitude would lead to trouble before long. I guessed that neither *Model Engineer* nor *Model Railway News* had been profitable for some time and I did not imagine that a shrewd businessman like the then Chairman, Kenneth Garcke would allow such a situation to continue for long. Action was not long in coming. The staff of both *Model Engineer* and *Model Railway News* were told that they were to be moved to Maidenhead where the company owned two very large houses. One was allocated to *M.E.* staff and the other to *Model Railway News*.

Since at the time I was living at Enfield, close by the North station on the old Great Eastern line, my daily journeys would have been rather expensive, especially as at the time I was running a Jaguar XK-150 (several years old!) However, the company were quite generous over this, allowing a good addition to my pay. Through the Managing Director, I was also told that I would not have to start work at the new premises until 10am each working day. However, as may be expected, I did not like the change because I lost my very large drawing board, and the *M.E.*

workshop was no more. I heard later that all the machinery and most of the tools, materials, etc. were sold off.

A fortnight later, it was announced that the company were being taken over by the Watford Group and that the remaining staff would be located at Hemel Hempstead. Three days after this, all that remained of *M.E.* and *M.R.N.* staff were myself and the firm's draftsman, Mr. Pedder, all the others having been given notice of dismissal, including the Editor of *Model Railway News*.

I was sent for by the new M.D. Mr. Laidlaw ('Dickie') Dickson and, hoping that I was about to be made Editor of *M.E.*, I was eager for good news. Unfortunately there was trouble at the outset. 'Dickie' told me that I was to be offered the position of assistant to the Editor who, it was proposed, would be Mr. Vic Smeed, then Editor of *Model Boats*. However, I was not prepared to be junior to Mr. Smeed, who though sound on purely editorial



The late Bill Carter's superb GNR 'Atlantic' locomotive, a winner of The Duke of Edinburgh Trophy.



A front view of Bill Carter's locomotive.



Lord Gretton at Stapleford Park standing alongside his 10¹/₄in. gauge John of Gaunt locomotive, built for him by David Curwen.

Right: one of Lord Gretton's miniature liners at Stapleford Park.



matters, had far less knowledge and experience of railways and engineering matters. I left the office with the matter unresolved and on returning the very next day, I was summoned to the M.D.'s office to be told that the company's mind had changed and that I would, after all be appointed Editor of *Model Engineer*, while Mr. Smeed would remain with *Model Boats*.

I have described the pleasant first floor office allocated to me with its view across to the river as well as my problems with my young secretary with her slow shorthand and habit of putting the wrong letters into the wrong envelopes. I had no alternative but to give her notice. Although I was reprimanded for sacking this young lady, I was pleased to appoint another young lady in her mid 20s who turned out to be most efficient, extremely

willing, and who proved to be a wonderful help during my early days in the new office.

Stapleford Park

I am sure that many of my readers will remember the late Lord Gretton (Senior). My earliest memory of him is his extraordinary taste in his different activities including his lions and his 10¹/₄in. gauge railway which encircled the lake in his estate known as Stapleford Park and by the locals as the 'House with a Hundred Stables'. I do not think Lord Gretton was a hunting man; apart from the lions, his main interest was the railway and the passenger-carrying miniature liners which plied the lake.

It was probably the building of the big 2-6-4 American type locomotive that brought me into the scene. This would have been a few years after my appointment as Editor of *M.E.* Lord Gretton invited me to a party at Stratford-upon-Avon to celebrate the building of his two miniature liners, which incidentally is where I was to meet David Curwen, that great model and full size engineer. Curwen had always been well-known for the fine 4-4-2 locomotives (I believe he built no less than nine of these engines, not to mention some very fine locomotives which he built for the Audley End Railway in Essex). Returning to Lord Gretton, I believe he was a director of one of the largest breweries in the country and I understand

he had purchased the estate from the original owner, the Earl of Leicester.

Some months after I had met Lord Gretton, who had been appointed President of the SMEE, he invited me to stay for a weekend at Stapleford Park so that I could become acquainted with the railway. At the same time I was able to enjoy a few days among the timeless features of the old mansion, which I understand has been sold and altered to what might be called a Country Hotel on the Grand Scale.

One rather amusing moment during my stay there was when Lord Gretton and I sat down to lunch on the Saturday. One of the kitchen staff with a sense of humour laid out the huge table, which must have been around 25ft. long, with a place set for the Lord at the top and for the commoner (me) at the other end furthest away from Lord Gretton. Needless to say, we both had a good laugh while one of the staff moved my place up close to the head of the table.

Lord Gretton was one of the kindest men I have ever met, always considerate of his guests. A true gentleman of the type very rare today.

●To be continued.



The late A. Bowness, a distinguished writer who specialised in early nautical matters.



Some of the valve gear on the author's 3¹/₂in gauge 4-6-4 L&Y chassis.

Martin Wallis

find not 57, but 72 varieties, and is spoilt for choice before moving on to a wagon news update and a description of the steering gear.

●Part XXXIV continued from page 148 (M.E. 4188, 7 February 2003)

I am often asked for advice from prospective builders concerning choice of prototype. My advice is twofold, first to purchase some catalogues to gauge relative prices, and secondly to go to some traction engine rallies to chat to the traction engine model builders. Model engineers are always keen to advise and comment.

In this vein I recently had an e-mail seeking advice and the overall length, boiler diameter etc., of *Little Samson* in both the 3in. and 4in. scales. I replied, and wished the writer every good fortune. His response was that he felt he needed it! At that time, he had details of 72 different designs and noted among other things that a 2in. scale ZTS Superba ploughing engine was in fact 3in. longer than a 4in. scale Ruston Proctor SD steam tractor. Clearly the poor chap was spoilt for choice, and the scale alone was a poor guide as to the bulk of the finished model.

I asked if I might look at his list of the 72 designs — could there really be so many? By return came the data on a spreadsheet, most impressive and running to over a dozen sides of A4 paper. However, to set it into context, where a design is offered in more than one scale it had been counted more than once, but a number of suppliers were missing and with their designs added a figure of 72 discrete designs could well be achieved, maybe even exceeded.

I understand that further details may be obtained from www.edell.co.uk/72.html and is posted in zip, sit and pdf so it ought to be available to most with access to the internet.

Universal Carrier update

The Savage undertype Universal Carrier project is now edging towards completion. Most of the



The Savage Universal Carrier was built with three types of boiler: the locomotive type (illustrated), a conventional vertical boiler or a water tube boiler. This contemporary photograph reveals that there is plenty of room for a dummy load containing a motor and battery (see accompanying text).

SAVAGE'S LITTLE SAMSON in 3in, 4in. (and other) Scales

pattern making is now complete, all that remain are the lost wax castings for the boiler fittings. Likewise, most of the drawings are now prepared.

As with *Little Samson* there is an advance party, each building a wagon and providing photographs to illustrate the forthcoming series. One builder working in Devon is building a wagon with wooden wheels but with a 12-volt car battery and an electric motor for motive power. I understand that the electric drive might still employ the wagon's two speed gearing, differential and chain drives to the back wheels.

The notion of using the chassis/wheels/steering/brakes/gearbox as a basis for an electric vehicle had not occurred to me, but now it has it is certainly an interesting departure. I would guess that both the battery and the motor could together be disguised in a dummy payload, the motor driving through a hatch in the floor into the gearbox

below. Perhaps the motor could be incorporated into the gearbox itself. In the fullness of time, I very much hope to publish some pictures and details of this wagon. I understand that the builder is also planning to radio control his lorry having already built with every success a smaller radio controlled vehicle.

Any reader interested in joining the project is assured that there is still time, additional photographs for the forthcoming series are always welcome.

Little Samson progress

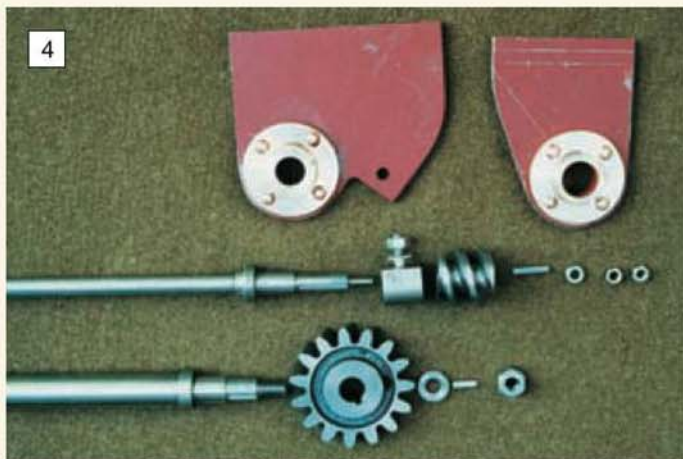
Photograph 2 is a fairly close representation of where the *Little Samson* series has got to, now very much nearer the end than the beginning. In the picture, the canopy has been fitted and the flywheel removed to facilitate fitting the steering shaft. I am tempted to describe the canopy sooner rather than later as it is good for morale — lots of



Progress to date, John Freeborne's 4in. scale Little Samson. (Photo: P. Kybert)



Stan Nipper's 3in. scale steering worm and wheel. (Photo: S. Nipper)



Component parts of John Freeborne's 4in. scale Little Samson steering gear. (Photo: P. Kybert)



1in. scale steering components. The chain drum is just $\frac{3}{16}$ in. dia. and the steering wheel fabricated from 2mm nickel silver. (Photo: J. Milne-Fowler)

"It's nearly finished!" and "My word, you have made a lot of progress!" This contrasts with items such as the feed pump where hours and hours of work result in an item which nobody notices at all. However, before starting the canopy, the steering, gear selectors, and gear guards will be described.

Steering

'Crude but effective' is a term which can reasonably be applied to traction engine steering. A steering wheel is connected by a long shaft to a worm and worm wheel which gives a substantial reduction and turns the drive through 90deg. to a shaft running parallel to the throatplate. A chain is wrapped around the circumference of this shaft so that when the shaft is rotated, one end of the chain is paid out and the other pulled in. The ends of the chain are connected to the front axle.

Refinements

To prevent over-steering, and a front wheel becoming locked beneath the boiler barrel, a check chain is usually added. The works drawings call for a check chain which finishes up 2in. long on *Little Samson*. Arranged between the two steering chains, when travelling straight forward this chain hangs down, becoming increasingly taut as a steering lock is introduced.

