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On the cover ...

Steve Elliott's Fowler Z7 ploughing engine was a much admired subject for attention at the 72nd Model Engineer Exhibition at Sandown Park Exhibition Centre. In 1:4 scale, and 10 years in the building, most of the information was obtained by scaling original Fowler Works drawings now stored at the Reading University. Further details were obtained by measuring full size engines, two of which are stored in Bedfordshire. Despite its immaculate appearance, this quarter size model, which weighs in at 8 1/4 cwt., has been steamed and runs very well. Entered in competition for the Duke of Edinburgh Challenge Trophy, after much consideration, cogitation and debate, Steve Elliott's superb model was awarded this ultimate accolade.

(Photograph by Mike Chrisp)

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SMOKE RINGS
With the Editors

Eternal Tools Prize Competition

We cannot recall the last occasion on which such a competition was featured in these pages, so by combining its unique nature with the useful and valuable prizes on offer, this competition, which has been arranged in conjunction with our friends at Eternal Tools, is rather a special one.

The panel on the facing page shows what you can win in the way of diamond tooling for your own workshop. With sets of diamond grit files, and wheels to suit various grinding machines, what can you lose? All we want you to do is to demonstrate your knowledge of this magazine, the Eternal Tools company, and the use of diamond abrasives, by selecting one of the four options for each of the three questions printed on the form. To avoid spoiling your copy of this magazine, one photocopy of the form will be accepted for the purpose of your entry.

When you have made your selection by circling a, b, c, or d in each case, you should return the form to Model Engineer/Eternal Competition, Nexus House, Azalea Drive, Swanley, Kent BR8 8HU to arrive on or before 17 March 2003. Entries received after that date will not be accepted. Five forms will then be drawn at random from those bearing the correct answers and the lucky winners informed of their good fortune no later than 31 March 2003.

Good luck!

The late Harry Holland

We are indebted to Claude Poulsen who wrote some notes about Harry Holland whose death was reported in *M.E.* 4186 (10 January 2003). In his preamble Claude identified himself as President of the Hutt Valley Horticultural Society. This is quite true, but he really wrote as President of the Hutt Valley Model Engineers Society which is perhaps more to the point. We regret any confusion which may have arisen.

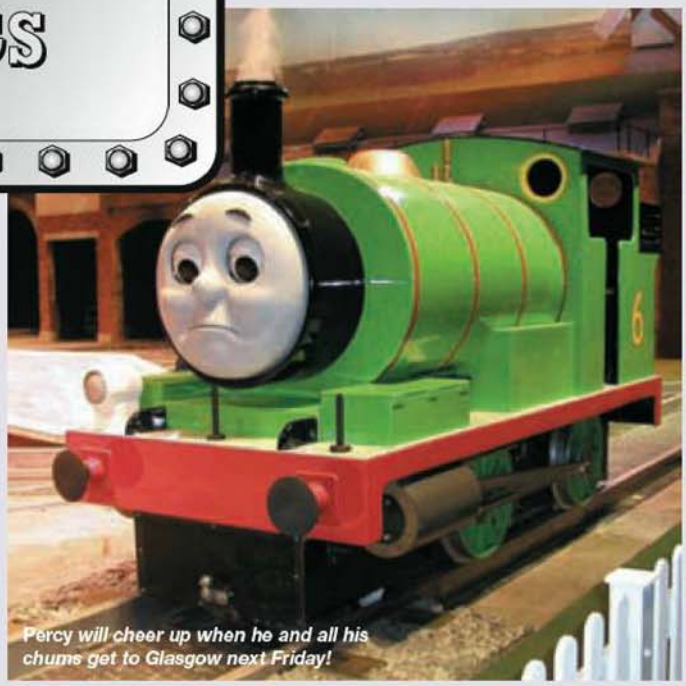
Claude writes: *"A retired toolmaker, I am keen on horticulture, philately and, of course, model engineering. I must confess, however, that to my profound shame I have done very little modelling because I seem to get hung up with clocks!"*

Thomas and Friends The Big Live Tour

Regular readers will recall mention of our visit to BBC Special Effects Division to see the models under construction which were to be used in the show. This brief report was squeezed into *M.E.* 4185, 27 December 2002 since when the show was very well received when it opened as stated on Boxing Day at Birmingham NIA.

The tour continues at Glasgow SECC, 14-16 February; Wembley Arena 20-23 February; MEN Arena, Manchester 1/2 March; Sheffield Arena 22/23 March; London Arena 28-30 March and CIA Cardiff 4-6 April.

To book, call the venue of your choice, contact the Ticket Hotline on **0870-010-8449** or book online at **www.thomasthetankengine.com**



Percy will cheer up when he and all his chums get to Glasgow next Friday!

Charity for African Education

Geoff Halstead, Trustee for the above cause has contacted us in the hope that model engineering clubs and societies may be inclined to help out by providing club badges/patches for charity.

"As usual," writes Geoff, *"we are always looking for ways of raising funds, and wonder if you could assist us by putting a request in* Model Engineer *asking if any clubs would be prepared to donate a club badge and/or patch to help us.*

"What we would like to do is to have the badges and patches suitably mounted on a display of some sort and then to auction these displays some time in the future."

If you can assist, then please contact Geoff Halstead, Trustee, Charity for African Education, 27 Fieldhouse Gardens, Diss, Norfolk IP22 4PH; tel: 07904-351143; e-mail **gch@africaneducation.org.uk**

New Zealand Update

Alan Bibby, author of the recent short series of articles with the above title, has written to point out a transcription error in his text which will certainly have caused confusion Down Under!

The following text appears at the foot of the middle column on page 656 in Part I published in *M.E.* 4185, 27 December 2002:

"The club is currently developing plans for a ground level track on a big new development at the Agricultural and Pastoral Showground a few blocks from their present site, and is hoping to host the 2006 MEANZ Convention. When completed, the new site will be one of the best in New Zealand."

This text was originally part of an extended caption to the photograph of Canterbury SMEE's new club loco, a BR 08 shunter and refers to that society.

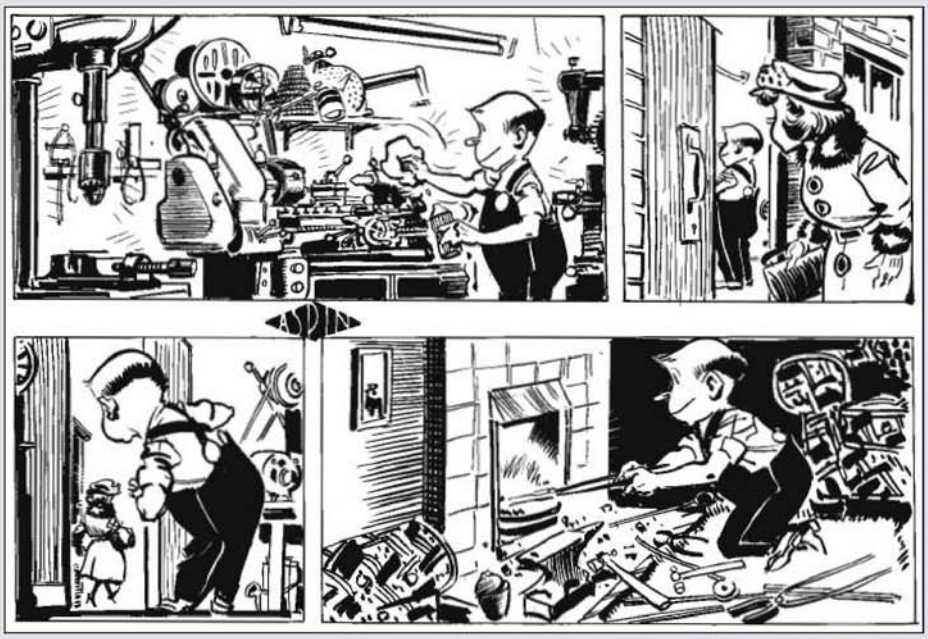
Following publication of Part I, we also received a telephone call from Peter Carr in Wellington, New Zealand pointing out that the top left hand photograph on page 657 incorrectly identified him as Peter Jones with his locomotive *Owain Glyndwr*.

We regret any confusion which may have been caused concerning the activities and achievements of Canterbury SMEE and Peter Carr, both in New Zealand, and hope that this notice will set matters straight.

AGM: Southern Federation of Model Engineering Societies

We are pleased to provide advance notice to all interested parties that the Annual General Meeting of the Souther Federation MES will take place on Saturday 15 March 2003, commencing at 2pm, at The Black Country Living Museum, Tipton Road, Dudley, West Midlands.

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



POST BAG

Dr. Figureau's model traction engine which he seeks to identify.

Traction engine query

SIRS, - I purchased a little traction engine at a car boot sale (photographs herewith). It could be the work of a model engineer, is 10in. long, and is probably English since at the time I was a Frenchman living in England. It is not perfect and has a badly adjusted firebox but the smokebox and wheels are castings. The smokebox is 1 3/4in. diameter and is a one-piece casting with the chimney and has cast upon it the words Invicta, Linton, 1879, together with the image of a horse.

I do not recognise this model and would like more information before I restore it. Can any readers help?

On another matter, I have bought from Warco a Formit triple machine which I find very useful. My only problem is that I do not know how to roll a conical shape on this type of machine. Does anyone have any ideas?

