MODEL ENGINEER

Vol. 193 No. 4235

26 November - 9 December 2004

COMPETITION and LOAN MODELS WELCOME for the 74th MODEL ENGINEER EXHIBITION

ELECTRO-PNEUMATIC CONTACTORS

Traction control for an electric locomotive

HARRISON'S H3 SEA CLOCK

Building a replica

MIDLANDS MAGIC

Marvellous models at Castle Donington

VOL 193 NO 4235 £2.40

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HIGHBURY

THE MODEL ENGINEER EXHIBITION

29-31 DECEMBER AT SANDOWN PARK, ESHER, SURREY

WARCO

The widest choice... the best prices!

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

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

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

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

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

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

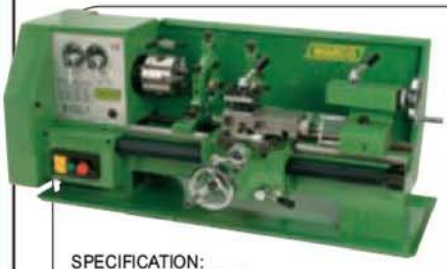
- THE ULTIMATE MODEL ENGINEERS LATHE
- HARDENED AND GROUND BEDWAYS
- TAPER ROLLER BEARING HEADSTOCK SPINDLE
- TEE SLOTTED CROSS SLIDE
- POWER CROSS FEED
- NORTON THREAD CUTTING GEARBOX
- 2HP SINGLE PHASE MOTOR
- BACK GEAR WITH 50 RPM LOW SPEED
- 1 3/8" SPINDLE BORE

SUPPLIED WITH ACCESSORIES AT NO EXTRA CHARGE
- 6" 3 JAW CHUCK
- 8" 4 JAW CHUCK
- 10" FACE PLATE
- FIXED & TRAVELLING STEADIES
- FOUR WAY TOOL POST
- IMP/MET THREADING
- STAND, COOLANT TRAY, REAR SPLASH BACK

VMC Mill
ONLY £1,450
inc VAT & Delivery

SUPPLIED WITH POWER FEED TO X TRAVEL AT NO EXTRA COST

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



BV-20 Lathe
ONLY £525 inc VAT & Delivery

Optional floor stand £99

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

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

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

WM-20 MILLING MACHINE
NEW

ONLY £3,500
inc VAT & Delivery

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

Warco Mini Lathe
ONLY £375 inc VAT & Delivery

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

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

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

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

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

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

Warco WMT 500
ONLY £1399 inc VAT & Delivery

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

Delivery UK-Mainland

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

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

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

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On the cover ...

Built by D. G. Harris of Stamford MES, this 1:6 scale miniature power shaper was just one of many superb models displayed at the recent Midlands Model Engineering Exhibition. It is pleasing to record here that the Judges voted the Stamford club display the best at this year's event. The James Hetherington & Sons Limited prototype for this exhibit was a 10in. stroke power shaping machine of the mid to late nineteenth century. In common with many such machines of the period, it is of the 'travelling head' variety which may be less familiar to readers than the type with a traversing table. Mr. Harris' model was well finished and all the working surfaces had been delicately hand scraped to represent correct machine tool fitting practice. For a review of other models at Castle Donington turn to page 638 of this issue.

Photograph by Neil Read

INDEX to ADVERTISERS

Machine Mart

49 SUPERSTORES NATIONWIDE

NEW STORE GLASGOW NOW OPEN

Where Quality Costs Less

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

MASSIVE PRICE CUTS

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

SAVE £11.75

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

CL251MH (ATTACHMENT)

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

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

MASSIVE PRICE CUTS

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

ONLY £649.95 EX VAT £763.69 INC VAT

Full range of accessories available

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

Shown with optional floor stand

ONLY £119.95 EX VAT £140.94 INC VAT

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

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

Clarke AIRBRUSH KITS

FROM ONLY £7.99 EX VAT £9.39 INC VAT

DIY KIT - CABIH

- Spray pattern adjustable

ONLY £7.99 EX VAT £9.39 INC VAT

PRO KIT - CAB2P(pictured)

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

ONLY £23.95 EX VAT £28.14 INC VAT

Clarke DRILL PRESSES

MASSIVE PRICE CUTS

FROM ONLY £29.95 EX VAT £35.19 INC VAT

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

Chuck sizes:
13mm CDP5DD-CDP251F
16mm CDP301B-CDP451F
20mm CDP501F

B=Bench mounted F=Floor standing

Full range of Drill Vices available

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

* Includes wet 'T' slot table & worklight

Clarke 12 SPD MILL/DRILL

ONLY £599.00 EX VAT £703.83 INC VAT

CMD12SC

Precision engineered with cast iron head, base & column

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

Clarke METAL LATHE

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

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

FULL RANGE OF ACCESSORIES AVAILABLE

Clarke MICRO MILLING & DRILLING MACHINE

CMD10

ONLY £239.95 EX VAT £281.94 INC VAT

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

Clarke VICE

MULTI - PURPOSE CMV125

ONLY £37.95 EX VAT £44.59 INC VAT

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

Clarke BENCH GRINDER STAND

BGS1

- Complete with bolt mountings & feet anchor holes

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

Clarke POLISHING KITS

To fit bench grinders. Includes: • Tapered spindle, and polishing compound • Coloured cotton mop for initial cleaning • Pure cotton mop for a high polish finish

6" Kit £19.95 EX VAT £23.44 INC VAT

8" Kit £24.95 EX VAT £29.32 INC VAT

ALSO AVAILABLE:

4" Polishing Kit for Hand Drills

TURBO AIR COMPRESSORS

TIGER 8/40

SLASHED £69.95 EX VAT £82.19 INC VAT

MASSIVE PRICE CUTS

* Oil Free † Belt Driven

TIGER 8/40

OTHER MODELS IN THE RANGE	MOTOR	CFM	TANK	WAS INC VAT	EX VAT	INC VAT	
8/45*	1.5Hp	6.3	24ltr		£84.95	£99.82	REDUCED
8/40	1.5Hp	7	24ltr	£92.94	£69.95	£82.19	
Panther 25	2Hp	8.2	24ltr		£129.95	£152.69	
Panther 50	2Hp	8.2	50ltr		£169.95	£199.69	
10/70†	2.0Hp	9	50ltr		£254.95	£299.57	
15/55	3.0Hp	14	50ltr		£259.95	£305.44	
15/65†	3.0Hp	14	50ltr		£359.95	£422.94	

Clarke rubber air hose (10m)

FROM ONLY £10.95 EX VAT £12.87 INC VAT

Clarke AIR TOOLS & SPRAY GUNS

MASSIVE PRICE CUTS

TYPE	MODEL	WAS INC VAT	EX VAT	INC VAT	
Pro Spray Gun	-	£21.99	£16.95	£19.92	REDUCED
Super Pro Spray Gun	SP14C	£35.19	£27.95	£32.84	
Super Pro Spray Gun	SP18C	£35.19	£27.95	£32.84	
Air Hammer	CAT298		£15.95	£18.74	
Die Grinder Set	CAT368	£24.46	£19.95	£23.44	
Grit blast gun	SB1		£21.95	£25.79	
Spot blast gun	SB2		£24.95	£29.32	
6" Dual Action sander	CAT80		£24.95	£29.32	
1/4" Sq. Drive Ratchet	CAT228	£31.67	£25.95	£30.49	
3/4" Air drill	CAT278	£32.84	£26.95	£31.67	
14pce 1/2" Ratchet set	CAT221B	£42.94	£33.95	£39.89	
13pce 1/2" Impact wrench set	CAT231B	£46.94	£37.95	£44.59	
High Speed Saw	CAT268	£34.02	£25.99	£30.54	

Clarke SWING ARM & MAGNIFYING LAMPS

FROM ONLY £7.95 EX VAT £9.34 INC VAT

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

Ideal for fine detail work

- Features clamp

* Lamp Only

Clarke BENCH GRINDERS

CBG8W features 8" wetstone & 6" drystone.

FROM ONLY £12.75 EX VAT £14.99 INC VAT

MASSIVE PRICE CUTS

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

‡ REDUCED! CBG8W was £41.07 inc VAT CBG8RSC was £31.67 inc VAT

Clarke ENGINEERS WORKBENCHES

FROM ONLY £114.95 EX VAT £135.07 INC VAT

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

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

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

Clarke AIR COMPRESSOR

WIZ OIL FREE MINI AIR COMPRESSOR

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

MASSIVE PRICE CUTS

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

Clarke ROTARY TOOL SYSTEM

CRT40

ONLY £25.50 EX VAT £29.96 INC VAT

Kit includes:

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

Clarke TAP & DIE SETS

FROM ONLY £12.95 EX VAT £15.22 INC VAT

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

‡ REDUCED 28 piece was £24.62 inc VAT

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

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

Clarke HEAVY DUTY

PROFESSIONAL TOOL CHESTS & CABINETS

THE ULTIMATE IN TOOL CHEST STORAGE!

- Extra heavy gauge double wall steel construction

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MODEL	DESC	DRAWER LOAD	EX VAT	INC VAT
CHB204	4 Dr chest	38kg	£74.95	£88.07
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CHB206	6 Dr chest	38kg	£94.95	£111.57
CHB209	9 Dr chest	38kg	£119.95	£140.94
CHB203	3 Dr step up	38kg	£54.95	£64.57
CHB215	5 Dr cab	43kg	£169.95	£199.69
CHB217	7 Dr cab	43kg	£199.95	£234.94
CHB212	3 Dr cab	43kg	£129.95	£152.69
CHB213	3 Dr cab	43kg	£159.95	£187.94

Clarke TORCH KITS

BEST BUY CAR WELDING

CBT5K (left) 5 functions; hot knife, soldering torch, hot blower, pencil flame torch & wide flame. Requires butane gas.

ONLY £19.95 EX VAT £23.44 INC VAT

CBT1 (right)

- Uses gas lighter fuel
- Adjustable flame (temp up to 1300°C)

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Clarke MIG WELDERS

FROM ONLY £119.95 EX VAT £140.94 INC VAT

Includes free:

- Face mask
- Earth clamp
- Gas regulator

Pro90-150TE also inc

- Welding wire
- CO_2 gas bottle

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

* Turbo fan cooled for longer welding at full output

Clarke MEASURING INSTRUMENTS

OTHER SIZES AVAILABLE

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

‡SLASHED CM145 was £35.19 inc VAT

Clarke SOLDERING GUN KIT

CSK100

ONLY £12.95 EX VAT £15.22 INC VAT

- 100w, 230v, trigger operated instant heat soldering gun with spare tip
- Solder Coil & pot of flux
- Scraper/probe tool
- De-Solder tool to remove excess solder
- 30w, 230v soldering iron & stand
- Hands free magnifier

KIT BOX INCLUDED

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CAG115C BEST BUY Practical Householder

FROM ONLY £12.95 EX VAT £15.22 INC VAT

Inc. disc & handle

* 115mm, #230mm

MODEL	DUTY	MOTOR	EX VAT	INC VAT
CAG121*	DIY	500w	£12.95	£15.22
CAG115*	PRO	500w	£25.95	£30.49
CAG115C*	PRO	720w	£24.95	£29.32
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GREAT Books and Projects

a Christmas selection:-

Clockmaking for the Model Engineer • Thorne • £ 13.95

■ Written to help the established engineer who would like to build a first clock, here there are no instructions on how to get the best from your lathe, how to set up work on the milling machine, or similar sorts of advice; it is assumed that you know these things already, and are experienced in the use of hand tools.

■ This book takes you through the construction of a typical clock, describing those techniques of the clockmaker that differ from, or are seldom used, in model engineering. Specialist tools and their uses are also described as the need for them arises. Virtually all of these tools can be made by the clockmaker.

■ Finally, drawings are provided for one simple, and unusual, clock which is ideal as a first clock making project, but which still requires you to make all the pieces likely to be found in many more complex timepieces.

■ Here Colin Thorne provides the engineer with an ideal introduction to the fascinating world of clock making. Here is comprehensive information, put over in a relaxed and readable way, with lots of wrinkles which will useful to all engineers, whether or not they go on to build their own horological masterpiece. Any engineer considering making his first clock should have this book on his bookshelf.

■ 88 A4 format pages. 58 drawings in text plus complete set of 9 drawings for the *Benjamin Franklin Clock* and 11 B & W photos. Softcover.

Building the Tesla Turbine • £ 7.60

■ As we know from sales of our book *The Tesla Disc Turbine* (see bottom right), interest in these wonderous machines is high, possibly helped by the fact they are pretty simple to make.

■ Whilst it does give some historical background, the main purpose of this book is to show you how to build your own Tesla turbine, in this case a fairly big machine having eighteen 3 diameter discs, and measuring 3½ wide by 6 long x 4 high. This may not sound very large, but these fascinating machines pack quite a wallop, Tesla himself aiming for ten horsepower to the pound of weight .

■ This book from Vince Gingery is an excellent guide to a straightforward and quick project, which results in something quite spectacular. 48 pages, 46 drawings and photographs. Softcover.

Building Stirling Engines without a lathe • Hoejfeldt • £ 8.10

■ Fancy building a working engine with hand tools only? Now you can!

■ Described are a simple Stirling, or hot-air engine, followed by five other increasingly sophisticated machines which demonstrate the main types of Stirling engine, all built using only ordinary hand tools, an electric soldering iron and a gas blow-torch, from tin cans, wire coat hangers, old gloves, parts from scrap computers, gramaphones, video players etc.

■ The author covers how to build the first engine in some detail, and then how to construct the subsequent five engines, which largely develop from each other, in slightly less detail, but still plenty enough for you to build them. You won t find any drawings, as the measurements of your engines will depend on the dimensions of the scrap you use, notably the tin-can for the cylinder, but deriving the dimensions is covered in the text, and there are numerous photographs of set-ups, parts and so-on to guide you.

■ There is also a brief overview of the history of the Stirling engine, and an Appendix of recommended reading, films and useful websites. 40 A4 format pages. 45 B & W photos and illustrations. Softcover.

Building the Maltese Falcon • Shelley • £20.45

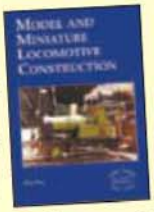
■ Want to build a BIG model I.C. engine? Well now you have the chance!

■ Jim Shelley has a passion for big model aircraft, in his case a 15 ft wingspan Taylorcraft, and developed the *Maltese Falcon* to power this.

■ The result is a 260cc Flat Four, Side Valve engine which turns a (scale) 34 x 18 propeller at 2500 rpm, and measures 8 in length and depth, and 13 in width across the heads. Essentially designed to be built from solid, Jim can supply certain parts, notably a magneto kit, and standard Honda pistons can be used if you want to get your *Maltese Falcon* running as quickly as possible - parts suppliers are listed.

■ What is really intriguing about the *Maltese Falcon* is what else you could drive with it, in some cases with modifications to the cooling arrangements; large scale model road vehicles, notably a model tractor, and 7¼ gauge railway motive power, but an outboard motor, a GT lawn mower and a motor bike would also all seem possible for the clever amongst you.

■ In this book you get the full drawing set of 11 sheets, reduced in size to fit A3 format, and 36 A4 pages of notes, hints and tips on building the engine, plus numerous photos of parts and set-ups for making them; this isn t a construction manual in the conventional sense, but it is all good solid information aimed at helping the builder to make a model I.C. engine which really will make people s jaws drop! Wirebound with card covers.



Model and Miniature Locomotive Construction • £33.30

■ Great book by Stan Bray on the construction of model locomotives from Gauge 1 to 7¼ gauge - steam, electric & i.c. powered locomotives are all covered, with the accent on the passenger hauling scales.

■ Frames, axleboxes, valve gear, cylinders, boilers, wheels, platework and other major components are covered in separate chapters, each illustrated with drawings and photographs of the relevant parts and their construction.

■ Very good on the machine set-ups for parts, and a cracking good read and ideas book being written in Stan s inimitable style; there are numerous asides, often humourous, and 100s of hints, tips and shortcuts. High quality and hardbound. 208 pages. 158 drawings, 300 B & W and 32 colour photos. 12 charts.

Building the Bentley BR2 World War I Rotary Aero Engine • £14.90

■ This book contains full drawings and instructions for building a one quarter scale working model of a *Bentley BR2* rotary aero engine; amongst the most powerful, and last, rotary engines to appear. In 1982 Lew Blackmore won the Duke of Edinburgh Challenge Trophy at the Model Engineer Exhibition with his model and subsequently wrote this book on the engine s construction.

■ As far as we are aware, this is still the only book describing the building of a large scale working model of a real aero engine. The model makes a fascinating project for the more advanced model engineer - an ever increasing number of excellent models have been constructed from this book.

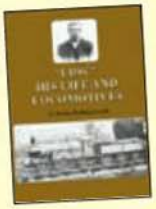
■ No castings are required to build the engine which makes it an economical, as well as satisfying, project. Also included is a reprint of the 1925 MoD descriptive handbook for this engine, which will aid those less knowledgeable on this type of engine to understand its working. If you are interested in IC engine building, or just want to build something different, then this is a book you should consider carefully. 95 pages, with full drawings and numerous photos of set-ups, parts etc. A4 format paperback.

Building Stirling I • Warbrooke • £ 7.20

■ In this best selling book, Ted Warbrooke describes how to build a unique form of Stirling Engine which does not have a displacer. The theoretical possibility of such an engine had been long considered, but as far as we are aware, Ted s was the first design that actually worked.

■ Because the only moving parts are the piston, crankshaft, crank and flywheel this is a very simple engine to build, and an ideal project for the beginner. Equally it will have considerable appeal to Stirling Engine enthusiasts as the possibilities for experimentation with this design are considerable.

■ This book contains full drawings for the engine, plus hints and tips on building it, assembly photos etc.. *Stirling I* requires no castings, and can largely be made from bits in the scrap box. Simple but accurate turning, some hand work and some soldering are all that is required to build this fascinating engine. High quality 32 page A4 paperback.



'LBSC' His Life and Locomotives • £26.50

■ There can be few model engineers who have not come across LBSC s designs or writings and the statistics are impressive: 112 designs published over 44 years, over 3000 articles published in *ME* and other magazines, the last only a month before his death at the age of 84. And he built 55 small steam locomotives himself.

■ What made him famous was his style of writing - informative, opinionated and down to earth, it gave the ordinary man the confidence to realise that he could build models if he wanted to, and then told him how to do this. When one considers just how many model locomotives have been, and are being, built to an LBSC design, his impact will be realised.

■ In this masterly book Brian Hollingsworth looks at LBSC s life, writings and designs in some detail, warts and all. The enmity between LBSC and Henry Greenly is considered at length, as is his latterly somewhat fraught relationship with *ME*, and his sexuality.

■ This is a fascinating and highly readable book on a fascinating and highly readable man, and is a book any model engineer with an interest in the growth of his hobby should have on his bookshelf. 112 pages. Over 220 B & W photos and drawings. Hardbound.

The Tesla Disc Turbine • Cairns • £ 6.90

■ Nikola Tesla is famed for the Tesla Coil, but another of his inventions is the subject of this book and has nothing to do with electricity, other than perhaps as a possible means of generating it. This was his Disc Turbine for which a British Patent, which also covered a compressor variant, was granted in 1910.

■ Unlike a conventional turbine, in which the rotor consists of bladed segments, in Tesla s machine these were replaced by discs. Tesla claimed that a very small, but extremely powerful machine was possible using this principle - his aim was to produce a 25 hp machine that would fit inside a bowler hat.

■ Here the concept, and the history, of the original engines, are described in detail. Uses for such turbines, including car and light aircraft, are proposed, all illustrating the extraordinary versatility of Tesla s engine. Finally the drawings and building instructions for a small Tesla turbine, which any model engineer can build, are included. Not only does a Tesla turbine provide a very high power to size ratio, it can be used as a compressor or pump. Build one and see just how versatile it can be!

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SMOKE RINGS
With the Editors

CAD and the designer

The editorial team always enjoys the debates which arise in the *Post Bag* columns of *Model Engineer*. It seems that the subject of computer aided design is causing some interest at the moment, and there is much speculation as to its ability to reduce errors on the drawings we rely on for the production of our models. It is difficult to over-estimate the effect that this technology has had in industry. Neil was once involved in a study to assess the cost savings resulting from the introduction of CAD technology into the company in which he then worked. They amounted to a minimum of 50%, stemming mainly from the simple fact that the designer no longer had to prepare finished drawings after making his preliminary or rough drawings. Once he had his rough drawings, he had his finished drawings too as any errors and wrong lines were simply eliminated from the screen before printing. The powerful analytical and self-checking facilities which feature on some of the more advanced CAD packages also played a part in achieving this saving.

Does CAD software cut down on errors? Any CAD package still relies on a person to press the buttons and create the design, and so it follows that errors are still possible. Neil recalls a conversation with an experienced CAD training instructor in which he asked how long it took to train someone before he or she became a proficient CAD designer. The instructor thought for a moment and said *"I can show someone how to use the system in a couple of weeks and then they need a few weeks practice to gain proficiency. However, that does not mean they are competent designers. At one time, it was not uncommon for newly qualified designers to work under a senior designer for a period of up to 10 years before they were considered fully competent and worth the full rate of pay. Being trained in CAD does not teach you how to design."*

Bearing these words in mind, it is perhaps not surprising that errors occasionally creep into drawings produced by our contributors and it says much for their ability that we get away with so few. Much is made of the practical skills necessary to practise model engineering but we tend to forget that designing is also a skill, a very demanding one at that.

We recently had the opportunity to examine some reproductions of the drawings of the LNER A4 Pacific locomotive, *Flying Scotsman*. The quality of draughtsmanship was superb and the drawings could well be considered as works of art. We believe the draughtsman who prepared those drawings would have trained up very well on CAD — it is evident that he had nothing to learn about design work.

It should also be noted that CAD packages do not teach the skills involved in making correct engineering drawings. In the same way that to be comprehensible, never mind effective, written communication demands structure involving the correct use of words, grammar and punctuation, drawings too require a standardised and recognisable format. CAD software is superb at making drawings look neat and tidy, but it cannot correct badly prepared material.

New home!

Dave Roberts, proprietor of D. J. Bookbinders, the transport magazine and journal binding specialists, tells us that they have now moved to new premises in Dorset. He writes:

"Since we wrote to you in August with details of our new address, we have been on the move again! We knew our stay at the Enterprise Centre in St. Albans would only be temporary, as it has been our ambition for some time to move to the country, but we did not know just how short a stay it was going to be. As you can see from our new address, we have found our idyll in the Dorset countryside. We hope to be up and running again by mid-November, but please give us a call before coming or sending anything by post.

"We do hope that if you have been a personal visitor you will consider the journey to Harmans Cross worthwhile, but we would welcome you as a postal customer and can give you details of our postal rates on enquiry. If you are coming in person it normally takes us a couple of hours by car from St. Albans. We are on the main road from Corfe Castle to Swanage. The journey from Waterloo to Wareham takes 2 hours and there is a bus service from Wareham to Swanage which stops at the top of our drive. There are many attraction on the Isle of Purbeck to make it worth a visit, not least the Swanage Railway which runs from just outside Corfe Castle at Norden, into Swanage. Harmans Cross station is a 15 minute walk from our premises.

"We can assure our postal customers that the service will be as before, and once we have evaluated courier services in the area we hope to be able to offer a more competitive price for the return of larger quantities of bound volumes in one parcel. Please 'phone to check prices.

"We look forward to welcoming you to our new home and workshop."

D. J. Bookbinders have moved to Lifton, Valley Road, Harmans Cross, Swanage, Dorset BH 19 3DX; 'phone: 01929-481419; e-mail: **djrob@binders.freeserve.co.uk**

A Gearing Paradox: M. Jacques Maurel in France made this gear mechanism and asks readers to decide whether the arrangement is locked or movable - and why?

A new challenge

We know from the letters received that many readers enjoyed the puzzle posed by M. Jacques Maurel when he presented his Intriguing Object (*M.E.* 4165, 22 March 2002). We are therefore delighted to publish here the first in a new series of questions from this contributor. As on the previous occasion please *do not* send answers to *Post Bag*; the answer will appear in the next issue.

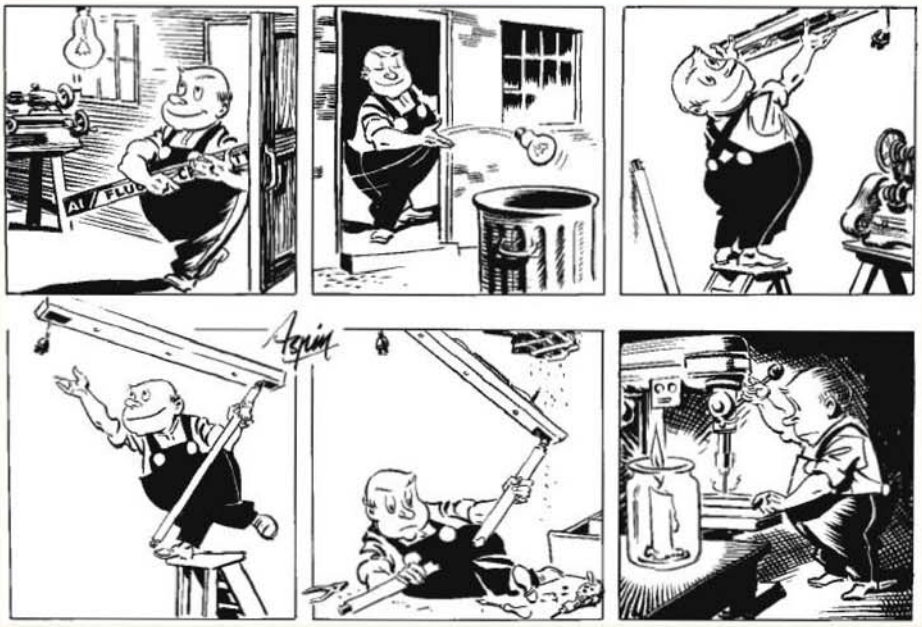
The accompanying photograph (above) shows a mechanism made with three stepped gears meshing together. Each stepped gear consists of a stack of ten wheels, each wheel (the thirty wheels are identical) being a spur gear which has three teeth of true involute form. The module is approximately 25mm and the pressure-angle approximately 50 degrees.

The question is this: is this mechanism movable or locked — and why?

Superheaters

Following recent correspondence concerning the silver-brazing of stainless steel superheater elements to their headers, we are pleased to report that the appropriate Johnson Matthey Argobraze 56 filler rod is now available from Polly Model Engineering Ltd. ('phone 0115-973-6700) at £7 plus 75p p&p(UK) per ø1.5 x 600mm rod. A stainless steel grade flux is also available from the same source for use with this silver-brazing alloy.

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



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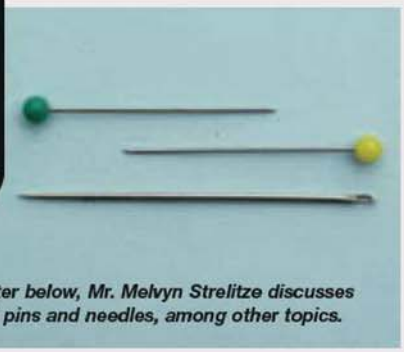
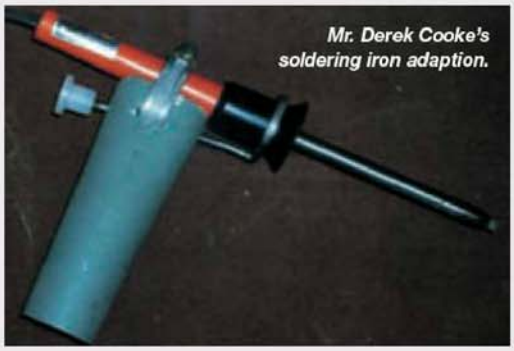


In his letter below, Mr. Melvyn Strelitze discusses imported pins and needles, among other topics.



Mr. Derek Cooke's soldering iron adaption.

Paper and pins

SIRS, - Having recently prematurely ended my working life that started as a thirty-shillings a week apprentice in what was supposed to be 'a trade for life' in West Yorkshire's textile engineering world I have seen many odd facts stated in engineering books, but a few recently have me really baffled.

In a book on Swindon's GWR works there is a mention of railway wheels made of compressed paper! Could these have been light duty wheels for dangerous environments in chemical/explosive works or something more (or less) esoteric?

In the same book, the author talks about chunks of steel being dangerously chipped off red hot pieces being stamped that heated up during flight across the press shop so that when they landed they glowed white hot. What could this heating be due to?

In a book on sniping there is the remark that during tests a 'paper' bullet had the best penetrating power of all! How could paper be so rolled, pressed or otherwise formed so as to penetrate steel plate?

Model Engineer readers span all sorts of weird employment circles so perhaps some can shed light on these paper wheels and bullets and press shop missiles.

We are quite pleased with all the Chinese made tooling now available that quite often has a finish never attained in Britain, but has anyone noticed that the Chinese cannot make a sharp needle or simple dressmaking pins that are both sharp and rigid enough to penetrate simple cloth? Both needles and pins are very blunt and the pins are seemingly made of soft mild steel rather than the better pin steel used formerly in Britain. Samples enclosed for your comments (*photo above—Ed.*) and please don't ask why I combine engineering with dressmaking!

Melvyn Strelitze, W. Yorkshire.

PTFE piston rings

SIRS, - I write to ask if anyone is aware of any information regarding the machining, sizing and fitting of PTFE piston rings. Stan Bray refers to them in his book* but provides no details. I also noticed a snippet on the topic from Mr. R. J. Hobdell (*M.E.* 4226, 23 July 2004).

Perhaps an article on the subject may be of interest to readers building steam engines. In the meantime any assistance which could be provided on the subject would be much appreciated.