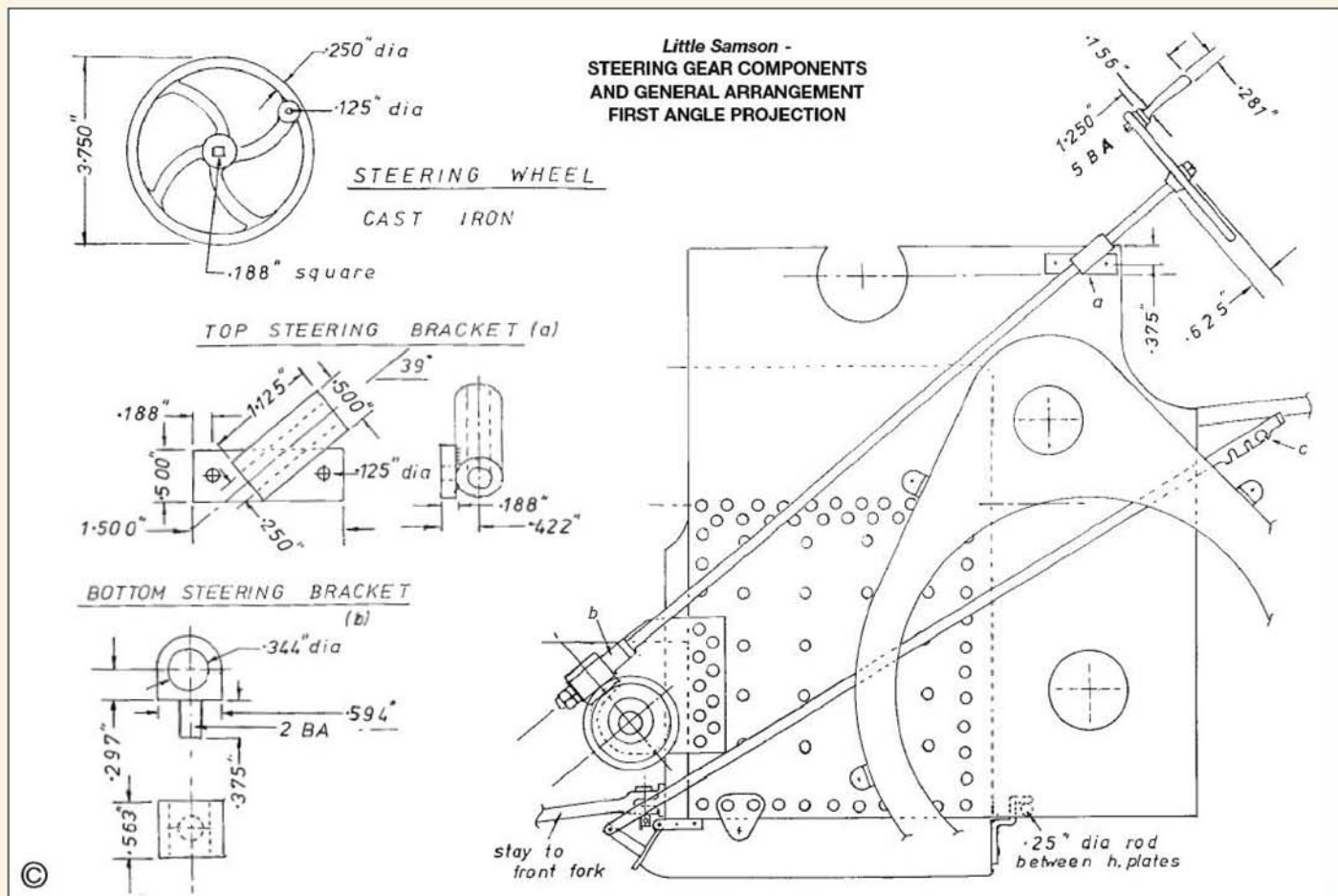
On some engines bottle screws are added to tension the chains, some having the further refinements of springs to absorb some of the inevitable jarring on uneven ground. *Little Samson* appears to have been built with neither; leastways, they are not detailed on the works drawings or visible in the works photographs. Builders are, of course, welcome to add them if desired. The steering chains should never be taut, a small amount of slack is usual.

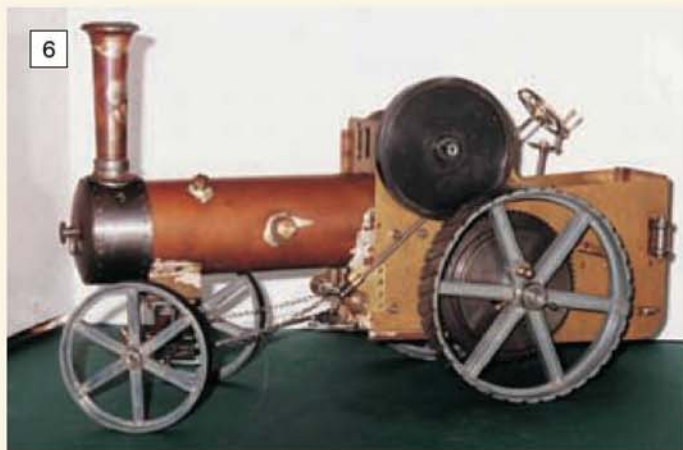
Dutch crabs

In preparing our *Little Samson's* steering, the works drawings are naturally the primary source of information. As seems usual, however, the drawings are also the source of some confusion. On this particular drawing, right in the middle of the sheet and with no obvious bearing on any particular view is the legend '2 Dutch Crabs $\frac{11}{16}$ th threads - $\frac{3}{8}$ in. steam pipe to pattern'. I could take a guess at the $\frac{3}{8}$ in. steam pipe, as sometimes rather than use a long fragile sand core a piece of steel tubing would serve to core out the casting, but cannot guess where, and it is not the chain drum: the drawing has it solid.

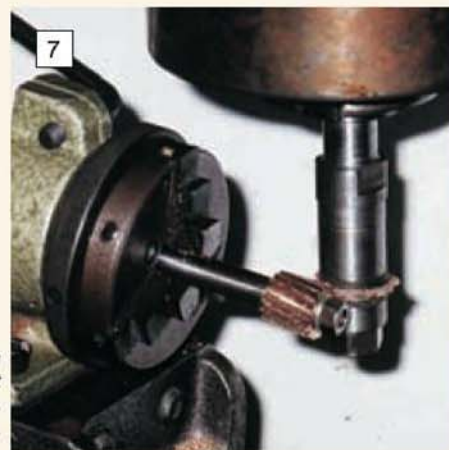
The $\frac{11}{16}$ in. threads preclude it from being a 1908 request for a seafood take away!

Elsewhere, rather than giving any tolerances, the steering shaft is described as '1in. rough', and the hole in the top steering bracket, into which it





Left: steering assembled on the 1in. scale Little Samson. (Photos 6 - 8: J. Milne-Fowler)



Right: the teeth are individually cut on Jonathan's 1in. scale worm wheel.



Left: the final tooth profile is formed on the worm wheel by a process known as free hobbing.

Right: handmade 3in. scale steering chain, spacers, and eyes to connect it to the chain drum. (Photo: S. Nipper)



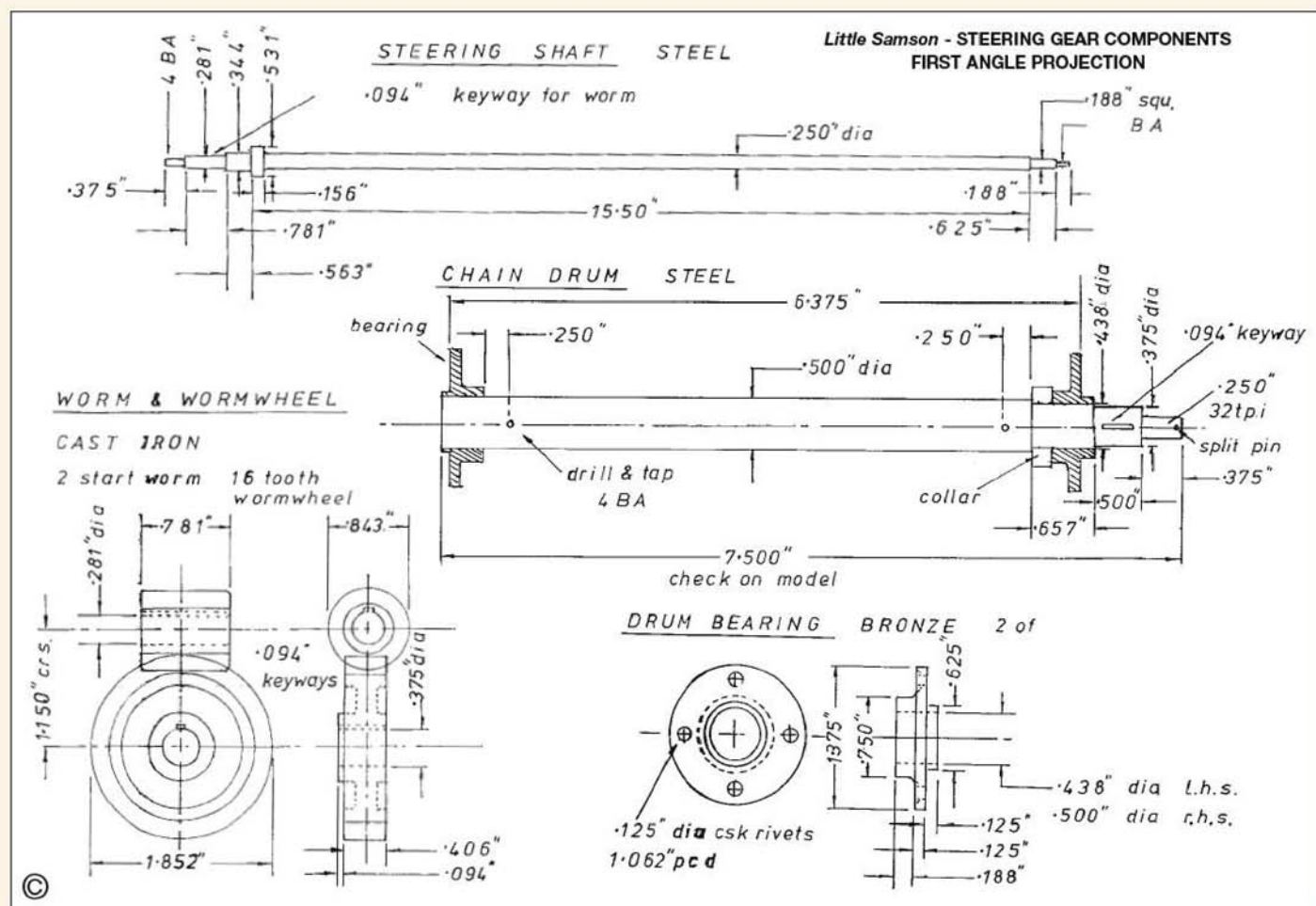
fits, as '1in. full'. The practical approach is continued in the worm wheel specification where the teeth are 'slanted to suit double threaded worm'.

The bits for the steering are laid out in photos 4 and 5. The steering wheel is supplied as an iron casting in 3in. and 4in. scale but in other scales

will have to be fabricated. The delicate little steering wheel by Jonathan Milne-Fowler in Australia was carefully fabricated. In 1in. scale, the steering wheel rim and spokes were formed from 2mm nickel silver wire obtained from a jewellery supplier, while the hub and handle were made

from bronze brazing rod and the whole assembly then silver-soldered.

The steering wheel with its curved spokes is elegant and matches the brake hand wheel and flywheel. The steering wheels were originally cast on-size with a view to being given a dusting





Left: I couldn't resist this fine view of David Hall's 3in. Little Samson. (Photo: B. Camps)

Right: the front axle stay bar connects the front axle to the throatplate. (Photo: S. Nipper)



with a file and a few coats of paint. However, public demand was for a machining allowance so the pattern was changed accordingly.

Worm and worm wheel

The commercial worm and worm wheel is shown in photo 4. To be prototypical they should both be in a ferrous material, steel for the worm and cast iron for the worm wheel. Brass or bronze, while it is much easier to machine, is not really appropriate. The worm, as per works drawings, is a two start one and meshes with a gear cut worm wheel. It is certainly hoped that the teeth on the machine cut worm wheel are done a little more scientifically than at the turn of the century.