Dr. J-L Figureau,
Brioude, France.

Matters of opinion

SIRS, - I note Clive Barton's comments about Swindon locomotives (*M.E.* 4182, 15 November 2002) and fully agree with his remarks about the monotony of the Great Western Railway. Other far better designs are available, both in full size and in 5in. and 7 1/4in. gauge, which are much more modern. I fail to understand why the GWR packed all its valve gear between the frames; their locomotives must have been the very devil of a job to work on. To be logical the valve gear should be outside to facilitate inspection, maintenance and lubriction.

The GWR Castles were only beefed up Saints, the GWR Kings were only beefed up Castles with their queer taper boilers, expensive to manufacture Belpaire fireboxes and the smaller (tank) locomotives with their pokey little smokeboxes. Modern steam locomotives have large smokeboxes (e.g. Peppercorn Al and BR Britannia) which were found to enjoy better draughting and reduced coal consumption.

Concerning Mr. Barton's note about the Swiss Locomotive and Machine Co. (SLM) at Winterthur in Switzerland. I am fully aware of their locomotives and as recently as Thursday 29 August last I had a ride up the Brienz-Rothorn-Bahn with a new SLM steam locomotive — continuous barking for an hour!

Regarding a simple tender locomotive of 2-6-0 wheel arrangement, I suggest consideration of the LNER Class K5, a Thompson 2-cylinder rebuild of the K3. There is little between the frames, a fat parallel boiler and a group standard 6-wheel tender. Not only all that but drawings are available in 5in. gauge, dimensioned in both imperial and metric units.

M. Breeze, Cambridgeshire.

Alchoholics unanimous

SIRS, - A fellow model engineer friend sometimes undertakes work for others and has recently been asked to put a very fine 5in. gauge Britannia into running order and also to change the name from *Oliver Cromwell* to another. Peter ventured to ask: *"Why change the name?"* to which the reply came that Oliver Cromwell had been the chap who closed down the pubs!

May I point out that a perfect solution is available to soothe this gentleman's feelings on this important principle and which has an established precedent within the Britannia class of locomotives.

First, there was a batch of Brits which was allocated names of Great Western broad gauge locomotives and secondly, a far-sighted ex-GWR secret agent infiltrated Crewe Works and made sure that one Brit, No. 70047 never carried a name with just this situation in mind.

Need I say more than that in May 1849, Swindon Works turned out the broad gauge 0-6-0 engine (2MT?) *Bacchus*!

A happy and preposterous New Year to all,

John Hill, Devon.

Cleaning and casting

SIRS, - Having spent most of my working life as an industrial metallurgist, reaching Head of Department level, with the benefit of that experience I feel able to comment on two points that have arisen in recent issues of this magazine.

First: pickling — much has been written on this topic, all of it correct and sensible. Many combinations and concentrations of acids are used industrially for very specific purposes and which are beyond the advisory limits for the model engineer. There are two significant points:

First: *all* acids are dangerous, even citric and acetic! Secondly: It is possible with care, and I emphasise *with care*, to dispose of acids in a safe and proper manner with little or no danger to the drainage system. The problem with putting any acid into the drainage system is that it attacks the material of the drain, and the jointing compounds, whatever their type and age. There is also the aspect of contamination of the drainage system with heavy metals such as copper, nickel, cobalt, chromium, tin and others which are environmentally unfriendly.

The way in which we disposed of our acids and alkalies was to ensure that the pH of the effluent was controlled at all times. By this I mean the acidity/alkalinity of the liquid actually going down the drain. At a domestic level this can be achieved simply by ensuring that the acid is first neutralised and then diluted. I prefer to use Soda Ash or cheap Sodium Bicarbonate which can be obtained from supermarkets as 'Bicarbonate of Soda', or from a brewing supplier. The chemist has a purer version which is more costly and not necessary.

When Sodium Bicarbonate is added to any acid it effervesces rather like health salts; it should be added slowly and steadily, stirring all the time, keeping going until it stops fizzing. Do not add it all at once. Then add some more for good luck. A deposit of harmless salts should be formed on the bottom of the container. The solution will be a little warm and should be allowed to cool.

Now, here is the tricky bit; the solution is now neutral, or as near as makes no difference, and must be diluted to about 40 times its volume to avoid contamination problems. The easiest way is to add a cupful of solution to a full bucket of water and slowly put it down the drain, leaving the hosepipe running into the drain all the time. This may all seem a lot of trouble, but I have used this technique industrially for years. I admit that we were rather more sophisticated with our controls and volumes, but this is a safe and painless way to dispose of any acid, even citric acid.

One severe and final word of warning: *do not under any circumstances* use any form of 'Caustic' either Caustic Soda (Sodium Hydroxide) or Caustic Potash (Potassium Hydroxide) with any of the pickling acids. Stick with Bicarbonate of Soda, the use of which is safe and easy. The reason is simple. Sulphuric acid is chemically 'strong' and so are the Caustics. Strong mixed with strong is very explosive and can be very dangerous. A Caustic burn is every bit as bad as an acid burn and in my opinion more insidious.

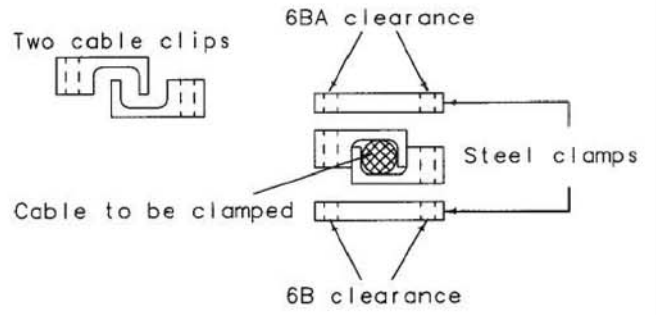
And now to the casting techniques as described in *M.E.* 4184, 13 December 2002. Mr Taylor has produced a very interesting series of articles on his unusual 'burnt air' engine, but as he is quick to point out he is not certain of the nature of some of the problems he has had. Allow me to add some more information. For many years, casting technology was considered a 'black art'; in recent years there has been much more understanding of metal solidification processes.

Mr Taylor's photo 38 shows what is undoubtedly 'shrinkage' or 'shrinkage tearing' This is due to the top of the casting solidifying with no liquid metal reservoir for the large volume at the bottom to obtain the necessary replacement for the contraction during cooling and solidification. The result is that the core maintains the centre hotter and less solid or pasty until something must give. Result: 'cracklike' shrinkage.

A 'hot tear' is a hot crack in a casting due to restraint of some form, preventing contraction during cooling after the metal is just solid.

There is a way to cast similar shaped items with a core. The shape is similar to a chain block as used on hoists and I have cast many hundred.

The next point is less obvious, but I have been 'had' many times by this defect, so I am aware! The 'hole' in the casting is usually called a 'misrun' and allotted to cold metal, as Mr. Taylor has done. Careful study of



© Mr. Dawes' ingenious design for a flexible cable clamp.

the photo shows 'flash' on the mould joint line, and that the little peg on the large diameter is well formed; this indicates adequate temperature. That being the case, it indicates that the metal, in rising over the main core to form the cylinder, which appears thin walled, has reached a stage where the air in the mould has nowhere to go and has a pressure equal and opposite to the pressure of the metal rising in the mould. This then results in solidification before the casting is fully formed, a problem which can sometimes be overcome by raising the temperature, but can also be improved by ensuring the mould has been 'vented'. One the reasons why 'old time' iron moulders used to 'spike' their moulds with a vent wire was to allow the gas or air to escape from the mould cavity, enabling the metal to fill the mould.

One further point is that I would have used a casting temperature of 680-700 centigrade (naughty; it's now Celsius.)

Herbert F. Morton, Cheshire.

Cable clamps

SIRS, - Every now and again I find I need a flexible cord grip to anchor a flex into some gadget or other. Sometimes there is something suitable in the scrap box, removed from some long forgotten dismantled appliance, but recently my search of the scrap box failed to yield anything suitable and I hit on the following scheme which may be useful to other readers.

The idea involves the use of two cable clips of the kind used to fix domestic cables of various sizes to walls, etc. Most of us dabble with domestic wiring from time to time and therefore will have a collection of these clips in sundry sizes. You have to find a couple which when assembled in the manner shown in the accompanying sketch seem to embrace the flex in a suitable manner.

When I make one of these grips I usually start by cutting off a piece of flex about an inch long and clamping it between the clips with a toolmaker's clamp to measure, with a micrometer, the distance between the two nails with which these clips are normally supplied. I then use this measurement to work out the centre distance between the two holes and co-ordinate drill them on my milling machine. I find that screws of 6 or 8BA are usually about right.

Sometimes the bottom clamp is drilled tapping size and can then be screwed to some part of the 'appliance'. It can also be made from a piece of angle and the fixing screws can then be put in the limb not occupied by the clamping screws. I hope the sketch above makes all this clear.

To obtain a neat result, the screws have to be tightened evenly so that everything sits 'square'. I am aware that at first sight the whole idea seems a bit 'skew whiff', but once one has been made up it can be seen that the flex is more than adequately clamped and that also it does not seem to be unduly distorted. Moreover, it would seem that because the clips are plastic, should the flex be damaged by overheating at any time there is little chance of of a live wire touching the metal parts of the clamp.