As an afterthought, Bay Plastics of Newcastle stock various types of filled PTFE. I believe the carbon filled variety to be the best for steam use. I stand to be corrected in this matter, but it seems awfully expensive at about £12 or more per inch of 60mm diameter.

John Southouse by e-mail.

*(*Model and Miniature Locomotive Construction *by Stan Bray, ISBN 0-9536523-7-8 is published by and available from Camden Miniature Steam Services, Barrow Farm, Rode, Frome, Somerset BA11 6PS; 'phone: 01373-830151; fax: 01373-830516; e-mail: orders@camdenmin.demon.co.uk for £33.30, UK p&p included.)*

Modifications to a soldering iron

SIRS, - Herewith another offering in the hope that it will help fellow sufferers from the pangs (that's a kind word) of old age.

Some years ago, a reader writing to *Post Bag* recommended the 'Scope' soldering iron. At that time my rarely used electric soldering iron (dating from the thirties, and on its second element) was taking a long time to heat up, and probably on its last legs. I owned a 'Miniscope' and its transformer, so it seemed a good idea to purchase its 'big brother'. Both these operate by having a large current from a low voltage transformer pass through a carbon resistor in intimate contact with a small copper bit, the contact being provided by sliding the resistor against the rear of the bit. The 'Iron' is thus into action in seconds.

The *Mini* had a convenient lever, but when its big brother arrived, I found I had to push a sleeve forward while holding the iron, in order to make it perform. Okay for the young and agile, but in the end I had to adopt the solution shown. The handle is a piece of aluminium alloy tube, about 35mm dia. and about 135 mm long. It was sawn from the end of our backyard umbrella which was too high. A half inch rat tail file was used to groove the top end after it had been squashed in the vice. An offcut from a shop restoring exhaust systems for motor cars would be able to produce a similar tube, or a piece of 'two by one' drilled through the longer dimension and then sawn through the hole would do.

A Jubilee clip is used to hold the handle to the 'iron'. The operating rod was either 5/32in. or 4mm dia or thereabouts. A round hole was drilled at the back of the handle to clear, and one at the front, which was elongated using a small file. The rod was welded to a loop cut from the end of a suitable piece of pipe, and this was the 'pusher' for the sleeve on the iron. The push-button was turned from a piece of round polyethylene, and like the rod, threaded 5/32in. BSW.

Enough thread was organised for a lock nut, but this proved unnecessary. The slots for the Jubilee clip were chain drilled, and with a piece of wood between the sides, a small cold chisel cleared most of the rest. A file, a relic of Kettering ignition, finished the job. It may look as though the clip goes through the push-rod, but it pursues a circular course beneath it. The thin hard alloy of the handle gave an adequate grip on the tapered body of the 'iron'. Otherwise I would have interposed some insulating tape. The final result was a posh piece of coarse engineering.

A note of caution: when using the sort of acid fluxes which are used in conjunction with the solders for stainless steel, or humble old Baker's fluid (zinc chloride), or phosphoric acid (obtainable from your friendly neighbourhood hardware store as 'Rustkiller' or similar) do be careful about applying them to the bit on your 'Scope'. Keep the bit pointing downwards, and use a minimum of the stuff. If you don't, the next time you come to use the 'iron' you may well find it is dead.

There is an apple green layer on the carbon resistor, and on the thread (1/4in. BSW) of the copper bit. Scraping the heating element clean is easy, but trying to hold the bit to wire brush the verdigris from its thread is not easy. A degreased 1/4in. BSW button die can come in handy. An hour later, you may well be back in action! Those cotton buds made like double-ended bacterial swabs, and available in your local supermarket or friendly corner shop are useful for application of these fierce fluxes. They are useful for swabbing up excess Loctite too!

The name Jubilee might fox some readers. The worm drive clip was put on the market by Terrys of York at about the time of King George V's Silver Jubilee. Almost 70 years later, it is still going strong. It can come in handy as a work holder. Coarse engineering? Costs next to nothing, requires little effort and time, does the job, and who cares what it looks like? It is the antithesis of putting scraper marks on surfaces which don't need it.

By the way, it was the Terry of York which made top-notch springs, not the Terry of York which made superb chocolate, and still does. I hope the other Terry is still going.

Derek Cooke, Western Australia.

Loch toolboxes

SIRS, - Neville Evans mentions the modifications made to some of the tenders fitted to the Highland Railway 'Lochs' when the toolbox was removed from the rear (*M.E.* 4232, 15 October 2004).

According to two authoritative sources, it was the tank which was extended, not the frames which were shortened; the longer tank is said to have increased the capacity by 100 gallons. The three 1917-built locomotives had the modified tenders from new. Curiously this modification does not seem to have been made to the almost identical tenders fitted to the 'Big G'oods.

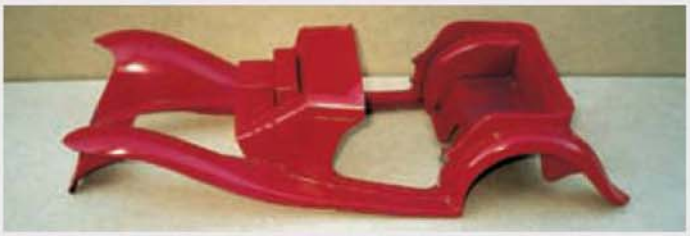
The authorities referred to are *H. R. Locomotives - Book 1* by J. R. H. Cormack and J. L. Stevens, (Railway Correspondence & Travel Society, 1988) and *Rail Model Digest No.1*, featuring Peter Tatlow's illustrated description of the H. R. 'Lochs'.

Ian Dawson, Sussex.

Annabel

SIRS, - Just a line to express my pleasure on reading Jim Robson's article on *Annabel* in *M.E.* 4232, 15 October. I have always been fascinated by the huge American locomotives with their multiple power units and the enormous power available. They certainly put our British engines in the shade and indeed it is doubtful if the huge American types could ever be accommodated on our railways.

The article will certainly whet many readers' appetites for more information and I turned to my copy of *The History of North American*



Mr. Stephen Atkinson's miniature MG TC progresses. Top left: the completed chassis is painted; bottom left: the bodywork is ready for fitting the doors and bonnet; right: an assortment of 'bits and pieces' with one wheel chrome plated as a test piece — they have now all been similarly treated.

Railroads, edited by Bill Jenne, and published in 1986 by Bison Books Ltd. Sharp and highly detailed, the photographs are amazing, and include not only a magnificent 2-6-6-2 (pages 172/3), a superb 2-8-8-4 (pages 102/3), but an amazing 'triplex' articulated 2-8-8-8-2 (pages 120/121).

However, not only does the book show articulated locomotives, it also features many earlier and simpler locomotives and some of the other monsters, such as the huge turbine locomotive, a 6-8-6 with 16-wheeled tender. This locomotive features huge connecting rods on the four drivers each side and enormous steam pipes to the turbine (turbines?). Another interesting design was the cab-ahead locomotive, shown on pages 8/9 in 2-8-8-4 formation, a fascinating engine, rather as if the engine is running in reverse (even the cylinders are behind the drivers but the cab is forward, with windows and so on all round and across the front.

As I understand it, the main problem with articulated locomotives was the loss of steam pressure in the pipework between boiler and pistons, solved, if at all, in many different ways. Unfortunately the book referred to is an *historical* account of the growth of the American railway *industry* rather than the intimate details of its locomotive construction, and for these established booksellers, including old friends, Camden Miniature Steam Services ('phone: 01373-830151) will surely be able to help as few railways have been photographed and written about more than those in America. I am sure Jim Robson will find answers to his questions quite easily, perhaps on the Internet.

Richard A. Deal, Hertfordshire.

Socket sets and square stuff

SIRS, - I did enjoy *M.E.* 4231, 1 October 2004. The tiny socket set was an inspiration — I have already made one, though I am not happy with the ratchet wheel or the finish, so I will be making a second!

I believe this to be the sort of article people mean when they ask for more articles like in the 'old days', very much in the spirit of *Duplex* and *Geometer.*

Can anyone point me in the direction of a supplier of 1/16in. square mild steel? I need some for *Lady Stephanie's* eccentric 'rod' but I can only find brass in this size.

Neil Wyatt, Staffordshire.

MG TC progress

SIRS, - Following publication of the article describing my louvre press (*M.E.* 4228, 20 August 2004), I enclose for your interest some recent photographs showing progress on my MG TC.

I am now working on the final part, the bonnet. I have the sides made with their louvres as detailed in the article, but the hinging together of the four sections is proving to be a real problem. Making piano hinges and the top hooking-together type of hinge is not easy.

My aim is to have the car ready for the next Model Engineer exhibition at Sandown Park. It is the best I can manage, so all I can do is to hope!

Stephen Atkinson, N. Ireland.

Monotube boilers

SIRS, - I have been experimenting with flash steam or, as they are referred to more precisely, monotube steam generators. Mine are installed in 5in. gauge gas and oil fired locomotives and of course the issue of boiler testing has arisen. I would like to get this sorted out and cleared up, if possible with a ruling from the Southern Federation of Model Engineering Societies. There is no mention of this type of boiler in their boiler testing guide book.

I have had one tested as if it were an ordinary boiler, but all that is being tested is a length of 8mm copper pipe, which everyone knows would take a few thousand psi (mine was tested to 600psi). The only parts really tested are the unions at each end of the pipe! Two other clubs said it did not need a certificate, as it is not a boiler, just a long steam pipe. If they burst, nothing much happens except a loss of pressure, bystanders being shielded from the leak by the outer casing.

I have been told that if a monotube is treated as a boiler and tested under Southern Federation rules, it must be made of copper and not stainless steel. All the 'Experts' will tell you that flash boilers *must* be made of stainless or else they will melt or burn away. Mine has not done this, but I would prefer stainless in a future project, and I am told it cannot be tested. I have used stainless for a separate superheater, fitted after the regulator and auxiliary take-offs. The objection to stainless in conventional boilers is mainly based on the welding of it, but these monotubes need not be welded at all.

Does anyone seriously think that a stainless steel tube is in danger from a working pressure of 300psi? This implies that copper is stronger than stainless under the conditions obtaining, which we all know not to be true.

What is the position regarding flash steam hydroplanes? Some time ago there was some publicity about a monotube boiler suitable for coal firing (Ted Jolliffe had something to do with the company promoting it) but testing was never mentioned. The trouble is that it always seems to be assumed that all we ever make are conventional locomotives with conventional boilers. We should not have rules which discourage experimentation. My own opinion is that the safety valve and any *external* pipework should be tested since that is where steam leaks could be dangerous.

I think that stainless should be permitted in a monotube boiler, because it is already widely used in superheaters. It is quite absurd to recommend it in a locomotive type boiler and condemn it in a monotube type. Unless an arbitrary point is selected, as I have done by fitting a regulator at a certain point, you cannot tell where the 'boiler' ends and the 'superheater' begins!

I really hope that some clarification can be made on this issue.

Keith Pearson, Gwent.

Bandsaw blades

SIRS, - With reference to Mr. G. McLatchie's letter relating to bandsaw brazing (*M.E.* 4232, 15 October 2004), Axminster Power Tool Centre solved the problem for me (usual disclaimer). I bought from them an American made kit identified as a Blade Brazer. Contained in a plastic box, the kit comprises a grinding jig, flux, brazing material, clips to hold the blade while heating, and full instructions.

Axminster's own bar code label attached to the box carries the number BR 15101, which is presumably their catalogue number. I hope this information is of use.

Incidentally, my last order from Axminster was about a month ago, and the young lady who took my order explained that I would receive the items one to two working days from the time of my call, which was on a Friday morning. I received my goods Monday morning. You can't expect much better than that!

Derek Collier, S. Gloucestershire.

ELECTRO-PNEUMATIC CONTACTORS

An accelerating relay. The coil carrying the motor current lifts the contact disc seen at the top of the relay. The calibration is adjusted by adding weight to the container in the coil.

Colin Beckwith

introduces a major new series on electric traction.

Part I.

Model engineers who build steam locomotives have always endeavoured to manufacture accurate representations of their chosen prototype in terms both of their construction and operation. This article has arisen from a wish to apply a similar psychology to miniature electric traction and to provide an insight into the level of complexity to which the Author has gone toward achieving this. The goal has been to reproduce the operation of a full size electric locomotive in model engineering scales. While the focus is on the design and construction of the key item of apparatus, namely the electro-pneumatic contactor, the series will also provide a basic grounding in electric traction techniques.

Driving a full size electric locomotive is nowhere near as difficult as driving a steam locomotive. Efficient steam operation derives from years of learning locomotive design coupled with an understanding of its very individual operating characteristics. It could hardly be said that driving an electric locomotive is as physically demanding as driving a steam locomotive. I accept this fact without reservation and respectfully tip my hat to those who can drive steam locomotives with nonchalance.

"Hang on though, there must be more to electric trains than that?" I hear you say. *"Yes!"* I answer, *"there is much more to it than selecting forward, releasing the brake and pulling the power handle round to notch 4."* True enough, although the motorman has quite a simple job when it comes to moving and stopping the train. The reason that he has such an easy time is more by design than by accident, enabling the delivery of energy to machines requiring, in full size, hundreds of kilowatts of electrical power. This is where the feats of science and engineering begin; feats which include accelerating the vehicle at the maximum rate which wheel-to-rail adhesion will permit, and doing so not on one traction-unit, but on say six, which may be up to 250 yards down the train, with equal precision of control on each. Or controlling as much as 10,000hp with no more effort than it takes to drive a car — and frequently less. It is the technology that enables this to happen which is the focus of my model engineering goals.

So much for the full size jobs; what about applying this to a miniature traction unit? Well, you could get one of any number of proprietary black boxes and connect this to a hefty battery and a couple of wheelchair motors. Then, *hey presto*, you are half way to an electric locomotive, albeit less brakes and bodywork. I realise that this description represents the aspirations of many in our great hobby. I hope these good folk will forgive me if say now that this is not my approach. I feel I have sufficient grounds for a single-minded lack of reticence here. My justification is born out of a familiarity with what goes on beneath countless electrical equipment covers and slab-sided locomotive bodies. I will try to give readers a basic understanding of how and why I elected to aspire to building a miniature version of a full-size electric traction unit.

Electric traction techniques

On the outside, electric trains are quite simple looking devices, gliding in and out of stations with seemingly effortless power. A glance inside abruptly changes this impression for observers unfamiliar with electrical technology. I must be careful here to avoid over complicating the whole issue. Most will appreciate the basic items of power equipment necessary to make an electric train go, forgetting for now the plethora of system voltages, which further mask the issue, and focusing on the immediate. We know that electric trains are almost universally propelled by large electric motors. We also know that trains will take their power, while under way, from some fixed supply installation; this will be at whatever voltage or format befits the service and terrain.

Between this supply infrastructure and the motors, we introduce a control system into which the driver will interface. The degree and boundaries of this interface will depend on the particular traction application. For example, a multiple unit on suburban duty will only really want to get up to full speed and do so as quickly as the limits of adhesion will allow. The steam locomotive in this instance needs more of a hand, as it were, the hand in this case belonging to the driver. The locomotive has a varied role ranging from heavy freight to fast passenger service; for this reason its driver has to adopt a very proactive approach to his task. He is given the very fine control of the road speed that the driver of a multiple-unit has not.

I would love to explore in great detail the complexities of AC traction, DC traction, system voltages, control systems, traction motors, drive systems and so on, but this is not really within the scope of this article. However, I will observe that electric trains, whatever class of service they occupy, will always need a control system. It is the electro-pneumatic or EP power contactor that can be a key component of any traction control system. It is the device which isolates the power circuit from the supply. When the driver opens his controller, the power contactors will close and start the traction motors. Often it will protect the vehicle's wiring, for example in the event of a short circuit in the traction motors. It will disconnect and isolate the power equipment from the supply when the train slows on approaching a station.

Remote switching

The levels of power required for most electric trains are too high for direct 'hand' switching of motor circuits. Such has been the case for many years, and various methods have been tried. So what exactly is 'remote switching'? It is a phrase I have used to describe the function of a relay in the simplest of terms. This relay, if given a very large switching duty together with specialised contact design, then becomes a power contactor thus allowing high-energy circuits to be switched remotely.

Let us consider this electro-magnetic or EM power contactor, given to switching perhaps hundreds of Amperes. Large currents need large conductors, typically 1,500 Amperes per sq. inch, which adds to the mass of all the moving parts. In an EM device these are invariably lifted in order to close the contacts. The coil needed to do this for a contactor rated at 250 Amperes, small by railway standards, is very large and hungry on power. Some readers may be familiar with the almost ubiquitous Metropolitan Vickers R type EM contactors used on hundreds of suburban trains for the Southern Railway between the wars. The contactors were rated 250 Amperes at 660 Volts and they were huge. Power demand for their operating coils was so high that they were fed at line voltage, yes that's right, 660 Volts. How's that for a Health and Safety issue? Due to the limitations of the EM contactor, a separate circuit breaker was needed to provide adequate fault clearance and isolation. This circuit breaker was bigger and even heavier than the contactors.

This situation can be improved relative easily with a little lateral thinking; not by me, unfortunately, but by others in the years up to and including 1905. Compressed air is, and was then, freely available on electric trains as it was provided for the braking system. This led to the use of a small air cylinder in place of the massive coil to close the contacts, control of the air flow being by means of a solenoid valve with a much smaller coil. Due to the minimal power requirement, the solenoid valve coil could be energised from a low voltage supply. The use of air at a pressure of about 70psi allows a large force to be generated by the cylinder to close the contacts very firmly.

Sufficient reserve capacity can be provided to compress a large spring located inside this cylinder when the contacts close. Once the air is exhausted from the cylinder this opening spring then gives extremely rapid separation of the main contacts. The EP contactor is thus eminently suitable for clearing electrical faults on the vehicle, an aspect which compares with the EM circuit breaker mentioned above. Unlike EM applications, the EP equipment requires no specialised circuit breaker,

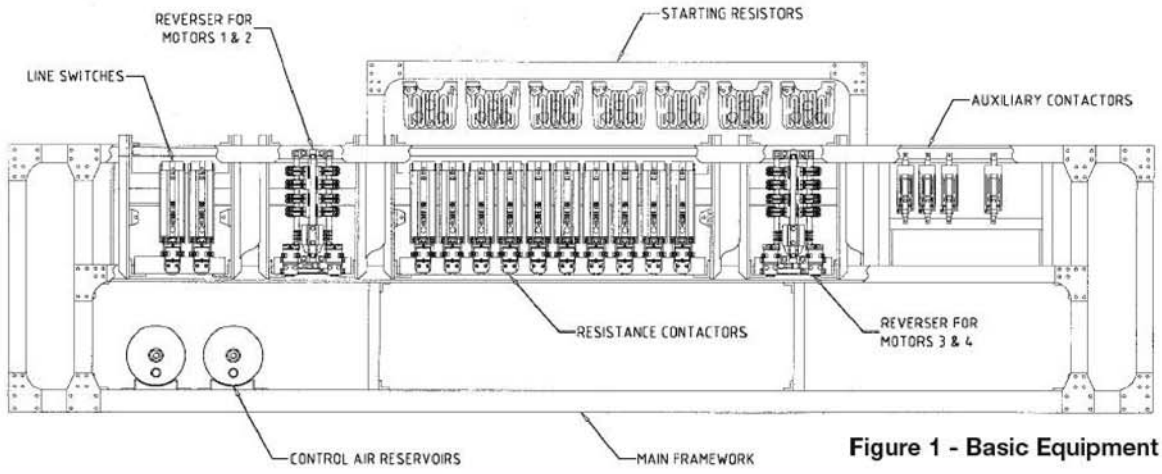


Figure 1 - Basic Equipment Layout

this duty now being in the hands of the so designated EP contactors. For any particular application, any EP contactor can be made interchangeable with others within the equipment on that vehicle. This simplifies design and reduces the predominance of spare parts and tools. It should be said that this feature predominates in the EM equipment contemporary with my choice of EP contactor, neglecting the circuit breaker of course.

Description of locomotive

The locomotive I have chosen to 're-create' is the well known 1200hp machine introduced by the Metropolitan Railway in 1922 and manufactured by Vickers Limited of Barrow in Furness. To my knowledge, two examples still exist; one is No. 5 *John Hampden* which resides in the London Transport Museum at Covent Garden, the other is of course No. 12 *Sarah Siddons* still operated by London Underground. The control system of these locomotives is very similar to the Southern Railway electro-magnetic installations once so common. The similarity even stretches to the traction motors, which are the celebrated Metropolitan Vickers 339. The Southern Railway ordered thousands of similar 339 motors for its suburban electrification.

The 1200hp locomotive is to be regarded as somewhat out of the ordinary and genuinely ahead of its time for 1922. The use of self-ventilated motors was an innovative step in those days, as was the simple two bogie configuration on a unit of this output and speed. The general rule of locomotives so flippantly referred to earlier does not hold true with the Metropolitan locomotive which was designed on multiple unit lines. This includes automatic acceleration, which is not strictly locomotive territory. To be fair though, it is possible for the driver to enable slow speed operation by holding the controller at half speed. This is the only non-wasteful speed step available, this being by virtue of the rheostatic series/parallel control used. With careful manipulation of his master controller, the driver can also hold the acceleration in any 'notch', a term more commonly associated with steam locomotive reversers.

It may be as well to explain some of the technicalities referred to above, particularly automatic acceleration and rheostatic control. Most motors are designed to have a very low internal resistance and traction motors are no different. I will not go into mathematics here, but suffice to say that connecting a motor having a resistance of 0.25 Ohms to a 660 Volt DC supply will result in the delivery of a couple of thousand Amperes or more. If this were allowed to occur, it would be an utter catastrophe, so clearly something has to be done, resulting in the need for the rheostat and rheostatic control. This rheostat is not much more than an enormous bank of electric heaters designed to waste energy. More importantly they limit the traction motor current to around 350 Amperes at initial starting.

The complication of the so called, 'back emf (electo-motive force)' now appears. Once the motor starts to rotate, it generates a voltage opposing that of the supply. Because this back emf opposes the line voltage, the motor current falls markedly as the locomotive accelerates. It is now necessary to switch out parts of the rheostat to raise the voltage to counteract the back emf of the motor. A fixed number of these resistance steps are cut out, continuing the progression up to full speed. This is done by power contactors, which operate in a 'programmed' sequence under the control of a special relay. The relay tells the contactors when to switch and thus accelerate the train. The accelerating relay, as it is termed, enables the acceleration process to be automated.

By this means, each 'resistance notch' is cut out at the proper time, or more correctly the proper current. The effect of this is to limit the starting current to a pre-determined value based on the optimum acceleration rate. The accelerating relay (**photo 1**) consists of a coil which carries the traction motor current with a disc shaped contact. Operating vertically, the relay lifts when the current is too high, opening the contacts. When the current drops the relay contacts drop thus re-establishing the circuit. The current at which the relay lifts is pre-set on the bench using special weights.

The amount of current deviation is governed to a great extent by how many notches occur during the acceleration cycle. The Metropolitan locomotive chosen has 14 distinct notches furnished by 13 electro-magnetic power contactors. These locomotives had two separate control equipment sets, one set for each pair of traction motors. The consequence is that each locomotive has 26 contactors plus two circuit breakers. For convenience I will describe only half of the locomotive. In order to limit the duty on the starting rheostat the two motors, each wound for 600 Volts, are arranged in series configuration. The first stage is rheostatic progression up to half voltage. That is 300 Volts across each motor.

The motors are then re-connected in parallel with further rheostatic progression up to full voltage and speed. This is accomplished without any break in tractive effort, under the auspices of a process called bridge transition. All this can be achieved without the intervention of the driver, save only to initiate the sequence by virtue of his master controller. The bridge transition described can be accomplished with a defined switching sequence. This sequence is pre-programmed into the equipment using specific control wiring layouts and the auxiliary contacts on which I will provide more details later.

It is the duty of the power contactors in the equipment, be they EP or EM, to provide this switching capability. They are the key components of any traction control regime.

My locomotive

When it came to reproducing this I was forced to make what I would call substantial compromises. I did not want to reproduce the locomotive control system exactly, but use it as a basis for the electrical equipment I have developed. I wanted to apply this methodology in a sympathetic manner and end up with a locomotive that looked similar inside and out, but only differed in the technical detail, albeit minimally.

I wanted to have series/parallel control and be able to apply automatic acceleration, in short to be able to copy the functionality of the full size locomotive. To achieve this I would have to apply exactly the same level of complexity to the control equipment whether it was electro-magnetic or electro-pneumatic. Mainly for reasons of practicality, but probably with a fair degree of obsession, I have chosen to use electro-pneumatic contactors to perform the switching functions.

I have included a basic equipment layout (**fig 1**) in order to show where the EP contactors figure in the main scheme. It will be seen that there are three main sets of equipment. The two line switches are provided for power circuit isolation and are EP contactors. The unit switches are divided into two parts. The four circuit setting contactors switch the power circuit configuration between series and parallel while the six resistance contactors switch out sections of the main starting resistor or rheostat. These ten EP contactors are mounted together but separate from the line switches.

The other items shown are the two reversers which, as their name suggests, reverse the traction motors. These are also EP in operation for many of the reasons stated in favour of EP contactors. The main starting resistor is mounted above the resistance contactors for ease of wiring and due to the heat generated when carrying current. Consisting of up to ten separate boxes frequently called grids, they are made of cast iron in sections, built-up to the correct resistance value.

To be honest I have to admit that at present the locomotive is still a 'design', but it is well developed and almost completely defined. The vast majority of the development work has been done and the control equipment forms the main part.

●*To be continued*

Trepanning the rocking arm mounting holes in the milling machine after chain drilling. The holes were then bored to size using the boring head.

Milling the keyway in the headstock plate for the master cam striker plate. The plate should to be a good fit in this keyway and needs careful fitting.

CAMCUTTER

A. J. Aldridge
in South Africa, explains how to make the headstock and tailstock units of his novel machine.

●*Part V continued from page 501 (M.E. 4233, 29 October 2004)*

The two plates which form the headstock **(fig 14)** can be profiled, sawn or laser cut which would include the 64mm wide sloping hole in the plates. In my own case, the pair were roughly guillotined then bandsawn to the shape with all measurements taken from the top bushing. My first attempts at making this hole were by chain drilling and knocking out the waste with a chisel, but in 8mm plate this is very heavy going and a far better way is to trepan the hole on the milling machine or vertical slide **(photo 22)**. Once the hole is in both plates, which are tacked together for the operation, the remaining features can be attended to.

At this stage most of the dimensioning is fairly open. The 22mm holes do not have to be exact, this just happens to be the size of the biggest drill in my possession. The keyway **(photo 23)** for the striker plate, on which the master cam bears, must be a good tight fit to the mating striker plate, so it is probably as well to make this first and use it as a gauge **(fig 15)**. The striker plate takes considerable force when the machine is cutting and must not have any free play, which would be seen in the cam profile as an error,

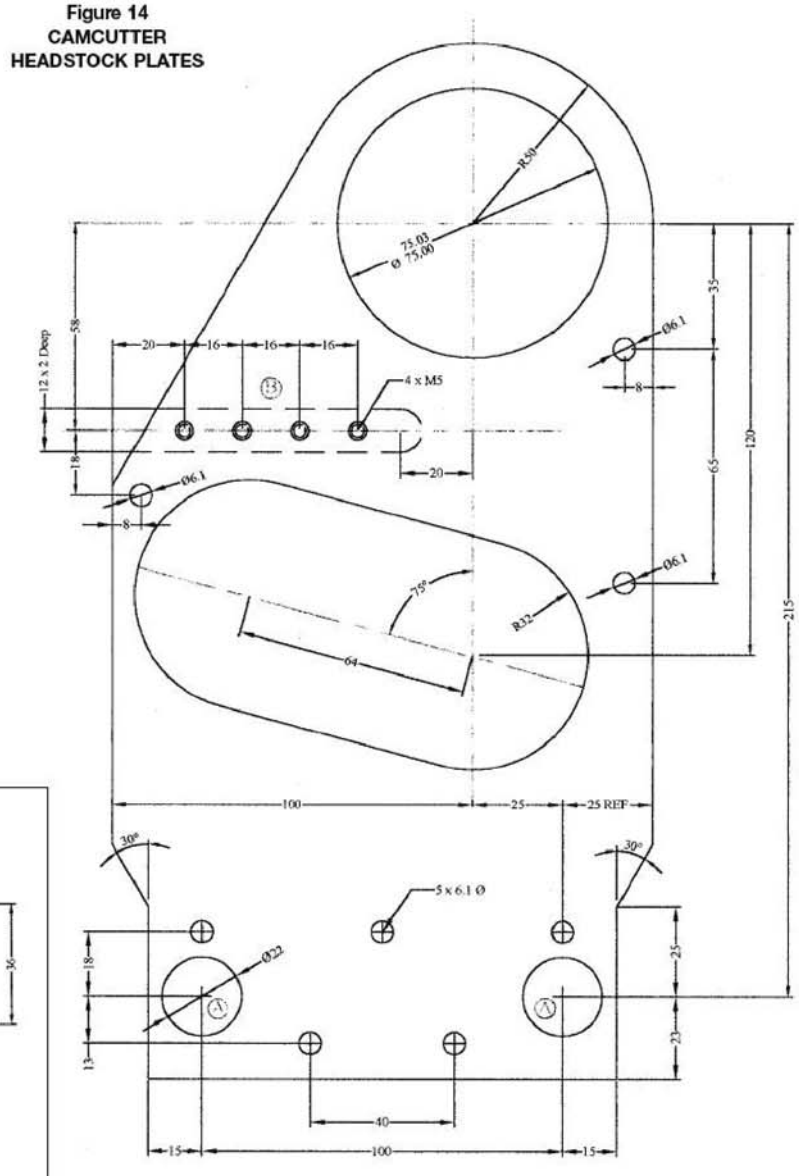


Figure 14
CAMCUTTER
HEADSTOCK PLATES

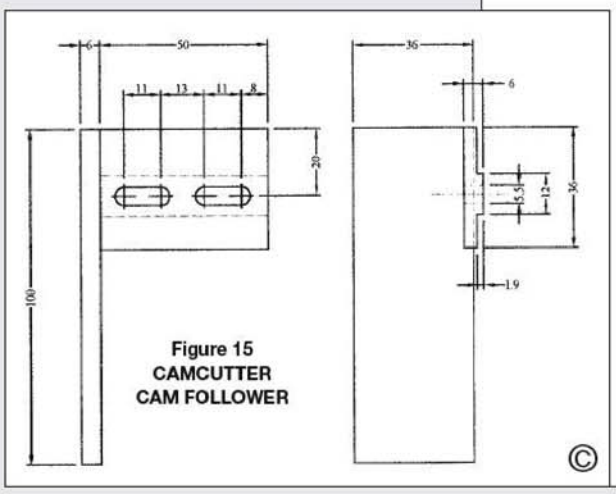


Figure 15
CAMCUTTER
CAM FOLLOWER

Boring the circular ends of the elongated sloping hole used for the tailstock stand plate on the milling machine.