The parts for Jonathan's beautiful little 1in. scale engine were all scratchbuilt. The steering components are laid out in photo 5 and are shown assembled on the engine in photo 6. The single start 36DP worm is cut on a piece of mild steel of 0.281in. diameter. To avoid cutting impossibly small keyways, it is drilled about two thirds of its length to fit the lower end of the steering shaft and the remainder tapped 10BA. The worm wheel was made of bronze and is a 16 tooth helical spur gear with the helix angle to match the worm. Here too, much thought was given to how to fit the worm wheel to the chain drum, as fitting a key to a 1/8in. dia. shaft did not appeal. A taper fit was employed, using a standard 1:10 taper and an 8BA nut to pull it tight.

Dimension of consequence

The only dimension of consequence on the steering gear is the centre distance between the worm on the steering shaft and the worm wheel; if too small, it will over-mesh and if too large it will be too loose. The dimension in 3in. scale is given at 1.150 inch. If everything is carefully marked out and made to drawings, it ought to fit together first time with the correct clearances.

First make the top steering bracket to the prescribed angle of 39deg. but do not drill the holes that fix it to the hornplates until satisfactory alignment is confirmed.

The right and left-hand steering brackets will have already been made, drilled, and riveted to the hornplates. There is therefore little opportunity to make adjustments to the gear centres in the left-hand steering bracket, short of drilling the 2BA clearance hole out larger and fitting an eccentric bush. If circumstances dictate this approach, either make the bush a press fit or Loctite it in.

Chain

Some builders are lucky with their steering chain and manage to obtain a length of commercial chain of the correct proportions. Regrettably, all too often the chain available is much too spindly and of inadequate section, and worse still finished in bright chrome plate. I have yet to see a full size engine with bright chrome steering chains. Garden centres can be good places to look, along with your local ironmonger — if it still exists! In 3in. scale, the links should be 0.563in. long and two chains each 15in. long.

Many builders may resort to making their own chain which is not as arduous as it sounds. Oxy-acetylene will be a great asset, the intense local heat roasting the joint nicely without heating adjacent links. A very neat silver-solder joint may be obtained, as witnessed by Stan's chain in photo 9. Strictly speaking, model engineers should not have oxy-acetylene bottles, but most evening classes will be able to help. Very few model engineers have oxy-acetylene in their home workshops, and for those who do, I wonder just how it ties in with their domestic household insurance. My understanding is that

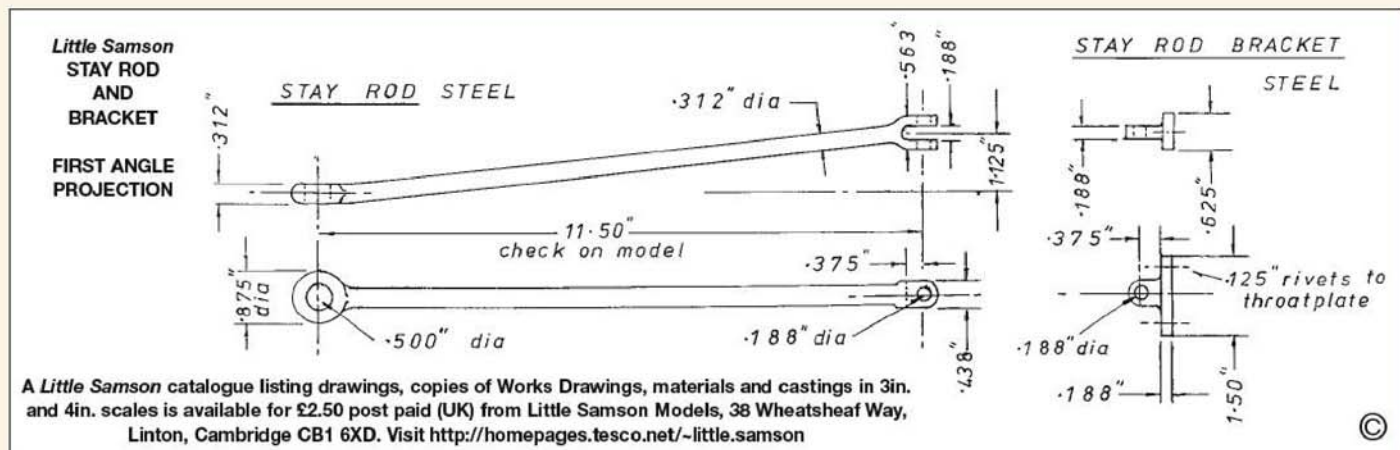
routine household insurance (the sort of policy most of us have) would not entertain the risk. Also, do the owners/users of the bottles have all the relevant safety certificates that are a legal obligation these days?

In 1in. scale, the chain was made from 1mm diameter nickel silver wire. Winding the wire around a mandrel just 1/8in. by 1/16in. formed the links which were then sawn axially on the mandrel with a piercing saw. The embryo links were then individually flattened with pliers to eliminate the helical skew. So far so good, and making individual links by silver-soldering the joints proved successful, but making complete chains proved impossible. When attempting to solder the joint within a length of chain inevitably the links themselves became silver-soldered to each other. Half the links were therefore not silver-soldered. Jonathan adds that he is not confident that with open links, his nickel silver chains will be strong enough and is considering remaking them with stainless steel links which will be stronger and better able to stand up to 'road shocks' before the links start to open. The chain was attached to the front axle with 10BA eyebolts

Front axle stay bar

This stay bar is a prominent feature on the prototype and I think it is certainly worth including on our model. It is shown in the drawings as a dummy and is for aesthetic purposes only. Most full size manufacturers did not fit them and there were no recorded ill effects. However, any builders wishing to make the stay fully functional should not be prevented from doing so. A support bracket welded to the boiler would be needed at the bottom front edge of the throat plate.

●To be continued.





The cutter devised for machining the displacer slots. Note the detachable spur used for setting.



The cutter in use. It is mounted between centres on the lathe and could be used with power cross feed.

THE BURNT AIR ENGINE

Frank Taylor

describes how he machined the displacer castings.

●Part VIII continued from page 131
(M.E. 4188, 7 February 2003)

Continuing now with the construction of the engine, by this time I had acquired a small milling machine which was used to do most of the preliminary work on the castings. Photograph 65 shows a special cutter I made for bringing the cast slots to size. The inserted cutter bits are held in slots with a grub screw which operates on a taper so that it locks hard into a corner which supports it against all cutting forces.

Each cutter takes a 0.055in. bite and these overlap. The position of the cuts, from every aspect, had to be impeccable. The cutter was positioned by a removable spur. In use this spur was employed to position the cutter on the casting datum lines and removed prior to cutting.

Photograph 66 shows the cutter in action. The set up looks somewhat flimsy and I expected trouble, but there was none — it worked like a

dream. With power cross-feed I stood and watched most of the time. I had visited a working water mill the previous week and the sound of this cutter was just like it. Just now and then one cutter would dominate and it was easy to spot the offender. Two strokes of the slip stone on the face restored the even beat. I found it a very enjoyable experience. As you see all the chips from machining were saved (miser!) and later you can see what was done with them.

Displacer rotors

These were milled from aluminium alloy strip using a rotary table on the lathe cross-slide. Each section of the rotor was made of two halves, which were later welded together.

Photograph 67 shows one half of a section. The circular slots, which were cut to within 0.015in. of the back side, did not finish on the shaft centre line so the arc swept by the rotary table was different for each slot. Angles were calculated, a cutting schedule made out, and all was okay.

As you see in photo 68, this pile of parts represents a lot of repetitive work. The next operation gave a welcome change.

Welding the rotor sections

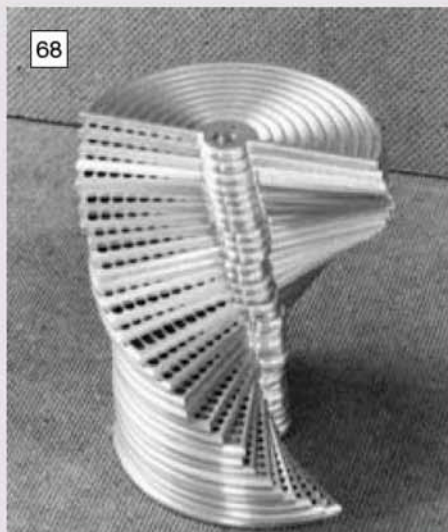
I used the *Lumiweld* system for this job and found it very easy. After cleaning with a stainless steel brush, a special alloy rod is used without any flux. It appears that the rod alloy dissolves into the surface aluminium alloy and lowers its melting point so that the parent metal fuses with the weld metal. I found the rod took to the aluminium alloy like soft solder to clean copper. After a run round to 'tin' the aluminium alloy the weld metal can be built up. An ordinary brazing torch is all that is needed for the weld.

Photograph 69 shows the two halves assembled in a fixture ready for welding. The V-groove for the weld can be seen. I found it awkward to do the weld in this fixture and changed it to the one in the next photo. The old car water pump (photo 70) was used to rotate the work while welding. This photo shows the weld completed.

Photograph 71 shows the appearance after assembly and machining of the outside diameter. In the centre of the rotor is a recess in which is fitted a small flap valve, just visible. The purpose of the valve is as follows. These rotors are quite flimsy. I have not tested them to destruction but



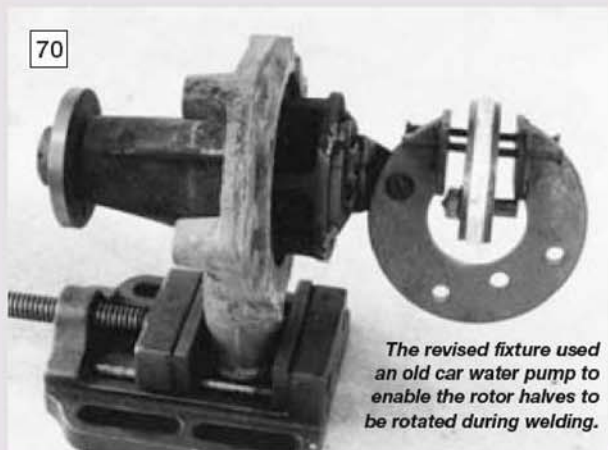
One half of a displacer rotor section. The thumb and fore finger give an impression of its size.



The stack of displacer rotor halves artistically arranged for the camera.



Original fixture used to hold the rotor halves together for welding. This was not a success.



The revised fixture used an old car water pump to enable the rotor halves to be rotated during welding.

they will stand about 50psi external pressure. However, less than 1psi pressure internally will cause them to bulge with disastrous results in the engine. My solution to this problem was to provide a very slow leak into the rotor (via the thread of an unsealed screw) and the flap valve to allow rapid exit for gas out of the rotor. Steel shim (0.005in. thick) was used to make the valves.

A stack of shim (photo 72) was assembled between two thicker plates, clamped, drilled and tapped for the three small screws in the centre. This assembly was attached with four screws to a larger plate fixed to a rotary table. The pattern you see was milled out using a slot drill and then released by undoing the four screws. A hacksaw completed the cutting followed by filing to finish.

When the three screws were undone there was a set of delicate little valves needing no further treatment (photo 73).

During my early experiments with methods

disadvantages. I chose to hold it on the plate with something approaching a vacuum, provided by the intake of an old fridge compressor.