Robert Dawes, Somerset.

Round bed Drummond

SIRS, - Thank you for publishing my previous letter about my experiences at 'The Sentinel' (*M.E.* 4182, 15 November 2002). It was interesting to see it next to a letter about the old round bed Drummond lathe. I believe my father bought his in 1919/20 for £5. I still have the two essential spanners.

I recall that sometime in the 1920s a design for a back gear was published in *M.E.* In 1945 both my father and I had had enough of treadling (me especially since I had lost an important part of one leg in the war). We found a motor, added a countershaft and by using change wheels and an extra belt, rigged up a back gear. This did away with fine feeds so a worm geared into another change wheel on the leadscrew was driven by another belt,

Since writing the foregoing I have read Mr Ellis' informative article on Drummond lathes. Ours never had a top-slide. Perhaps they were extra on the £5 machine and we never had any of the extras mentioned as my father was only interested in model locomotives and saw no need for such equipment.

Perhaps my father, Brigadier Richards may still be remembered as a demonstrator of boiler making at the Model Engineer Exhibitions in the early '60s.

On this machine I managed (in 1948) to produce many of the bits needed for the overhaul of a Riley 9, including valve guides, valves (finished in the works), bushes, etc., and reboring one big end on which the 'foreigner dept.' had erred. I still have the special cutter I made to trim the outside of the white metal.

Your correspondent also mentioned the 3½in. Drummond. I was sold an old one for which I paid £5 in about 1963. This machine was fitted with both a treadle and a motor, obviously a works attachment since the motor was suspended below the swarf tray. A pinion on the motor engaged with a gear ring cut on the large diameter of the treadle flywheel. I do not know when such a conversion was offered but I do know that the motor weighed at least four times as much as a modern one.

On another matter, a practice which astonished me when I first saw it was the way in which, for example a pinion shaft 12-15in. long would be turned. The bars would be cut about ½-¾in. over length and held by this ½-¾in. in a 4-jaw chuck for machining at high speed using tungsten carbide tooling. The shafts would be finished by facing to length and centred while held in soft jaws.

David R. Richards,
Ligueux, France.

Lapping paste

SIRS – With reference to the difficulty reported by Keith Wilson in obtaining small quantities of fine grit abrasives for lapping work (*M.E.* 4184, 13 December 2002), at least three craft suppliers in my area stock abrasive grits in small quantities at prices which are not too exorbitant. They supply it for lapidary work and polishing beaten copper work and enamel, craft work.

Squires Garden Centre (yes, honestly!) in Sunbury has a craft centre with such stuff in 25-30gm packets. Likewise, HobbyCrafts (a craft superstore with branches around the UK) stock it. Both suppliers also usually have jeweller's rouge and crocus powder for really fine work (though there's always toothpaste for that). Try **www.hobbycraft.co.uk/** for store locations.

I hope this information is useful.

Bob Margolis, Hampshire.

(HobbyCraft is also a handy source for paint, brushes, adhesives and much, much more besides — Ed.)

Supplier

SIRS, - I would like to bring to readers' attention a supplier in the North of England by the name of Global Surplus Ltd., Grantham Road, Boothtown, Halifax, tel: 01422-362526, mobile: 07754-302082.

They sell second-hand machine tools as well as new and second-hand hand tools, nuts bolts, and all manner of sometimes hard to find items (cf. Whistons).

I have no connection with the business other than as a customer who has had good service from a company who seem to try hard to help people like myself who sometimes can be difficult to please.

Trevor Drabble, by e-mail.

Speed control

SIRS, - Like many people, I avoid letter writing if I possibly can. However, an exception that is worth writing about is to tell of my delight with the experience of using the Newton Tesla speed control system, as advertised in *M.E.* on my lathe.

My only regret is my previous indecision, for I now realise how much I have been missing. Its simplicity to fit and use, its smoothness and near silent running make an 'also-ran' machine into a 'winner'.

If this type of speed control system interests you, then I recommend it. Read Newton Tesla's advertsement, talk to them on the 'phone, as I did — they are extremely helpful, and I can't believe you'll regret making a purchase.

Usual disclaimers as to any connection with Newton Tesla apply.

Don Cole, Buckinghamshire.

THE 72ND MODEL ENGINEER EXHIBITION RESULTS AND AWARDS

THE DUKE OF EDINBURGH CHALLENGE TROPHY

Stephen Elliott Fowler Z7 Ploughing Engine

CLASS A1: HOT AIR ENGINES

Highly Commended:

James Douglas Fire-Eater Engine

CLASS A2: GENERAL ENGINEERING MODELS

Gold Medal:

Herbert Stumm Hydraulic Engine - Ph. Mayer, 1880

Bronze Medal and The Tom Nevins Memorial Trophy:

Norman Barber *Vulcan* Beam Engine

Commended:

Ian Cornish Twin Cylinder Duplex Engine

CLASS A3: INTERNAL COMBUSTION ENGINES

Gold Medal and The Edgar Westbury Memorial Trophy:

Bill Connor Matchless G50 Motorcycle Engine

CLASS A4: MECHANICALLY PROPELLED ROAD VEHICLES

Gold Medal and The Bradbury-Winter Memorial Challenge Cup:

Cherry Hill Gilletts & Allett Traction Engine 1862

Silver Medal and The Aveling-Barford Trophy:

John Walker Atkinson 6 Ton Standard Steam Wagon

Bronze Medal:

William Pike Aveling & Porter Roller

Highly Commended:

William Pike Living Van

Commended:

William Pike Water Cart

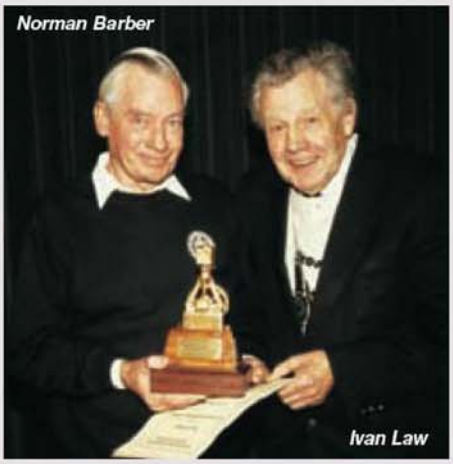
CLASS A5: TOOLS AND WORKSHOP APPLIANCES

Silver Medal and The Bowyer-Lowe Challenge Cup:

Ian Hunt Pipe Bending Machine

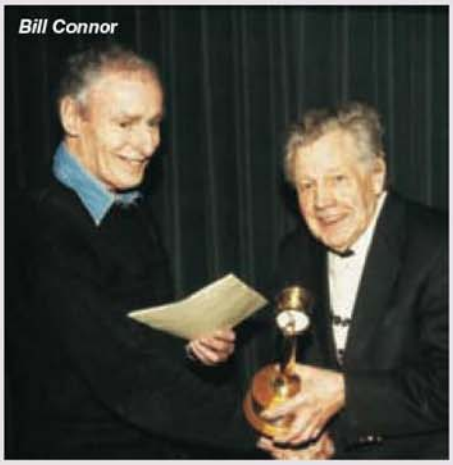

Stephen Elliott

Gerard Veenheiuzen


Norman Barber

Ivan Law


Herbert Stumm


Bill Connor


Cherry Hill


John Walker

Bronze Medal:
Peter Clark Adjustable Ring Chuck

Bronze Medal:
David Richmond Power Hacksaw

Bronze Medal:
John Slater Clocking Attachments

Highly Commended:
Graham Tyler Myford Lathe Accessories

CLASS A6: HOROLOGICAL, SCIENTIFIC AND OPTICAL APPARATUS

Gold Medal:
Kenneth Pert Great Wheel Skeleton Clock

Gold Medal:
Kenneth Pert Strutt Epicyclic Skeleton Clock

CLASS A7: GENERAL ENGINEERING EXHIBITS

Highly Commended:
Graham Tyler Fittings for *Firefly* 5in. Gauge

Commended:
Susan Parker Ergonomic Keyboard Design Concept Prototype

CLASS B1: WORKING STEAM LOCOMOTIVES (1in. scale and over)

Gold Medal and The J. N. Maskelyne Memorial Trophy:
Gerard Veenhuizen 7¼in. gauge Locomotive *The Rocket*

Silver Medal and The Crebbin Memorial Cup:
John Eldred 5in. gauge GCR 'Immingham' Class Locomotive

Silver Medal:
Vincent Henshaw 7¼in. gauge Locomotive *Sans Pareil*

Silver Medal:
David Small 7¼in. gauge Locomotive *Jupiter*

Bronze Medal:
Alan Priest 7¼in. gauge BR Standard Class Pacific

Very Highly Commended:
Robert King 5in. gauge NZR Alco Mallet Compound

CLASS B4: SCRATCHBUILT MODEL LOCOMOTIVES OF ANY SCALE

Gold Medal and The Charles Kennion Memorial Trophy:
Philip Brien 5in. gauge Austrian Federal Railways Class 1245

CLASS B5: SCRATCHBUILT MODEL LOCOMOTIVES (Gauge 1 and under)