Reaming the hole that receives the spindle in the tailstock top member. The component has been attached to a plate for machining.

therefore plain bolting is unacceptable. The keyway has a line of holes which will be used to clamp the striker plate through holding bolts.

The details which make up the headstock are shown on **fig 16**. Note that the bushings are given definite tolerances, something which we model engineers tend to avoid, but which should be used. In our normal work we tend to work to the nearest 0.001in. and get excellent fits, but that will not work all that well in this construction, hence the need for detailed tolerances. Each bushing will require a shallow groove for the lubricant to move around the circumference. The actual lubricant would normally be grease, but I think that machine oil might be more suitable here as the machine is not in continuous use and oil spreads more quickly than grease.

When placing the bushes, the oil entry hole is drilled through from the headstock plate. The spacers can be left for the time being until such time as erection takes place when exact dimensions can be found. The inside plate of the headstock will be glued or welded to its footing, but it will also be dowelled at the early stages of erection. The outer plate will almost certainly be off and on several times, and this has to be properly dowelled with tight fits in each location.

The spring return and guide has undergone three revisions, each teaching a new lesson. The primary one is that a great deal of force is required to keep the cam and follower together. The guide body is fabricated by welding or brazing. The 34mm dimension should be checked against the job at each erection stage.

Tailstock

In many ways the tailstock is very similar to the headstock, using very similar machining set ups. In fact, I made the headstock and tailstock ▶

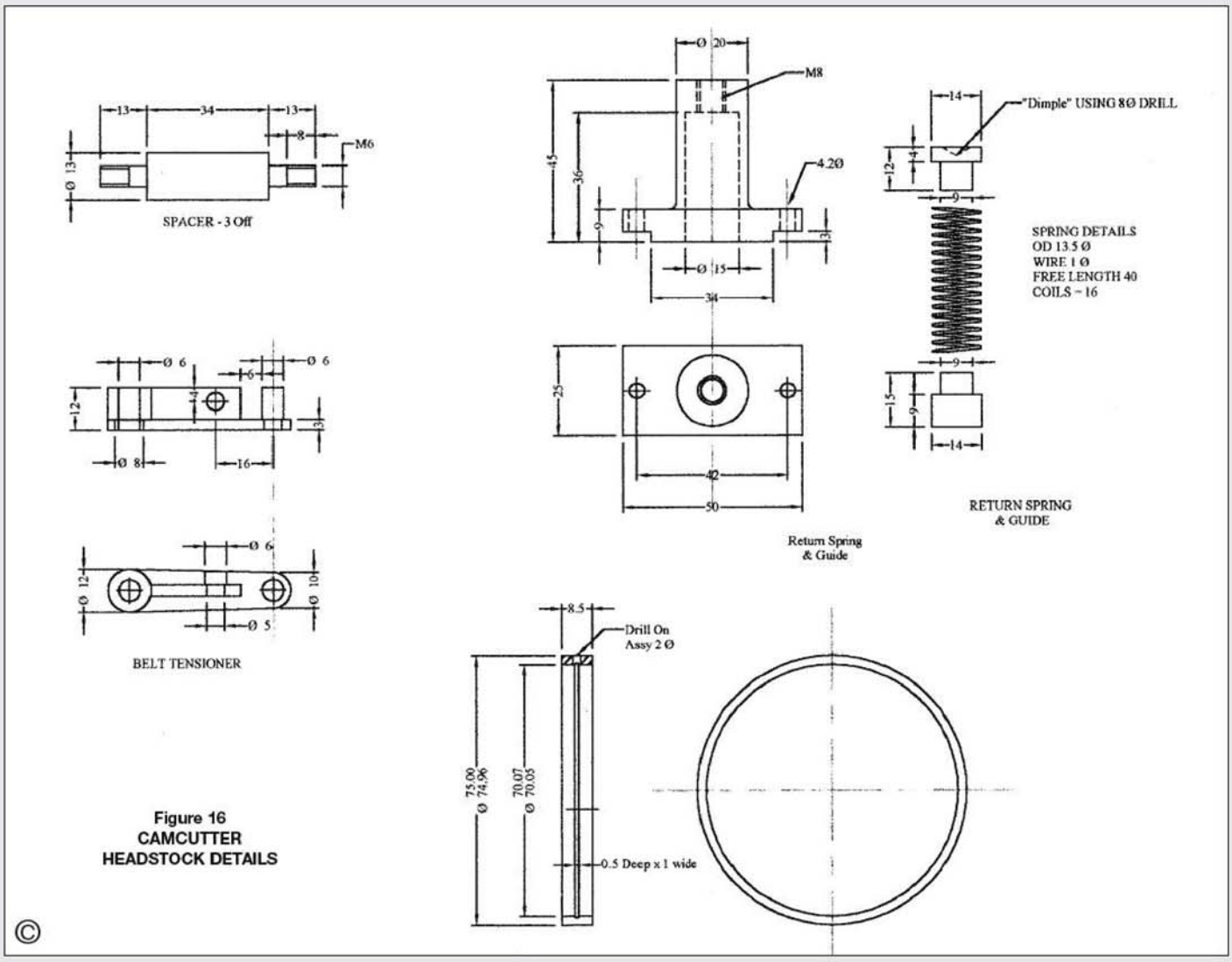


Figure 16
CAMCUTTER
HEADSTOCK DETAILS

one after the other, particularly to get the angle of the slot the same in each case (**photo 24**). The tailstock leans back merely to gain a little more length on the workpiece without enlarging the bar bed; the actual angle is not vitally important but should be about 15 degrees. Longer bar beds could not be accommodated on my ML7 as shown earlier (photo 16, *M.E.* 4231, 1 October 2004) with the lathe at its maximum for drilling the end holes in the bars.

It was an afterthought to sit the tailstock proper on a separate saddle section, but this will allow the construction of cams with concave surfaces, as used in locomotive work, to be made singly but accurately with the tailstock out of the way. The core of the tailstock is the rotating centre section which has low friction bearings, but plain bushings could be used. The centre can be propelled forward or backward, as in a normal lathe, with a square thread and hand wheel.

The machining of the top part starts with turning a cast iron or steel block to make the bearing or bush seats. If the block is long enough both steps can be done in one setting, otherwise it is a case of turning end for end, clocking the position and machining the other end. The next stage should by now be familiar as it uses buttons to find the 15mm offset, as we have done for the rocking arm (**photo 25**). Boring of the housing is also more of the same with all measurements referred to the outer diameter and with due attention paid to the stated tolerances.

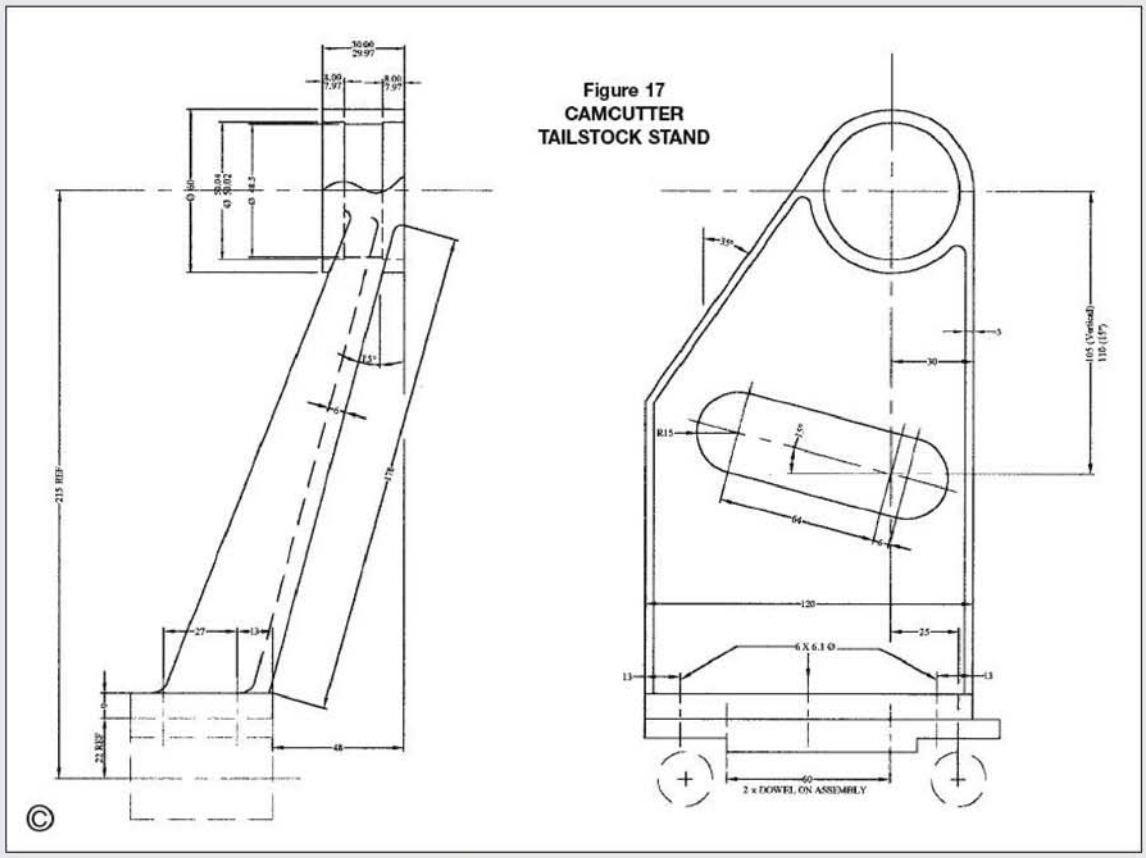
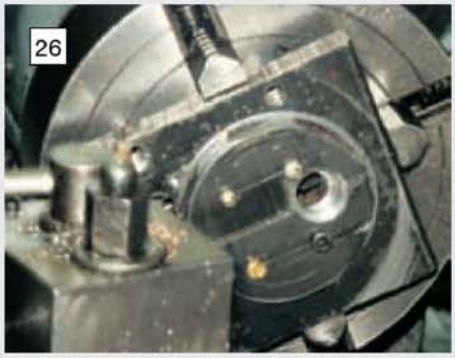


Figure 17
CAMCUTTER
TAILSTOCK STAND



Machining the tailstock split back plate as a single disc by bolting it to a fixture plate held in the 4-jaw chuck.

The bushes themselves are bronze turnings which, once pushed home, should just protrude beyond the housing with the one nearest the headstock free in its hole so it can be readily removed to allow the centre to pass through. On final assembly it may be glued, but this should not be necessary. The back plate is split to facilitate assembly and was machined in two halves on a fixture plate (**photo 26**). The parts were attached to the fixture plate using the holes for the fixing screws. It should be noted that the usual button method was not used in this case for setting out the 15mm offset, as very close dimensioning was unnecessary. Further details of the tailstock will appear next time.

●*To be continued.*

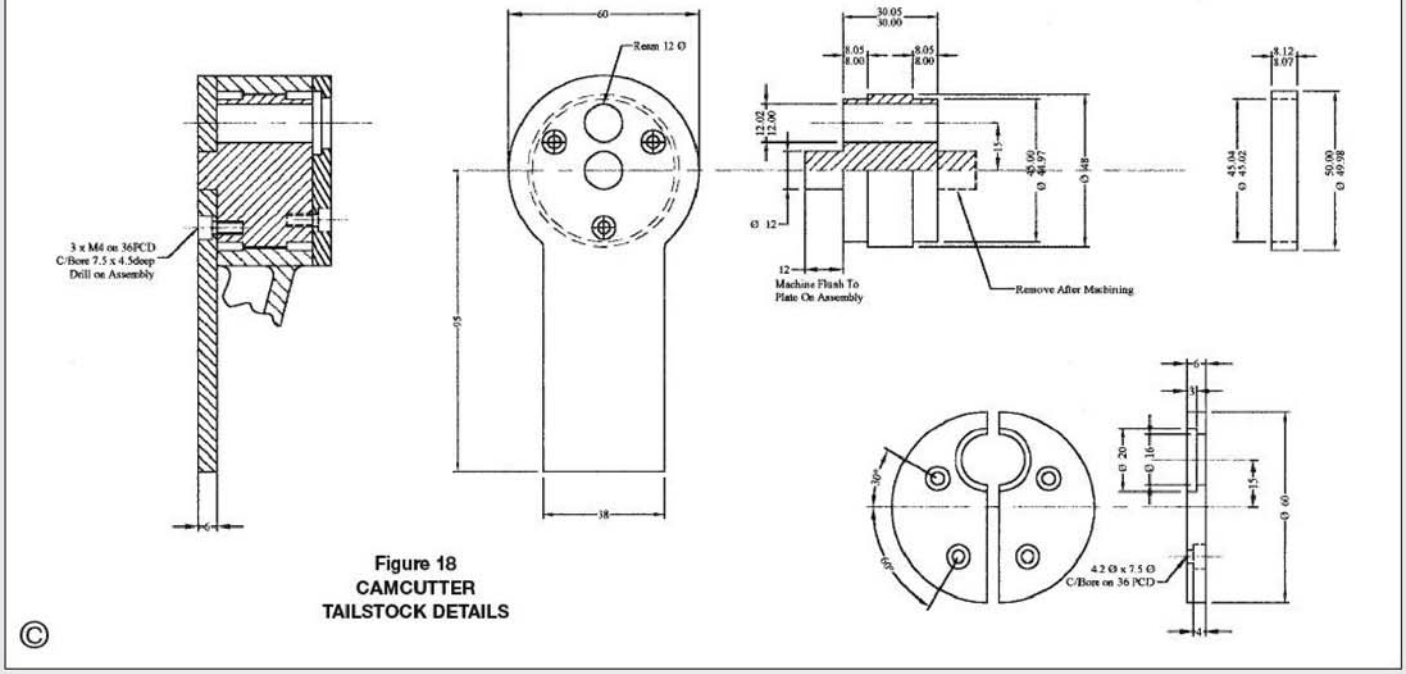


Figure 18
CAMCUTTER
TAILSTOCK DETAILS

AN INTRODUCTION TO PRESS TOOLS

Jim Haslam

continues his discourse with an explanation of how he tooled up for some circular locking plates.

●*Part II continued from page 499*
(M.E. 4233, 29 October 2004)

Small press tool punches and dies made from silver-steel and gauge plate can be easily and economically made, especially when used in conjunction with a standard punch and die holder. When only a limited number of pressings are required the punch and die assembly can be used unhardened; it is however helpful to lubricate the punch and die to extend their wear life.

Consider the following example of small tooling used in the production of the circular locking plates (**fig 1**).

1: Thirty 1mm thick blanks were guillotined approximately 75mm square; the corners were roughly cut to an octagonal shape and to remove excess metal.

2: The blanks were drilled to 12mm diameter and mounted on a bolt. The bolt served as a mandrel, enabling the outside diameter to be turned in the lathe using the 3-jaw chuck and tailstock support.

3: A small silver-steel notching punch (**fig 3**) was made, hardened and tempered and fitted to a mild steel holder to suit the ram of the fly press.

4: The matching die, also made from silver-steel (25mm dia.) and hardened and tempered, was fitted in a standard base plate holder. The base plate was then clamped to the bed of the fly press, having been aligned with the punch previously located in the ram of the press. Standardised base plates and punch holders allow small dies and punches to be interchanged, thus giving economy in materials.

The die base plate was fitted with a datum pin to enable the previously turned blanks to be located relative to the notching die and indexed as required. No stripper plate was used.

Marking out fluid was applied to the face of the base plate and radial lines marked out to enable the first and subsequent notches to be indexed for position. This was then repeated for 13 notches. With careful setting, pitch error was minimal. An alternative arrangement could have involved a removable location pin to fit in previous punched notches.

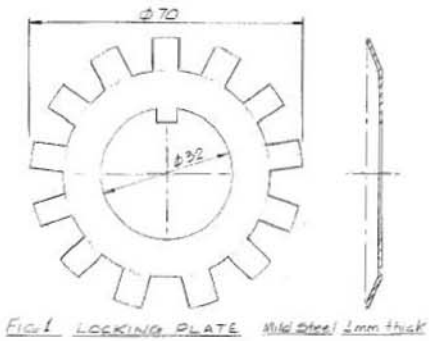
5: A soft punch was produced by milling a groove to produce the required internal keyway tab (**fig 2**).

The reverse tab, needed in the die, was formed by inserting and silver-soldering a rectangular piece of stock material and finally finishing flush to give the required cutting face. With discs located on the outside diameter, and punch and die lined up and clamped securely to the press, they were ready for piercing the centre hole.

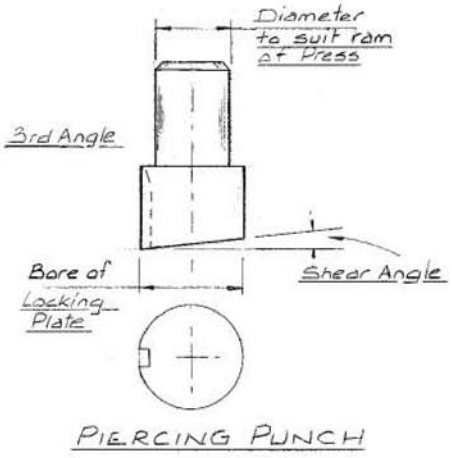
A large size fly press was used, but despite giving it a hefty swing, even with fly weights fitted, the ram bounced back nearly up to its starting position and did not pierce the hole. This was not surprising since the circumferential length of shear edge was in the order of 100 millimetres.

To overcome this, a 'shear angle' was added to the face of the punch to give a gradual 'can opener' type of continuous cut which was quite effective. As mentioned previously, it was important to set the stop collar on the ram to control the depth of punch penetration, and since no stripper plate was fitted, the discs required manual removal from the punch, care being taken to avoid sharp edges!

The final operation was to dish the locking plate using the tool shown in **fig 4**.



The finished locking plate or tab washer.



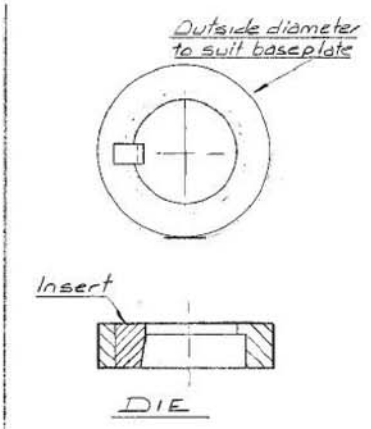


FIG 2

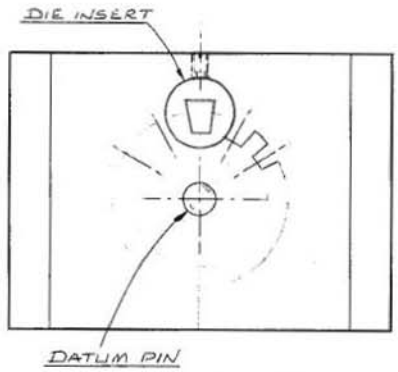


FIG 3. DIE-HOLDER

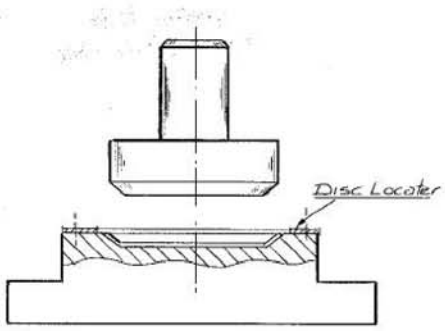
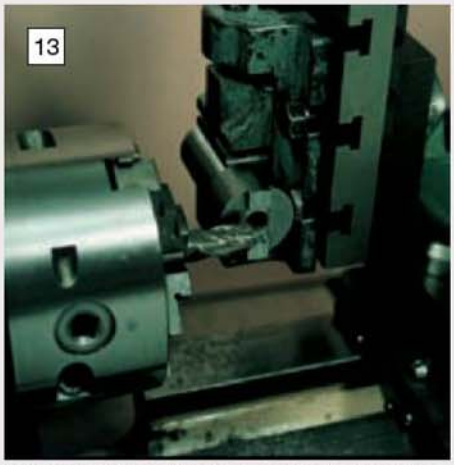
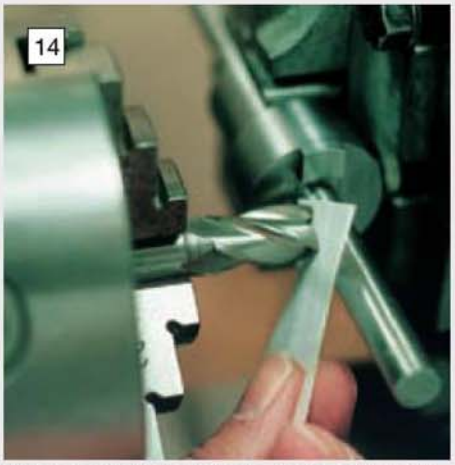


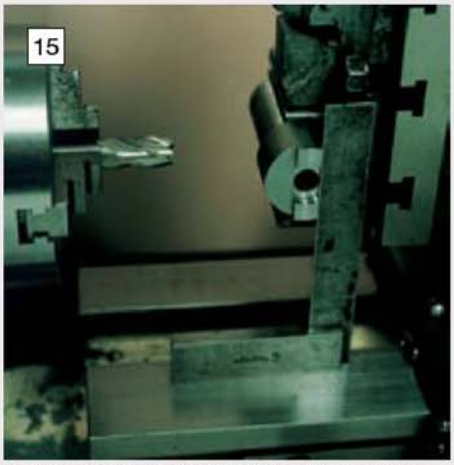
FIG 4 BENDING PUNCH.



Milling the lugs on the base of the pillar with the work held in the small Myford vice.



Using a cigarette paper to locate the cutter with respect to the work (lathe drive disconnected).



Using a square to check that the lugs are square to the bed and hence parallel to each other.

A PARTING OFF STOP

Bill Steer

describes how to mill the lugs on the base before moving on to the remaining components for, and use of this handy accessory.

●*Part III continued from page 509 (M. E. 4233, 29 October 2004)*

We next need to mill away part of the base, leaving the two location lugs. This should be easy for anyone with a regular, heavy milling machine. The work can be clamped or held in a large machine vice and the two sides of the shoulder worked on at one setting. Like the support head, this too is a little more involved if it has to be milled in the lathe, using the vertical slide. Owing to space constraints within the lathe itself, the first difficulty to be encountered is that of holding the work. Fortunately, now that the column is near its finished diameter, it is just possible to grip it in the Myford vice.

The set-up that I eventually used is shown in **photo 13**. The depth of cut was governed by way of the cross-slide, and feed was provided by the vertical slide, working downwards. This arrangement is not ideal, since the upward thrust of the cutter is being taken by the movable and hence less rigid jaw of the vice; also, any free play in the system will be influenced by gravity trying to pull the workpiece downwards. Both these effects can result in a poor finish; however, by using fine feeds and ensuring that the slide ways are set on the tight side, satisfactory results can be obtained. The alternative is to have the workpiece facing towards the rear of the lathe and to feed in an upward direction, but this makes it very difficult both to watch and check progress. In either case it is important to avoid climb milling resulting from an accidental reversal of the feed direction.

Alignment operations

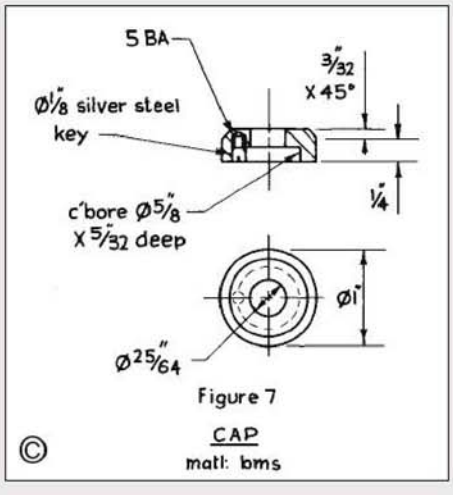
Before starting the milling operation, check that the hole drilled for the key will be correctly aligned with the lugs once they have been formed, not that this will have any bearing on performance, but it will look better if it is. Also, using a dti, check that the body of the work piece is square with the axis of the lathe.

Begin by milling one side of the lugs first, using a series of shallow passes to bring the cut to its full 1/8in. depth. An easy way to determine where the edges of the lugs should come is to pass a length of 3/8in. dia. silver-steel rod through the central hole and use this, in conjunction with the end of the milling cutter and a feeler gauge or cigarette paper, to set the final saddle position (**photo 14**). Needless to say, the drive to the lathe must be disengaged before one's fingers are placed in the vicinity of the milling cutter!

Once the first side has been completed, the work piece can be rotated through 180 degrees. Check again that it is still square to the lathe axis and that the recently machined surfaces are truly vertical; the milling operation can then be repeated. **Photograph 15** shows a further check being made during this latter operation. When nearing the final cut, check the depth so far with a DTI, and compare it with that of the first side (**photo 16**). The amount of material taken off during the final cut should be such that both readings become equal. Exercise some caution here, since if you overdo it, you will have to turn the work around and take more off the first side!

Finally, having released the work from the lathe, remove any burrs with a fine file, and test it by placing it in a suitable T-slot, preferably one which has had little use. It should sit down firmly, without rocking. If it does show any tendency to rock, try it in another slot; the amount of distortion that can occur at the edges of T-slots, despite careful use, can be quite surprising.

If it continues to remain unstable, and your T-slots are beyond reproach, then I suggest getting out the engineers' blue and using a fine file/small scraper to correct things. It is important to get this right, since any discrepancy will put undue strain on the slots once the completed stop is bolted into position. Of course, should you discover that your T-slots are not as good as you thought they were, it might be worth using the scraper in conjunction with a surface plate on them!



Finishing the pillar

Once the pillar fits the T-slots nicely, its outer profile can be finished. Set the work between centres using the previously made plugs once more, with the base nearest the catch plate. Reduce the top section to 5/8in. dia., testing with the head assembly to ensure that a good fit is achieved. The specified length of this portion is 5/8in. but the position of the shoulder, which is more important, should be determined from the base, taking into account any cross-slide to centre height discrepancies mentioned previously.

Provided you have exercised reasonable care so far, any resulting variation in the length of the top section should be small and of no consequence. With the top section completed, the main body of the pillar can be skimmed to bring it to size. Reverse the work piece, not forgetting to place some soft packing under the driving dog, and finish the base. Finally turn the chamfered edge separating the two regions.

Cap

To make the cap (**fig 7**), start with a piece of mild steel a little larger than the finished diameter, say 1 1/8in., and about 1 1/2in. long, to provide sufficient material by which to hold it. Grip it in the 3-jaw chuck, face, centre, drill and ream out to 3/8in. diameter. Remove it from the chuck and fit the keyway drilling jig, bolting it into position. Drill No. 37 to a maximum depth of 5/16in. Tap this hole 5BA, finishing with a bottoming tap to ensure that the thread goes to full depth, and then open up with a 1/8in. dia. drill 5/32in. deep.

Return the workpiece to the 3-jaw chuck and open up the 5/8in. dia. recess with the aid of a small boring tool. Use the plug gauge made previously to ensure a good fit. Drill out the 3/8in. dia. hole to 25/64in. to ensure that the cap is located by the pillar rather than the T-bolt passing through it. The outside can now be machined to size and the embryonic cap parted off, a little over length,

Using a DTI to check that both bedding faces share a common datum.

The inside of the cap showing the position of the restraining key.

Screw cutting the T-bolt. Note the adaptor under the top-slide to facilitate the angle setting.

from the stock. Re-chuck the workpiece, face the upper surface to length and chamfer the edge.

The key is made from a short piece of 1/8in. dia. silver-steel threaded 5BA at one end and with a screwdriver slot in the other. When fitted to the cap, it should be held by four or five threads; at the same time the portion visible inside the cap should be thread free (**photo 17**).

T-bolt, nut and washer

Figure 8 provides details of these parts. I suggest making the nut first, as it can then be used as a gauge when cutting the thread on the bolt. Although a commercial nut and washer could be used, for the sake of appearances, I prefer to make my own for this type of application. For the nut, start with a length of 0.6in. across-flats hexagon steel. This is the standard size for 3/8in. BSF and I believe that it is still available. Face, chamfer, centre and drill 21/64 inch. Tap 3/8in. BSF and part off to length. The washer is straightforward, and needs no further comment.