Photograph 74 shows the mounting plate and you can see how the vacuum was spread over the



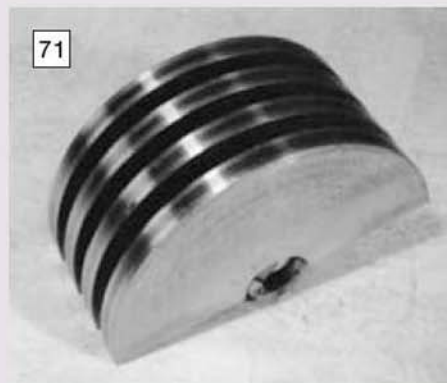
The fixture devised to make the 0.005in. thick flap valves used to control rotor internal pressure.



The set of flap valves after being released from their machining fixture. No further work was needed on these items.



The fixture shown complete with a rotor in place for demonstration purposes. The idea may help someone with a fixturing problem.



A sample of the rotors after welding and machining of the outer diameter.

back of the rotor at the same time as providing support. The protruding screws are positioned to take the cutting forces and prevent sliding.

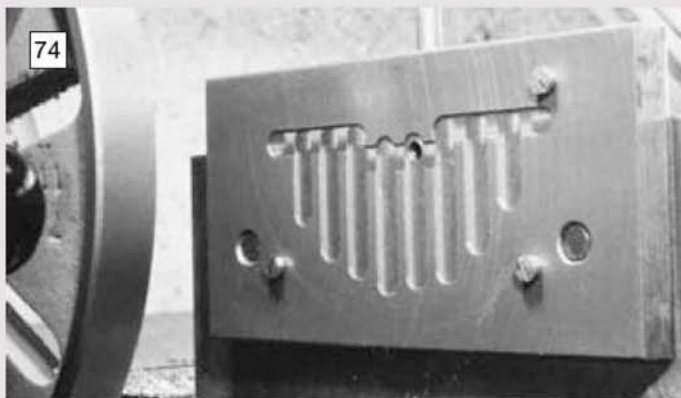
In photo 75 a half section is set up for machining and is quite firmly held. It's a shame I didn't need to use it, but the method might come in useful on some future job.

Heaters

Six 1kW electric fire elements were cut, reduced in length and rewound (photo 76). These were connected in a series/parallel arrangement such that they gave 1.3kW maximum power. The elements and wiring are supported and enclosed with ceramic material.

When the elements are pushed on to the casting and supported at the far end there is an air gap between the elements and the casting. With the engine earthed and running through an earth leakage breaker this has proved to be a safe and reliable system.

●To be continued.



The vacuum fixture designed to facilitate machining of the surfaces of the rotors. In the event this operation was not required.



Three of the six electric heater elements withdrawn from their casting for the benefit of the camera.

A LIGHTWEIGHT CAMERA TRIPOD



The Author's finished Tripod.

Harry Whitelaw

explains his need for a lightweight camera tripod and sets about making one using inexpensive telescopic radio aerials.

●Part I

In addition to my interest in engineering I am keen on hill walking and also dabble in photography. When out hill walking I like to take a group photograph of the walking party. Until recently this involved balancing the camera on a convenient rock or fence post and using the camera timer to allow me to join the rest of the group. This was an unsatisfactory and precarious arrangement (for the camera) and I decided to buy a camera tripod.

A visit to the camera shops showed that while there were many tripods to choose from, they were all either too bulky or too heavy to suit my purpose. Would it be possible, I thought, to make a lightweight, compact tripod? After some deliberation I decided to consider telescopic radio aerials for the tripod legs.

A couple of aerials were 'in stock' so some experiments were conducted and one of the aerials was dismantled for examination. I found that a telescopic radio aerial is a little miracle in miniature engineering in its own right. Except for the smallest diameter section which is made of solid brass wire, each section is a thin wall, chrome plated, drawn brass tube. The difference in the diameter between each section and the next is only 1mm (0.040in.). The wall thickness of the tubes is only 0.15mm (0.006in.). Also, inside each section, in addition to the tube that forms the next section, there are two thin Beryllium copper, or perhaps bronze plate springs. These engage in holes punched in the wall of the smaller tube and move with it as the aerial is extended and retracted. These provide the friction necessary to ensure that the aerial does not collapse under its own weight.

The force required to close the aerial is progressive with the minimum force, of about 700 grams (1½lbs.), required to close the smaller diameter sections. As my camera weighs in at 225gms (8oz.) it was clear that three aerials would be well able to carry the camera without collapsing under the load. Next I tried some bending experiments. A light sideways force was applied to the tip of the extended aerial. The conclusion from this was that due to their small

diameter, the two thinnest sections were too flexible and would have to be discarded. This was easily done by turning off the swaged-over end of the third section and pulling out sections one and two. These were immediately put into stock as potentially useful material.

The next stage was to design and make a tripod. The first attempt worked well; however, with the intention of making the tripod compact and light, I selected too small an aerial. With the camera mounted on the fully extended tripod I found it necessary to put one knee on the ground to get my eye down to the camera viewfinder. On the hills of Scotland this is not usually a good thing. The final version used slightly larger aerials.

The required aerials were purchased from Maplin Electronics. This retailer of electrical components has branches in most large towns and operates a postal service (usual disclaimer). The aerial is 9.5mm in diameter, the extended length is 1.31m, it has 10 sections and the cost was £4.19 each (including VAT).

The final version of the tripod is depicted in the drawings and is shown in photos 1 and 2. It is very satisfactory in use and with the camera mounted on the fully extended tripod, the eyepiece is approximately 110mm (4.3in.) above ground level.

Design

This project was proposed to our Editor in response to an appeal of his, made some time ago, for projects suitable for younger readers and those new to miniature/model engineering. While the camera tripod is not a 'model' project it does involve some interesting machining operations and might be of interest to younger readers owning a camera. It may also be of interest to some of the older readers who include photography among their hobbies.

The dimensions on the drawing are in metric units as it is expected that this would be more acceptable to younger readers. Some alternative imperial threads are suggested to suit those with a lathe fitted with an imperial lead screw. Almost all of my threading tackle and cutters are in imperial sizes so the parts for my tripod involved a mix of imperial and metric dimensions.

Parts

In making the parts I used the tools, equipment and machinery that I have available. All that is required, however, is some simple marking off equipment and a lathe with a vertical slide. It is



A self-portrait of the camera and tripod, all done by mirrors!

not my intention to give a 'blow by blow' description of how the parts can be made but offer the following notes.

Leg securing nut

Producing the Leg Retaining Nut first will provide a thread gauge for use in testing the thread fit when cutting the thread on the Body. As with several other parts, the Leg Retaining Nut is knurled. The knurling is partly decorative and partly functional and any form and depth of knurl will serve. Although aluminium is fairly easy to knurl, a considerable pressure is required. It is better therefore to turn the O/D and to cut the knurl before threading.

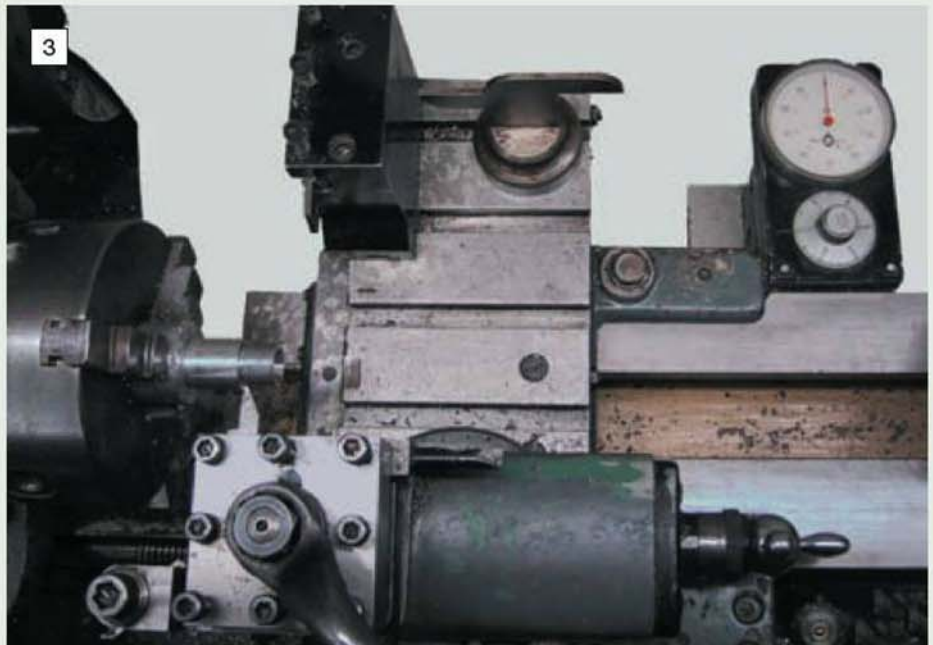
The thread specified is 16mm metric fine. This has a pitch of 1.5mm, and is equivalent to just over 16tpi. The alternative thread suggested is 5/8in. BSF which is actually 16tpi. The thread I used is 5/8in. UNF which is 18tpi. Use what you have but 16mm metric coarse, with its 2mm pitch or just over 12tpi, and 5/8in. Whitworth at 11tpi are somewhat too coarse to be considered ideal.

My preferred method is to cut the thread using a single point thread boring tool initially then finish off the thread form using a tap. The technique I use is to stop the cut at exactly the same position on every pass. To do this I use a 'Travadiol'. This extremely useful instrument (usual disclaimer) is

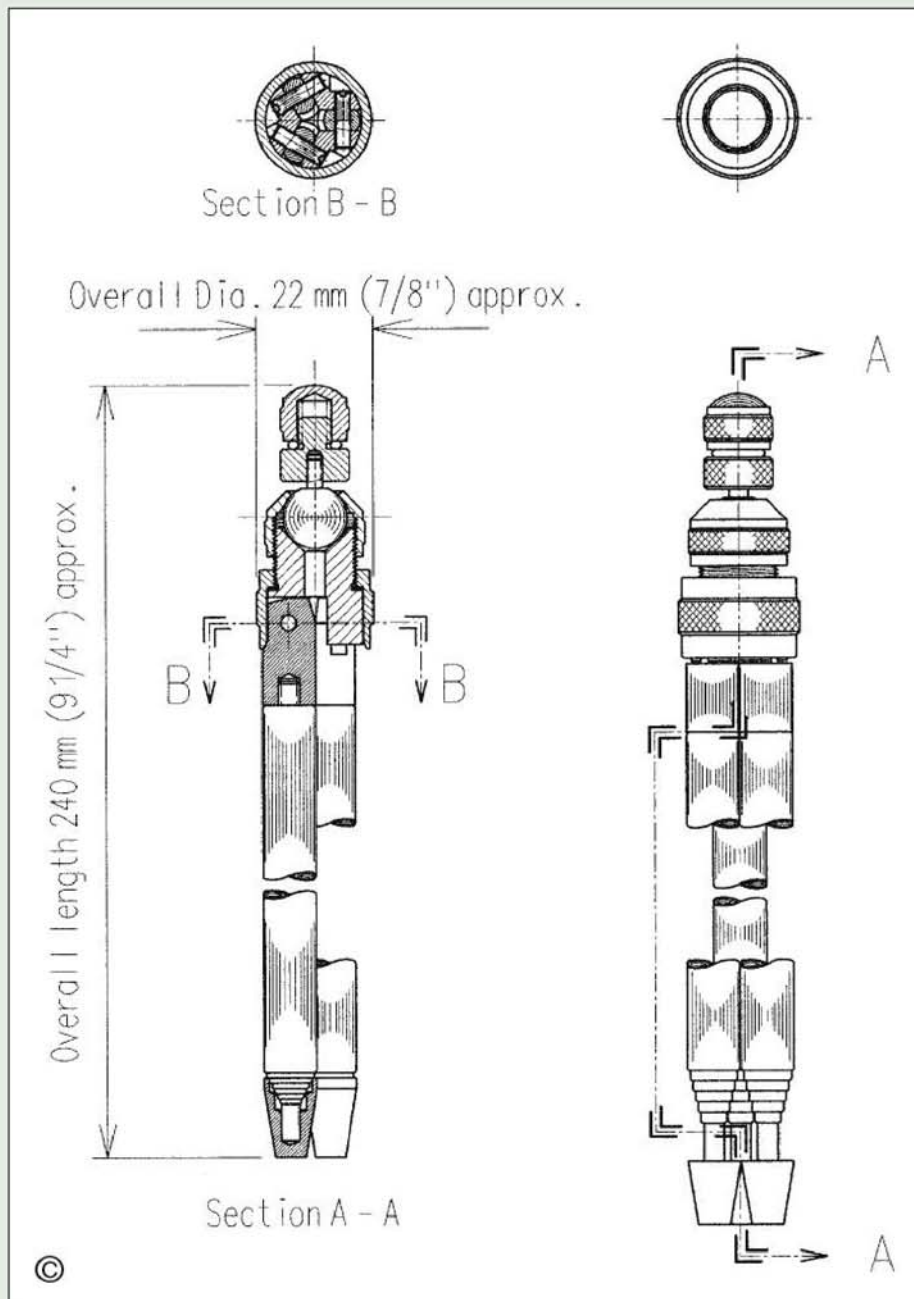
mounted at the rear of the saddle (photo 3). It has a roller, with a roughened surface, which runs on the rear face of the lathe bed. As the saddle is traversed the saddle movement is indicated in thousandths of an inch on the dial. A knob records tenths of an inch of travel. Both the dial and the knob can be zeroed. Although one might expect that there would be some slip of the roller when running on an oily lathe bed, in fact the instrument is totally reliable.