Silver Medal:
David Jones BR Class 9F *Evening Star*

Very Highly Commended:
David Field LB&SCR Billinton B2X

Very Highly Commended:
Rafe Shirley LNER J27 0-6-0 Tender Loco

CLASS B8: KITBUILT ROLLING STOCK

Very Highly Commended:
Andrew. More GWR Open 'C' Tube Wagon

CLASS B11: RAILWAY BUILDINGS AND LINESIDE ACCESSORIES (to any recognised model railway scale)

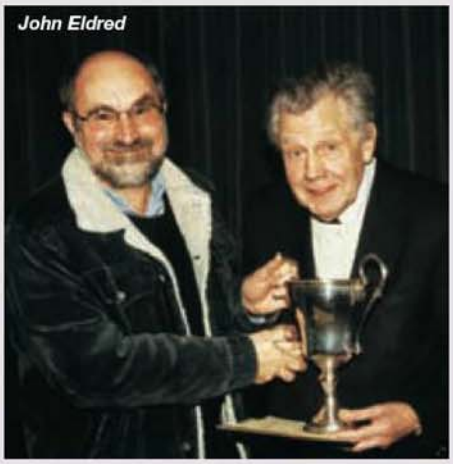
Very Highly Commended:
Peter Mann Great Eastern Signal Box

CLASS B12: TRAMWAY VEHICLES

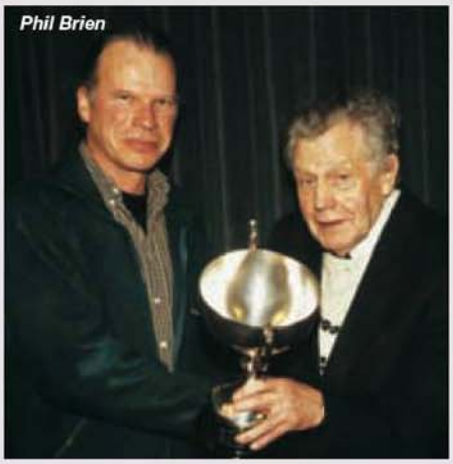
Highly Commended:
David Orchard Coventry Tramcar No. 71

CLASS F2: GENERAL CRAFTSMANSHIP NOT OTHERWISE CLASSIFIED

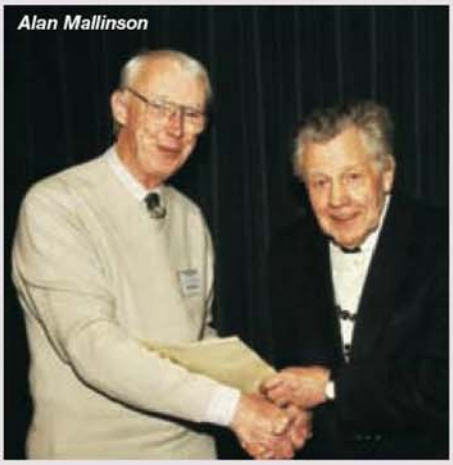
Bronze Medal:
Stephen Atkinson Ferrari 360 Modena

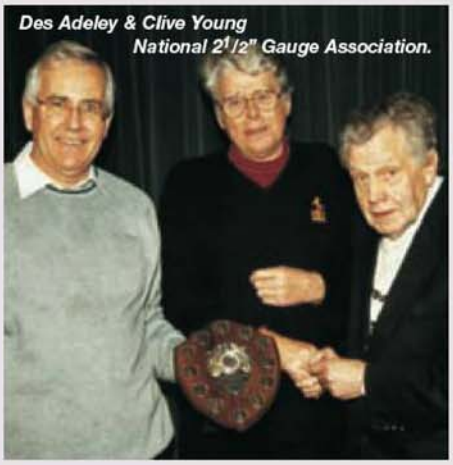

John Eldred


Gerard Veenheiuzen


Phil Brien


Brian Young


Alan Mallinson


Des Adeley & Clive Young
National 2½" Gauge Association.

Bronze Medal:
Eric Best LB&SCR *Brighton* of 1878

Bronze Medal:
Eric Best *Beachy Head* - SR 2424

CLASS G1: CARRIAGES AND OTHER SPRUNG VEHICLES

Gold Medal and The John Thompson Trophy:
Brian Young Nicholson's Hay Tedder

Silver Medal:
Timothy Smith Waring & Gillow Ornamental Trade Van

Silver Medal:
Brian Young Bamford 'Royal' Mower

Bronze Medal:
Ralph Kitching Garden Seat Horse Bus

Bronze Medal:
Roger Morgan Bull Wagon c1900

CLASS J3: ANY TYPE OF MODEL MADE BY AN UNDER 18 YEAR OLD

Gold Medal:
James Finch Wimshurst Machine

CLASS K1: NON WORKING CARS

Gold Medal:
Alan Mallinson 1929 Bentley Le Mans Speed Six

Highly Commended:
Jon Neech *Monte Carlo or Bust*

CLASS K2: NON WORKING TRUCKS

Silver Medal:
Peter Mealing PzKpfw IV Panther Ausf A Tank

Highly Commended:
Jon Neech *Mad Max 2 - The Road Warrior*

CLASS K7: FUNCTIONAL MODEL CARS/VEHICLES

Bronze Medal:
Peter Mealing T34-85 Tank

CLASS L1: AIRCRAFT MODELS

Silver Medal:
Michael Matthews *Glamorous Glen III* N.A. P-51D Mustang

Bronze Medal:
John E. Stevens Fokker EIII *Eindekker*

Very Highly Commended:
David Horton Fokker DR1 Triplane

Very Highly Commended:
Alan Lincoln PBY Catalina

Very Highly Commended:
Ian Redshaw Sopwith Pup

Commended:
Colin Agate Henschel 126

Commended:
Colin Agate BE2c Bomber

BEST CLUB STAND

National 2½" Gauge Association

Very Highly Commended:
Gas Turbine Builders Association

Highly Commended:
I.C. Engine Builders Group

BUYING A BOILER?

Mike Leahy

outlines recent legislation and describes the effect that it has on the sale of boilers and kits or completed models.

The model engineering fraternity in the UK, having recently undertaken a lengthy dialogue with the Health and Safety Executive on the safety aspects of our modelling activities, which came to a favourable conclusion, now finds itself involved in additional bureaucracy regarding pressure equipment. Legislation in the form of *The Pressure Equipment Regulations 1999* (PER), imposed by the European Community, and *The Pressure Systems Safety Regulations 2000* (PSSR), now governs the design, manufacture, sale, installation, examination, testing and maintenance of nearly all pressure equipment and assemblies. Encompassing equipment from one extreme to another — from the simple Mamod type boiler to those used in power stations — the various types of boilers constructed and used by the model engineer fall within aegis of these regulations, e.g. those powering miniature locomotives, miniature traction engines, miniature road vehicles, miniature stationary engines and boats, etc.

With the increased sales of model kits incorporating a boiler, and the tendency for the self-builder to purchase a completed boiler, there has arisen the need of some easily digestible information to help a prospective purchaser understand the requirements of the new regulations. Both articles of legislation are lengthy tomes (60 pages and 62 pages respectively), each written in its own flavour of 'legalese', and what follows is presented as an interpretation of how the author understands their relationship to our model engineering activities. While every endeavour has been made to ensure this information is correct, it shall not be taken as legal advice.

It should be noted that boilers used in road vehicle and boating applications may be subject to additional regulations which are outside the scope of this article. These guidelines are intended to be read from a purchaser's point of view and should not be used by a manufacturer for whom they are incomplete.

The Regulations

The Pressure Equipment Regulations 1999 (PER), a Statutory Instrument resulting from a Directive of the European Community through the Department of Trade and Industry (DTI), govern the design, manufacture and placing on the market of pressure equipment or assemblies. There are exemptions, but for our purpose, excepting equipment operating at 0.5bar or less, they will apply to our types of boilers/assemblies. The enforcing agency will be the Health and Safety Executive (HSE) excepting in those instances of private use when it will be the duty of the weights and measures authorities

The Pressure Systems Safety Regulations 2000 (PSSR), issued by the Health and Safety Commission (HSC), govern the design and construction of pressure systems that fall outside the scope of the PER. They also govern the subsequent installation, examination, testing, operation and maintenance of pressure systems. For steam vessels these regulations include all equipment operating at a pressure of 0 bar (0 psi) upwards. PSSR is very similar in scope to previous legislation, the old *Pressure Systems and Transportable Gas Containers Regulations 1989* (PSTGCR), now revoked, retaining the well established provisions of PSTGCR excepting that the transportable gas container regulations have been removed along with regulations that overlap or duplicate the provisions of PER. As we have worked within the framework of the old PSTGCR for many years, PSSR should pose very few difficulties, if any. Strictly speaking PSSR only applies to pressure systems used at work. However there may be some implications when using miniature locomotives, etc., where the public may be present — it would need a case at law to establish this fact — and so in order to demonstrate a commitment to safety it is prudent to follow the principles in PSSR.

Transportable gas containers are covered by *The Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996* (CDGCPL2) and *The Transportable Pressure Vessels Regulations 2001* (TPVR) and are outside the scope of this article.