For the T-bolt, start with a piece of bright mild steel, 3/4in. dia. and about 4 3/4in. long. Holding this in the 3-jaw chuck, and using a Slocombe drill, make a centre recess in each end. Remove it from the chuck and set the workpiece up for turning between centres. Starting from the tailstock end, reduce a good 3 5/8in. length of it to 3/8in. diameter. Continue to reduce the end nearest the tailstock to about 5/16in. dia. for a length of about 3/8in.; this portion will eventually be cut off. At the far end, where the head is to be formed, turn a shoulder 5/8in. diameter by 1/8in. long. Next, take a very light cut over the remaining material for a distance of about 1/4in., just to clean it up; the final diameter of the head will obviously finish slightly less than 3/4in., but this will be of no consequence.

Screw cutting

The thread for the T-bolt is best screw cut (**photo 18**). For this, I prefer to feed the tool in at half the thread angle, using a skewed top-slide, rather than attacking it directly from the cross-slide. In my opinion, this method is more tolerant of tool geometry and consequently produces a better finish to the work. Once the required depth has been reached, either run a chaser or a die along the thread to complete the operation. Check the fit against the nut and make such adjustments as may be necessary.

Now using the 3-jaw chuck, carefully grip the work by the threaded portion, taking care not to overtighten the jaws and damage the thread, and turn away the end of the screw containing the centring hole; it should be left slightly spherical. Reverse in the chuck and part off, or otherwise turn away the surplus material from this end, leaving a 0.150in. thick flange to the workpiece. The sides of this flange, and the underlying shoulder, can easily be milled in the lathe using the vertical slide and small machine vice to hold the work (**photo 19**). As with the base of the pillar, take care to ensure that both sides of the flange/shoulder are finished to the same thickness, to prevent uneven loading of the bolt and consequent distortion of the T-slots.

Although the machining processes of the T-bolt, nut and washer are now complete, for purely aesthetic reasons it is nice to give them a blued finish. To obtain a uniform colour, wash the parts well in strong detergent solution, thoroughly rinse under running water, dry carefully and stand in a shallow tray of sand. Heat the tray from underneath and ▶

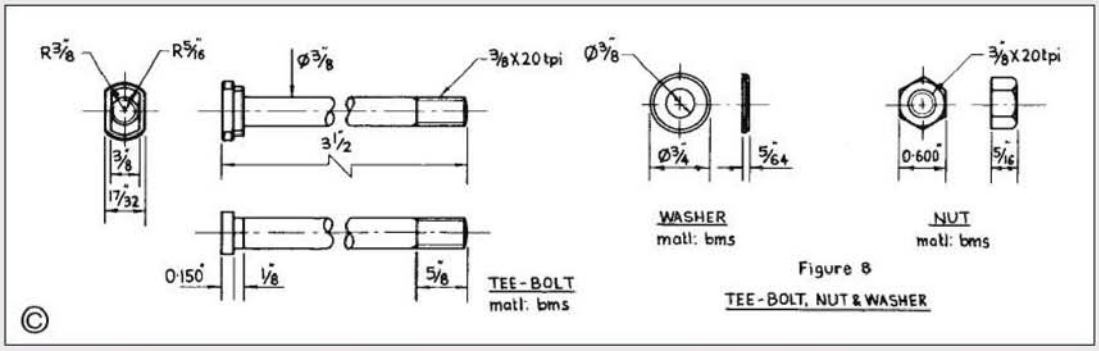
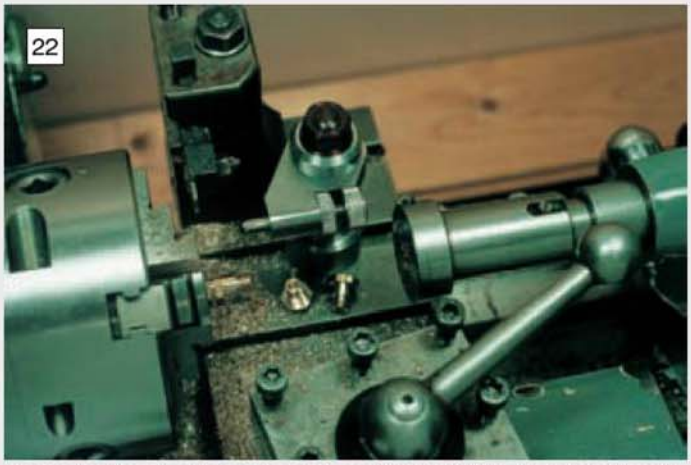


Figure 8
TEE-BOLT, NUT & WASHER

Milling the end of the T-bolt to give necessary form to engage in the T-slots of the cross-slide.

The T-bolt with its nut and washer. All were carefully blued using the sand bath method described in the text.

The parting off stop is often used in conjunction with a saddle stop, the drawing of which is given below.



A typical application: using the parting off stop to help in the production of banjo unions.

watch the colours appear.

Depending on the depth of sand in the tray, this can take some time. Do not be tempted to speed things up by playing the flame directly on the work — you will only spoil it! When the desired shade of blue has been reached, remove the parts quickly and immerse in a container of cold water. After drying, cover them with a good film of oil. **Photograph 20** shows the finished parts.

Assembly and use

Assembly of the stop, I think, should be quite obvious. It is normally positioned in the T-slot which runs next to that occupied by the parting tool. The simplest application is for straightforward repetitious parting off. For this, the parting tool should be positioned close to the chuck, the saddle locked and the stop set in relation to the parting tool to give the required component length. Feedstock is then withdrawn from the chuck until it engages with the stop, moved near to the lathe centre line by means of the cross-slide and, after tightening the jaws, the component is parted off and the procedure repeated. Using this method, small discs or rods of material can be cut off to uniform size quite rapidly, the only limitation being that the stock must be small enough to pass through the mandrel.

Useful as this basic application may be, the real benefits of the parting stop come when it is used in conjunction with a saddle stop. This latter device enables the completion of a range of intermediate operations before parting takes place. Although saddle stops have been described in these pages many times before, their value is so great that I felt it worth including a drawing of my own (**fig 9**), for the sake of anyone to whom they may be unfamiliar.

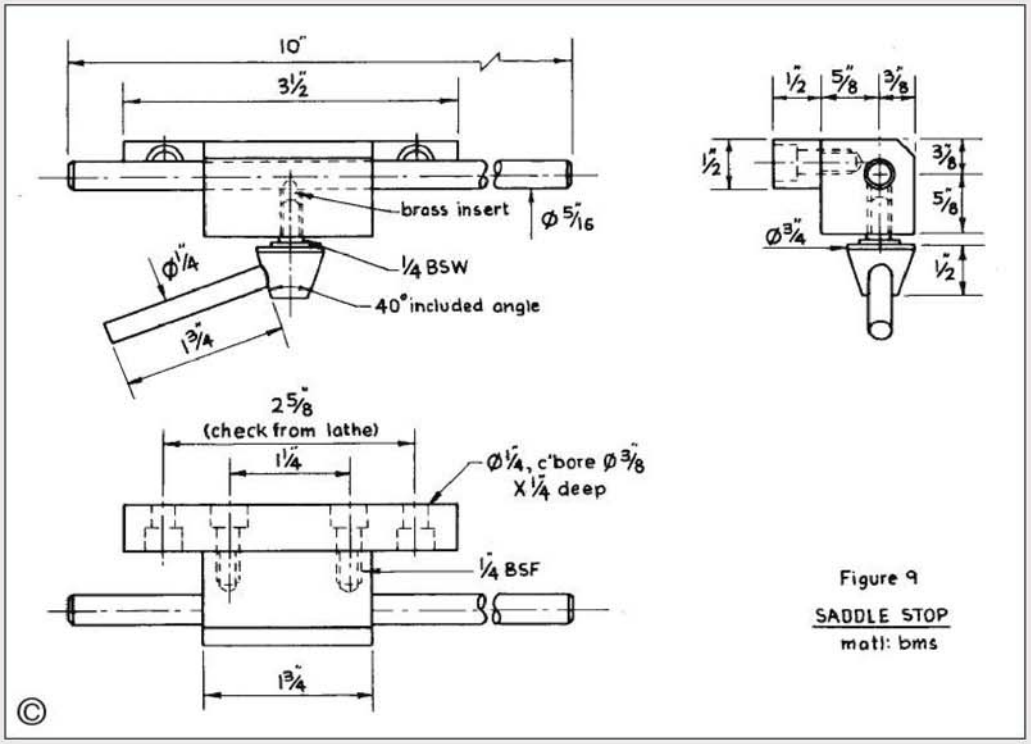
This particular stop was made from odds and ends well over forty years ago, and it has been in constant use ever since! It is bolted to the lathe via two of the tapped holes intended for the quick-change gearbox. Construction is quite straightforward and I do not intend to describe it, but further details can be gleaned from **photo 21** for anyone who may be interested.

Setting up for a production run

Photograph 22 shows the parting stop being used in conjunction with the saddle stop to produce a batch of inner members for banjo unions. Each part, as seen, required nine operations for its manufacture, including three from the tailstock; these took about three minutes in total, to complete. Interconnecting cross holes will be drilled later as a separate operation. The key to this type of production is that all tool movements in the direction along the lathe bed are controlled via the saddle and that all distances, in this direction, are referred directly or indirectly to the saddle stop.

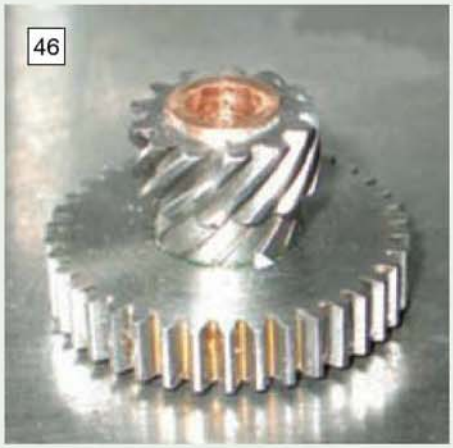
The setting of the saddle stop is dictated by the parting tool, the side of which, with the saddle arrested, should be as close as possible to the chuck jaws without fouling them. The parting off stop can now be set with reference to the parting tool to give the finished component length. If the component is to have a section of reduced diameter arranged at its right hand end, then a knife tool can be set up in the front tool holder and the position of the top-slide adjusted to define the length of this section when the saddle is against its stop.

Should more than one reduced diameter section be required, this can be achieved by inserting suitable spacers between the saddle and its stop; I often use the shanks of drills for this. All tool movements across the lathe are performed in the usual way via the cross-slide. These movements can also be limited by means of stops, but for small runs the use of calibrated hand wheel settings can be just as convenient.

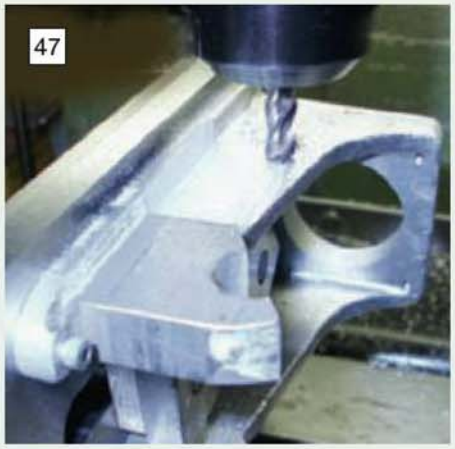


Once the lathe has been set as described, we can have a trial run. First, the parting stop is brought to the centre line of the lathe, by movement of the cross-slide feed screw. Then, with the saddle firmly held against its stop, feedstock material with a faced end is pulled forward from the chuck until it makes contact the parting stop. The chuck jaws are then tightened. Any shouldering operations can now be undertaken, limited by the saddle stop, as can anything involving the use of the tailstock including tapping, drilling, and the like. Finally, again with the saddle held against its stop, the item can be parted from the stock material. At this point the component should be carefully checked for size and any necessary adjustments made to the tooling before proceeding with the main run.

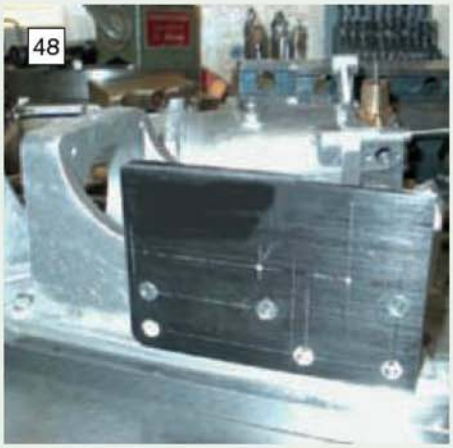
This gives but a brief insight to a typical application of the parting off stop. If, like me, you find yourself frequently making small repetitive fittings then I am sure you will find this tool a useful and versatile addition to your collection.



The spiral gear is attached to the large pinion by means of a through bush.



The side of the main frame was machined to accept the camshaft gearing adaptor plate.



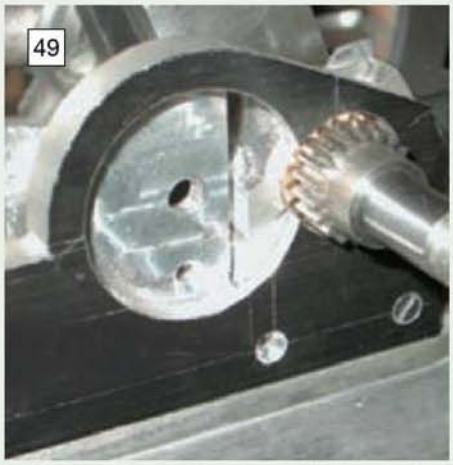
The adaptor plate was fixed in position prior to finish machining.

WYVERN
BUILDING A CLASSIC I.C. ENGINE

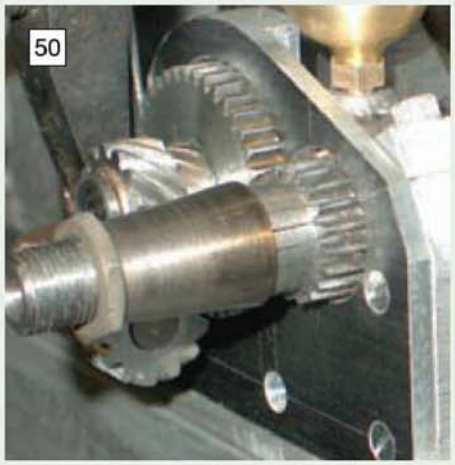
Peter Rawlinson
concludes his description of building this handsome engine.
●*Part IV continued from page 503 (M.E. 4233, 29 October 2004)*

The large pinion and the spiral gear were mounted on a straight knurled bronze bush using high strength Loctite (**photo 46**). The main frame was re-set in the milling machine and the side machined to take the extension plate for the 2:1 gear cluster (**photo 47**). The plate was screwed into place (**photo 48**), machined and fitted with its gears (**photos 49** and **50**).

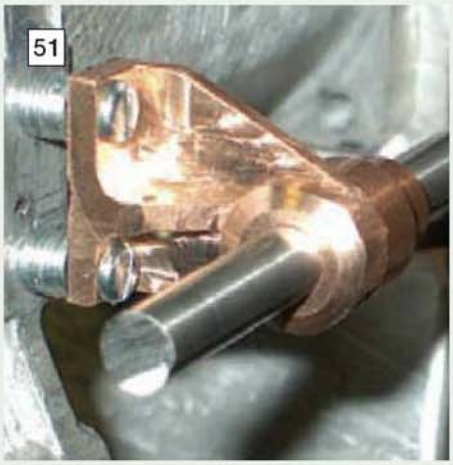
The brackets were then machined, but as the camshaft centre had been altered, the bracket for the cylinder head was too short and required a spacer. A rough size was first determined using washers (**photo 51**) and brass spacers finally machined to size. Fitting the bracket nearest the ▶



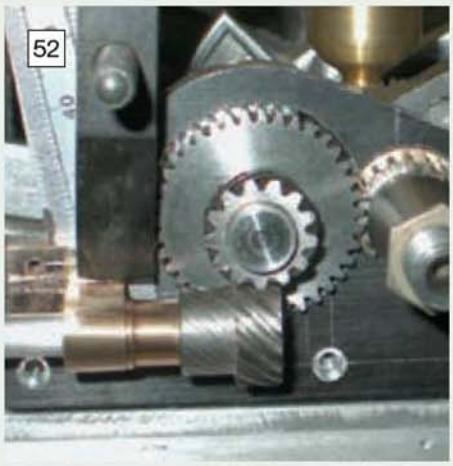
The adaptor plate was profiled and bored to suit the large pinion.



The camshaft drive in place on the engine: 1:1 spiral gears are used with 1:2 pinion gears.



Establishing the correct length of spacer for use with the camshaft support bracket.

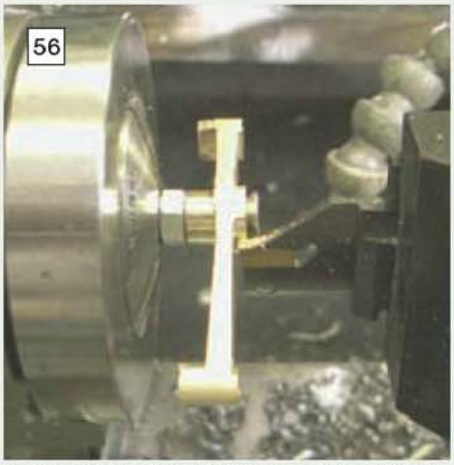


Fitting the front camshaft bracket was done by a process of trial and error.

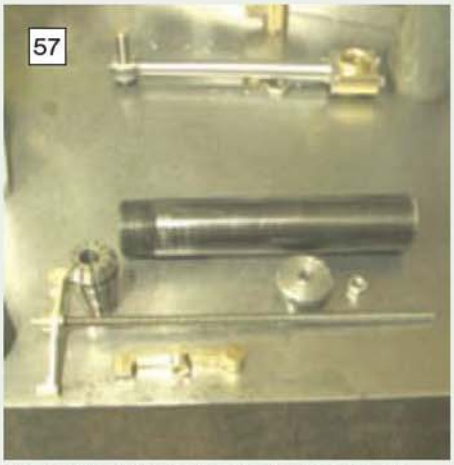
The bronze rocker arm casting was certainly an awkward shape to hold for machining.

Work was facilitated by soft-soldering the rocker arms to a piece of brass.

The brass backing plate gave unimpeded access to the workpiece.



Machining a rocker arm with the work mounted on a mandrel in the lathe.



A selection of the tooling used to machine the rockers, shown in the foreground.

spiral gears was accomplished on a trial and error basis. It was first drilled tapping size for its mounting bolts, offered up, the holes spotted through and finally drilled and tapped **(photo 52)**.

The rocker arms were then tackled **(photo 53)**. These were soldered to a brass plate and machined on the milling machine and the lathe **(photos 54, 55 and 56)**. The tooling used is shown in **photo 57**.

I planned to cut the cams on my CNC milling machine but as they had straight 'sides over the rising face' a little thought brought me to realise that they could be more easily machined using a rotary table. Blanks were machined first and set on a silver-steel mandrel for machining. When this had been completed, the top curved area was hand finished to a template **(photos 58 and 59)**.

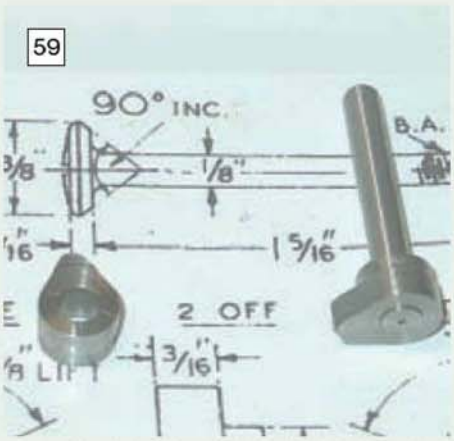
The cylinder liner was tackled next; supplied in the form of an iron bar approximately 1 1/2in. dia. it is about 3/4in. overlength. I reduced a 16mm length at one end to 28mm dia. to suit the largest collet I can fit in my lathe. I like to use Rotabroach cutters and since the bar had not been cored I used these cutters to bore the initial hole. Working from both ends, I used a 20mm dia. cutter in the small end and a 30mm dia. cutter in the large end, leaving the core plug for some future use **(photo 60)**. The resulting liner had only a 4mm wall in the collet and a 'washer' thickness of 3mm which meant that the cuts could not be big **(photos 61 and 62)**.

The bore was finally honed using a three stone hone mounted in my tailstock drilling attachment as described in my article in *Model Engineers' Workshop* issue No. 46 for November 1997 **(photo 63)**. My method for checking the bore is shown in **photo 64**.

The piston was cleaned up with a file, held on its cast body and the spigot fully machined **(photo 65)**. Further work was completed with it held on this spigot in a collet **(photo 66)**.

Photograph 67 shows the piston being aligned for the gudgeon pin hole using the laser centre finder described in my articles in *MEW* issues Nos. 79 and 81 for January and April 2002.

Milling a cam; final shaping of the profile was completed by hand.



The finished cams superimposed on the drawing of one of the valves.

Careful machining resulted in a core of cast iron retrieved from the bar supplied.

Machining the cylinder liner using the Author's favourite tool, a Rotabroach cutter.

The finish turned cylinder liner ready for the final honing process.

Honing under way on the lathe. The hone is powered by a home made drive unit.

Checking the cylinder bore for size using an internal micrometer.

The first operation on the piston was to machine the chucking spigot.

Machining the piston; internal milling has already been completed and finish turning is being done.

The set-up used for machining the gudgeon pin holes in the piston.

Milling out the internal features of the piston; note the collet block held in the machine vice.

The piston and connecting rod assembly shown with the cylinder liner and piston rings.

The interior of the piston was machined with the piston held by its spigot in a collet in a fixture mounted in the milling machine vice (**photo 68**). It was only after this that the piston was separated from its spigot. The completed liner, piston, connecting rod and rings are shown in **photo 69**.

We now come to what I consider to be the fiddly bits which comprise the valves, carburettor, ignition points, eccentric rocker and pivot pins, and last but not least the painting — which I detest. All the pivot pins were made of silver-steel so that they could be through hardened. A simple off-centre jig was made to turn the eccentric parts of the pins which were then slotted for a screwdriver using a collet and slitting saw. The valves were made from silver-steel, being machined, threaded and finally parted off.

The carburettor wasn't too bad, and I added a throttle at the inlet of the inner air valve. I made the air poppet valve in two pieces which were pressed together. I have fitted detent springs on all the adjustment positions and done away with the 'lever' arm on the accelerator control.

I was unable to bend the exhaust pipe to a sufficiently tight radius to clear the carburettor and have fitted a packer or extension between the cylinder head and the carburettor to increase clearance. I am aware of a precedent for this which seems to have done no harm. Many years ago I had an Ariel *Colt* motorcycle which had a knock in the engine from new. The problem was resolved at the Ariel factory by fitting a right angle spacer between the head and the carburettor. I noticed no adverse effects, and the knock was cured.

The ignition points presented me with a problem as the tungsten tips were not available at the time; fortunately I could obtain some which had already been riveted to a spring. I found that the tip could just be held in a collet and the riveted-over portion carefully turned away. One contact was then soldered to the head of a 6BA screw and the other was riveted to a spring.

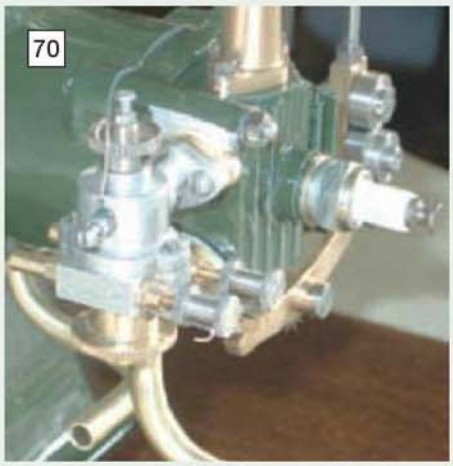
The rocker arms have already been discussed; if I were making them again I would certainly make them from bronze plate.

With no excuses for further delay, the painting finally had to be tackled. All parts received a dose of etching primer and one component was given a trial coat of a maroon metallic paint. It didn't look right and I changed the colour scheme to black for the flywheels and a 'standard' dark green for the other parts.

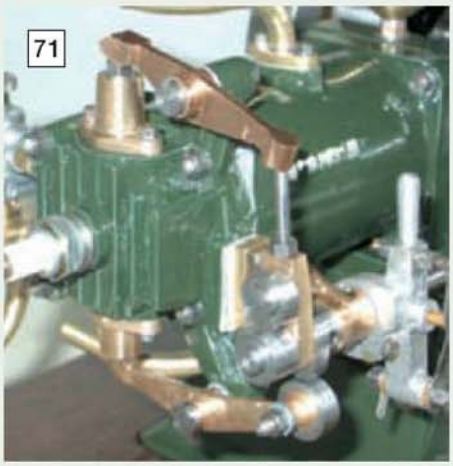
Final assembly was straightforward; the engine has only 'chuffed' for relatively short periods, so I will have to sort out a better cooling and fuel system, and a permanent coil for the ignition.

Casting are still available from Woking Precision Models ('phone 0780-844915) and parts are still available for the tailstock drill and the top slide power unit from Model Motors Direct ('phone 01749-860111).

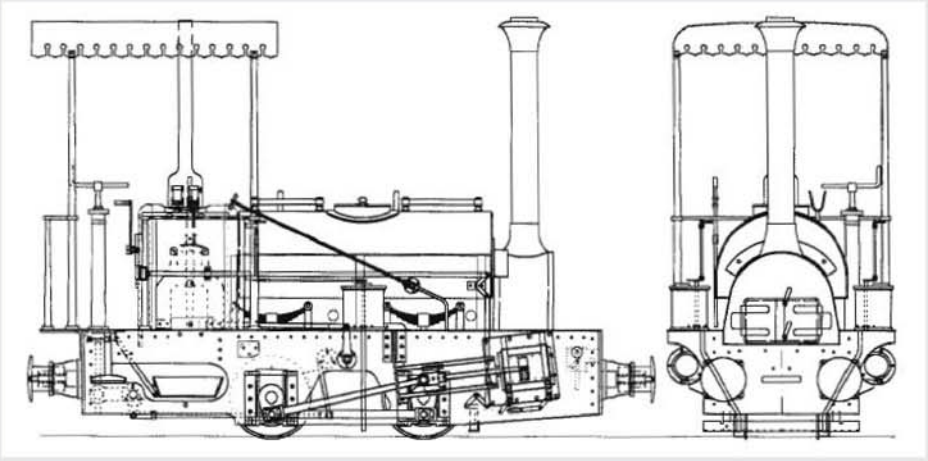
As always, I am happy to assist if I can, but only by 'phone on 01233-712158.



The carburettor used on the engine. Note the spring wire to prevent the control creeping.



Another view of the cam and rocker assembly of the Wyvern engine.



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

Derek Brown and Mark Smithers describe an axle pump and the brakes for this industrial locomotive, and show the smokebox pipework.

●*Part IX continued from page 507 (M.E. 4233, 29 October 2004)*

Before we start with the brake gear, for reasons concerning the layout of the accompanying drawings it is convenient to look at the axle pump and to include drawings of the smokebox pipework. This latter will be afforded the necessary description in the next instalment of these notes.

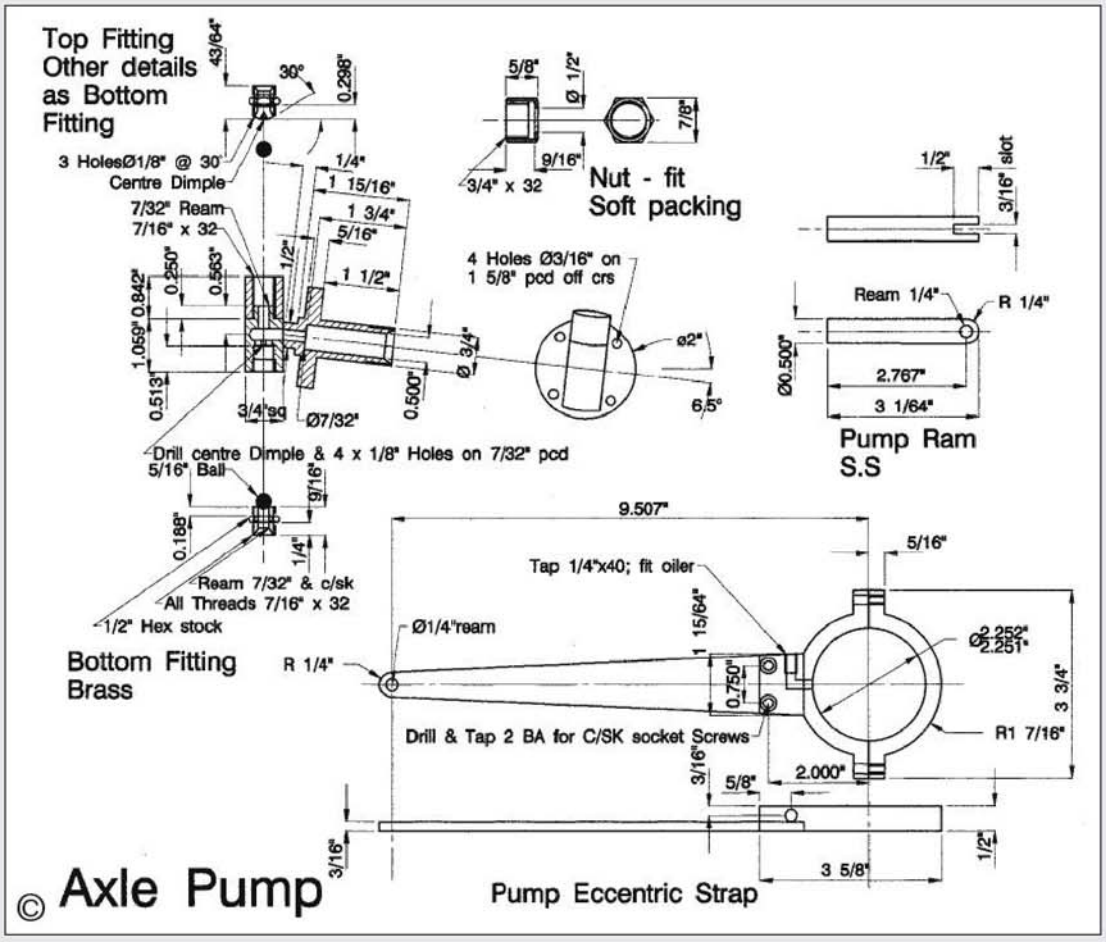
Axle pump

Although it goes against the grain with me to fit an axle pump, in this locomotive there is clearly a need for the sake of authenticity. I have scaled it down in size for two reasons: first it does not work on the usual model engineering way of bypassing back to the water tank, but is either 'on' or 'off', requiring priming each time it is operated, and secondly I do not appreciate a device which overfills the boiler every few minutes. Hold on to your chair, the obtrusive control system will be described whenever we have a tank on which to hang it.