The procedure I use is as follows:

- 1: Take the first threading cut to a distance into the bore that will eventually allow the plug tap to clean up the thread beyond the eventual parting off position.
- 2: When that point is reached, without disengaging the half nuts, disengage the machine clutch.
- 3: Set the Travadial knob and dial to zero.
- 4: Note the reading on the cross-slide dial,



Screwcutting with the aid of the Travadial.



disengage the half nuts, withdraw the tool and returned it to the start point.

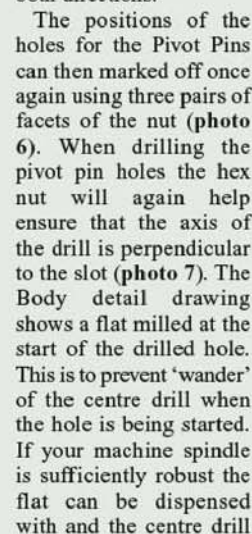
- 5: Without operating the machine clutch, re-engage the half nuts using the thread dial indicator. N.B. gently moving the saddle back and forth while depressing the half-nut lever ensures that the half-nuts are fully engaged. Otherwise the threading tool may not 'pick up' the thread correctly on the next pass.
- 6: Return the cross-slide to the previously noted position and advance the tool by the depth of cut.
- 7: Re-engage the machine clutch.
- 8: Disengage the machine clutch when the Travadial pointer is about 0.005in. (0.1mm) before the zero position. Leave the half-nuts engaged. I find that the saddle can be consistently stopped within a couple of thou. of the required position and at thread cutting speed there is virtually no overrun.
- 9: Finish the cut by pulling on the drive belt until the Travadial pointer reaches zero.
- 10: Repeat from step 4.

This is a tedious but reliable method.

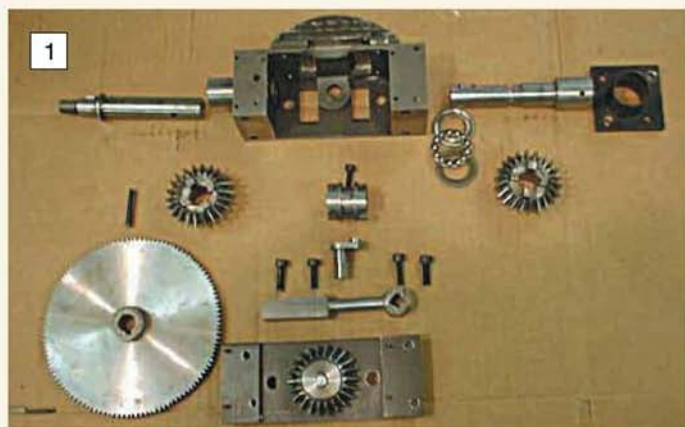
I work with the belt guard open when cutting internal threads. I can imagine what the safety experts will have to say about that but, by applying a bit of the common sense which they seem to lack, it is possible operate in complete safety.

Not everyone will have a 'Travadial' so alternative methods for consideration are:

- a: Tap the thread without first threading with a single point tool. This will be made easier by using a tapping drill 0.1 or 0.2mm (0.004in. or 0.008in.) larger in diameter than that recommended.
- b: First cut a recess, just greater than the thread depth and of width 2 or 3 times the thread pitch inside the bore formed by the tapping drill. Finish the cut in the recess. It is possible to detect by ear when the cut finishes and the tool enters the recess. Alternatively, a piece of masking tape across the lathe bed where the saddle is to be stopped will give a good indication. Always stop the cut by disengaging the machine clutch then, when you are happy that the cut is complete, disengage the half-nuts and withdraw the tool. A mistake is more likely to be made if the cut is stopped by disengaging the half nuts.



Picking up the hole position prior to drilling.



'Exploded' view of gearbox components. Note male dog clutches in gears.



Gearbox assembly with bottom plate and idler gear ready for fitting.

LEADSCREW REVERSER

Mike Wogan

of Brandon & District SME makes a leadscrew reversing gearbox for his Chester Centurion lathe.

After nearly 50 years of using a wide variety of lathes, from old mangles to superstars, I was somewhat disappointed to find my new Centurion lathe/mill purchased from Chester for my retirement had no leadscrew reverse fitted; reversing could only be achieved by fitting another wheel in the gear train. After much thought and deliberation I arrived at the solution which follows. I claim no originality for it as similar systems were fitted to several machines including the pre-war Atlas lathes.

Fitting the mechanism together inside the original clutch casing is like squeezing a quart into a pint pot, but it works! Most of the parts are Chester components modified to suit their new application. **Photograph 1** shows an exploded view of the components. Careful study reveals the male dog clutches pressed into the bevel gears, and the clearance holes and pockets in the case to avoid the gears and prevent unwary fingers being trapped. **Photograph 2** shows the assembly with the bottom plate and idler gear ready for fitting. **Photograph 3** shows the completed unit in position on the machine and ready to run.

To make the modification, proceed as follows:
1: Remove the dog clutch assembly and leadscrew



A view of the unit fitted to the Author's lathe.

- from the machine and dismantle. Note: sawn off nails make excellent pin punches.
- 2: Leave the **input shaft** as original.
- 3: Assemble the **output shaft** back in running position without the internal thrust race and lock nuts. Mark the shaft at the inside face, remove and reduce to 15mm dia. concentric with the existing 15mm diameter.
- 4: Counterbore the **input/output bevel gears** 25mm dia. and 9mm deep at the root of the teeth.
- 5: Turn and mill the **new dog clutches** similar to the original but on a sleeve to the bore of the gear, then bore out to 15mm diameter.
- 6: Reduce the overall length of the **sliding clutch collar** to suit. Mill new **female dog clutch** each side of the selector groove. Check that the parts slide into engagement with the input and

output bevels.

- 7: Counterbore the idler bevel 25.5 dia. by 9mm deep at the root of the teeth. Face off the back of the gear to the shoulder. Make a shouldered centre bush to fit the gear and thread a centre hole M8 to fix to new bottom plate.

Assembly is very much a fitting exercise. Clearance for the gears must be cut into the case and pockets milled into the back of the selector quadrant. It is also necessary to produce a 'V' shaped cutout in the headstock base to clear the selector lever (photo 3). The selector quadrant has detents for the lever to engage forward and reverse drives, and a neutral position in the centre. The bottom plate and spacers are put into position, clamped, checked and then fixed. Trial and error and educated guesswork are very much the order of the day!

Parts required

- 3 off bevel gears as per Centurion apron.
- 6mm mild steel plate approx. 150 x 55mm (bottom plate).
- 2 off 4mm mild steel strip approx. 25 x 55mm (bottom plate spacers).
- Approx 100mm of 6 x 50 x 50mm mild steel angle (quadrant).
- Assorted M4 and M5 cap head screws.
- Assorted 2.5, 4 and 5mm roll pins.
- Odd bits and pieces from the scrap box for mandrels and bushes, etc.



UK News

A request to the London Borough of Harrow by Harrow & Wembley SME for the erection of a fence at one end of their track in order to improve safety brought the reply that such a fence must, for the present,

remain at the bottom of council priorities. It seems that the society will just have to put up with the situation for a while longer. The matter of refuse disposal is also under discussion with the council as it seems that the contractors do not include the area of the park in which the track is situated in their rounds. It was finally agreed that the club would be supplied with 'wheelie bins' and make their own arrangements for emptying them. The idea of

fitting gates to the level crossing, again in the interests of safety, is also to be abandoned since it is believed that fitting them would encourage further vandalism. Problems could also arise if the people using them did not close the gates after use. The wooden posts at the entrance of the crossing will instead be replaced with metal posts, and flashing lights installed to warn of the approach of a train. The club open weekend in August last year received considerable coverage in the local newspaper and the published photographs are to be stored in the club archives.

On the whole, the general public enjoys its access to club tracks and of course provides a sizeable proportion of the income of many societies. Nevertheless, now and then an individual can create problems, as was recently the case for Maidstone MES. Reputed to be a retired surveyor, the person concerned reported directly to the local authority his belief that the club's Mote Park track was unsafe. Needless to say, this was a great surprise to members who pride themselves on their regular inspections and maintenance, and certainly did not agree with his findings. The local authority was

obviously obliged to follow up the matter and at one stage it looked as though the club would have to pay for a full survey. However, members of their council are rather more enlightened than some and arranged to accompany club members for an inspection. They were provided with diagrams and details of the track construction, and the inspection team departed perfectly satisfied that the track was safe. Situated in a public park and subject to routine vandalism, the track is always inspected before the start of any running, but no written record of these inspections has been made in the past. Following the complaint, a record will be made with such comment as may be necessary. Other societies might consider following suit just in case some other well meaning member of the public decides to register an opinion concerning the safety of their passenger carrying railway track.

While approval has been given for the construction of a track by Taunton Model Engineers at Creech St. Michael, this does not mean work can begin as it is still necessary to discuss the project with the Playing Fields Association. Following an excellent intake of new members, the idea of introducing a mentoring scheme is being considered whereby an established

member would be paired with a new member to make him/her feel welcome and to help and advise as required. Members have been offered the opportunity of a private viewing of an auction to be held at Honiton Galleries on 27 March at which numerous interesting models, model engineering equipment and model railway items will be sold including *Magnum Opus*, the unique 4-cylinder 3¹/₂in. gauge compound locomotive built by one time member, the late Sam Sampson.