The boiler testing requirements of the Southern Federation of Model Engineering Societies (SFed), Northern Association of Model Engineering Societies (NAMES), 7¼" Gauge Society (7¼"G Soc), etc., contain additional, long established criteria (mainly to meet the demands of their insurers) and these also have been taken into consideration when writing this article. Where included, these requirements are clearly indicated and while they may have no legal standing it would be folly to ignore them. Additionally, constraints are imposed on the size of boilers that may be examined/tested within these testing requirements. Therefore, anyone wishing to subsequently avail themselves of these facilities should take into consideration any limitations they impose, before commissioning a boiler.

Effects of PER

While this article is aimed at those purchasing boilers from a commercial supplier, it may be pertinent at this point to establish the effect of PER on the model engineer who constructs his own boiler.

PER is intended to eliminate technical barriers to trade within the European Community and to harmonise the different sets of regulations that each of the member countries had previously in place. The regulations were intended only to apply to commercial transactions but because of the catch-all nature of this type of legislation we found our activities caught in its net. Little thought, if any, was given to the activities of the amateur boiler maker and for that matter the cottage industry that has grown up to supply the hobby, and while there are no problems for the model engineer making a boiler for his own use, there arose a difficulty should he wish to sell it as a part of a working model at a later date.

However, as a result of representations made from within the hobby, *The Pressure Equipment (Amendment) Regulations 2002* have recently been made that retains the *status quo* for the model engineer who wishes to build his/her own boiler. In essence, the amendment enables any pressure equipment that has a history of usage otherwise than in the course of business since its manufacture, but before being made available for sale for the first time, to be excluded from the requirements of the 1999 Regulations.

Any new boiler (excepting those with an operating pressure of less than 0.5bar) placed on the market before use, falls within the remit of the PER. In theory this could affect a club member building a boiler for another club member for payment, but under most circumstances where more experienced club members simply offer help, this should not be a problem (although when in doubt about the possible application of the PER you should seek your own legal advice). Of course any boiler built outside the remit of PER legislation should comply with PSSR in matters relating to design and construction (it would also be prudent to consider the design and manufacturing criteria within the essential safety requirements of PER as they contain much useful information as to what is deemed to be good practice).

The commercial boilermakers/model suppliers are obviously the people who will bear the brunt of this legislation. While for the smaller sizes of boiler it may mean them having to undertake nothing more than additional paperwork and having to establish the fact that his/her boiler designs and construction are safe, builders of medium size boilers will, additionally, have to institute methods of production control, and for those building the larger sizes of boiler there will probably be considerable costs involved in engaging the services of a Notified Body. However, there will, no doubt, be a knock-on effect for their customers in that the burden of the additional paperwork, drawings, increased costs, etc., will be passed on to the purchaser by way of higher prices.

An obvious advantage to the commercial boilermaker is that he will be able to sell his product anywhere within the European Community without having to make reference to local regulations (although this has not been a problem in the past).

The application of PER fully came into force on 30 May 2002. Prior to that date other provisions applied and any boiler built to those provisions must have been completed and placed on the market on or before 29 May 2002. It is therefore essential that all receipts for boilers purchased before the cut-off date be retained and be made available to subsequent purchasers of a model *ad infinitum*. This will establish that the model/boiler was first placed on the market before the legislation came into force and thus enable it to be re-sold as a working model. Likewise it is important that the self-builder keeps a record of the construction and use of a particular boiler along with subsequent pressure test certificates, etc., to establish a *bone fide* set of credentials, thus enabling it to be sold on, and that these records are made available to any subsequent purchaser. ▶

When talking of pressure equipment/assemblies it is essential to understand that an assembly constitutes the boiler and all the pressure parts from the feedwater inlet (including the inlet valve) to the first joint downstream of the steam outlet (including the outlet valve). This includes superheaters and inter-connecting tubing which may be at a risk of overheating and are not capable of isolation by interposing shut-off-valves. Additionally included are the associated safety accessories and tubing connected to the boiler involved in services such as draining, venting, etc. Items such as cylinders, injectors, feedwater pumps, etc., are therefore not part of an assembly. When purchasing a kit or completed model, the provision of items such as safety valves, water gauges and pressure gauges, etc., would be deemed necessary to comply with the regulations.

The regulations are concerned with the risks created by a release of stored energy through a system failure. Technically, they are based upon the indisputable premise that as the pressure of the system, the size of the system, and the hazardous nature of the system contents increase, so does the danger therefrom. Requirements for design, materials, construction and conformity assessment therefore increase in severity as these factors increase.

Categories

Depending on their pressure and volume, steam boilers can be classified as follows:

1. **Less than 0.5 bar operating pressure**. No limit to volume. Falls outside PER and is governed by PSSR.
2. **Boilers up to and including 2 litres volume**. No upper pressure limit. 'Sound Engineering Practice' under PER applies.
3. **Category I**. Boilers above 2 litres volume, up to and including 50 bar-litres, maximum pressure 32 bar.
4. **Category II**. Boilers above 50 bar-litres, up to and including 200 bar-litres, maximum pressure 32 bar.
5. **Category III**. Boilers above 200 bar-litres, up to and including 3000 bar-litres, maximum pressure 32 bar, maximum volume 1000 litres.
6. **Category IV**. Even bigger, unlikely that anyone will build a model that falls into this category — one hopes!

Outlined below is a general list of criteria applicable to the design, manufacture and placing on the market of all categories of boiler, derived from PER, PSSR and the boiler testing procedures of the various national organisations (eg. SFed/NAMES/7¼"G Soc). They will equally apply if purchasing a complete/part built model or kit, that incorporates a boiler.

Be safe in use.

Suitable for intended use. Eg. boilers for traction engines and portable engines are subjected to additional stresses, such as that imposed by the reciprocating motion and road shocks — due allowance must be made in the design for these additional stresses.

Comply with PER/PSSR. It shall be designed/manufactured in compliance with the relevant category of PER or PSSR.

The CE mark, which may not be less than 5mm in height.

Marking and labelling. Boilers to be marked accordingly, to comply with PER (or PSSR if below 0.5 bar working pressure). The boiler should be marked in a visible, legible and indelible form with the identification of the manufacturer, its serial number, where required the CE mark and the Notified Body identification number (certain categories only). More than likely the above markings will be stamped on a dataplate firmly affixed to the boiler, preferably on the backhead where it can readily be seen.

Boilers which are manufactured under PER to 'Sound Engineering Practice' or those manufactured under PSSR must not carry the CE mark.

Additionally, other information should be supplied but, in cases where the equipment may be too small for it to be marked as above, this additional information may be supplied on a label attached to the equipment. For our purposes the information should include:

- name and address of manufacturer.
- year of manufacture.
- identification of equipment according to type and serial number.
- maximum allowable pressure (bar).
- volume of the equipment (litres). Volume is measured as the cold capacity of a boiler filled to the brim (such as for a hydrostatic test).
- minimum allowable pressure where it is other than atmospheric.
- test pressure (bar) and date.
- safety device set pressure (if a completed model).
- intended use.
- weight in kg.

Documentation. Additional paperwork also needs to be supplied:

- the appropriate pressure test and material certificates,

and, dependent on pressure and volume:

- a written declaration of conformity.

Many of the boilers we purchase, eg. those for Gauge 0 and Gauge 1 locomotives and those used in model boats, will be of less than 2 litres capacity and thus will not be stamped with the CE mark. They will have been built to comply with 'sound engineering practice' which, although not formally requiring full adherence to the essential safety requirements, will be designed and manufactured in such a way as to ensure safe use. They will still need to be marked with a serial number, and the identity of the manufacturer, and be supplied with the relevant documentation.

Materials. Materials used in construction should be suitable for intended use. Boiler manufacturers must obtain documentation from the material manufacturer showing that the material meets specification and, for equipment in Categories II, III and IV, must supply appropriate copies of the material certificates to the boiler user. While not all categories of PER require certification of materials, it is a requirement of the SFed/NAMES/7¼"G Soc minimum boiler testing codes that, wherever steel is used in the manufacture, such documentation is necessary and that the barrel tube and plates be stamped with the correct numbers and the welding have been carried out by a suitably qualified welder.

Existing/published designs. Historic designs and methods of construction may continue to be used, provided the essential safety requirements are met. Unfortunately, the commercial boiler builder cannot claim 'grandfather's rights' for an old boiler design as he/she will still have to show that it was built to comply with the regulations. When working to an approved design, any deviation from the design should be duly documented along with supporting calculations.

New designs. If commissioning a new design, technical documentation will have to be drawn up that will cover its design, manufacture and operation and will contain such things as:

- a general description of the pressure equipment.
- conceptual design and manufacturing drawings, with descriptions and explanations enabling the drawings to be understood.
- design calculations and their conclusions.
- jointing and non-destructive testing procedures.

Obviously any prospective purchaser will have to discuss these matters with the intended manufacturer, who will probably be the best person to carry out such work.

This is also an area that may have some implications for the model engineering press, as many of the series of articles describing a model include a design for a boiler. While historically such designs have proven to be safe and of adequate strength it may now be appropriate that the relevant calculations are made available to interested parties.

Test pressures. The initial test pressure should meet the SFed, NAMES, 7¼"G Soc or insurance company minimum boiler testing requirements.

Operating instructions. All boilers and assemblies must be accompanied by adequate instructions for use. Instructions for the user must contain all necessary safety information relating to:

- mounting, including different pieces of pressure equipment in any assembly.
- putting into service.
- use.
- maintenance, including checks by the user.
- periodical examination.