The components are few and simple. We have already dealt with the eccentric and its strap when doing the valve gear, and this one is just narrower than those that drive the valves. The sheaves are made from castings in the time-honoured way and bolted to the straps as before. I looked long and hard at the pump body, considered a casting for it, and came down on the side of fabrication, using a mixture of brass and bronze. Bronze should be used for the cylinder, reamed 1/2in. dia. after fabrication. The flange may be made from 2in. dia. brass, with the four holes for the 2BA fixing screws drilled off centres to give easy spanner access to all of them. The silver-soldering process must be done at the same time as all the rest.

The valve chamber of the body is made from a 1 5/16in. length of 3/4in. sq. brass. After facing to length, drill 13/64in. dia. to a depth of 1/2in., turn down the first 1/4in. to 0.434in. dia. and screwcut 7/16in. x 32tpi. Next drill the cross hole in the position drawn and hold the other way round to bore 5/16in. deep for tapping the bottom end 7/16in. dia. x 32tpi. Finish this bit by drilling four holes for the water passage 1/8in. dia. as indicated.

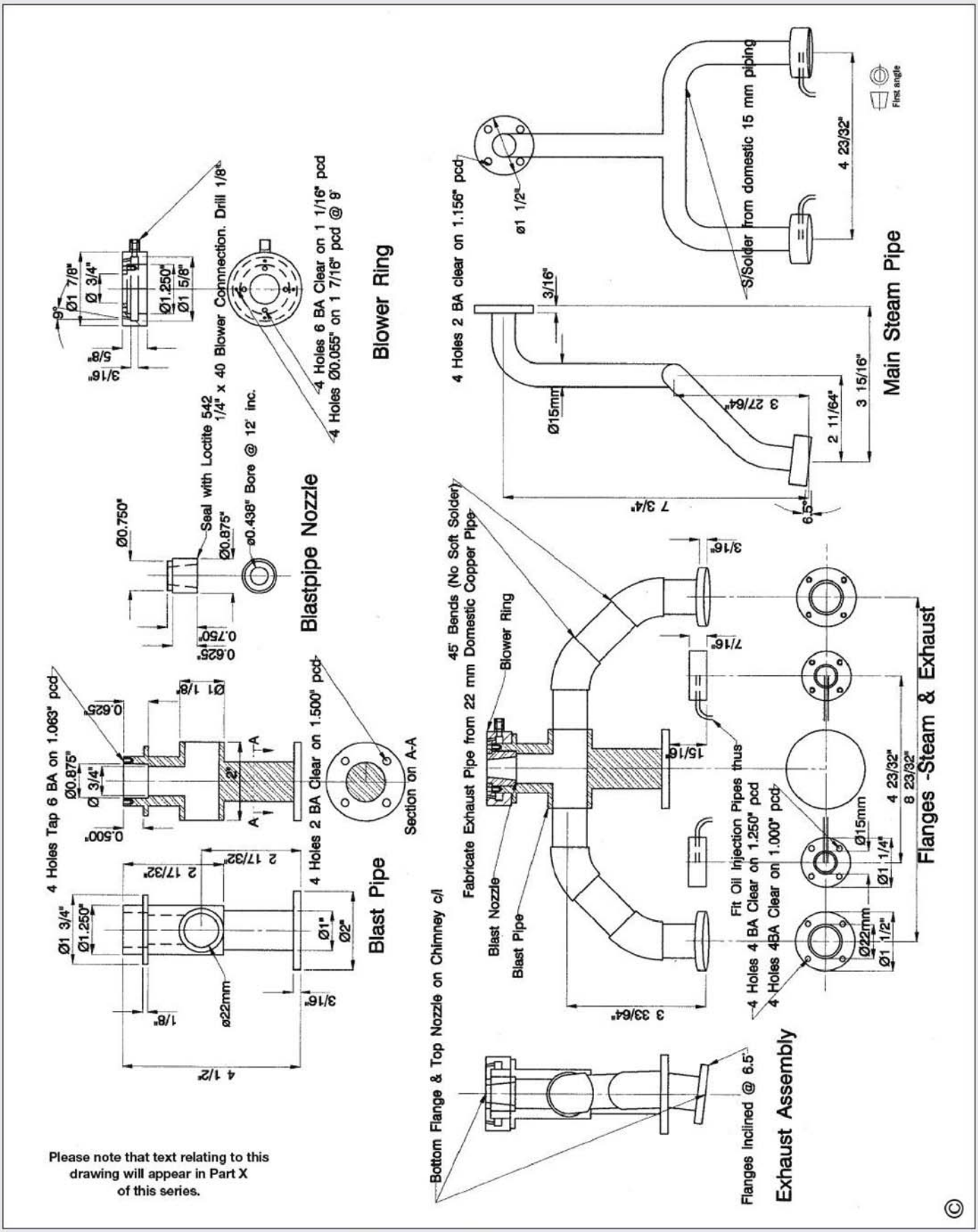
The end of the pump body should be faced at an angle of 6.5deg. and held in place against the valve chamber for the silver-soldering operation, making sure that the body is aligned in the same plane as the valve chamber, with the flange holes correctly offset at 45deg. to the common plane. The other parts can all be made from hexagon bar, which facilitates assembly and maintenance. In designing this pump, attention has been paid to the ability to lap the valve faces flat, bearing in mind that the balls can be nitrile rubber, and the water holes provide a very free passage and little chance of valve bounce.



Brake gear

The brake gear makes a neat assembly, located by the holes which have already been provided for it. The handbrake lever is another of those prominent features in which Manning Wardle made use of existing standard gauge designs, although the drivers operating the full size locomotives were of similar stature to those driving their large counterparts and I suppose it is only right to expect lever sizes to be the same on all machines.

The hand-brake is convenient for a quick application as necessary, but it has been possible to incorporate a steam brake into the bargain, neatly hidden between the frames and out of sight except



Please note that text relating to this drawing will appear in Part X of this series.

if you peer into the back of the large slot in front of the buffer beam. The Victorians regarded braking systems with a pinch of salt; I seem to remember F. W. Webb of the LNWR once said with the utmost arrogance *"My engines are meant to go and not to stop."* Luckily we know better today.

Brake construction

Braking is on only two wheels, so the assembly is simpler than on many locomotives; the brake blocks are wooden, a good material for the purpose. Starting with the handbrake bracket, mutilate a short length of angle iron; I have drawn 1/4in. thickness, but this is not critical and you should be able to lay your hands on some 6 or 8mm thick metric angle fairly easily. The Bracket fits outside the left frame in the neat recess provided in the footplating and is fixed to the frame by 1/4in. BSF screws.

The handbrake stand is a swarf production job from 2in. dia. bar, a 12 1/2in. length being ▶

required. The first challenge is to drill the hole right through the middle, best done one half from each end with the bar running true in the lathe. If you doubt the possibility of drilling through in such a way as to make the two bores meet in the middle, then read my article on sharpening NC points on large drills in *Model Engineer* 4023, 4025 and 4031 (16 August, 20 September and 20 December 1996). The standard jobber drill point requires considerable end thrust on the drill from the tailstock of the lathe which makes the drill wander as it goes in deeply.

The cure for this problem is relief of the point by one of several recognised means of sharpening. Dormer manufacture excellent split point drills (at a price) and a 13mm size would be perfect for the task in hand, but if you are prepared to do it yourself, then the NC point is also the bee's knees for what we want. Unless you can get hold of a long series drill, the standard 1/2in. dia. drill is not long enough to go half way through, so drill as deeply as you can with the standard drill and finish the final 1in. with an extension of 1/2in. dia. mild steel silver-soldered to the butt of the drill, making sure that you maintain alignment between the two components during the joining process.

I suppose some armchair critic will write in protesting that gun drilling is the answer to very long holes, but this is model engineering, not production work, and gun drills require long lathes and a very high pressure coolant supply which forces the chips through the straight chip slots via a passage right up the middle of the drill. I am not in that league!

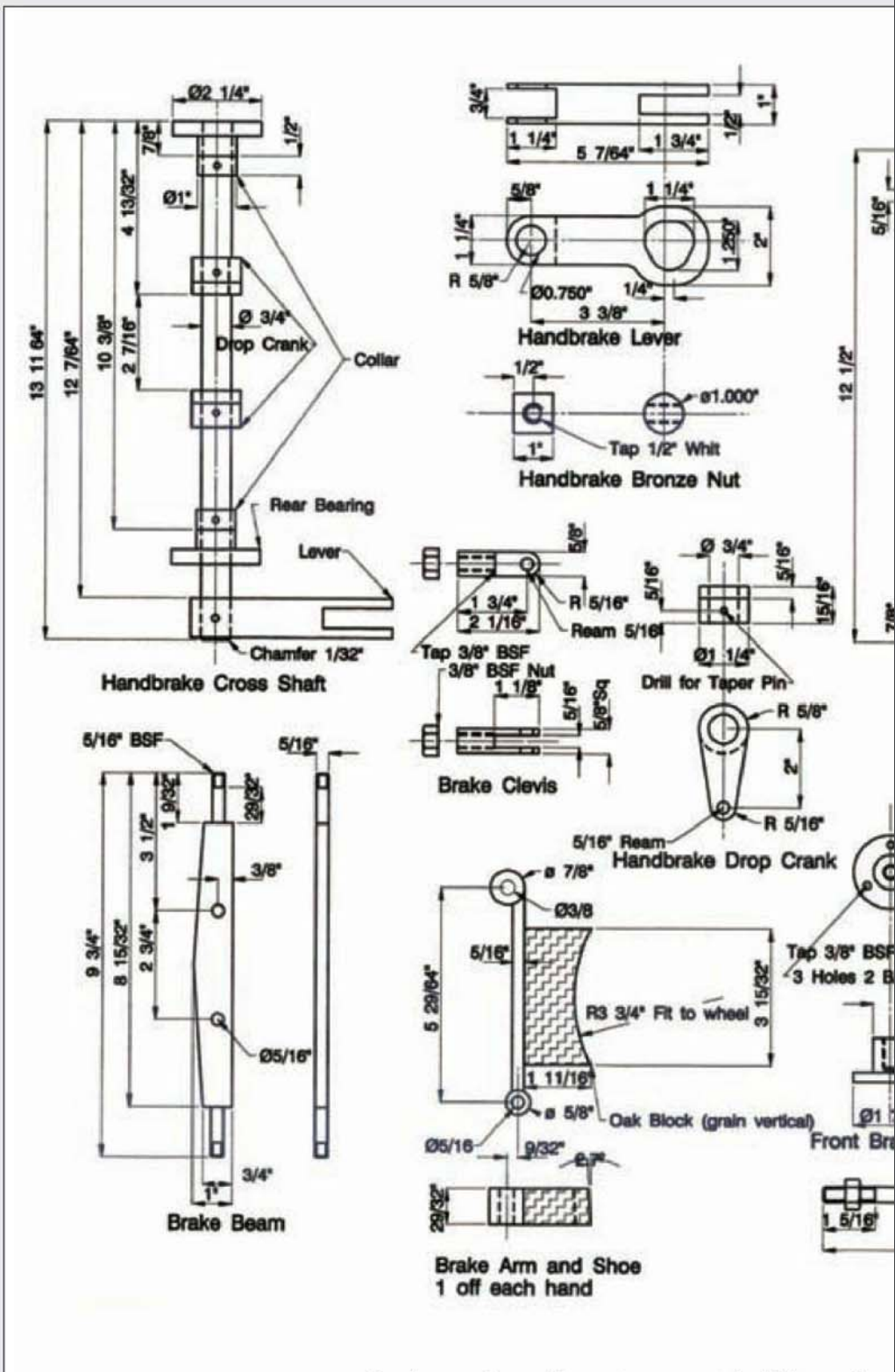
Having drilled the hole by hook or by crook, make sure there is a small 60deg. countersink at each end, ready for finishing the outside between centres. The main part of the body tapers from 1 3/8 to 1 1/4in. diameter; this may sound like a trivial specification, but believe me, it is aesthetically important. It is analogous to the tapers in Greek columns in ancient buildings and if you get it wrong, the effect is lost. The knopp near the top of the column is another frippery, as on wine glass stems, again not to be ignored. The rest, as they say, is straightforward. Note the small bronze washer to take the end thrust under the head of the column; this avoids steel on steel contact. You will need a 3/4in. dia. BSF nut to fit the thread on the bottom end.

Next, the handbrake handle and screw is a job for turning between centres, with the help of a travelling steady. Starting off with 3/4in. dia. material, come down to 1/2in. dia. in a single cut, the steady regulating the size produced, with a fine feed rate. Aesthetics come into the shape again at the top end of the shaft. The handle should be 5/16in. dia. stainless steel, pushed into the cross-hole at the top of the shaft and restrained by Loctite 603.

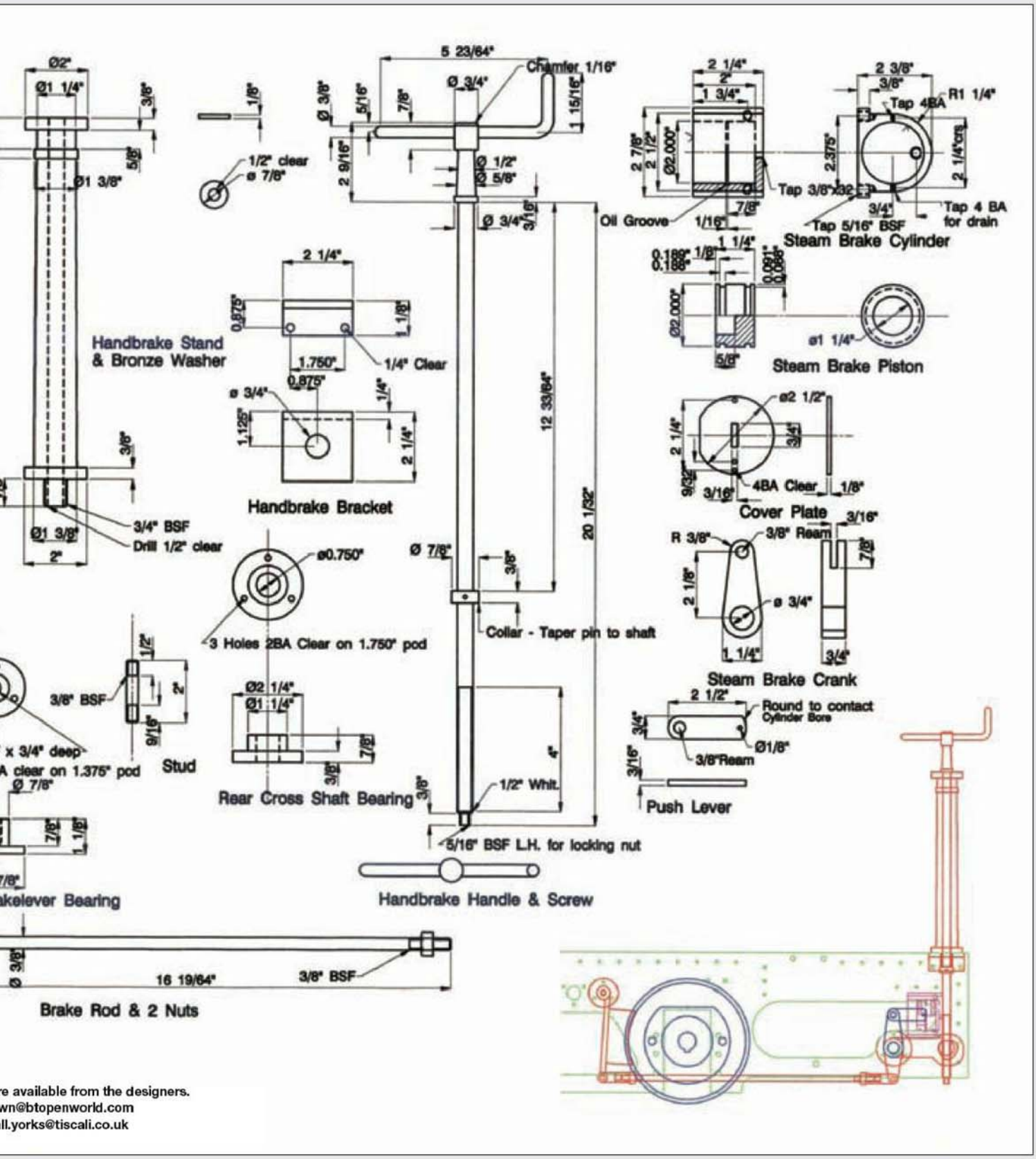
The other components of the brake gear need no special mention, save to say that the brake block is correctly made from a length of oak, the radius being cut on a bandsaw, with the table inclined at 2.7 degrees. Rely on the running-in process to produce conformity to the wheel treads. The brake arm, on which the brake block fits, is fabricated from three parts silver-soldered together while maintaining alignment between the axes of the top and bottom components.

At the bottom right-hand corner of the drawing which we have been studying is a colour assembly of all the parts. This is included to demonstrate the way in which CAD checked that the relative sizes and positions of all parts were correct. From the drawings which we have already examined you will recognise the frames (green, colour 2, layer 2), wheel (blue, colour 1, layer 1) and so on. The various drawings were merged with that of the brake gear and parts picked off and manipulated until they fitted. The proof of the pudding was that the brake block fits well, with the suspension at the design height, and with the various adjustments in their mid positions. That little exercise took me about fifteen minutes, which I regard as time well spent. Now try doing the same thing with pencil and paper! For printing as you see it, on the same drawing as the component parts, I commanded the assembly to shrink by 50%, merely to get it into the spare corner of the drawing on the screen.

The steam brake consists of a cast iron cylinder, for the machining of which the same remarks apply as those written for the main cylinders. It is



Drawings, castings and laser cut components for this locomotive a
Contact D. A. G. Brown, tel: 01780-753162, e-mail: dag.bro
or Mark Smithers tel: 01609-773734, e-mail: marks_northa



re available from the designers.
wn@btopenworld.com
ll.yorks@tiscali.co.uk

designed for two Clupet rings of 2in. dia., acting on a piston machined from cast iron stick. The annular groove in the middle of the cylinder bore is to enable Light Superheater Oil to be fed around the piston, between the rings to keep things going sweetly. For lubrication purposes the cylinder is tapped on its horizontal centre-line to suit a commercial grease nipple. The other tappings are (1) 3/8in. x 32tpi on the back centre line for the steam supply; (2) 4BA in the bottom back corner for a drain; (3) two 4BA holes on the front machined surface for the cover plate and (4) two 5/16in. BSF holes for fixing to the main frames.

From the assembly it is apparent that the piston pushes the push lever and lifts the handbrake lever, making use of the elongated slot to raise it clear of the bronze nut which is lifted only by the handbrake. You should place a spring over the end of the push lever, so that a 1/8in. dowel pin in the lever reacts under spring pressure against the piston, tending to keep the latter in its place when steam is not applied.

The main plumbing of the steam brake will be dealt with at a later stage, but you should put in a short drain line from the bottom corner 4BA hole with a restriction to No. 55 drill size, so that in operation the brake leaks away to the track and keeps the system clear of condensate. If you try really hard you can even direct the discharge onto the rails, so as to make them slippery! Just watch out! Several of the parts for the brake system can be laser cut, if required.

●*To be continued.*

The superheater coil. Note the common banjo fitting on the left of this photograph.

The steam pipes, regulator and other fittings prior to fitting to the boiler.

FOWLER STEAM WAGON

Tony Webster
continues with the superheater and boiler fittings before turning to details of the chassis.

●*Part XII continued from page 512 (M.E. 4233, 29 October 2004)*

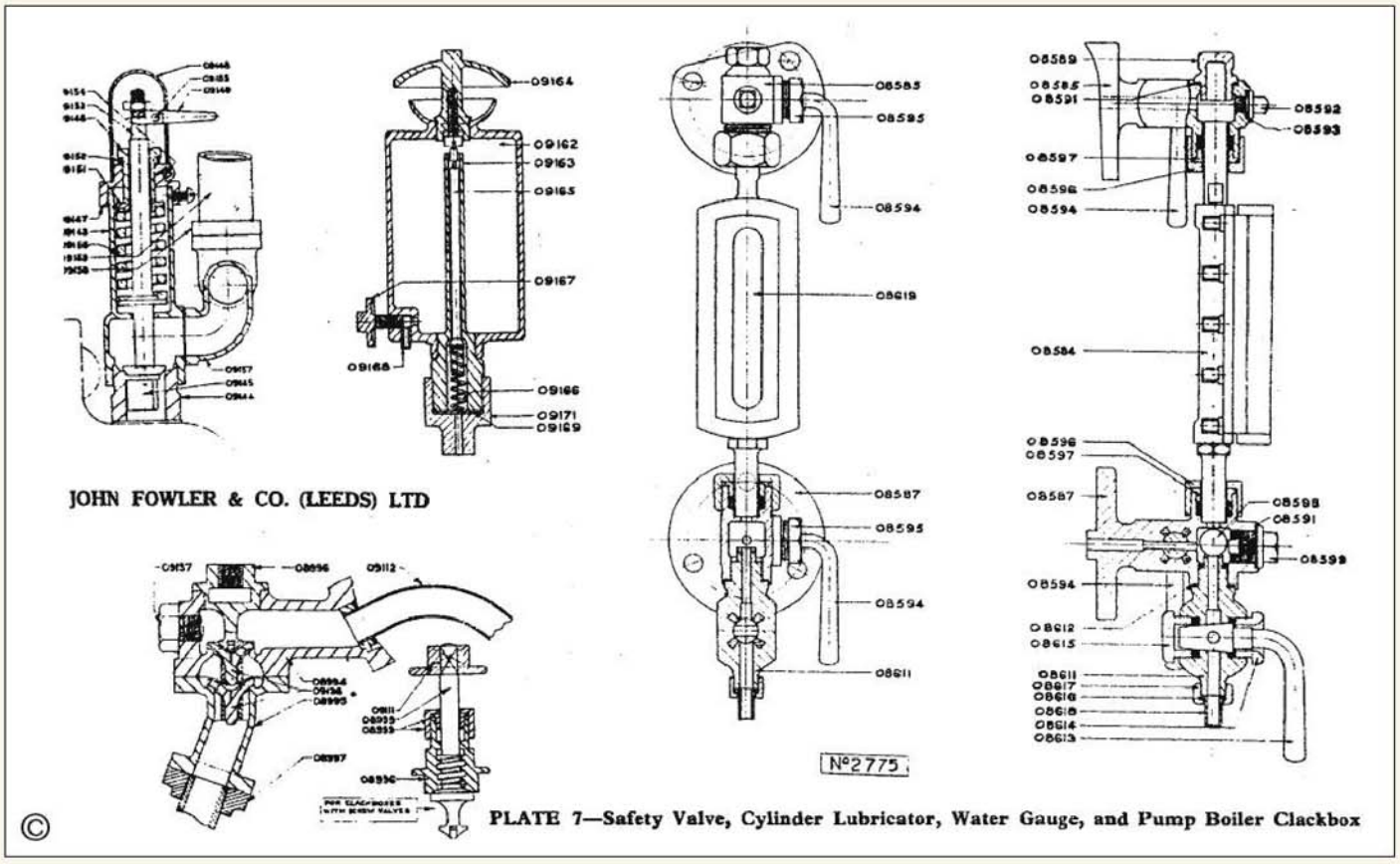
The superheater consists of two concentric double coils, one left and one right-hand, of 8mm O/D copper tube. The outer coil is of 1 3/4 left-hand turns and the inner coil is of 2 1/4 right-hand turns. They both start from 1in. O/D banjo fittings with hollow 3/8in. stainless steel bolts securing them to the steam take off bushes inside the smokebox. Both coils terminate in the same banjo with a 1/2in. dia. hole. Phosphor bronze or gunmetal is used because high melting point brazing rod is used in this hot environment in the smokebox and brass would melt at this temperature. The common banjo connects with the input tube of the regulator, but more of that later. A superheater made of copper is soon eroded away by grit from the fire carried in the exhaust. Stainless steel of grade 321 is much to be preferred; 3/8in. O/D x 16swg or 10 O/D x 1mm wall thickness will take a thread to make a secure assembly before welding by a third party.

Boiler fittings

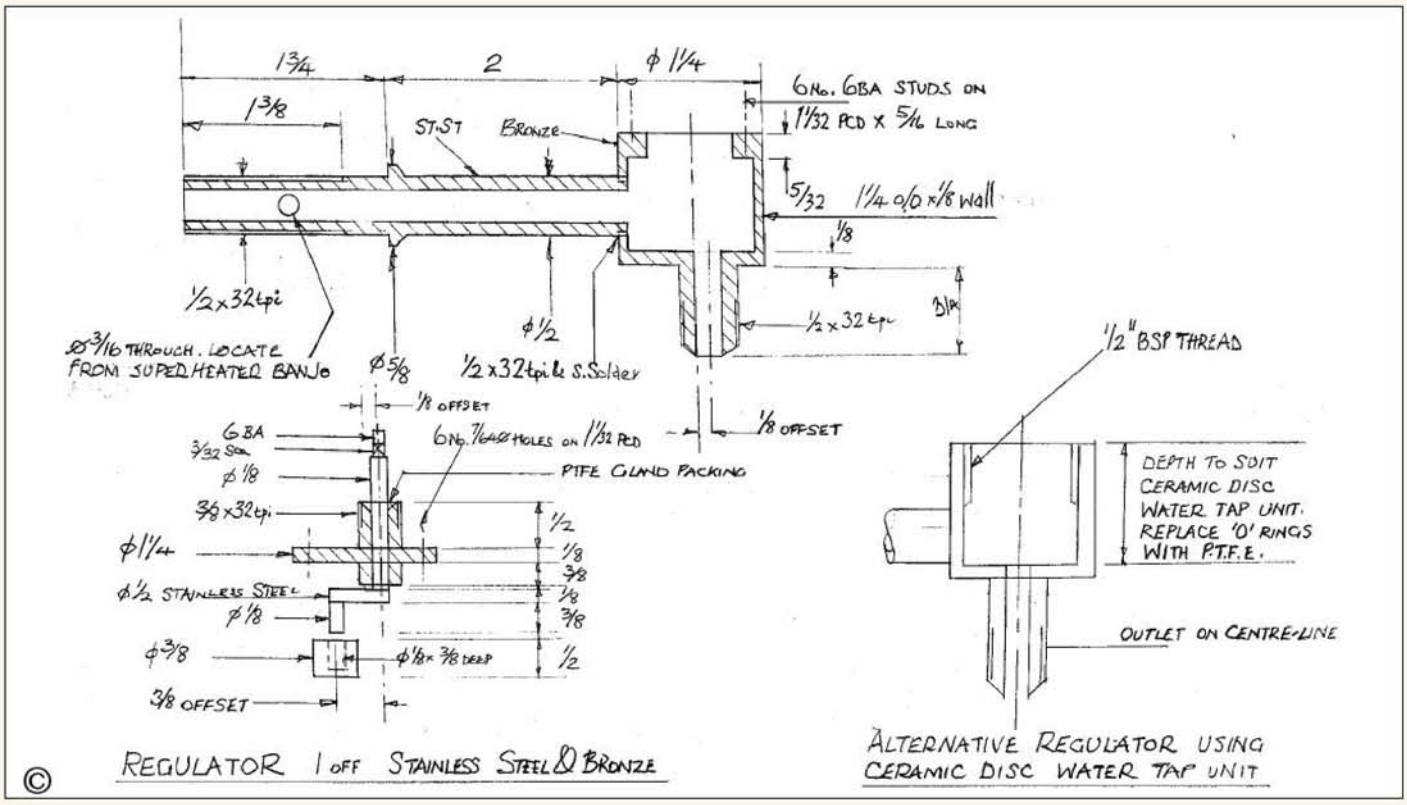
Most of the fittings are made from 1/2in. A/F drawn hexagon bronze bar. The blowdown valve is straightforward and is fitted to the left front bush. This makes it easier for right handed operation and it is also away from the steering drop arm. The other three bushes are plugged. The boiler water feed clacks are both on the left hand side above cab floor level. It is worth going to the little extra trouble of making stainless steel wing valves. If hexagon bar is used it helps to quickly locate it in three positions in the vice for milling the spaces between the wings. They are first turned to size and the 60deg. seating turned.

While set up to make these, it is a good plan to make two more for the safety valves. These require a concave top face to allow the point on the spring rod to apply spring pressure below the level of the seat. After parting off they are held by the outer diameter of the wings in a split bush in the 3-jaw chuck and the top face turned concave. Two more are needed for the boiler feed pump on the gearbox.