The Kinver Link from the **Kinver and West Midlands SME** contains much detail about track superelevation, which we all realise is necessary but is often somewhat hit and miss when incorporated into track building. Brian Wallis, author of the article, has clearly done considerable research on the matter and has arrived at an equation relating the amount of superelevation with the radius of the curve. Used for the construction of the Kinver track, anyone who has driven a locomotive on this track will confirm how well it has been laid out. For members' benefit, a new site map has been prepared using AutoCAD which means that future changes will simply require an update, not a complete redraw. A non-steam event is scheduled for 24/25 May followed the next day (Bank Holiday Monday)

by a steam-only day. While the public are to be excluded from the non-steam event, which will include a barbecue, we assume that members of other societies will be welcome. Information can be obtained from Rob Fern (01902-337304).

The annual **Surrey SME** New Year's Day steam-up differed this year from their usual format. Previously always a members-only private affair, this time the general public were also admitted. Incessant rain resulted in flooding of the ground level track station with the result that a temporary facility was set up on the level crossing. Several areas around the track were also under water but, as plenty of locomotives were running, drivers do not seem to have been deterred. No such problems arose for those on the raised track of course, on which activity proceeded as normal. A good supply of hot soup, rolls, tea and cake ensured that the day was enjoyable for all concerned. Now it's back to the workshop until the next running day on Good Friday.

A day set aside for the charity Diabeticcare by **Harlington LS** raised £550 which was doubled by Barclays Bank PLC, making a tidy donation to the charity. Still on the financial side, British Airports Authority donated a handsome sum to the club towards the costs of buying

more shrubs and flowers to enhance what is already a very attractive garden. Another grant was received from the Co-operative Community Fund for the overhaul of some rolling stock which is now painted maroon and fitted with hydraulic brakes. There is still some concern about the future of Harlington Village, and therefore the club site, for if an additional runway is built at Heathrow Airport it is most likely that the club will be obliged to move. Not being a society to be intimidated by such things, members are still planning for the future; their latest projects include a new railway for garden gauge models and an extension to the club workshop.

After protracted negotiations, **Chichester DSME** has at last obtained a nominal 20 year lease from the local authority so the club can now plan ahead. However, as with many such arrangements, after 5 years, get-out clauses allow the landlords to give 12 months notice to quit if the land is required for development, in which case the authority has undertaken to endeavour to find them suitable alternative accommodation. The club is lucky, for many other recently negotiated leases have been of short duration, making it very difficult to plan ahead. With their immediate future settled, work has started in earnest to

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

- 7 **Vale of Aylesbury MES.** Dr. Arthur Tarrant: *The Wells & Walsingham Light Railway*. Contact Clive Ellam: 01296-623433.
- 7 **Kinver & West Midlands SME.** *Bring and Buy Sale*. Contact John Campbell: 01384-891244.
- 7 **Maidstone MES. AGM.** Contact Martin Parham: 01622-630298.
- 7 **North London SME. Meeting.** Contact Tony Dunbar: 01992-465625.
- 7 **North Norfolk MEC.** Doug Hewson: *Ground Level Tracks*. Contact Gordon Ford: 01263-512350.
- 7 **Rochdale SMEE. Models Competition.** Contact Mike Foster: 01706-360849.
- 7 **Romford MEC. Competition Night.** Contact Colin Hunt: 01708-709302.
- 8 **Reading SME. Club Running.** Contact Graham Bustin: 01189-615450.
- 8/9 **Kew Bridge Steam Museum.** Grease, Grime & Graft Activities. Information: 020-8568-4757.
- 9 **Durban SME. Meeting.** Contact Niall Mann: 031-7673640.
- 9 **Gas Turbine Builders' Ass'n. AGM & Seminar.** Contact Tom Wilkinson: 01508-570977.
- 9 **Hornsby ME. Running Day.** Contact Ted Gray: 9484-7583.
- 9 **Leeds SMEE. Running Day.** Contact Colin Abrey: 01132-649630.
- 9 **Sutton MEC. Track Day.** Contact Mike Dean: 0208-657-5401.
- 10 **Bedford MES. Dick Crane: Small Talk.** Contact Ted Jolliffe: 01234-327791.
- 10 **Frimley & Ascot LC. Brian Attwell: The Ffestiniog Railway.** Contact Bob Downman: 01252-835042.
- 10 **Melton Mowbray DMES. AGM.** Contact Phil Tansley: 0116-2673646.
- 10 **Saffron Walden DSME. AGM.** Contact Jack Setterfield: 01843-596822.
- 11 **Dockland & E. London MES. Quiz Night.** Contact P. M. Jonas: 01708-228510.
- 11 **Manx Steam & MEC. AGM.** Contact Mike Casey: 01624-861613.
- 11 **Northampton SME. Auction.** Contact Pete Jarman: 01234-708501.
- 11 **Sutton Coldfield MES. Jack Bearman: Footplate Experiences.** Contact Roger Timings: 0121-308-5875.
- 12 **Chingford DMEC. Dave Whiting: Auction Night.** Contact Martin Masterson: 0208-989-5552.
- 12 **St. Albans DMES. Latest Projects.** Contact Roy Verden: 01923-220590.

- 12 **Staines SME. AGM.** Contact Mike Kingham: 01932-788793.
- 13 **Cardiff MES. Bring & Buy.** Contact Trevor Jenkins: 029-2075-5568.
- 13 **High Wycombe MEC. Eddie Lewcock: LMS at Derby.** Contact David Savage: 01494-527402.
- 13 **Leyland SME. Project Night.** Contact Mark Entwistle: 01772-422411.
- 13 **Sutton MEC. Photographing Your Projects & Models.** Contact Mike Dean: 0208-657-5401.
- 13 **Tonbridge MES. John Martin: Clockmaking, Engineering's Ancestor.** Contact D. C. Brunning: 01732-352153.
- 13 **Worthing DSME. Bits & Pieces.** Contact Bob Phillips: 01903-700642.
- 14 **Colchester SMEE. Hugh Mothersole: Steam Boats Past & Present.** Contact L. G. Hammond: 01376-511686.
- 14 **Hereford SME. Jim Sinclair & Dr. Fenn: Railway Architecture.** Contact John Arrowsmith: 01432-265151.
- 14 **Kinver & West Midlands SME. Len Crane: Slides & Films.** Contact John Campbell: 01384-891244.
- 14 **North London SME. My Workshop - Members' Reminiscences and Discussion.** Contact Tony Dunbar: 01992-465625.
- 15 **Erewash Valley MES. Annual Dinner.** Contact Jim Matthews: 01332-705259.
- 15 **Historical MRS (Scottish Area). Meeting.** Contact Richard Crockett: 01896-750730.
- 15 **SM&EE. Rummage Sale.** Contact David Boote: 01202-745862.
- 15 **Southern FMES. AGM.** Contact Brian Thompson: 01920-830629.
- 15/16 **Guild of Model Wheelwrights at Shire Horse Show, East of England Showground, Peterborough.** Contact Biddy Hepper: 01492-623274.
- 16 **Frimley & Ascot LC. Club Run.** Contact Bob Downman: 01252-835042.
- 16 **Hornsby ME. Sailing Day - Fagan Park.** Contact Ted Gray: 9484-7583.
- 16 **Leighton Buzzard NG Rly. Birthday Special.** Enquiries: 01525-373888.
- 16 **Leicester SME. AGM.** Contact Raymond Wallis: 0116-285-8824.
- 18 **Basingstoke DMES. Auction.** Contact Ian Shanks: 01420-561741.
- 18 **Chesterfield MES. AGM.** Contact Mike Rhodes: 01623-648676.
- 18 **Nottingham SMEE. AGM.** Contact Graham Davenport: 0115-8496703.
- 18 **Romney Marsh MES. AGM.** Contact John Wimble: 01797-362295.

rebuild the raised track with the intention of having the whole job completed in time for running to commence in early April. Other plans include a new station building for the raised track and the fitting of vacuum brakes to ground level rolling stock. A new boiler for the club locomotive has also been delivered for sorting out in time for the start of the running season.

The Manx RAF Association has proved to be a very satisfactory venue for members of the **Manx Steam & MEC** where eight meetings a year will be held on the second Tuesday of the chosen months. Having suffered from a shortage of driving cars for some time, the club has now purchased two which have been fitted with battery operated vacuum braking systems in order to conform to club requirements. These cars will be available for use by drivers of visiting locomotives and by guards at the rear of trains, thereby providing the guard with a reasonably comfortable ride as well as improved control over the train.

The annual southern area get-together of the **National 2 1/2" Gauge Association** will be held at the **Surrey SME** track, Mill Lane, Leatherhead which, although frequently used by Association members, is a new venue for this particular meeting. The range of

available drawings and castings is constantly being increased, and a model now proving very popular is a *Stirling Single*. Many members are producing drawings for designs for which the society is supplying castings; frames profiled by the water jet cutting process are also available. Way back in the 1930s the late LBSC organised two competitions for models of *Dyak*. As far as is known, the last was in 1936 and the Association is seeking further information about it.

Members of **Bristol SMEE** are studying a copy of a new lease and management agreement from Bristol City Council for their Ashton Park track site; legal advice will also be sought. Their 2002 exhibition proved so popular that the club has been prompted by traders who attended to hold another this year providing us all with a repeat offering to enjoy. Profits from the last exhibition are being used to improve the facilities for the evening programmes by purchasing a radio microphone and a new overhead projector and screen. Consideration is also being given to replacing the old slide projector.

Considerable discussion concerning the future of the **Birmingham SME** raised track has brought forward several suggestions which will be put to members at the AGM. It all

seems to have started with plans to upgrade the station which is now approaching its sell-by-date. Ideas have since developed to the extent that the station may be completely re-sited and the raised track rebuilt to provide an extended run. No further details are yet available but the club's reputation for excellence suggests that we can expect some really good ideas. An old locomotive chimney that once graced the club grounds has now gone to a restored Jinty on the East Lancashire Railway. In exchange, the club now has a similar chimney which unfortunately is nowhere near as good as the one they parted with, but is being renovated. When finished, it will be suitably sited in the club grounds.

World News

Zimbabwe

Some time since we last heard from **Mashonaland SME**, staff at *Model Engineer* as well, no doubt, as some readers, were concerned that in view of the situation in Zimbabwe perhaps the society had ceased to exist, or maybe worse. At long last we have heard by e-mail that although times are not easy, all is well to the extent that the society has actually gained two new members during the last six months. Public running has continued

on a monthly basis and there has been no decrease in passenger numbers. In fact, after a 12 year break, the society reintroduced its locomotive efficiency trial, which was won by Cyril Haden driving *Firefly*. Members will resume public running in February for the summer period, and at least one new locomotive is soon expected to come off the stocks. It turns out that the reason we had no news from the society was because Secretary Ian Andrews, our contact, has been seriously ill and unable to attend the club meetings for five months. We hope he now feels better and continues to make a good recovery.

New Zealand

Following vandalism to a member's car, **Otago MES** members are being urged to ensure that nothing that can be used to cause damage to property is left outside in the grounds. The damage appears to have been done with a hefty piece of wood left on scaffolding at the end of the club headquarters. There are fears that if material of this nature is left around there may be some vandals who would attack on a regular basis. It probably would not stop at cars but may include damage to and possibly theft from the clubhouse.