Protective devices. Provision shall be made for the fitting of protective devices, eg. safety valve/s, water gauge, pressure gauge, etc. Provision should also be made for the fitting of a drain valve.

Inspection. In the larger boilers, provision should be made to enable internal inspection.

Kits. For the purposes of this article, kits are defined as those supplied as a set of fully machined parts with a completely built boiler

Table showing relevant PER category of some known miniature locomotives and traction engines

Model	Gauge/Scale	Maximum Allowable Pressure	Boiler Capacity	Bar-litres	Category for PER
Tich	3 1/2in. gauge	80 psi (5.515 bar)	0.895 pint (.508 litres)	N/A	SEP
Britannia	5" gauge	100 psi (6.895 bar)	12.5 pints (7.1 litres)	48.95	Category I
Romulus	7 1/4in. gauge	90 psi (6.201 bar)	30.1 pints (17.1 litres)	106.037	Category 2
Mclaren T/E	6" scale	200 psi (13.79 bar)	225.4 pints (128.07 litres)	1766.085	Category 3

1 bar = 14.5038 psi **1 litre = 1.760 pints** **1 pint = 0.568 litres** **10 psi = 0.689 bar**

The author wishes to collate data on the boilers of various models. Please help by sending information on your boiler(s), care of the Editor: e.g. type/model, scale, capacity and operating pressure. (Capacity is filled to the brim as for a hydraulic test).

and able to be assembled with a minimum of equipment. Kits should be provided with such protective devices as may be necessary for preventing danger:

1. Be supplied with a water level indicator. (tri-cock water gauges should be fitted where practicable. This enables the water gauge to be isolated in the event of a gauge glass failure and also enables the gauge glass to be 'blown-down').
2. Be supplied with a safety valve(s) that will not allow the boiler to exceed 110% of working pressure no matter how hard it is worked.
3. Be supplied with a pressure gauge on which the working pressure of the model is clearly and indelibly indicated.
4. Have provision to be able to remove or shut-down the heat source in the event of an emergency (eg low water level, sticking safety valve, etc.)
5. Provision should also be made for some sort of boiler drain valve.

Completed models. Completed models should be provided with such protective devices as may be necessary for preventing danger. The same devices as outlined in the Kit section above should be fitted and have been set and tested accordingly before delivery.

The accompanying tables show the different documentation one may expect to receive, according to category. Also included in each table is an outline of the requirements for design and manufacture to be undertaken by a commercial builder.

In summary

So, what should we expect to receive with the boiler when it is delivered? Basically nothing more than additional paperwork that shows that the boiler was manufactured to comply with PER or PSSR if below 0.5 bar. While it may seem as though one might expect to receive reams of paper, the relevant information will probably fit on one sheet of A4 paper.

Remember to keep all documentation in a safe place as it may be needed for inspection should there ever be a mishap with the boiler (highly unlikely!) It will definitely be needed, to be passed on, should you ever subsequently wish to sell the boiler/model; for without this documentation the model may not be sold as a working model.

As indicated earlier, the burden of these regulations will probably result in an increase in prices, but the figures of 30% or more which have been bandied about seem to be somewhat unrealistic. The majority of boilers manufactured by our boilermakers are of Category I or lower. There should be no additional costs for boilers up to 2 litres and little additional costs for boilers up to 50 bar-litres. If you have a design that is a borderline case, then a judicious shifting backwards of the smokebox tubeplate or dropping the maximum allowable pressure by a few pounds or a combination of both may be sufficient to squeeze a boiler into a lower category. Bear in mind, however, that this will involve an alteration to design parameters requiring re-calculation, new drawings, etc. Category II boilers and bigger will pose a problem, in that the costs involved in monitoring and engaging the services of a Notified Body will have to be met. No doubt the boilermakers will need to approach such organisations as an unified body with the hope of gaining some concession on fees. However, the fear is that these costs may be apportioned across the whole range of boilers thus placing a disproportionate burden on the purchasers of the smaller boilers.

Before closing it might be worth noting the effect that PER will have on the secondhand market. Any boiler, either as a stand alone unit or incorporated into a model, placed on the market prior to 30 May 2002 is exempt, provided evidence to support that fact is available (eg. a receipt). Any amateur built boiler placed on the market after that date will have to have a history of usage prior to it being placed on the market. All new commercially built boilers placed on the market after that date will have to have proof of compliance with PER, be stamped with the CE mark (excepting those of less than two litres capacity) and have the appropriate documentation. If these criteria can be met there should be no problems whatsoever, other than the need to ensure any paperwork is correct and accompanies the boiler during its lifetime. Therefore if buying a secondhand boiler or model incorporating a boiler, intending it to be used as a working model, then ensure that it comes with its credentials!

I would like to thank staff at both the Department of Trade and Industry and the Health and Safety Executive for their help in compiling this article.

Mike Leahy represents the Southern Federation of Model Engineering Societies on the Miniature Railways Liaison Group, formed by the HSE to enable model engineers to participate in formulating health and safety guidance for their hobby. He has also been party to representations made to the DTI on the Pressure Equipment Regulations.

TABLE 1
LESS THAN 0.5 BAR OPERATING PRESSURE
(No upper volume limit)

Below 0.5bar (approx 7.5psi) PER is not applicable. However, the boiler and any ancillary equipment (if supplied) must comply with the requirements of PSSR in matters relating to design and construction.

The pressure system or article shall be properly designed and properly constructed from suitable material so as to prevent danger – PSSR Regulation 4.(2)

The pressure system shall be provided with such protective devices as may be necessary for preventing danger. – PSSR Regulation 4.(5)

What to expect:

Pressure Vessel only

The boiler should be permanently marked to show the manufacturers identity and its serial number.

Documentation should include:

- the manufacturers name and address.
- the date of manufacture.
- the maximum allowable pressure (ie. 0.5 bar).
- the minimum allowable pressure, if other than atmospheric. (A vessel of such a low operating pressure could be part of a condensing system and therefore subjected to vacuum).
- design temperature.
- valid pressure test certificate.
- operating instructions.
- the standard to which the vessel was built.
- steel boilers should have the appropriate material certificates, the barrel tube and plates be stamped with the correct numbers and the welding have been carried out by a suitably qualified welder (SFed/NAMES/7¼"G Soc requirement).

Additionally:

- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level).
- provision should be made to allow the boiler to be drained.

Kit

In addition to the above, the fittings should be supplied and, if a heated vessel, a means of being able to remove or shut down the heat source in an emergency should also be provided.

Completed model

In addition to the above, the fittings should be installed with the safety valve pressure set and tested. The boiler test certificate should be suitably amended to record this fact.

The manufacturer should be able to provide sufficient written information regarding design and construction as may reasonably, foreseeably be needed to enable the provision of the Regulations to be complied with. The manufacturer doesn't necessarily have to supply such information to the purchaser, but it must be retained for inspection should the need arise.

In 5in. gauge a Britannia boiler may have a capacity of 12½ pints and, if operating at 100psi will be a 48.95 bar-litre unit fitting PER Category 1.

TABLE 2
BOILERS UP TO AND INCLUDING 2 LITRES VOLUME
(No upper pressure limit)
Boilers in this category need to have been designed and manufactured in accordance with 'sound engineering practice' (SEP) in order to ensure safe use.
What to expect:
Pressure Vessel only
The boiler should be marked to show the manufacturers identity and its serial number. CE marking shall not be affixed to SEP equipment.
Documentation should include:
- the manufacturers name and address.
- the date of manufacture.
- the maximum allowable pressure.
- the volume of the boiler.
- valid pressure test certificate.
- intended use.
- instructions for use.
- weight (empty).
- steel boilers shall have the appropriate material certificates, the barrel tube and plates be stamped with the correct numbers and the welding have been carried out by a suitably qualified welder (SFed/NAMES/7¼"G Soc requirement).

Additionally:
- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level).
- provision should be made to allow the boiler to be drained.

Kit
In addition to the above, the fittings should be supplied and, if a heated vessel, a means of removing or shutting down the heat source in an emergency should also be provided.
Completed model.
In addition to the above, the fittings should be installed with the safety valve pressure set and tested. The boiler test certificate should be suitably amended to record this fact.

The manufacturer needs to be able to show the boiler has been designed and manufactured in accordance with 'sound engineering practice'. Copies of all drawings, calculations, etc., relating to its design should be retained to enable subsequent inspection by the relevant authorities should the need arise. The manufacturer doesn't necessarily have to supply such information to the purchaser.

TABLE 3
CATEGORY I
(Boilers above 2 litres volume, up to and including 50 bar-litres, maximum pressure 32 bar.)
Boilers in this category need to have been designed and manufactured in accordance with Module A of the Conformity Assessment Procedures. (Internal Production Control)
What to expect:
Pressure Vessel only
The boiler should be marked to show the manufacturers identity, its serial number and the CE mark.
Documentation should include:
- the manufacturers name and address.
- the date of manufacture.
- the maximum allowable pressure.
- the volume of the boiler.
- valid pressure test certificate.
- intended use.
- instructions for use.
- weight (empty).
- a Declaration of Conformity, that the equipment satisfies the requirements of the Pressure Equipment Directive.
- boilers should have the appropriate material certificates.
- the barrel tube and plates of steel boilers shall be stamped with the correct numbers and the welding have been carried out by a suitably qualified welder (SFed/NAMES/7¼"G Soc requirement).