You may have your own pet design, or supplier, for the water gauge glass. A bought-in gauge set will require an extension pillar for the lower fitting. If you make your own, different lengths of valve body can be made to suit. I show



© **PLATE 7—Safety Valve, Cylinder Lubricator, Water Gauge, and Pump Boiler Clackbox**



a drawing of a three-cock gauge which utilises a PTFE insert, the body being made from 1/2in. drawn hexagon bronze bar

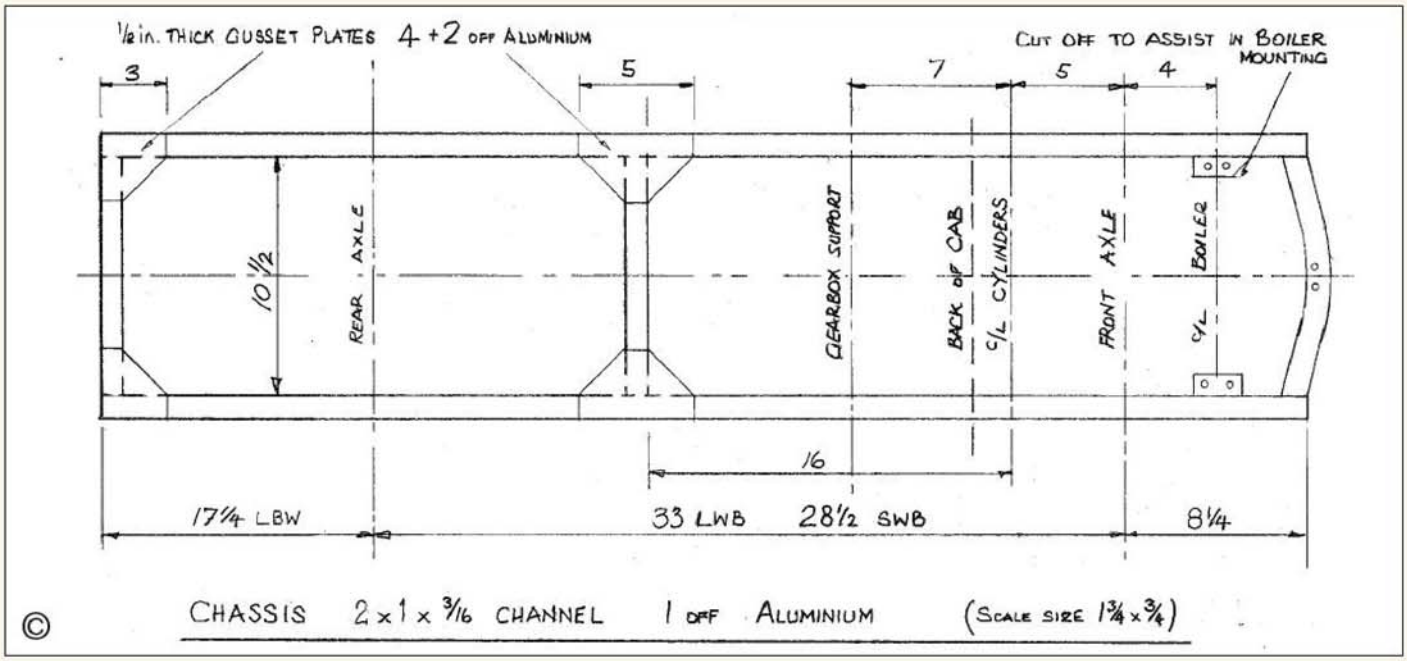
The top of the smokebox forms an upstanding cylinder through which passes the regulator steam pipe, exhaust pipe and blower pipe. The special fixing screws for the smokebox door clamps also screw into it (details to appear later).

The smokebox door is domed and can conveniently be made from a 6in. dia. saucepan lid with a flat stainless steel plate secured inside to make the airtight seal with the upstand mentioned above. The central hole should be marked out from the firing chute which may be off-centre. The

The finished chassis in grey primer. Note the use of gusset plates to strengthen the corners and orientation of the various channel sections.

two are joined together by a centrally flanged gunmetal tube which forms the hopper rim at the top, and the external sleeve which laps onto the central firing chute or its extension at the bottom. Countersunk screws are used to secure the plate to the underside of the flange, and a separate set of screws secures the lid to the top face. The thickness of the flange is determined by the amount of dome on the lid you use.

In front of the firing chute is the 1 3/4in. dia. chimney which slides into a short sleeve or tube having a flange at its lower end. This flange is screwed to the upper face of the flat plate and is a close airtight fit in the lid. The airtight seal between the



The components of the regulator; thin wall 1 1/4in. OD brass tube should not be used here.

The regulator components shown partially assembled.

The regulator shown further on in the assembly sequence.

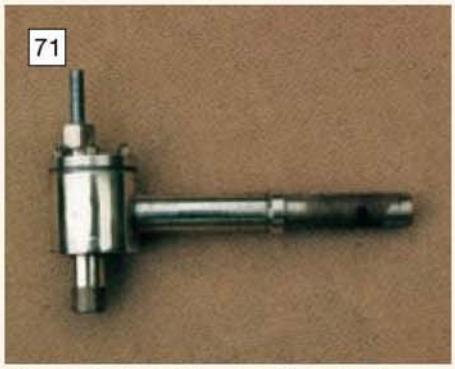
smokebox door and the smokebox upstand is provided by a length of fibreglass tape rolled into a tube and stuck to the underside of the door with a liquid gasket sealant.

Four clamps hold the door down onto the smokebox upstand. These four screws are spaced equally to clear all other pipes and fittings.

The grate is made up from 15 x 3mm (5/8 x 1/8in.) stainless steel using 6mm long spacing tubes and M4 or 4BA studding (allthread). The central bars are shorter at the rear to clear the butt strap. It is best to avoid supporting the grate on integral legs as these always get in the way when raking out ash.

The ashpan should have straight parallel sides with good radius leading to the flat bottom. The diameter should be the same as or a little smaller than the boiler barrel. Here again a suitable stainless steel saucepan could be used which can be suspended from the firebox skirt with a spacer peg and two screws. Two pegs are likely to locate it better with a single screw which would be quicker and easier to locate.

The ashpan bottom should be kept flat and smooth, something to be borne in mind when joining the extension to the bottom, which projects through the air entry to the damper at the front. The butt-strap for this join should be



The complete regulator assembly awaits the handle but is otherwise ready to fit to the boiler.

underneath and countersunk rivets used.

Cut the saucepan down to height and make two horizontal saw cuts. Bend the ends out to be riveted to the air intake 'box'. Screw or rivet the damper hinges to the box making sure that the stainless steel door hinges freely and seals flat against the sloping end of the box.

The door operating rod approaches at an angle from above and is pinned between two brackets thus allowing a push or pull operation without slipping.

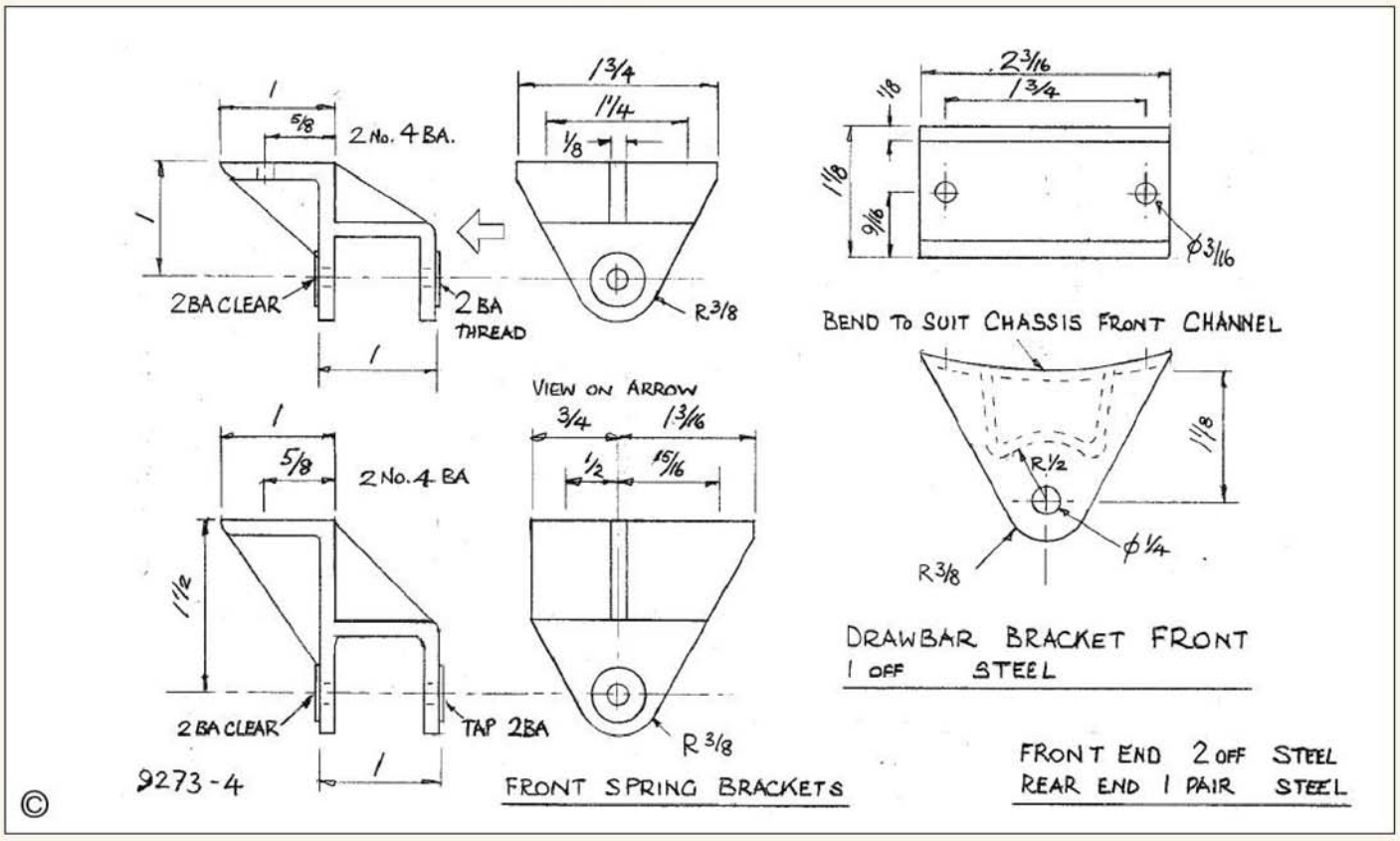
Regulator

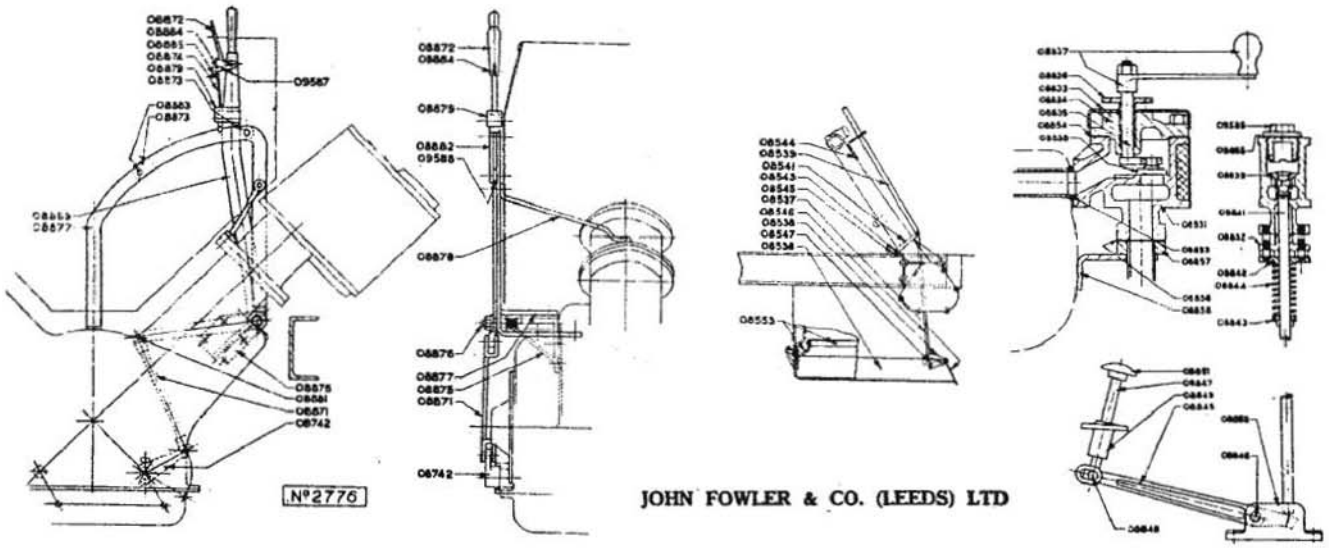
The full-size regulator consists of a cylindrical housing containing two chambers. The superheater communicates with the top chamber, and a circular disc valve is made to uncover a hole to pass the steam into the lower chamber and straight into the steam pipe to the high-pressure cylinder. The disc valve is moved by an overhung crank on the vertical regulator shaft which is controlled by the driver's lever.

This arrangement is supplemented by a further pair of chambers connected to those above, and to each other via a poppet valve controlled port. This valve is lifted from its seat by the foot pedal, thus the regulator steam is controlled by both hand or foot.

The regulator would scale at 5/16in. dia. and it would not be difficult to copy the drawings (**Plate 5**). However, my drawing shows the employment of a one-quarter turn water tap of the ceramic disc type. The complete unit is screwed into a 1/2in. BSP threaded blind hole in a 1 1/4in. dia. body. A side pipe is the steam inlet and the outlet is straight down. Unfortunately boiler pressure is on the shaft gland, but so it was the original. All O-rings are replaced with PTFE.

From the regulator, the steam pipe curves to pass along the cab floor to the 'button' valve,





© PLATE 5—Reverse Gear, Ashpan Damper Gear, Regulator, and Accelerator

turns up by the high-pressure cylinder, and over 180deg. before entering the cylinder via a 90deg. elbow. This last elbow incorporates the cylinder oil intake and the mounting for the displacement lubricator. I assume that the 180deg. loop is to ensure that the oil goes into the cylinder and not down the steam pipe.

Chassis

This is another place where weight can be saved by fabricating from aluminium alloy channel. However, aluminium alloys can be less stiff than steel so, to offset this disadvantage, 3/16in. thick channel should be used. The main dimensions are 2 x 1in. whereas scale size would be 1 3/4 x 3/4 inch.

The main side channels are arranged flange outwards and the ends flange inwards. The front end channel is bent into a neat curve. This is achieved by annealing a suitable length of channel and, before separating it from the whole length, pulling it up, flanges up, under the lathe chuck with the end of the channel resting on a block of wood on the lathe bed, using the unannealed part as a lever. Choose the length with the best part of the curve, mark two parallel lines 10 1/2in. apart and cut off.

Stiffness can be further enhanced by enlarging the rear corner gusset plates riveted above and below the rear corners of the chassis. Similar enlargement of the top-only gussets on the middle cross-member is adopted. Since taking the photographs of the chassis I have discovered that the front corners should also be gusseted.

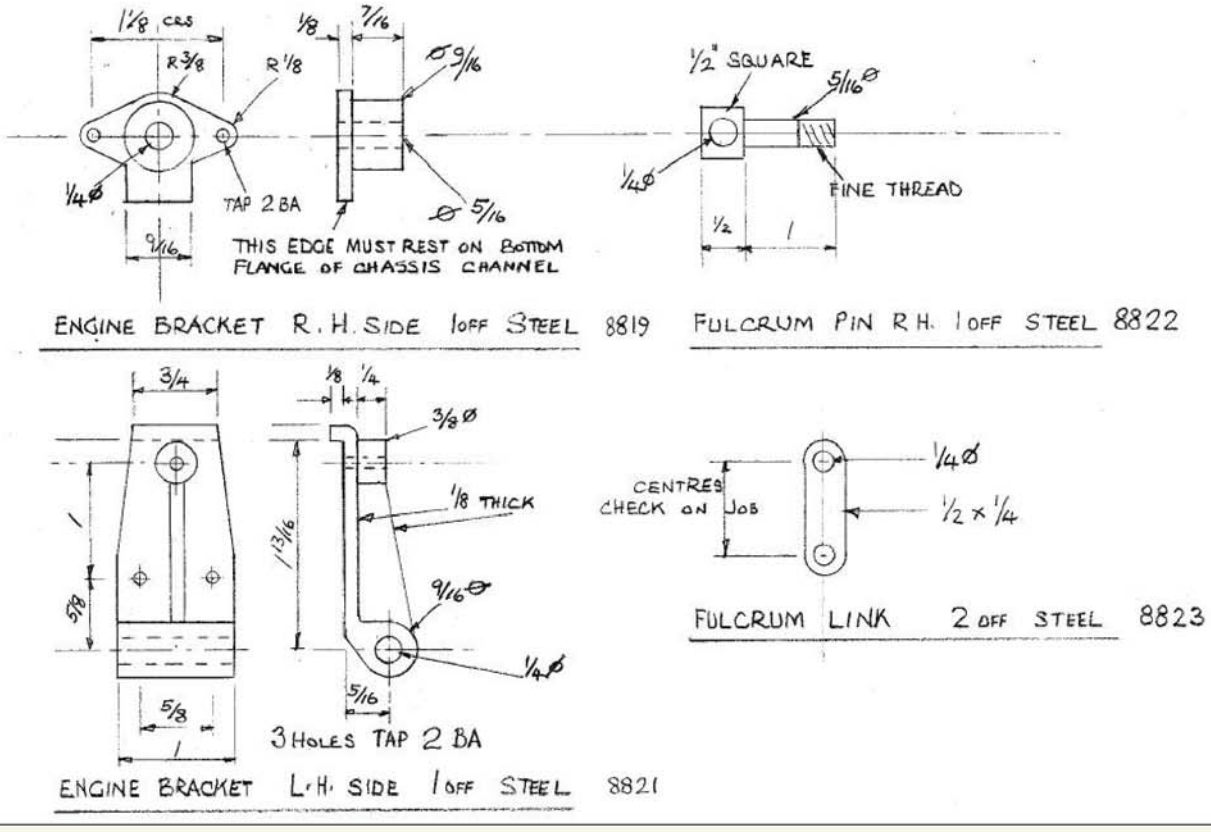
The pair of angles that make up the cross-member which supports the gearbox, are made from the same channel but with one flange removed and part of the web removed to clear the gearbox; 1 1/2 x 1in. angle could be used.

Each corner of the main chassis is assembled by using a triangle of rivets through both legs of a short piece of angle onto the side and cross-members of the chassis. This is followed by the triangular gussets, each secured by five rivets.

Short angles (channels with one flange removed) are riveted on the inside of the side channels to support the boiler. The boiler is also supported on the front curved cross-member. The offcuts from these short angles are used to reinforce the central holes of the gearbox supporting angles.

The centre lines of the boiler, front axle, cylinders and rear axle, should be marked on the chassis side members.

●*To be continued.*



JOHN HARRISON'S H3 SEA CLOCK
BUILDING A REPLICA

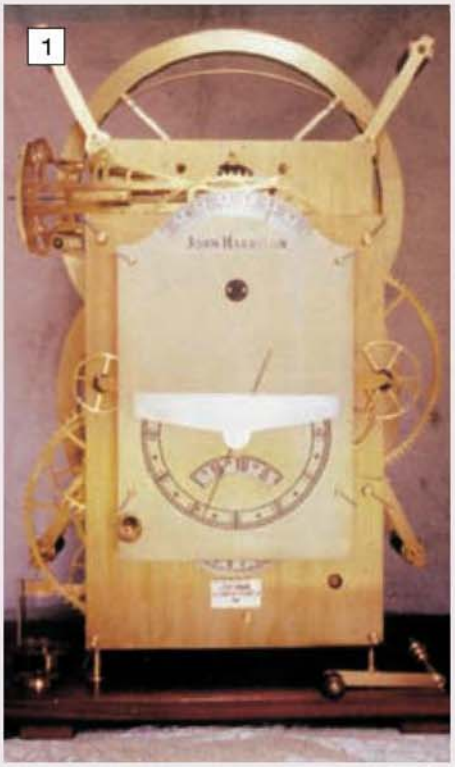
Don Unwin

introduces his replica of a historical horological masterpiece.

●*Part I*

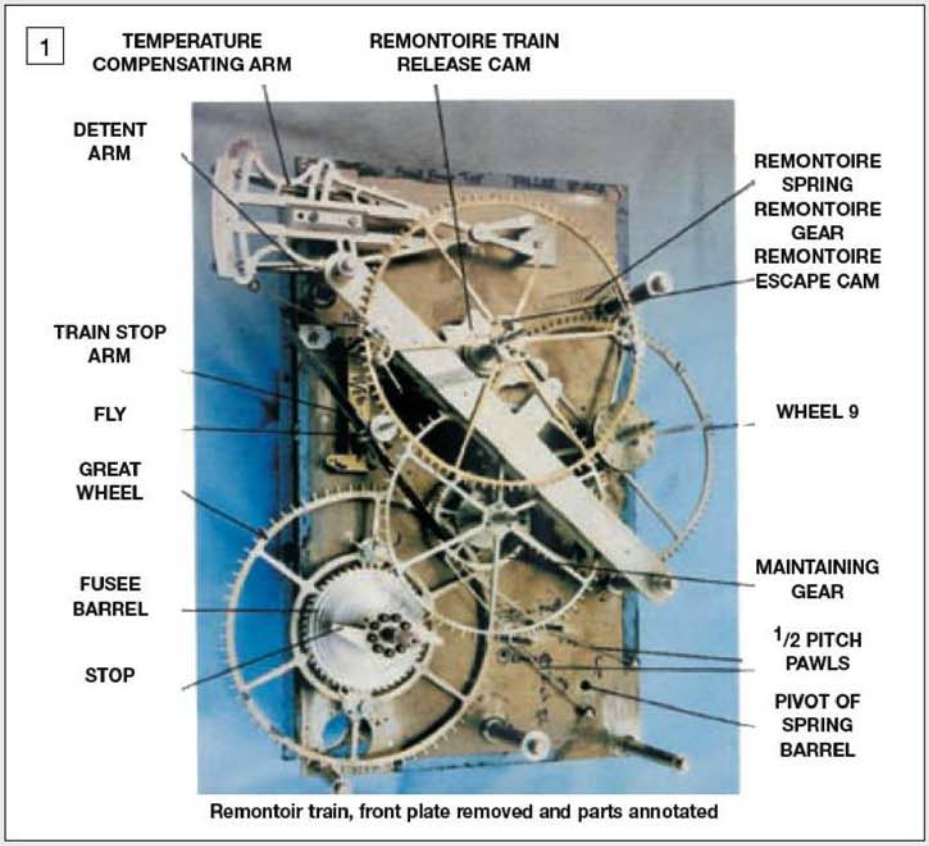
After I had completed my Grand Orrery, the description of which began in *M.E.* 4127, 25 August 2000, I was looking for another 'beefy' project to tackle. Somebody suggested making a replica of John Harrison's sea clock H3. The publicity given by Dava Sobel's book *Longitude* together with the *Longitude* films on television has increased public awareness of the work of John 'Longitude' Harrison and his efforts to gain the £20,000 prize. Now when I say I have built a Harrison H3 most people have some idea what I am talking about. Harrison made three sea clocks or chronometers designed to keep very accurate time even while being tossed about on a ship at sea. His final successful design, the H4, was in the form of a watch of about 5 1/2in. diameter and quite different from the previous three which were very large. Sobel's book is well worth reading if you have not already done so.

Why H3 in particular? The reasoning involved the belief that because the clock never went to sea no replica had been made of it. Harrison had spent nineteen years trying to get it to perform satisfactorily before abandoning it and going on to make the successful H4 watch chronometer. Also, apart from it being Harrison's third attempt to win the £20,000 Longitude Prize, its other claim to fame was the incorporation of two of his outstanding inventions. One was the caged roller bearing and the other, even more world shattering, was the temperature sensitive bimetallic strip.



A front view of the nearly finished clock showing the various dials for telling the time.

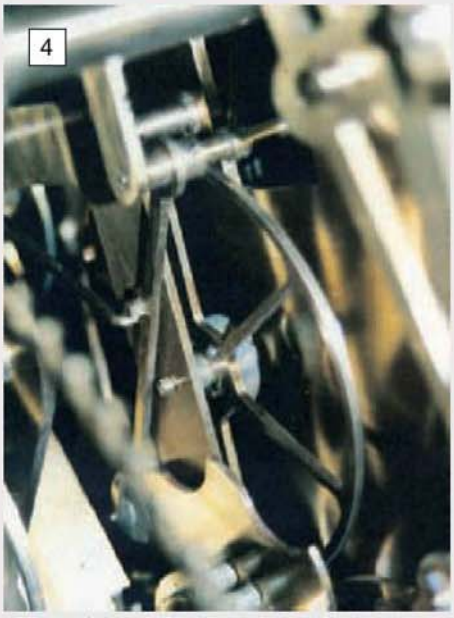
The clock under construction showing the two distinct sections referred to in the text.



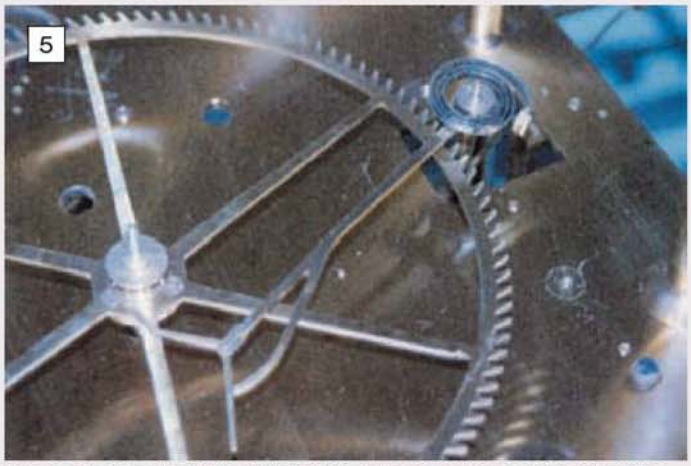
Remontoir train, front plate removed and parts annotated

Examples of the bimetallic strip are still widely used industrially and are incorporated in almost every domestic appliance.

Two other innovations of his were the grasshopper escapement and the use of a coarse ratchet wheel with two pawls set half the tooth



A view of the mechanism showing the fly, stop arm and detent arm latch.



The escape wheel with 'lantern pinion', detent arm, loose claw and spring referred to in the text.

Machining the MDF board pattern for the balance wheel castings using the milling machine.

pitch apart, giving the effect of a fine ratchet wheel but with strong teeth. Another of his earlier introductions was the maintaining gear which provided drive to a clock while it was being wound.

Research

When the replica was suggested I had to search for all available information to discover what I had let myself in for. Every reference to Harrison, and his H3 in particular, was followed up to the extent that after a few weeks I had a good idea of what was involved. However, while many illustrations are reproduced in the references consulted, they are all similar or the same. Considerable help came from Rupert Gould's 1931 lecture about his restoration of H3 reproduced in the *Horological Journal* in 1932.

Probably the greatest breakthrough came when I discovered the Royal Greenwich Observatory Archives in the Manuscript Room at the Cambridge University Library, just a couple of miles from my home. When E. J. Dent had the original clocks cleaned in 1836-40 he arranged for a draughtsman, probably Thomas Bradley, to prepare a set of drawings now in the RGO Archives at Cambridge. I went to see these and when I explained my reason for looking at them the Library supplied me with two sets of excellent full size copies, one to keep for reference and the other to pencil all over!

Bradley's drawings are drawn full size and very detailed; they include the layout and many detail drawings of components but are devoid of any dimensions. Unfortunately, work on the drawings appears to have stopped before they were completed; the left side elevation remains unfinished and there are no elevations of the top, right side, or underside. Although eighteenth century workers seemed to have used $^{1}/_{12}$in., it appears from the drawings that Harrison was using inches, eighths and sixteenths, although I am sure that he just made his parts fit together exactly as I do today!

Soon after starting work, and a second time when construction was well advanced, I went to see the original clock at the Old Royal Greenwich Observatory on a couple of occasions. I had prepared a list of points to look at and made many notes; no photography is permitted, as the clocks are still the property of the Admiralty. My first visit was curtailed as I sensed the scrutiny of a battle-axe of a room steward who seemed to be keeping a somewhat aggressive watch on me, indicating the prudence of a prompt exit! On my second visit, since I had taken the precaution of making friends with him first, the steward was very helpful! *"Stay as long as you like, make all the notes you want, but no photographs"* he said.

Throughout the project I kept a running log of all time spent on it, from which I see that all this research took some eight months. However, it was not until the actual construction was under way that I discovered Bradley hadn't fully understood what he was drawing, so there were some errors. When revealed, the many subtleties in Harrison's design, which neither Bradley nor I fully appreciated also often involved remaking parts!

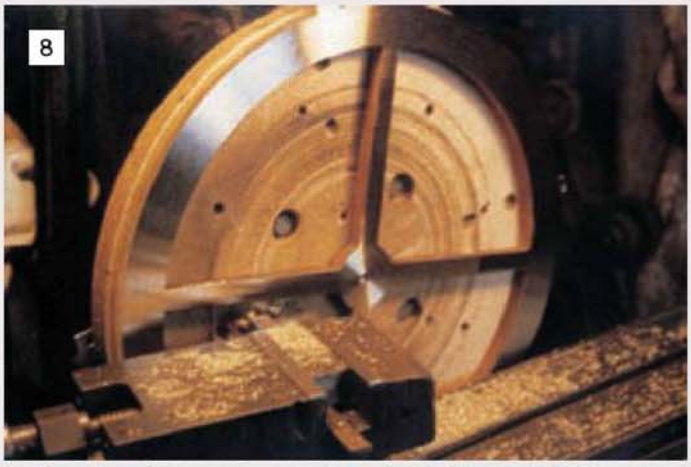
Construction

Photograph 1 is an illustration of the completed clock that stands about 27in. (0.69m) high and weighs over 60lb. (27kg). It is quite a massive piece of work and consists of two sections. That at the front provides the driving force to the escapement located in the back section. These two sections can be seen in the illustration **photo 2** of the clock during construction. The two large wheels in the back section are balance wheels which perform the same function as the pendulum of an ordinary clock. Acting through a train of gears in the front section the main spring drives a 'remontoire', the large gear at the top behind the dial plate.