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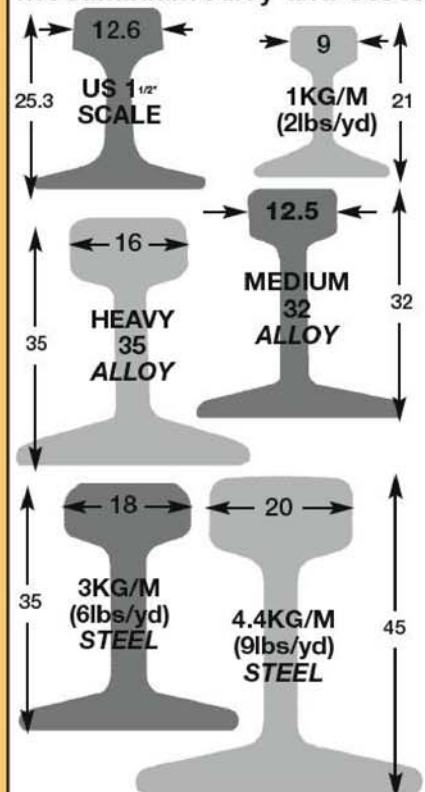
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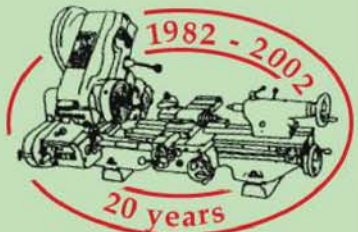
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LATHES

BOXFORD TUD 4 1/2" x 20" MK11 3 jaw chuck, cabinet stand, hand feeds	£395
BOXFORD CUD 4 1/2" x 20", change wheels, 3 jaw chuck, cabinet stand	new selection just in £750
BOXFORD CUD 5" x 22" MK11, c/wheels, 3 jaw chuck, 4 way toolpost	£1,400
BOXFORD BUD 5" x 22" MK11, c/wheels, power cross feed, T-slotted cross slide	£1,400
BOXFORD AUD 5" x 22" MK11, gearbox, power cross feed, T. slotted cross slide, cabinet stand	very nice £1,625
BOXFORD 1030 5" x 30", geared head, gearbox, power feeds, cabinet stand, clean machine	£2,250
COLCHESTER CHIPMASTER 5" x 20", gearbox, variable speed, 3 jaw chuck, face plate, 4 way tool post	Just £950
COLCHESTER BANTAM 1600 model, 5" x 20", geared head, power feeds, gearbox	£1,400
COLCHESTER BANTAM 2000, 6 1/2" centre height x 30", between centres, 1 1/4" bore, 16 speeds, D13 camlock fitting, 3 & 4 jaw chucks in very nice condition	£3,250
COLCHESTER STUDENT Square head, 1500 revs / 2 speed motor model, geared head, gearbox, imp/met, power cross feed & gap bed, dual dials, 3 Jaw chuck, taper turning, coolant, etc.	£2,950
COLCHESTER STUDENT 1800 6 1/2" x 40" + gap bed, 19" swing, 3 & 4 jaw chucks, Dickson tooling, taper turning, dial indicator, coolant, splash back, very nice, metric dials	£3,750
COLCHESTER TRIUMPH 2000 7 1/2" x 50" full screwcutting gearbox and power feeds, gap bed, 3 & 4 Jaw chucks, Dickson tooling, faceplate etc.	now £4,950
HARRISON L5, 4 1/2" x 24", fully toolled, complete with clutch	one of the best start up deals £950
HARRISON 140, 5 1/2" x 24", geared head, semi gearbox, 3 jaw chuck, gap bed, power feeds, clutch	£1,400
HARRISON 140, 5 1/2" x 24", geared head, gearbox, gap bed, power feeds, tooling, coolant	£1,725
HARRISON M250, 5" x 30", long bed, gearbox, power feeds, chucks, Acurite III DRO on cross-slide, dual dials	In very nice condition £3,250
HOBBYMAT MD65 2 1/2" x 12" Screwcutting Lathe with change wheels and some tooling	£425
MYFORD ML7 3 1/2" x 19", lathe, 3 jaw chuck	we have a large selection of this popular model £750
MYFORD ML7B 3 1/2" x 19", gearbox, 3 jaw chuck and tooling	£1,250
MYFORD SUPER 7 3 1/2" x 19", change wheels, 3 jaw chuck and tooling	Choice £950 - £1,150
MYFORD SUPER 7, 3 1/2" x 19", 3 jaw chuck, power cross-feed	Late model Choice
MYFORD SUPER 7 3 1/2" x 31", change wheels, 3 jaw chuck and tooling	Choice £1,400
MYFORD SUPER 7, 3 1/2" x 31", (long bed) power cross-feed, induction hardened bed , industrial stand and doors, green machine	£2,950
MYFORD SUPER 7B 3 1/2" x 19", gearbox, 3 jaw chuck and tooling	£1,250
MYFORD SUPER 7B, 3 1/2" x 19", gearbox, Power Cross Feed, cabinet stand, tooling	£2,750
MYFORD SUPER 7B, 3 1/2" x 19", gearbox, Power Cross Feed, Hardened bed, 3 jaw chuck and tooling on stand excellent condition from new and NOT re-conditioned	£3,400
RAGLAN CAPSTAN 10" x 24" 6 Station Turret, cut of slide, collet chuck (lever) & collets, bar feed, variable speed, coolant	£975
SMART AND BROWN 1024 Tool-room lathe, full screwcutting gearbox and power feeds complete with 3 & 4 jaw chucks, collet set, steadies and equipment	in very good condition £1,500
VICEROY TDS 1 GBL 5" x 24", gearbox, power slides, 3 MT tailstock complete with fixed steady	£1,400
VICEROY TDS 1 GBL 5" x 24", gearbox, power cross feed complete with 3/4 jaw chucks, steadies, Dickson tool set, tooling, cabinet stand and	A very rare imperial model at only £1,950

TOO MANY LATHES TO LIST!!

MILLING MACHINES V – Vertical, H – Horizontal

ADCOCK AND SHIPLEY IES Horizontal/Vertical Head, 30" x 8" powered table and feed gears, coolant	£1,625
BOXFORD VM30 variable speed / 30 INT head, table 21 1/2" x 6" + Abwood vice and collet chuck	£1,500
BRIDGEPORT Belt head 2 speed (short motor) head, R8 powered head, gearbox table, 42" x 9" table	Very nice £2,250
CENTEC 2B Horizontal, 1" arbor, table powered, 3 ph motor, single phase main motor	£725
CENTEC 2B Vertical/Horizontal, quill feed 2MT head, 25" x 5" table, pedestal model	£1,400
ELLIOT '00' OMNIMILL 3 Morse taper quill universal head, 28" x 7 1/2" powered table	Just In £1,850
ELLIOT Turret mill R8-10 speed 70-3000 rpm, table 45" x 10" (powered)	£1,500
EMCO FB2 Vertical 6 speed quill feed head 2 MT, powered 24" x 6" table, full coolant tray and cabinet stand	£1,950
HARRISON horizontal, 31" x 8" powered table	Now £625
HARRISON HV 30 INT swivel head & clutch, 30" x 8" table/powered	£1,950
HARRISON VERTICAL 30 INT swivel head & clutch, 30" x 8" table/powered	£1,950
SIG RAPID VERTICAL MILL 2 Morse taper, 2 speed motor, variable selector 175-2220 rpm, stand	£950
SIP RF30, milling/drilling machine complete with accessories	New £799
TOM SENIOR JUNIOR horizontal mill with a vertical head (sleeve to be made), table; 20" x 4 1/2", powered	£1,200
TOM SENIOR M1 horizontal, 25" x 6" powered table, 1" arbor	£575
TOM SENIOR M1 V/H, 25" x 6", 2 morse taper, 1" arbor	Selection £1,200 - £1,450
TOM SENIOR ELT MAJOR, 2 morse taper quill feed head, powered 37" x 8 1/2" table in	Extremely nice condition £3,200
VICEROY AEW vertical mill, 30 INT swivel head, powered table 34" x 8",	Very clean £1,625

DRILLS

ARBORA ER 25 / 25" Radial Drill speeds (8) 100-2900 RPM	clean table £1,425
ASQUITH 14-54 001 Mk2 (5mt) Radial Drill	£3,950
FOBCO 1/2" Bench, tilting table	£325
FOBCO 1/2" Pedestal drill tilting table	£345
MEDDINGS 1/2" pedestal drill	£245
MEDDINGS 2 Morse taper pedestal drills	Choice £275
MEDDINGS MF2 10 Speed 2MT Bench 240 volts drill	£350
POLLARD CORONA Pedestal 1/2" Morse	From £100
SIP HDP 600B 5/8" / 2MT Bench Drill, table operated by rack, speeds; (16) 162 – 3000 rpm	New £175
STARTRITE Mercury 1/2" 4 speed bench drill	£225
STARTRITE Mercury 1/2" pedestal drill, 240 volts	As New £300
WARCO 3MT Pedestal 9 speed drill, speeds; 150-2200rpm, table operated by rack	£495

GRINDING / BUFFING

CLARKSON MK1 Tool and cutter grinder complete with centres	£400
JONES AND SHIPMAN 540 Surface Grinder & Magnetic Chuck	Ex College / Seen no work £1850
MILFORD 12" Pedestal Grinder	£325
R.J.H. Buffing Machine, pedestal model Buffalo	£325
VICEROY Grinder, pedestal model	£145
VICEROY Buffers, pedestal models	Each £250