Additionally:
- provision should be made to allow the fitting of protective devices (eg a safety valve, a pressure gauge and, if a heated vessel, provision for fitting a device to assess water level).
- provision should be made to allow the boiler to be drained.

Kits and Completed models
As Table 2.

The manufacturer will have drawn-up technical documentation for the equipment that includes manufacturing drawings, design calculations, examinations carried out, test reports, etc., along with a Declaration of Conformity. The manufacturer must keep this documentation, for inspection by the relevant national authorities, for a period of ten years from the date of manufacture. A method of internal production control must be established that ensures the manufacturing process enables the manufactured pressure equipment to comply with the technical documentation and meet the requirements of the Directive. All the relevant Essential Safety Requirements must be met.

TABLE 4
CATEGORY II & III
(Category II. Boilers above 50 bar-litres, up to and including 200 bar-litres, maximum pressure 32 bar)
(Category III. Boilers above 200 bar-litres, up to and including 3000 bar-litres, maximum pressure 32 bar, maximum volume 1000 litres)
Boilers in these categories need to have been designed and manufactured in accordance with one or more of a number of conformity assessment modules, which increase in severity according to the increase of stored energy in the boiler. Design and manufacture will be monitored by a Notified Body.
What to expect:
Pressure Vessel only
The boiler should be marked to show the manufacturers identity, its serial number, and the CE mark together with the identification number of the Notified Body involved at the production control stage.
Documentation and provisions:
As outlined for Category 1 (See Table 3) but
- all boilers should have the appropriate material certificates (eg. certificates of specific product control), prepared by the material manufacturer, affirming compliance with specification. Barrel tube and plates be stamped with the correct numbers, to relate materials to certificates.

Kits and Completed models
As Table 2.

The manufacturer will have drawn-up technical documentation for the equipment that includes manufacturing drawings, design calculations, examinations carried out, test reports, etc., along with a Declaration of Conformity. The manufacturer will work in conjunction with a Notified Body, whose job it is to monitor and verify that the pressure equipment has been manufactured according to the relevant assessment module. Typically the Notified Body will examine the technical documentation and quality control methods, conduct checks on samples, assess materials and check conformity to harmonised standards, approve procedures for joining and verify that personnel undertaking such joining are suitably qualified. All the relevant Essential Safety Requirements must be met. All documentation regarding design, manufacture, quality assessment, examinations and reports from the Notified Body and other similar records must be kept, for inspection by the relevant national authorities, for a period of ten years.

THE BURNT AIR ENGINE

Frank Taylor

returns to his discussion of foundry technique with a report of his experiences with casting in brass.

●*Part VII continued from page 35 (M.E. 4186, 10 January 2003)*

At the beginning I intended to make all the top end parts and the oil management casting in brass, but because of difficulties that I could not overcome, the complicated displacer castings were made in gunmetal. Before doing any serious casting I thought it would be a good idea to melt a small quantity of brass just to get the feel of things. A visit was made to my local scrapyard where the man led me to an enormous steel tank full of brass water fittings. I noticed that most were brand new — how could such things be thrown out for scrap? I filled a nearby bucket and was pleased with the price.

The Author did not consider his first attempt at brass founding to be an unqualified success!

As far as I now know, these fittings are made of a 60:40 copper:zinc alloy with a little lead for easy machining; in other words, the brass had a high zinc content which ensured that I had an eventful baptism. I already had a little home made coke furnace which I used for the try out. There were no problems getting the brass to melt. Having fitted a lid to the crucible with the object of keeping the coke gases away from the metal, I decided that it was time to have a look to see if the metal was ready. The lid was stuck to the crucible, and access was limited. The more I tried to remove the lid the lower the crucible sank in the coke. Weighing up a nasty situation, there was only a very small amount of metal in the crucible and if something broke, the metal would get lost in the furnace. Being quite brutal the lid came off without breakage and, after more difficulty fishing the crucible out of the coke, I poured the metal. It behaved like a flare giving off a brilliant light and plenty of white zinc oxide fume.

When it all cooled down I had an ingot largely consisting of zinc and copper oxides. I had a feeling that I had a long way to go. To give you an idea how strong the feeling was I immediately decided that money would have to be spent on proper tools and equipment. The electric furnace, the commercial lifting-out tongs and pouring rings that were purchased make things much easier and makes one feel safe when lifting out the metal and pouring. Although pleased with my investment, the problem of the zinc burning did not go away. I had established that metal pouring temperature for the water fittings was about 910deg.C and the temperature for 65:35 ingot brass was around 930deg.C. On checking some tables I have showed that pure zinc actually boils at 913deg.C. I was somewhat perplexed.

There was another conspiracy which added to my dilemma. The catalogue of my former supplier offered the same cover flux for brass and gunmetal. The flux I was using was okay for gunmetal but not much good for brass. This was something that I learned later. However, despite this flux, I devised ways of overcoming the problem which may perhaps be somewhat unconventional, but were my answer to the problem at the time.

Photograph 41 shows my first attempt at actually making a brass casting. As you can see from the shape, it was for the oil management casting. It was a simple mould and it had a good size feeding head. Why not pour the metal straight into the feeding head? The answer is evident in the next photo.

To minimise the zinc burning I devised a method of pouring under a flame. The blowtorch had one air hole masked to produce a reducing type of flame (one hungry for oxygen), and the torch was fixed at the point of pouring. A couple of polystyrene chips were put in the mould to vapourise and blow out the air in the mould. I decided not to skim the flux from the molten metal before pouring as this exposed the metal to the air and the zinc burned. Pouring under the flame was exciting. The flame forced must of the flux back into the crucible and lovely clean metal could be seen through the flame. The flame gobbled up all the oxygen that was around and ▶

Perseverance led to improvement but there were countless inclusions; note also the cold shut.

Success at last! This casting resulted from introducing the metal rapidly into the mould and taking care to minimise its contact with atmospheric oxygen.

Another view of the successful brass casting; the use of a vertically split moulding box and several feeders also contributed to its success.

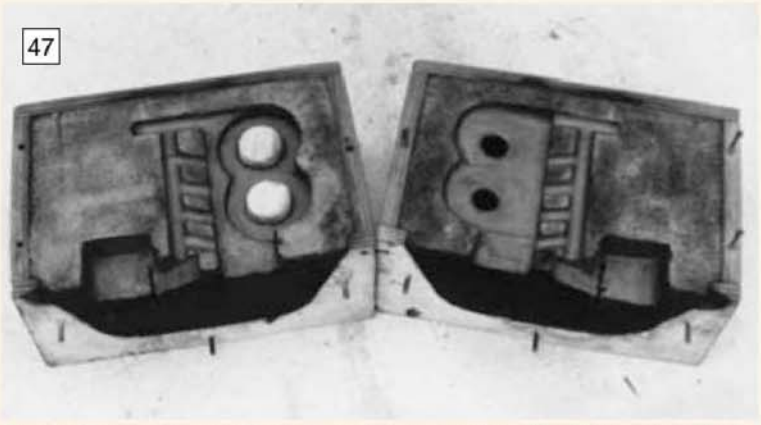
A simple brass casting made using a divided pouring basin (left) which encouraged the moten metal to flow cleanly into the sand mould (right).

This view of the mould shows the pattern in position and the sand in the process of being rammed up; note the two chills.

the zinc went hungry. It was a big improvement and the amount of burning was small and tolerable. I had hopes that we might actually have a casting.

Preliminary machining revealed that the metal was filthy (**photo 42**). The original photo shows a mass of fine inclusions on the machined face (I hope these reproduce okay in the magazine). If I had really thought about what happens when you draw a glass of water from a tap then I would not have poured in this way. Water from the tap can be seen carrying air down deep into glass even though it is much lighter than water. Similarly dirt oxides and flux were carried into the casting and were trapped as it solidified. This could be easily corrected but there was something else not seen before.

Look where the scriber is pointing. At first sight it appears to be a surface blemish but it is a discontinuity which goes deep into the casting and I think it is called a Cold Shut. This fault seems to be peculiar to brass. It can occur on the surface as seen here or it can appear in a complicated casting where the metal stream has to split to go round a core or protrusion. After going round the obstacle the two metal streams refuse to unite leaving a serious discontinuity in the casting.



The two halves of the mould with the pattern removed and the surfaces dusted with graphite to improve the resultant casting; the chills remain in place.

Brass appears to solidify over a narrow temperature range compared with gunmetal or aluminium and if the metal passes over the surface of the mould slowly the leading edge will start to solidify and the following hot metal will ride over it causing the fault shown here. A much faster pour seems to be one answer to the surface problem. For the internal fault things are not so clear cut but I believe the following factors play a part:

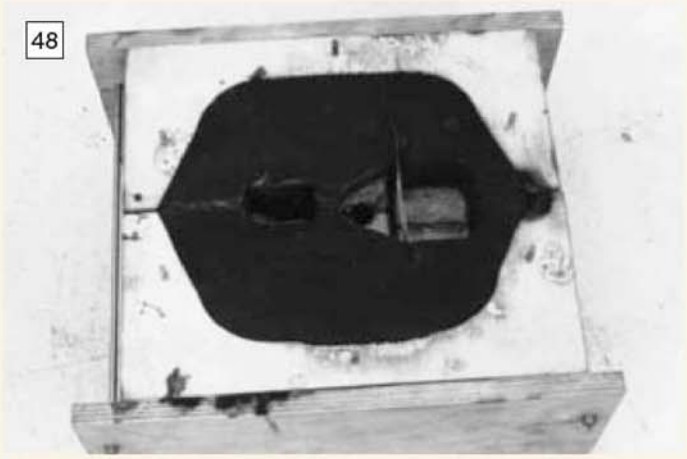
1: Splitting the metal stream; avoid if possible.
2: Oxygen in the mould causing zinc burning.
3: Too slow a pour.
4: Low metal temperature.