Attached to this gearwheel are two springs which, as it rotates, winds up the springs driving the escape wheel in the back section. The remontoire gear is released by the escape wheel to wind up every 30 seconds. To ensure that uniform torque is applied to the escape wheel, the two springs are coupled to a contoured cam on the escape arbor by fine flexible bronze tapes. So that the torque applied to the remontoire train is fairly uniform, the drive from the main spring is by way of a chain from the spring barrel to a shaped barrel or *fusée* attached to the great gear wheel. **Photograph 3** is a view of the remontoire train with the front plate removed and with the parts annotated.

The manner in which the remontoire train is locked and released is interesting. Meshing with the remontoire gear is a pinion on an arbor which carries the fly and a stop arm, **photo 4**. When the end of the stop arm catches the detent arm it locks the train. On the back or escape wheel side of the centre plate, the stop arm spindle has attached to it a second detent arm which carries a ▶

The finished pattern ready to go off to the foundry. MDF is a convenient material as it has no grain and simplifies the pattern making process.



Preliminary machining of the face of one of the balance wheels. They were too large for the lathe and the operation was done on the milling machine.

loosely pivoted claw engaging with one of the pins of a lantern pinion on the escape arbor, **photo 5**. As the escape wheel rotates, the claw which has caught the lantern pinion pin on the escape wheel is pushed downward so moving the detent arms until the stop unlocks the stop arm of the fly allowing the train to run.

The resulting rotation of the remontoire gear arbor carries round the release cam fixed to it which then pushes the detent arm down and moves the claw away from the lantern pinion on the escape wheel arbor. This allows the claw to be reset for the next cycle, which occurs every 30 seconds. To get it to function properly, adjustment of this mechanism was very tricky indeed. It is pretty to watch working but unfortunately difficult to see.

In the back section are the two balance wheels with the pallets and the escape wheel. Crossed wires on pulleys connect the two balance wheels so that they rotate in opposite directions and therefore cancel out the effects of the rolling of the ship. In fact, almost every moving component in the clock is counterbalanced for this reason, any required force being supplied by springs. One pallet of the grasshopper escapement is fitted to the top balance and the other on the lower balance, the angle of swing being about 12deg. either side of the central position.

A pointer on the escape arbor indicates the seconds at the top of the dial plate (photo 1) and the minutes on the curved scale near the bottom. Just above this, the hours are indicated through a window. To ensure that the clock remained running while being wound up Harrison devised his maintaining gear. In the eighteenth century the oils used for lubricating clocks were very poor so Harrison went to great lengths to avoid the need for any lubrication. All the arbors run on the outer diameters of two overlapping, large diameter wheels — one can be seen in photo 1 on the right hand side, about half way up. For the hubs of these anti-friction wheels he used the oily hardwood *lignum vitae*, which has self-lubricating properties, running on small diameter brass spindles. All the lantern pinion trundles, or teeth, consist of *lignum vitae* rollers running on very small brass spindles. The only metal-to-metal bearings are lightly loaded components with limited movements such as pawls running on shoulder screws.

Preliminary machining of the balance wheel spokes using the rotary table mounted on the milling machine.

Building

I hope this brief description gives some idea of the complexity of Harrison's masterpiece so that we can now pass on to describe some of the interesting details of the construction of the replica. As I am not a clockmaker I am quite sure that certain of the methods I used are not the same as those used by Harrison, nor those used by many modern clockmakers!

Making the pattern of MDF board for the balance wheel castings was the first job, seen being machined in **photo 6** and completed in **photo 7.** The four lugs on the rim, to be cut off later, were to hold the casting while machining the faces. Brass castings can be porous near the surface, so plenty of machining allowance had to be provided. However, a very co-operative foundry provided two nice brass castings which proved to be excellent although almost certainly much more dense than the Sheffield brass used by Harrison.

As they were too large to swing in my lathe they were turned on my milling machine using the set-up shown in **photo 8.** Holes were drilled and tapped in the four lugs on the casting rim, which was held by screws to the thick chipboard faceplate on the milling machine arbor. After facing they were transferred to my rotary table for machining the inside diameter of the rim and the spokes (**photo 9**). To allow any residual stresses that may cause distortion to be relieved, the part-machined wheels were left for several months before final machining to size.

●*To be continued.*

LOGGER & SLOGGER
AMERICAN TYPE 2-8-2 LOCOMOTIVES
for 5in. and 7¼in. gauges

Keith Wilson

explores the construction of grates and ashpans and discusses oil and gas firing.

●*Part XXXIV continued from page 394 (M.E. 4231, 1 October 2004)*

This series is very nearly finished. Oddly enough, in the long run it was more difficult than *Ariel*, which incidentally has turned out rather well. Obviously there were mistakes in the design, but has yet a correct locomotive design been published? *Ariel* builders who obtained their information from the supplier of castings (M. J. Engineering 'phone 01425-476234) were provided with a list of known errors; I have the list in my computer, so anyone who wants a copy can send an e-mail or SAE. No charge. I know of four that have been finished, it seems they go like the proverbial bats out of hell, but I have yet to see one personally.

Harder than a Pacific, of known complication? Yes, for despite over 200 excellent photographs sent 'through the pipe' by friends on Vancouver Island, small details are mainly missing on the outside, and some on the inside are beyond the reach of the camera. Likewise, the Baldwin drawings are rather sketchy, unlike the drawings from Swindon, Crewe, Derby, Eastleigh, etc.; and at least for *Ariel* I had virtually the complete set of Bulleid Pacific drawings, even if many were of the West Country/Battle of Britain class. Incidentally, water feed into the West Country boilers apparently sounded like a different type of w.c. flushing, so naturally enough the crews referred to them in other terms than West Country. Oliver Bulleid heard about it (grapevine?) and promptly changed the class name to Battle of Britain. Exactly how long the other name lasted I don't know, but I bet it was a long while! Also the nickname *Spam Cans* was most certainly *not* invented by dear old Curly despite claims to the contrary by one of his detractors. For that matter, he didn't invent the name of *The Galloping Sausage* for Gresley's big experimental locomotive either, for Nigel Gresley (as he then was) invented it himself, based on the German diesel train called *The Flying Hamburger*.

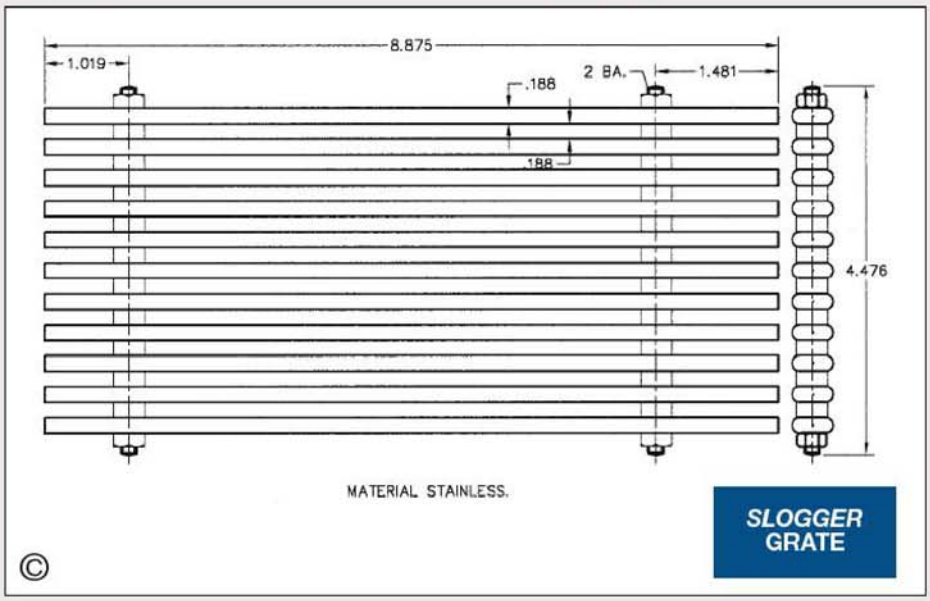
A few parts of *Slogger/Logger* still await description, and since I don't know much about them, it raises problems. I have a couple of invaluable sections of the *Locomotive Cyclopedia*; however, one other part dealing with cabs and

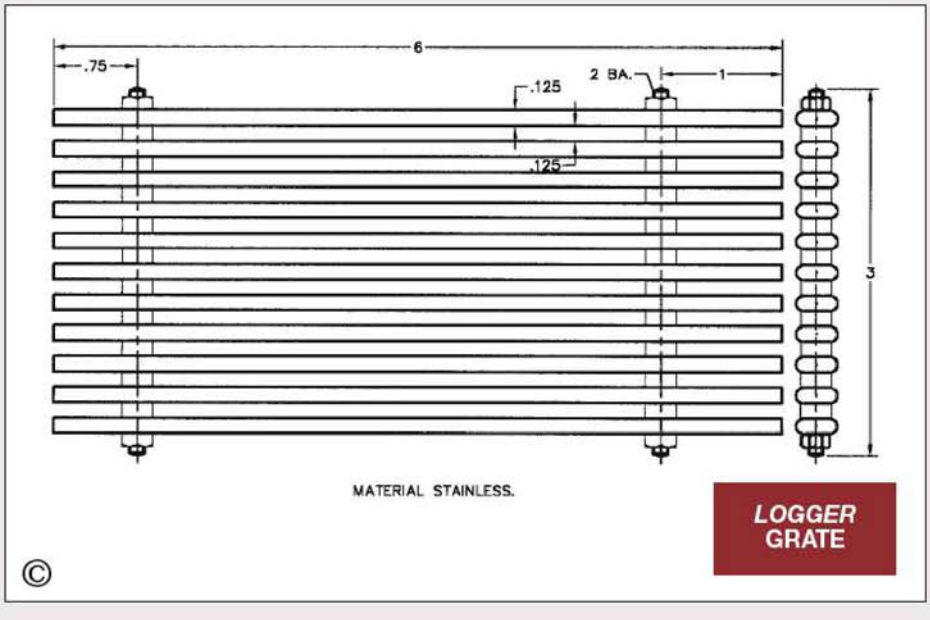
Wilson's Words of Wisdom:
A Labourer may remove an obtrusive rock in moments, but several months may elapse without two Wise Men agreeing on the meaning of a single vowel.

As the series approaches its conclusion, we felt it appropriate to remind readers of the appearance of a prototype locomotive.

fittings has yet to arrive. I am chasing it up, and it could make my life (and yours!) a bit easier.

I don't think I can offer any useful advice concerning oil or gas-firing, but there is no reason why coal-firing should not be used. In general, oil-firing shoves up the power output by about 50%, witness the occasion when an oil-fired GWR Mogul (2-6-0) operated the *Bristolian* for a week. I have yet to trace any details of the appointment, but when/if I do will pass them on. The *Bristolian* was originally a King job, but with its limited load I believe that a Castle later proved adequate. In emergency, other locomotives were sometimes pressed into service, of which perhaps the two most notable were *Fountains Hall*, and perhaps prize of all, the *City of Truro*. Both gave remarkably good performances, but of course in the ultimate case, power output depends on how hard the fireman is prepared to work. I understand the maximum power output of the Duchesses is beyond the power of the fireman, and those who were on the special GWR High Speed Train of 9 May 1964 will know something about locomotives working hard — and how! For the present about all I can design and show is the grate and ashpan.





Regrettably, the ultra-high quality stainless steel grates which Norman Spink once supplied are no longer available — alas, his supply has dried up. These grates were made from very high quality semi-triangular stainless which was quite difficult to cut and long-lasting in use. They also were *almost* insoluble in white-hot molten slag, so after long use they still 'went west'.

I don't know if the basic stainless is available in this shape (trapezoidal) but if it is then part of our problem is solved. With rectangular stainless, a grate can be made up from strips, I suggest strips about 1/8 to 3/16in. x 1/2in. for *Slogger*, 3/8 x 1/8in. for *Logger*. With a couple of holes in each, jig drilled for choice, they can be threaded onto a couple of stainless shafts spaced out by spacers (?) also in stainless, and with a nut screwed on each end, there's your grate. The spacers should be about the same width as the bars themselves, and need be no more than about 5/16in. to 3/8in. diameter.

A cheaper (and possibly easier to obtain) grate material is black mild steel, 3/16 x 1/2in. (or of course 5 x 12 millimetres. It has rounded edges, and not being as tough as stainless, doesn't last as long, but is easier to drill and machine — and cut, for that matter. I have used it for several years, until Norman's 'supergrates' became available.

Although I show drawings for grates, it will be as well the check the actual dimensions on your own locomotive. For the same reason I have not drawn an ashpan. It is very easy to sort out with the locomotive in front of you; I've had some. Juggling around with some cardboard, a knife, and a reel of sticky tape will give you a somewhat better idea of basic shape, remembering that you have to avoid various moving parts, and that some moving parts have to avoid the ashpan. The draincocks operating rod comes to mind, and although steam-operated draincocks are practicable, they still need to be connected to the cab.

From choice ashpans should be made of stainless or brass. Reason: conditions inside ▶

Train Mountain gas container on chassis.

ashpans are erosive, corrosive, and in general very unfriendly to metals. Erosive? Pertaining to grit, shot blasting, knackering of solid objects by physical means. Corrosive? Pertaining to chemical means. End results? From our point of view — similar. Fortunately, erosion is not so important in ashpans of our sizes, and corrosion is less with materials that don't react too fast with water. Aluminum? Amphoteric, which means soluble and therefore liable to chemical action in both acids and bases (alkalis), so avoid it despite apparent advantages.

It is quite possible to make dead-to-scale ashpans complete with trapdoors, etc., to extract ash and adjust air admission, I suggest for a working locomotive this is mostly wasted effort. In full size, grates were assembled on site from numerous castings; however, anyone wishing to faffle around assembling such a grate using long forceps and working in gynaecological fashion through the firehole is welcome to try. Imagine trying to drop the fire, etc. It seems therefore that an easily removable ashpan of simple construction is worth a thought.

In the case of long narrow fireboxes which frequently extend over the rear driving axle, the ashpan must perforce be in two parts; likewise the grate. Unless, that is, you enjoy removing the boiler from its chassis in order to drop the fire and clean the grate. A trapdoor in the bottom of each section is essential, but must be easy to open from the outside; that is, from outside the chassis. If the grate is mounted on a couple of stainless pins fitted through the lower flanges of the firebox where it hangs below the mudring, then replacing the grate will be great.

Heat can do much to distort a grate or ashpan, hence it would seem best for fairly thick material to be used — I suggest not less than 18g. (0.048in.). If it can be held in place by a single pin, so much the better. In the case of a double ashpan, as per last paragraph, the front pan should be easy to remove; the rear one, which is usually shorter, can be more of a fixture provided it has a trapdoor in the bottom. The front grate can be removed and replaced through the front trapdoor which should be made as large as you can, with plenty of air access. Ashes and clinker from the rear grate can be pushed forward via the firehole so that the debris falls through the front ashpan trapdoor. The suggested single pin mentioned above is all the more useful if it can pass through a hole in the frames, two holes in the ashpan, and through another hole in the opposite frame. The two ashpan holes are all the better for being connected by a piece of tube which protrudes beyond them on each side, in fact ideally just long enough to fit between the frames. Silver-brazed in place, it is also useful as a lateral (sideways) guide for locating the pan. This tube (preferably copper) is all the more useful for being belled out at each end.

The locks or fasteners for the trapdoors should be large, for otherwise grit and distortion will render them most difficult to handle.

I would like to make it clear that all my locomotive work and writings are aimed at a hard-working artifact which is easy to maintain and as accurate to the prototype as can be arranged. They look quite nice, and while others may win gongs at exhibitions (best of luck to them) I am seldom happy if one of mine goes into a glass case forever.

I recall very many years ago a club member who rarely attended any club meetings, but brought his locomotive along in a case, put it on the track, raised steam with distilled water and ran gently round the track for a total of about one hour, without taking passengers. Since this annual run always seemed to coincide with one of our open days when the public attended in copious numbers, as I am glad to state they still do, it was not an over-popular operation.

Of course, he had a perfect right to do this, but by occupying a track section with non-revenue earning operation … *'nuff sed*? What made matters worse is that he obviously thought his locomotive was better than ours.

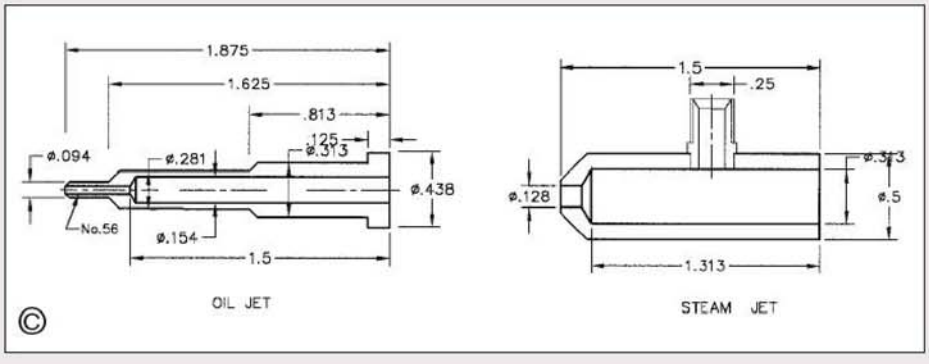
In the last instalment I promised drawings of an oil-tank for the tender, but such is not much use for coal-fired versions. Also, it is common sense to note that the driver, being perforce somewhat larger than scale, has to sit on (*Slogger*) or behind (*Logger*) the tender and reach over to get to the controls. Somewhat important, what? So a 'scale' size oil tank is out. In any case, obviously the tank is superfluous with coal-firing, ditto gas. Therefore, a secondary 'tender' for oil or gas is indicated.

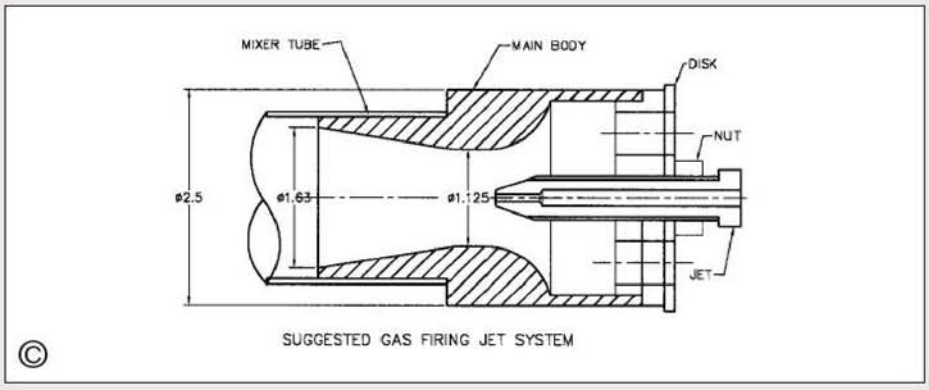
The finest solution of which I wot is/are the gas tankers on Train Mountain. I don't think there is any great need to provide a separate design for this item; much will depend on sizes of LPG cylinders available. Although we can easily make our own boilers as pressure-vessels, I fear that the HSE might well look askance at amateur-made gas-cylinders, for the amount of potential energy in the gas cylinder is very much greater than that in the boiler. It could be fun to make it like a big 'Vanderbilt' tender; for those not familiar with this type it was basically a squarish front portion with a big fat horizontally mounted cylindrical tank behind. It wouldn't be correct for *Slogger* or *Logger* of course.

By courtesy of some readers, suggestions for oil-firing and gas ditto are offered here. I must stress that they are only suggestions as far as I am concerned; you have to start somewhere after all.

Fittings which can be easily undone for disconnection of fuel supplies must be left-hand for combustible gases, but I am unaware of any such obligation for oil. Paraffin (Kerosene 'on the other side of the pond') is suggested, but I have no experience of either oil or gas-firing.

●*To be continued.*





LETTERS TO A GRANDSON

M. J. H. Ellis

describes his Universal Clamp and analyses the strength of threaded fastenings.

●*Part LXX continued from page 520 (M.E. 4233, 29 October 2004)*

Dear Adrian, ever since I began writing to you about model engineering, I have meant to say something on the subject of 'dogs', that is to say, the clamps used to hold down work for machining. But I have constantly forgotten to do so, and I suppose the reason is that they are such simple and commonplace things that they attract no attention. The plot of one of G. K. Chesterton's detective stories turned on the very same thing; nobody had noticed the murderer, because he was dressed as a postman, who was so familiar a sight that he went about unnoticed.

I think the very use of the name of 'man's best friend' is worthy of passing notice. In English technical usage it has at least three different meanings: clamp for holding down work; lathe-dog or carrier; and in 'dog-clutch'. In each case there is the connotation of 'gripping', which brings us back to the postman again. You will know that the French word for 'dog' is *chien*, but you may not know that it also has the meanings 'pawl, or catch', and 'hammer (of a firearm)'.

I don't recall ever having seen dogs of the holding-down variety offered for sale, and a perusal of illustrations in *Model Engineer* articles tended to show that people had improvised their own means for holding work down using a short length of bar material with a hole through it, and packing up the heel end of it with whatever bits of stuff came to hand. It seems to me that it is worth while having a versatile means of clamping down work ready to hand, and so I will now tell you about 'Grandpa's Universal Clamp'.

Since I began to think about what I would say, it has occurred to me that exactly the same principle was used for the tool-holder of my Myford Super Seven, but I was using dogs of the simple type which I am about to describe forty years at least ago, long before I bought the Myford lathe. As you will see from my sketch, it is just a short piece of bright mild steel flat bar, with a hole in it, or better still, a slot for the bolt, and a tapped hole at the heel end to take a 3/8in. Whitworth bolt. If the work is very thin, the threaded end of the bolt can be downwards, whereas if the work is thick, extra height can be gained by having the bolt-head underneath.

There are useful variants on this basic pattern. Sometimes, only one dog can be used, in which case, to reduce the risk of the work moving, I made a wider model ending in two short prongs. At other times, the area on which the dog can seat is limited, in which case a dog tapered at the end is required. I made one of that kind as well.

Thread strength

I have been giving thought to the effect on the strength of a screw fastening which would result from using a tapping drill larger than the core diameter of the thread. I see two possibilities:

1: The force which the fastening could withstand per turn of the thread would be reduced, but if the number of turns were sufficient, that would not affect the load which the bolt could carry, as it would fail in tension before the thread stripped.

2: If however, the length of the female thread were limited, e.g., if the depth of a blind tapped hole were restricted by other considerations, it would be the male, not the female thread which would be weakened. My analysis of the situation is illustrated in the accompanying sketch (**fig 2**).

Because the internal depth of the female thread is reduced, the cross-section of the male thread which is subjected to shear force is reduced in proportion to XY/AB, AB being the pitch of the thread; let this be denoted by 'P'. Denote XY, the effective pitch from the point of view of strength, by 'p'. Then, if the core radius of the thread is 'R', the full depth of thread is 'D', and the increase in the core radius is 'd'.

Neglecting the fact that the thread is not a circular ridge, but is actually helical, if the female thread were cut to its full depth, the area of metal subjected to shear force in one turn of the thread would be very nearly $2\pi RP$

(expression 1)

Similarly, the actual area subject to shear force is very approximately that of a strip of width p and length $2\pi (R + d)$

but $p = P (D - d) / D$

and so the area is $2\pi P (R + d) (D - d) / D$

(expression 2)

D cannot have a value of zero, so we can re-write expression 1 as $2\pi RP (D / D)$

The shear strength of one turn of thread is therefore reduced in the ratio of

(expression 2) / (expression 1)

or $2\pi P (R + d) (D - d) / 2\pi RPD$

Which reduces to $(R + d) (D - d) / RD$

$= (RD - Rd + Dd - d^2) / RD$

$= 1 - [(Rd - Dd + d^2) / RD]$

This ratio will be less than 1 provided that $(Rd + d^2)$ is greater than Dd that is, if $(R + d) > D$

This condition clearly holds good for any thread use, although it is interesting to note that it is possible to imagine a thread with so slender a core diameter that (R + d) would actually be less than D. But in such a case the thread would be so inclined to the axis of the screw that the basic approximation would no longer hold good. I don't think, however, that would necessarily invalidate the argument, since the same factor would probably be introduced in both numerator and denominator of the fraction. Anyway, I think that I have now pursued the matter far enough.

Before leaving the subject, it would be interesting to substitute some actual values in the expression $1 - [(Rd - Dd + d^2) / RD]$ above, to see what the theoretical reduction in strength would be. The following figures apply to 0BA: R = 0.0995in.; D = 0.0236in.; d = 0.0059in.

Substituting, this gives a ratio of

$1 - [(0.0995 \times 0.0059) - (0.0236 \times 0.0059) + 0.0059^2)] / (0.0995 \times 0.0236)$

$= 1 - [(0.000587 - 0.000139 + 0.0000348)] \div 0.002348$

$= 1 - 0.206$

In other words, the strength is reduced by 0.206, or 20.6%

Finally, let us estimate how many turns of the thread would be needed to equal the tensile strength of the bolt. My *Mechanics' and Machinists' Pocket Book* gives the shear and tensile strengths of gunmetal as 12.47 and 13.68 tons weight per square inch respectively. Taking 0BA again as example, the area subjected to shear in one turn of the thread (expression 2 above) is $2\pi P (R + d) (D - d) / D$ and substituting the appropriate values gives

$2 \times 3.1416 \times 0.0394 (0.0995 + 0.0059) \times (0.0236 - 0.0059) / 0.0236$

$= 0.0196 in.^2$

The resistance to shear force is then

$0.0196 \times 12.47 = 0.244$ tons weight.

The cross-sectional core area of the bolt is

$\pi \times 0.0995^2, = 0.311 in.^2$

and its tensile strength

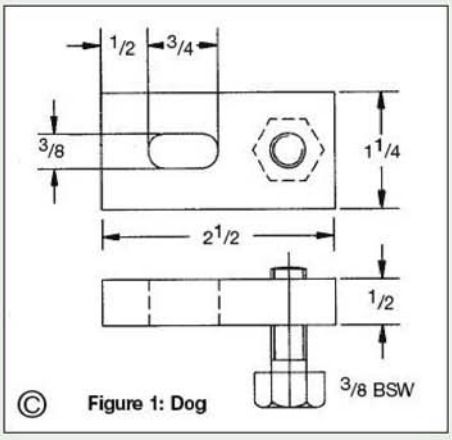
$0.0311 \times 13.68, = 0.425$ tons weight.

It follows that for the thread to provide equal strength in shear it will require

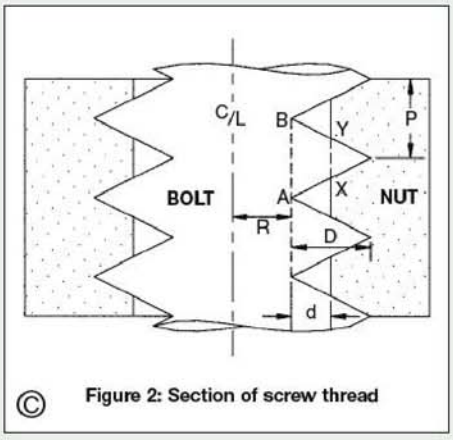
$0.425 \div 0.244 = 1.74$ turns and two would suffice. It doesn't seem very many, yet I can't find any error in my arithmetic.

Your affectionate Grandpa.

●*To be continued.*



© Figure 1: Dog



© Figure 2: Section of screw thread

Ingvar Dahlberg's remarkable 1:5 scale model of a Mercer Raceabout *was a huge attraction for visitors throughout the event.*

A glimpse under the bonnet of the Mercer reveals an authentic finish on the visible engine parts.

MIDLANDS MAGIC

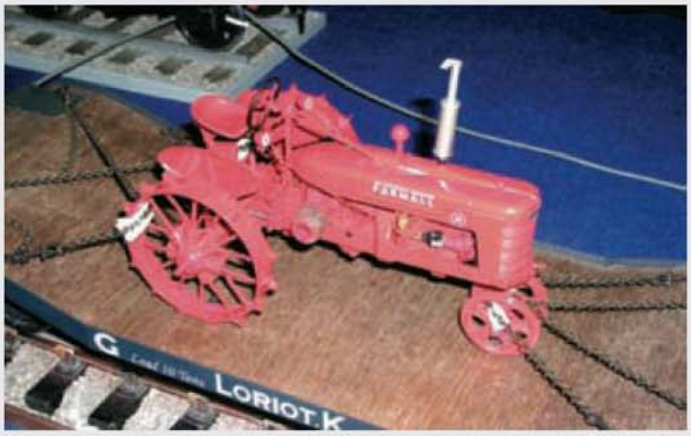
Neil Read

shares the photographs of some of his favourite exhibits taken at the 2004 Midlands Model Engineering Exhibition at Castle Donington.

It would seem likely that this year's Midlands Model Engineering Exhibition will be remembered for the heavy rain that accompanied the event and for the muddy, treacherous conditions that existed out on the car park. Incidentally, our thanks to the kindly soul who helped the editorial car on its way when it became stranded in the mud. Without your help we may have been there yet!

However, it would be a pity if the weather figured too largely in our thoughts as, apart from the activities of the Stoneleigh Steamers which were perforce somewhat curtailed, this was an excellent event and there was much to see and enjoy.