MISCELLANEOUS / FABRICATION MACHINERY

MARLCO NOTCH BROACHING FIXTURE + NOTCH BROACH	£425
CLARKSON DRILL POINT GRINDING ATTACHMENT FOR CLARKSON MK1 & MK11 GRINDER	£425
HARCOS UNIVERSAL HEAD FOR TOOL AND CUTTER GRINDER	£425
MYFORD VERTICAL SLIDES JUST IN	£95 / £155
MYFORD DIVIDING HEAD FOR ML7 AND SUPER 7 LATHES	AS NEW £395
MYFORD VM-D MILLING ATTACHMENT FOR ML7 AND SUPER 7 LATHES	AS NEW £675
TAYLOR HOBSON ENGRAVER MODEL K + BOX OF TOOLS AND EQUIPMENT	£1,400
BCA 12" HORIZONTAL / VERTICAL ROTARY TABLE	VERY NICE £425
QUANTITY OF SLIPS, HEIGHT GAUGES, SQUARES, STRAIGHT EDGES, MICROMETERS, CUBES, ANGLE PLATES AND MISCELLANEOUS MEASURING TOOLS	JUST IN
COPE AND DRAGS	WOOD £20 / METAL £30
TONGS (A VARIED SELECTION)	EACH £5
FLAMEFAST DS 130 CERAMIC CHIP FORGE	£345
FLAMEFAST DS 100 HEARTH	£140
BRIDGEPORT SLOTTING HEAD	£750
MARLCO BROACHING PRESS	£425
JONES AND SHIPMAN 4" x 24" bench centres	very nice example £450
TOM SENIOR slotting head	£450
STARTRITE 18-S-5 Woodworking / non ferrous bandsaw (5 speed bandsaw)	£950
DIAMOND fret saw, variable speed	£345
RJH BT 125 Fretsaw, variable speed	£345
SMART AND BROWN / CLARKSON H3-H5 toggle presses	Each £195 / £275
ARRAND 2MT long milling spindle	As new £75
VERDICT CLOCKS, Long/Short Metric and Imperial models	New £40
FLAMEFAST LD300 Soldering Iron Stove	£75
GRANITE 18" x 12" Surface Plate	£140
VIBROSHEAR Nibbler	Just in £425
TRIUMPH BURNED 4 Jaw Chuck	£245
TRIUMPH FACE PLATE D14	£70
JONES AND SHIPMAN Broaching Press + Stand	£375
ABB Inverter & 1/2 hp motor, wired up	£250
SIP 7" bandsaw, horizontal & coolant	New £750
WELLSAW hacksaw	Choice £245 - £345
BRIDGEPORT high speed drilling head	Now £300
STARTRITE SC31SD cut-off saw	£750
COMPLEX D28 toolpost grinder	£345
BOXFORD (imperial only) thread dial indicator	£35
ABWOOD 6" swivelmill machine vice	Each £495
VANCO 1" finisher / vertical + extractor	£345
BURNERD, D14 lever collet chuck + collets	£400
BURNERD, LO lever collet chuck + collets	£400
VERTEX Dividing head	New £245
VERTEX 6" - 8" - 10" rotary tables	good value equipment New From £135
MYFORD ML7 / Super 7 rear tool post	£40
MYFORD 254S rear tool post	New £40
MYFORD Vertical slide / fixed type (copy)	£99
LOCKWOOD QUAD HEADED 2mt Die Holder	quality equipment New £40
LOCKWOOD QUAD HEADED 3mt Die Holder	quality equipment New £40
LOCKWOOD Test Bar / 2mt Boxed	quality equipment New £39
LOCKWOOD Test Bar / 3mt Boxed	quality equipment New £42
MAGNETIC chuck - 18" x 6" fine pole	Never used £325
TOM SENIOR Model E pedestal stand	£150
UNION tool and cutter grinder stand	£135
HARDINGE capstan type toolpost	£175
50 INT Tooling; Selection	Just in
STARTRITE 352 woodworking band saw	£975
STARTRITE 14-S-5 woodworking band saw	£775
ALCOSA GF 080/1 Rapid Melting Furnace	£300
MYFORD Burned Gnipu 3 Jaw Chucks	Boxed £225
COLCHESTER D13 Burned 4 Jaw 8" light body independent chuck	one off £225
RJH 4" Linisher / Vertical complete with built in extraction	£625
MICROMETERS and associated measuring tools	Still packaged as new
POTTERY WHEELS, kilns and associated equipment	Just In Cheap
SPECAC Powder type press	£225
HARRISON L6 metric gearbox	As is £250
HARRISON L6 tailstock	£245
NEW FROM NEW ZEALAND - Machine vice, 55mm. Jaws precision miniature type ideal for vertical slides and smaller milling machines such as BCA now with the swivel base	
Vice on own	£134
Swivel base on own	£49
SIP 1 TON MOBILE CRANE Manufactured 2000 (used just once)	As new £375
MITUTOYO grade A set of slips	£245
F.J. EDWARDS 24" hole cutter	£525
Large bench vice	£70
LINK 1.5 ton vehicle crane + top hat	£625
MITUTOYO 103-913 metric set micrometers	£275
NORTON / EDWARDS arbor presses	£75 / £145
AJAX 6" hacksaw	£425
SURFACE plates from 12" x 12" to 36" x 36"	Very nice from £30
WEBER 1 1/2 ton mobile garage crane, late blue colour	£495
ELLIOTT 1250 STURDYMILL vertical head	One off (rare) £525
RJH finisher 4" wide belt, pedestal	£345
STEEL STOCK Just arrived	to callers only
ELLIOT U1 / U2 Slotting Head	£475
SWAGE BLOCKS	£125 / £145
J & S Universal grinding vice	Choice £275 / £325
BOX TABLES: Grade A and B, many sizes	£40 - £150
SLIPS / GAUGES Metric / Imperial, New Sets; 87 / 81 piece	£215 / £145
HORIZONTAL METAL BANDSAW 6" x 4 1/2" capacity	New £170
COLCHESTER STUDENT / MASTER Round head, face-plates, small / large	£50 / £80
QUALTERS AND SMITH 6" Hacksaw	£345
BORING HEADS 2 / 3 Morse, R8 Taper, Max. Capacity 4 1/2" round bar	New, each £90
ODONI Machine Bed Castings (pair)	Special £24.50
HEIGHT GAUGES by Chesterman, Shardlow, Moore and Wright	From £35
ELLIOTT 10M Shaper, 10" stroke	£325
DIG BOXES	From £45
TRANSWAVE 3HP Converter	New £295
TRANSWAVE 5.5HP Converter	New £385
TRANSWAVE MT & RT rotary converters	From £485
CROMPTON PARKINSON 1/2 HP, resilient mount, Boxford / Myford Super 7 Type motor, ...	New £140



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- 10 micron Accuracy

Conquest Lathe

NOW INCLUDES TEST CERTIFICATE



£395

VARIABLE SPEED
STANDARD ACCESSORIES

• 80MM 3-JAW CHUCK • Q.C.T.P. WITH 3 TOOL HOLDERS

Price includes VAT & Delivery*

920 Lathe Deluxe

- SWING OVER BED: 229MM
- SWING OVER CROSS SLIDE: 133MM
- DISTANCE BETWEEN CENTERS: 500MM
- SPINDLE BORE: 19MM
- TAPER IN SPINDLE NOSE: MT3
- MOTOR: 1/4HP
- 6 SPEED: 100-1800RPM
- NET WEIGHT: 100KG

STANDARD EQUIPMENT:

- 4" 3-JAW CHUCK WITH 2 SETS OF JAWS
- 7" 4-JAW CHUCK WITH REVERSIBLE JAWS
- STEADY REST • FOLLOW REST
- MT2 DEAD CENTRE
- MT3 DEAD CENTRE
- 4-WAY TOOL POST
- FACE PLATE
- TOOL BOX & TOOL KIT
- TRAY & SPLASH GUARD



£699

Price includes VAT & Delivery*

Model B-Super

- SWING OVER BED: 420MM
- DISTANCE BETWEEN CENTERS: 500MM
- MILL DRILL SPINDLE TAPER: 19MM
- TAILSTOCK BARREL TRAVEL: 80MM
- 7 SPEEDS 160-1360RPM
- SWING OVER CROSS SLIDE: 160MM
- SPINDLE TAPER: MT3
- DRAW BAR: M12
- CROSS SLIDE TRAVEL: 180MM
- MOTOR: 1/4HP
- NET WEIGHT: 155KG

STANDARD EQUIPMENT

- 4" 3-JAW CHUCK
- 2 DEAD CENTERS
- 1/2 DRILL CHUCK
- CHANGE GEARS
- MT3 CHUCK ARBOR



£699

Price includes VAT & Delivery*

Centurion

- SWING OVER BED: 420MM
- DISTANCE BETWEEN CENTERS: 520MM
- MILL DRILL SPINDLE TAPER: MT3
- TAILSTOCK BARREL TRAVEL: 80MM
- 7 SPEEDS 160-1360RPM
- SWING OVER SADDLE: 160MM
- SPINDLE TAPER: MT3
- DRAW BAR: M12
- CROSS SLIDE TRAVEL: 200MM
- MOTOR: 2 x 1/4HP
- NET WEIGHT: 230KG

STANDARD EQUIPMENT

- 4" 3-JAW CHUCK
- 2 DEAD CENTERS
- 1/2 DRILL CHUCK
- CHANGE GEARS
- MT3 CHUCK ARBOR



£1100

Price includes VAT & Delivery*

Champion Mill

- DRILLING CAPACITY: 20MM
- END MILL CAPACITY: 25MM
- FACE MILL CAPACITY: 63MM
- TABLE SIZE: 150x630MM
- NUMBER OF SPEEDS: 4
- SPEED RANGE: 400-1640RPM
- SPINDLE TAPER: MT3
- TILTING HEAD: 90° Left & Right
- MOTOR: 1/4HP

From **£585**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & ARBOR

Eagle 25 Mill/Drill

- MILL/DRILL CAPACITY: 25MM
- TABLE SIZE 190 x 585MM
- FINE FEED
- NUMBER OF SPEEDS: 12
- SPEED RANGE: 100-2150RPM
- SPINDLE TAPER: MT3
- SPINDLE TRAVEL: 100MM
- MOTOR: 1HP

Price **£699**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & MT3 DRILL CHUCK ARBOR
- EAGLE FACE MILL CUTTER
- T3 TILTING VICE
- M12 DRAWBAR
- NVR SWITCH GEAR
- INTERLOCKED CHUCK GUARD
- MANUAL AND PARTS LIST

Eagle 30 Mill/Drill

- MILL/DRILL CAPACITY: 32MM
- TABLE SIZE 210 x 740MM
- FINE FEED
- NUMBER OF SPEEDS: 10
- SPEED RANGE: 80-2300RPM
- SPINDLE TAPER: MT3
- SPINDLE TRAVEL: 130MM
- TILTING HEAD
- MOTOR: 1HP
- HIGH/LOW GEARBOX

Price **£899**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & MT3 DRILL CHUCK ARBOR
- EAGLE FACE MILL CUTTER
- V100 MACHINE VICE
- M12 DRAWBAR
- NVR SWITCH GEAR
- INTERLOCKED CHUCK GUARD
- MANUAL AND PARTS LIST

626 Turret Mill

- MILLING CAPACITY: 25MM
- DRILLING CAPACITY: 32MM
- TABLE SIZE 152 x 740MM
- FINE FEED
- NUMBER OF SPEEDS: 9
- SPEED RANGE: 190-2100RPM
- SPINDLE TAPER: MT3 OR R8
- TILTING HEAD
- MOTOR: 1 1/2HP

Price **£1340**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- ONE SHOT LUBRICATION
- HALOGEN WORK LIGHT
- MACHINE STAND
- DRAWBAR
- MANUAL AND PARTS LIST

Craftsman Gap Bed Lathe

- SWING OVER BED: 300MM
- SWING OVER GAP: 450MM
- SWING OVER SADDLE: 170MM
- DISTANCE BETWEEN CENTERS: 570MM
- SPINDLE BORE: 36MM
- SPINDLE NOSE TAPER: MT5
- CROSS SLIDE TRAVEL: 150MM
- COMPOUND TRAVEL: 89MM
- TAILSTOCK BARREL TAPER: MT3
- TAILSTOCK BARREL TRAVEL: 92MM
- RANGE OF SPEEDS: 50-1250RPM
- MOTOR: 1 1/2 HP
- NETWEIGHT 398KG

£1550

Price includes VAT & Delivery*



STANDARD EQUIPMENT:

- 6" 3-JAW CHUCK WITH 2 SETS OF JAWS
- 8" 4-JAW CHUCK
- STEADY REST
- FOLLOW REST
- STAND
- FACE PLATE
- SPLASH GUARD
- THREADING DIAL
- 4-WAY TURRET TOOL POST
- 3MT DEAD CENTERS
- T-SLOTTED CROSS SLIDE
- HALOGEN WORK LIGHT

Super LUX Mill

- MILLING CAPACITY: 25MM
- DRILLING CAPACITY: 32MM
- TABLE SIZE 240 x 800MM
- FINE FEED
- NUMBER OF SPEEDS: 6
- SPEED RANGE: 95-1600RPM
- SPINDLE TAPER: MT3
- TILTING HEAD
- MOTOR: 1 1/4HP

Price **£1500**

Price includes VAT & Delivery*



STANDARD FEATURES

- POWERED HEAD ELEVATION
- CAST IRON STAND
- ANGLE TILTING HEAD
- MANUAL AND PARTS LIST