As has become our custom, we herewith offer a brief glimpse of some of the exhibits which caught our eye. The choice is a personal one and no attempt has been made to photograph only the award winners or place the models in any sort of class order or category. Hopefully, this will enable readers to see and enjoy them as we did. No doubt formal reports of the event will appear elsewhere in due course for those who wish to study them. Meanwhile we invite you to stroll round the exhibition with us.



Martin Rant's 5in. gauge GWR Loriot K well wagon featured this delightful load of a period Farmall tractor.

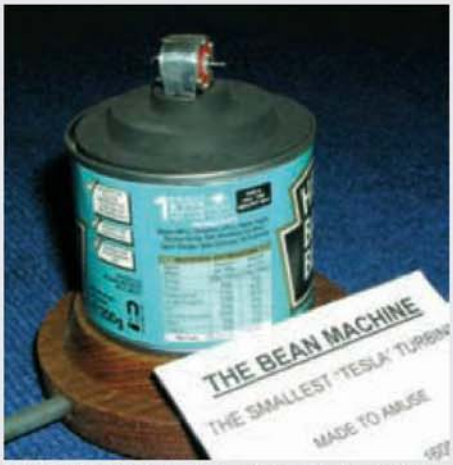
One of a number of fine locomotives on display was this 3½in. gauge GWR 4-6-0, No. 6026 King John *displayed by Russell Parkin.*

Featured on the SMEE stand was this diorama of Otto's workshop made by Cedric Mell.

Exhibited with Stephen Harbach's 1:4 scale model Burrell showman's engine The Griffin *was this fine example of the pattern makers art.*

No doubt recognisable to cider producers, this 1:8 scale apple scratter was built by J. Walford.

The impressive St. Pauls clock designed and built by Eric Woof to resemble the famous cathedral.



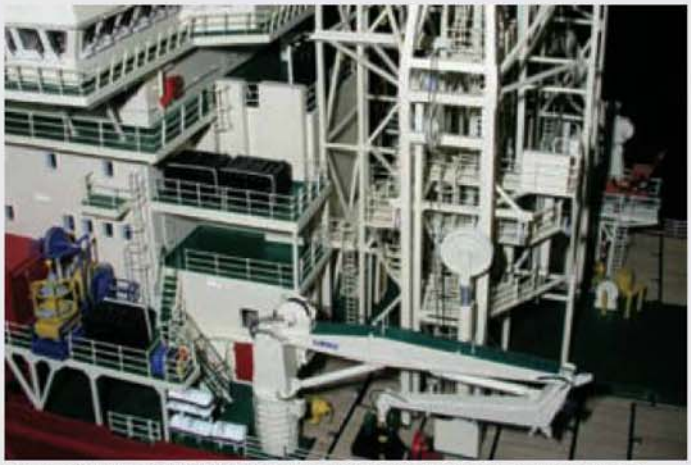
The smallest Tesla turbine in the world? Built to amuse, says the builder; sounds good to us!

Philip Hartshorn's reconditioned Myford ML4 lathe showed evidence of being carefully fitted together and was well finished.

D. Penny's superb 7¼in. gauge Dewhurst slag ladle and car had been given just the right patina.

Many visitors admired the delightful 1:10 scale open steam launch Maggie *built by M. K. Ranson.*

Charles Woodward's clock wheel and pinion cutting machine was carefully thought out and well finished.



Some of the wealth of detail on Jimmy Wood's 1:100 dive support vessel CSO Seawell.

Braving the autumn showers on Sunday was this superbly finished and presented full size Sentinel steam wagon.

CLUB CHAT
With Malcolm Stride

News from the Steam Locomotive Society of Victoria. Left: Bill Steward uses a hydraulic press to form a dished boiler end plate and right: progress is being made with work on the cutting wall.

The situation for this issue is unusual with everything coming from outside the UK. I was sorting through the current pile of newsletters and decided to start with the *World News* first to give all you far-flung model engineers a good crack of the whip and suddenly realised that I had hit my allotted word tally without any other material. I do try to vary things to ensure that all those of you who send in items get a fair mention, so this issue is 'news from afar.' I would also like to thank again all who provide newsletters and other information for this column, and to encourage you all to send photographs of the many and varied activities that come under the heading Model Engineering.

UK News

We understand that David Sexton, Secretary of **Ickenham DSME** moved house recently; his new telephone number is 01895-630125.

World News

Australia

Among the varied items 'on the table' at a recent meeting of the **Steam Locomotive Society of Victoria** was Les Whitfield's Wurzburg clock which is under construction. Les spoke of his progress and the trials and tribulations which have beset him, despite which he is making good progress with the project. Keith Hartley is a regular volunteer at Puffing Billy (local preserved railway?) and the latest task given to him was the cleaning and polishing of 12 brass handles for operating the 'deck lights' (the little windows in the clerestory roof). The carriage is 1NB (N = narrow gauge, B = second class) dating back to about 1900. The newsletter reports that *"some historically minded people would like to see the floor spittoons put back in!"* Dave Smith spoke of his welcome at **Cardiff MES** on his recent trip to England and Wales. The main scheduled item was the video prepared for the society's 50th Anniversary which illustrated some of the good old days at Surrey Hills (the previous site) and early days on the present site. Some of the members apparently *"looked a good bit younger on the screen."* Dave Smith then showed some video of the 5in. gauge scale locomotives and trains operating to timetable at the Gilling GL5 Rally on the **Rydale MES** track in Northern England. Member Phil Crook was reported as *"very taken by the sight and sound of so many locomotives and the rumbling and clickety-clack of the carriages and wagons, to say nothing of the shunters using their poles to uncouple the wagons."*

Apart from this, members have been busy with maintenance, mainly on renewal of the cutting wall, a major ongoing project. Despite a change of weather necessitating baling 18in. of water out of the foundations, and the concrete supplier running late, the foundations have been poured and now await rebuilding of the wall. When it eventually arrived the concrete *"was manhandled from the truck by barrow, chute and shovel to its final resting place."* One member making good use of the club workshop facilities is Bill Steward who recently machined up some aluminium alloy dies in the lathe and then used them in the 20 tonne vertical hydraulic press to produce some dished ends for a small vertical boiler to his own design. The ends were made from 1.6mm copper cut from the seamless barrel material, opened out flat, circles cut and annealed once. Some valuable lessons were learned in the process — after a few uses the female die showed signs of distress and would have benefited from being in some stronger material. A greater lead-in taper would also have been an advantage. However, Bill and his interested audience all agreed that the end product was more consistent and a lot quicker to make (excluding the die manufacturing time, of course) than hand flanging over the usual former. The dies are to be further modified to enable the holes for the firing tube to be pierced and flanged

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.

NOVEMBER

26 **Chichester DSME.** *Club Auction.* Contact Brian Bird: 01243-536468.
26 **Hereford SME.** *John Arrowsmith & Nigel Linwood: Sinsheim Exhibition 2003/4.* Contact Richard Donovan: 01432-760881.
26 **Historical MRS (Essex Area).** *Dave Carson: The Peter Davis Slide Collection.* Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.
26 **North London SME.** *Workshop Evening.* Contact David Harris: 01707-326518.
26 **Kinver & West Midlands SME.** *John Moxham: A Trip around God's Wonderful Railway Works.* Contact John Campbell: 01384-891244.
27/28 **Canvey R&MEC.** *Model Railway Exhibition at the Cliffs Pavilion.* Contact Brian Baker: 01702-512752.
27 **Historical MRS (Bristol Area).** *Gordon Gravett: Extracts from a Modeller's Notebook.* Contact Gerry Nichols: 0117-973-1862.
27 **Hornsby ME.** *Family Day & Boiler Inspection.* Contact Ted Gray: 9484-7583.
27 **Oxford (City of) SME.** *AGM.* Contact Chris Kelland: 01235-770836.
27/28 **South Lakeland MES.** *Ulverston Dickensian Festival (Portable Track).* Contact Adrian Dixon: 01229-869915.
28 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
28 **Otago MES.** *Public Running.* Contact John Clover, 221 Ravensbourne Road, Ravenbourne 9002, New Zealand.
28 **Steam LS of Victoria.** *Working Bee & Barbecue Lunch.* Contact Graham Plaskett: (03) 9750-5022.
30 **Wigan DMES.** *Bits & Pieces.* Contact John Chamberlain: 01744-882255.

DECEMBER

1 **Birmingham SME.** *Tony Sear: President's Evening.* Contact John Walker: 01789-266065.
1 **Bristol SMEE.** *Mike Keighley: Standing Stones.* Contact Trevor Chambers: 0145-441-5085.
1 **Chingford DMEC.** *Bits & Pieces.* Contact Martin Masterson: 0208-989-5552.
1 **Guildford MES.** *White Elephant Sale.* Contact Dave Longhurst: 01428-605424.
1 **Leeds SMEE.** *Christmas Dinner.* Contact Colin Abrey: 01132-649630.
2 **South Lakeland MES.** *AGM.* Contact Adrian Dixon: 01229-869915.
2 **Sutton MEC.** *Bits & Pieces.* Contact Mike Dean: 0208-657-5401.
3 **Aylesbury (Vale of) MES.** *Mike Clemence & David Knapman: More Sounds of Steam.* Contact Andy Rapley: 01296-420750.
3 **Brighton & Hove SMLE.** *The London, Brighton & South Coast Railway.* Contact Mick Funnell: 01323-892042.
3 **Chichester DSME.** *Christmas Dinner.* Contact Brian Bird: 01243-536468.
3 **Canvey R&MEC.** *AGM.* Contact Brian Baker: 01702-512752.
3 **Ickenham DSME.** *Christmas Dinner.* Contact David Sexton: 01895-630125.
3 **Maidstone MES (UK).** *Bits & Pieces & Crumpets.* Contact Martin Parham: 01622-630298.
3 **North London SME.** *A Christmas Social Evening with Anecdotes & Reminiscences.* Contact David Harris: 01707-326518.
3 **North Norfolk MEC.** *Dinner.* Contact Gordon Ford: 01263-512350.
3 **Portsmouth MES.** *Roger Bricknell: Concorde Engineer.* Contact John Warren: 023-9259-5354.
3 **Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
3 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
4 **Bradford MES.** *Annual Competition & Display.* Contact John Mills: 01943-467844.
4 **Frimley & Ascot LC.** *Family Quiz.* Contact Bob Dowman: 01252-835042.
4 **SM&EE.** *Competition Day, Work in Progress plus Christmas Party.* Contact David Boote: 01202-745862.
4 **York City & DSME.** *Bits & Pieces.* Contact Pat Martindale: 01262-676291.
5 **Basingstoke DMES.** *Public Running.* Contact Guy Harding: 01256-844861.
5 **Birmingham SME.** *Ladies' Day: Making Decorations.* Contact John Walker: 01789-266065.

In Memoriam

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

Ken Barnes	*Worthing DSME*
Ian Sutherland	*Canterbury (NZ) SMEE*

forward in the ends. As the editor comments *"Those wishing to obtain ready-formed dished ends please form an orderly queue on the right ..."*

Canada

Ken Klakowich, President of **British Columbia SME** reports that the summer has *"been a beauty. For the most part, the days have been clear and warm."* The annual 'Train Fest' had a very good turnout of locomotives with visitors from several US States and overseas. The visitors enjoyed a *"Roast Beef and Yorkshire Pudding dinner with all the trimmings"* on Saturday night thanks to the efforts of Catherine McDonnell, Janet Klakowich, and their team of ladies. Lyndsay McDonnell reports on the new world record 24 hour distance locomotive run at Train Mountain, Oregon. This was completed using a battery electric locomotive in company with a petrol/hydraulic. Both ran well with no problems, but some of the riding cars suffered bearing problems due to the side loads when going fast round the bends. The total distance covered was 209 miles. The electric locomotive was powered using batteries carried in a riding car so that change-overs could be done very quickly. The two trains ran one behind the other and averaged 62 minutes for each 9.5 mile (yes, really!) lap. Congratulations to all concerned on this achievement.

The **Toronto SME** picnic was held once again in perfect weather at Bob Allin's in Orono. Two locomotives ran on the 7¼in. ground level track, a 2-4-0 *Virginia* and a British locomotive. Much driving, mainly by Richard Trounce and Mike Salisbury, kept these two locomotives running most of the day. There were tables for models and quite a few arrived of various types. Dave Sage demonstrated his marine engine running while Dave Powell had his steam roller operating for whoever wished to try their hand at driving it. Dave Bowes had his boat up to about 35kph on the pond and tried to see if it could become airborne as well. John Chappell assembled his collapsible canoe and bravely took his annual picnic swim in the pond! Corn, hamburgers and hot dogs, as well as pop and coffee all went down well. Several members with exhibits attended the September meeting. Richard Trounce gave the third part of his talk on bearings. He spoke about the precautions needed for preloading ball races. When the shaft is the member, a 0.001in. interference fit is usual for the inner race-to-shaft fit with clearance for the outer race in its housing. For model engineering the best type of bearing is the sealed bearing to prevent ingress of dirt — the enemy of bearings. Mist lubrication is best and is superior because the atomisation of the lubricant ensures that it reaches all the ball race contact areas. David Bowes talked about some of the problems he had this summer with the twin-cylinder engine in his boat. He was running it at about 10,000rpm when the rear bearing cover came off, the crankshaft had failed (came apart). After this had been fixed, the muffler (silencer) shook itself apart. He has now added a collar under the muffler body which seems to have cured this ailment. A small bent aluminium alloy bracket supporting the ignition coils also failed. He has now increased the radius of the bend which seems to have rectified this. It was suggested that freezing aluminium alloy before bending reduces the chances of cracking at the bend (can any of our knowledgeable readers confirm this?). Dave Sage showed his recently restored Acadia 4hp Marine engine and talked about how he re-Babbited the engine's main bearings. He first turned down a bar the same size as the crankshaft journals to form a dummy shaft. Collars were made to locate the dummy shaft in the lower half of the crankcase, and sealed to keep the Babbit metal from running out during pouring. The whole assembly was heated to 325deg. F and dry graphite sprayed where he didn't want the molten Babbit metal to adhere. This was repeated for the top half. The upper bearings were poured with the shaft vertical and with the crankcase halves bolted together. He then separated the two cleaned up the crankcase mating faces and scraped in the bearing surfaces. Jim Small showed the smokebox door for his 7¼in. gauge locomotive and how the petticoat will fit; he spoke about the modifications for oil-firing this locomotive, which included the repositioning the petticoat from the usual (higher) position for coal firing. A spray gun type nozzle will be used as the oil burner, positioned at the front of the firebox and directed rearwards. A needle valve will be used to control the oil flow. Diesel fuel will initially be tried and compressed air will be employed to start the atomisation of the fuel.

New Zealand

Recent windy weather caused **Auckland SME** problem on a Sunday morning when a large piece of tree was broken off and landed right over the track. On beginning to remove the tree, President Gary Farquhar contemplated turning it into a third tunnel. A few 'Tuesday Club' members were better off for some firewood as a result of the incident. With just half and hour to spare, the track was cleared just in time for Sunday running!

Members of **Canterbury SMEE** are busy working on the track at Haswell; progress is being made on the turntable, station points (water pressure operated), passing bays and a water tank for the steam locomotives. Extra passenger cars have also been made. The track has already carried over 3,500 passengers. A *"good start"* has been made on the raised track and it is planned for this to be operational by the time you get to read this. The club is building a diesel/hydraulic locomotive based on the American F7. Member Ross Fielden has built the chassis which had its first trial in September. Ewan Allison is making the plug for the nose ready for Philip Robinson to do the fibreglass work. The rest of the body is to be made in steel by Ross. The boating section now has an operational pond but hopes to deepen it after the summer season. The section has acquired some fibreglass hull moulds for members' use. The newsletter also carries a health warning concerning Viton O-rings which, if exposed to temperatures over 400deg. C, decompose to release

5 **Bristol SMEE.** *Santa Special.* Contact Trevor Chambers: 0145-441-5085.
5 **Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.
5 **Cardiff MES.** *Santa Special.* Contact Trevor Jenkins: 029-2075-5568.
5 **Ellenroad Engine House.** *In Steam + Christmas Fair.* Enquiries: 01706-881952.
5 **Pinewood MRS.** *Santa Run.* Contact Ivan Hurst: 01276-28803.
5 **Reading SME.** *Public Running.* Contact Graham Bustin: 0118-9615450.
5 **South Durham SME.** *Running Day.* Contact B. Owens: 01325-721503.
5 **Sutton Coldfield MES.** *Santa Special.* Contact Neal Harrison: 0121-378-3992.
5 **Woking MRS.** *Santa Specials.* Contact Ronald Dewar: 01932-343331.
6 **Historical MRS (London Area).** *Pre-Christmas Social.* Contact John Millbank: 0208-948-0556.
6 **Lancaster & Morecambe MES.** *Auction Night.* Contact Harry Carr: 01524-411956.
6 **Peterborough SME.** *Bits & Pieces.* Contact Tony Meek: 01778-345142.
7 **Basingstoke DMES.** *Meeting Night.* Contact Guy Harding: 01256-844861.
7 **South Durham SME.** *AGM.* Contact B. Owens: 01325-721503.
7 **Stamford MES.** *Arthur Askew: Model Aircraft.* Contact David Ash: 01780-751211.
7 **Taunton ME.** *Four Short Talks.* Contact Don Martin: 01460-63162.
7 **West Wiltshire SME.** *Bring & Buy + Mince Pies.* Contact R. Nev. Boulton: 01380-828101.
8 **Birmingham SME.** *Stationary Engines.* Contact John Walker: 01789-266065.
8 **Chingford DMEC.** *Alan Rose: Spray Painting (Part 2).* Contact Martin Masterson: 0208-989-5552.
8 **Crawley ME.** Goffs Park Light Rly. *Fish & Chip Supper.* Contact Allan Sinclair: 01293-888203.
8 **Historical MRS (East Midlands Area).** *Pre-Christmas Social.* Contact Mark Shipman: 0194-983-6311.
8 **Norwich DSME.** *Christmas Meeting.* Contact Paul Reed: 01603-462925.
8 **Oxford (City of) SME.** *Bits & Pieces.* Contact Chris Kelland: 01235-770836.
8 **St. Albans DMES.** *Social Evening.* Contact Roy Verden: 01923-220590.
9 **Brighton & Hove SMLE.** *Workshop Evening – confirm by contacting Mick Funnel (01323-892042) or Gerry Collins (01273-553228).*
9 **Cardiff MES.** *Carl Pickstone: More Engineering Topics.* Contact Trevor Jenkins: 029-2075-5568.
9 **Fylde SME.** *Christmas Lunch.* Contact Alan Reid: 01253-882872.
9 **Guernsey MES.** *Meeting.* Contact Dave Simon: 01481-251017.
9 **High Wycombe MEC.** *Ian Ridley: Flying a Police Helicopter.* Contact Eric Stevens: 01494-438761.
9 **Historical MRS (Sussex Area).** *Pre-Christmas Social.* Contact Terry Cole, 17 Coombe Drive Steyning West Sussex BN44 3PW.
9 **Hull DSME.** *Charity Social Evening.* Contact Tony Finn: 01482-898434.
9 **Leyland SME.** *Project Night.* Contact Mark Entwistle: 01772-422411.
9 **Worthing DSME.** *Auction.* Contact Bob Phillips: 01903-243018.
10-12 **Great Western Soc.** (Didcot Railway Centre). *Thomas Santa Special.* Contact Jeanette Howse: 01235-817200.
10 **Hereford SME.** *Christmas Social.* Contact Richard Donovan: 01432-760881.
10 **Historical MRS (Essex Area).** *Christmas DIY Evening – Members' Latest Endeavours.* Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.
10 **Malden DSME.** *Video Show.* Contact John Mottram: 01483-473786.
11 **Fylde SME.** *G-Whizz Christmas Exhibition.* Contact Alan Reid: 01253-882872.
11 **Glasgow & S.W. Rly Ass'n.** *Gordon Thomson: Railways of Eastern Europe.* Contact Bruce Steven: 0141-810-3871.
11 **Guildford MES.** *Christmas American Supper.* Contact Dave Longhurst: 01428-605424.
11-12 **Reading SME.** *Santa Specials.* Contact Graham Bustin: 0118-9615450.
11 **Woking MRS.** *Beaver/Cub Santa Special.* Contact Ronald Dewar: 01932-343331.
12 **Birmingham SME.** *Children's Christmas Party.* Contact John Walker: 01789-266065.
12 **Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.

hydrofluoric acid which, if handled, attacks the skin and is impossible to remove. You have been warned!

By the time this is in print, the **Hutt Valley MES** auction will have taken place; a glance at the list of 319 lots suggests that the auctioneer will have had a very busy time. Hopefully members will have obtained some bargains as a result. Member Alan Kemp is looking for a suitable design of boiler for his steam driven dinghy. The boiler would be to steam a twin cylinder simple expansion engine of 1 1/2in. bore and 2 1/2in. stroke. Anyone who knows of anything suitable can contact Alan via the Editorial office. At the recent meeting Murray McKenzie had a new robotic tractor, called *Lunchbot* since a lunchbox is used to cover the works! The robot is *"designed to do nothing in particular apart from entertaining model engineers by wandering around its environs and avoiding objects while doing so."* This sounds like an excellent reason for its existence to me. Ross Johnson had his rejuvenated hot air traction engine which was also demonstrated following Brian Wheeler's talk describing his trip from Spain into Morocco and back to Spain via Tangier and Casablanca. During the trip Brian experienced a night out in tents on the edge of the desert, a camel train ride and Berber dancing. He pointed out that they only saw one train (other than the camel train) during their trip. Brian compensated for this by hiring a car in France and visited the preserved steam line at Tournon, south of Lyon. The photo, by Peter Anderson, shows Des Hill running 2970 with Wellington in the background.

With Wellington as a backdrop, Des Hill runs No. 2970 on the Hutt Valley track.

Work at **Maidstone MES** has been affected by some inclement weather which also forced the cancellation of one of the public running days.

United States

Another club that always seems to feature a fine collection of items at their 'Bits and Pieces' meetings is the **Bay Area Engine Modellers**. Their August meeting was no exception with three Wall four cylinder engines, a Seal 15cc, a Forrest Edwards radial machined from bar stock, a twin cam four cylinder, a *Little Devil* to the late Bob Shores' design, and a Coomber's rotary steam engine (how did that sneak in?) among other smaller items. A fine selection indeed. The society also had a very successful time recently at the *"Good Guy's West Coast Nationals"* where they *"ran engines all day for three long days"*. In particular Eugene Corl's 1:3 scale small-block Chevy got much well deserved attention from the attendees who where all keen hot rod enthusiasts. This attendance at non-model engineering shows seems to be a good way of spreading the word among those normally outside our usual sphere and might be something to be considered by other societies.

South Africa

Centurion SME report a decline in the number of passengers on public running days. Comments made by potential customers point to a need for more *"real steam locomotives."* As Editor Alex Groothhuijzen remarks *"This diesel driver for one, is more than willing to put his lawnmower (his word!) in a siding to give the real thing centre stage."* Rudy du Preez has produced a revised design for the steaming bay roof to simplify the construction. Members are considering building this themselves because the contractor could not start very quickly.

In the words of Dave Meiring from **Durban SME** *"Here is a piece of interesting but fairly useless information: the litre and the cubic decimetre (l000cc) have not always been identical. The litre was introduced in France in 1793 as one of the new 'Republican Measures' and defined as one cubic decimetre. The name derives from the older French unit the litron. In 1901, the litre was re-defined as the volume occupied by one kilogram of pure water at the temperature of maximum density (±4deg.C) and a pressure of one atmosphere. This was a bit of a mistake as that is not precisely one cubic dm due to the (very) slight compressibility of the liquid and is actually 1000.028 ccs. Then in 1964, the original definition was restored so it is again equal to one cubic dm or 1000cc."* This followed a much longer dissertation from Dave on the various units relevant to us model engineers. The Chairman reports on a busy year both with work on the track and on running days.

12 **Chichester DSME.** *Santa's Steam Specials.* Contact Brian Bird: 01243-536468.
12 **Frimley & Ascot LC.** *Santa Run.* Contact Bob Dowman: 01252-835042.
12 **Harrow & Wembley SME.** *Christmas Run.* Contact Dr. Roger Greenwood: 020-8427-2755.
12 **Hornsby ME.** *Running Day.* Contact Ted Gray: 9484-7583.
12 **Malden DSME.** *Santa Special (Ticket Only).* Contact John Mottram: 01483-473786.
12 **Pinewood MRS.** *Santa Run.* Contact Ivan Hurst: 01276-28803.
12 **Sutton Coldfield MES.** *Santa Special.* Contact Neal Harrison: 0121-378-3992.
12 **Woking MRS.** *Santa Specials.* Contact Ronald Dewar: 01932-343331.
13 **Bedford MES.** *Our Festive Quiz.* Contact Ted Jolliffe: 01234-327791.
13 **Hornsby ME.** *Meeting & Christmas Social.* Contact Ted Gray: 9484-7583
13 **Melton Mowbray DMES.** *Video Show.* Contact Phil Tansley: 0116-2673646.
13 **Saffron Walden DSME.** *Club Christmas Dinner.* Contact Jack Setterfield: 01843-596822.
14 **Historical MRS (North West Area).** *Pre-Christmas Social.* Contact David Goodwin: 01224-880018.
14 **King's Lynn DSME.** *Christmas Meeting.* Contact Mike Coote: 01533-673728.
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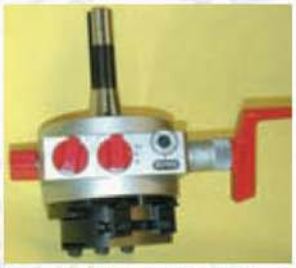

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From M25 North and West: Exit at Junction 10 onto A3 towards London. Exit onto A244 at Esher Common roundabout, signposted to Sandown Park. Turn right onto A307, Esher High Street at T-junction/traffic lights. Sandown Park can be found 1/4 mile along on left-hand side.

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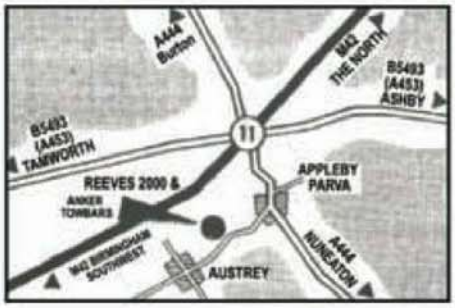

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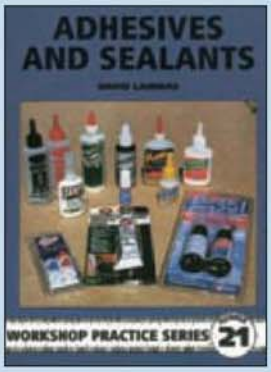

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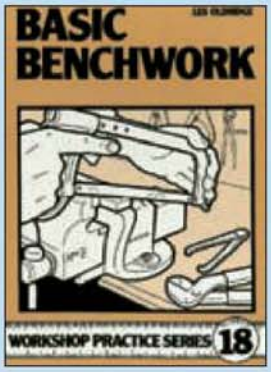

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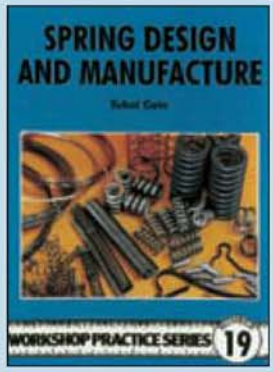

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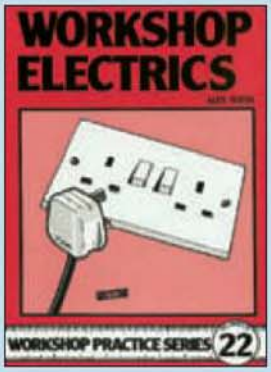

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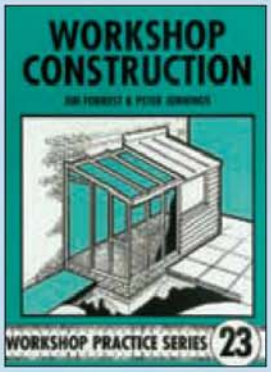

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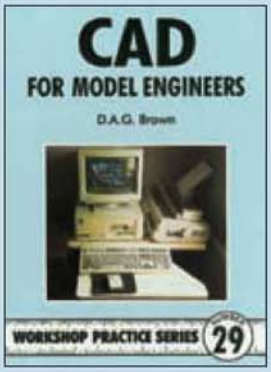

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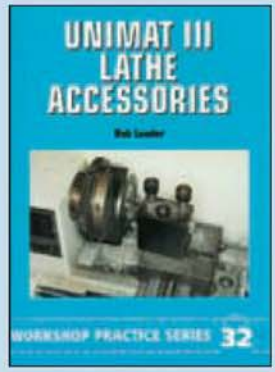

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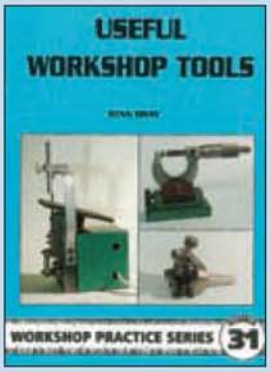

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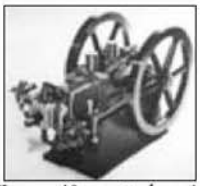
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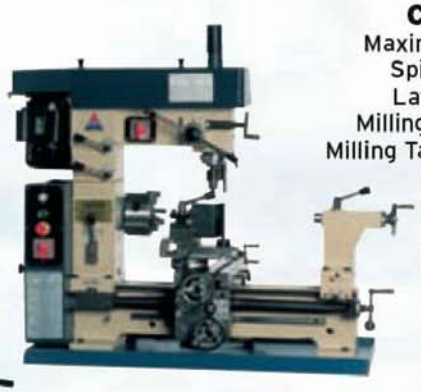

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