Much of the difficulty with brass can be overcome by using a different type of casting box which is split vertically instead of horizontally. This enables easy insertion of a feed system which I think is called a Saxophone gate. This system offers many advantages which are outlined under the next two photos.

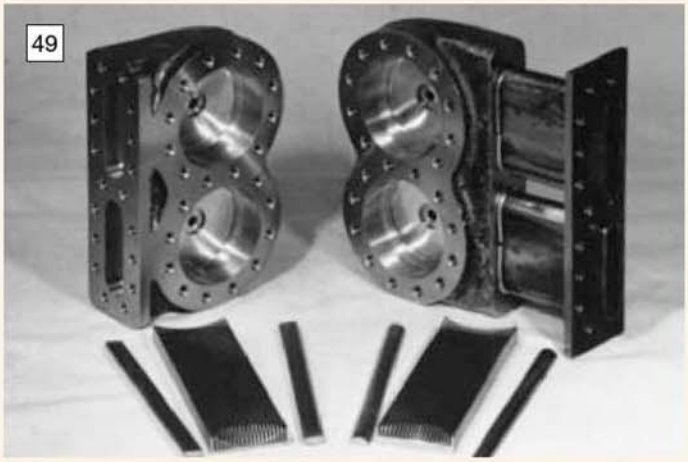
Photographs 43 and **44** show my first success with brass — it was very sweet and encouraging. I have no photo of the box in which it was cast but will show a similar box later. I was still using the wrong flux and pouring under a flame as before with a couple of polystyrene chips in the mould. Pouring was two to three times faster than I would pour aluminium. As soon as the mould was full the torch was applied to the feeding head to keep it feeding as long as possible. Later machining showed the casting to be an object of great beauty. Why did this sort of gate make such a difference? My interpretation and answer follow.

Action of the gate

Looking at photo 43, which shows the casting lying on its side, metal is poured down the sprue on the left and enters the casting at the bottom. Metal enters quietly with slight turbulence in an upward direction. Any flux inclusions or oxides are swept up to the surface of the rising metal and stay there. Further inspection of the photo will reveal two other outlets from the sprue to the



The two halves of the mould box have been securely assembled and the mould awaits its charge of molten metal.



Following successful sessions in the foundry and workshop, the resulting Mk. 1 cylinder heads are objects "...that would grace the mantelpiece."

The Mk. 2 engine displacer castings were complex and involved considerable use of cores and a three-part mould with loose pieces.

casting. When the metal is level with the lower of these it enters through this and gradually stops entering at the bottom of the casting. The same thing happens when the metal reaches the higher inlet going to the feeder head. Note that these inlets sweep the metal upwards ensuring inclusions are driven to the surface of the feeder head. This muck and flux help stop the zinc burning.

Why do all this? What happens in the casting is really quite elegant. When metal entering the bottom of the casting stops flowing it begins to cool and contract. Metal is now flowing into the mould from the inlet above. This is filling the casting of course, but it also provides feeding for the contracting metal below. The same thing happens at the next inlet which fills the feeder head for final feeding of the casting. In a large or long casting there can be a large number of these inlets.

Photograph 44 is included to reveal the extent to which the casting and feeder contract. What might have been a big hole in the middle of the casting is now a big depression in the middle of the feeder.

A better flux

Fortune had it that I was forced to change my materials supplier. The catalogue showed two types of flux, one for low zinc content copper alloys, and another for high zinc alloys (brass). The difference when using this flux was very marked. I could now dispense with pouring under a flame and could pour under the flux with very little burning. However, when doing so, some flux goes over with the metal and needs to be separated out before it enters the mould. This is done with a divided pouring basin.

The Mk. 2 engine heater castings turned out very well in gunmetal.

Photograph 45 shows a simple brass casting made using a divided pouring basin with metal poured under the flux. On the left of the photo is the part of the basin into which the metal was poured. To the right of the dividing plate can be seen the metal emerging from the basin and flowing into the mould. I think the photo tells the rest. The next three photos show the casting of Mk. 1 cylinder heads and features of the vertically split box as previously described.

In **photo 46** half the box has been rammed up in a horizontal position. The casting pattern, together with patterns for the feeds and pouring basin are still in place. Looking at the box, the side away from you will be the top when the metal is poured and that side can be unbolted to facilitate this.

This was my second attempt at this casting, the first effort was a failure due to a small area of porosity in the top part of the heads. This was probably a design fault in the casting shape and I could not provide any additional feeding. The two chills seen in the photo solved the problem by drawing heat from the faulty area and getting it to cool more quickly. These were just pieces of mild steel liberally coated with Zirtex and placed as you see.

Photograph 47 shows the two halves of the mould now in a vertical position with their top sides unbolted. The mould has been brushed with graphite powder which prevents sand penetration, assists flow of the metal over the surface and provides a better finish. I find that the mould surface is best dried well before pouring the metal. The graphite also assists here in that it prevents erosion in the face of the torch flame.

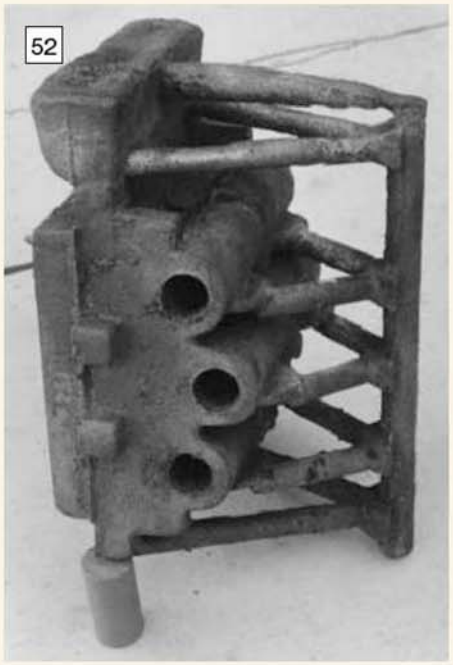
As can be seen in **photo 48**, we are now ready to pour. The box has been assembled and the two halves clamped tightly together with the aid of threaded studs. After bolting up, a small piece of tinplate is inserted to within $^{1}/_{8}$in. of the bottom of the pouring basin to provide a division. This must be coated with Zirtex to protect it from the molten metal. Just prior to actual pouring, the blow torch was placed such that the products of combustion enter the mould and get rid of most of the oxygen.

Castings straight from the mould are not very photogenic (that's my excuse because I haven't a photo!) so here they are in **photo 49**, shown in an assembly, as objects that would grace the mantelpiece.

Displacer castings for Mk. 2

These castings were very complicated with a great deal of coring which cannot be seen. Initially. I could not see a way of employing the techniques just outlined and reverted to a simple method of casting shown in **photo 50**. At first I thought I had got away with it but, about three quarters through the machining, I hit an area of porosity. I suppose this was inevitable seeing what had been learned before. A method had to be devised to incorporate what had been learned. I am not going to try to describe the mould except to say that it was in three parts with loads of loose pieces which had to be carefully winkled out.

Photographs 51 and **52** are of the Mk. 2 heater castings which turned out very well in gunmetal. The extra metal required meant that my largest crucible had to be filled to a point that could only be regarded as dangerously full. In photo 52 you can see that metal was a bit short but I was lucky. In photo 51 I took a chance and survived.



The Author's crucible was only just sufficiently large to supply the necessary quantity of metal.

Gunmetal is nice to work with, behaving something like for the much higher melt temperature. These castings were poured at 1170deg.C, just below the maximum for my furnace.

Casting quality

When deciding what is good and what is bad with any item, we have to consider its use and function. A casting with a hole in the centre is perfectly okay for some applications like brackets or mountings. Something that is hollow loses very little strength compared with that of a solid component. In these cases one can use simple moulds with low work methods. Where one is going to cut or drill deep into the casting or subject it to pressure, then a higher standard is required.

That concludes my casting escapades which I hope you enjoyed. Next time it's back to the construction.

●*To be continued.*

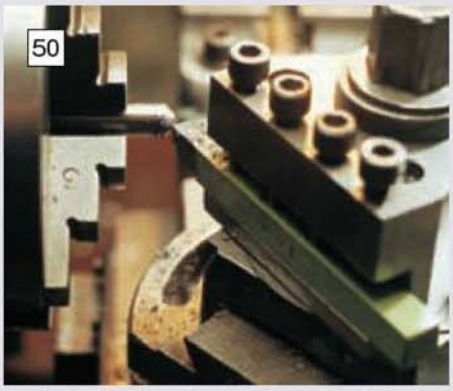
BRAY'S BENCH

THE JUNIOR
A STATIONARY INTERNAL COMBUSTION ENGINE

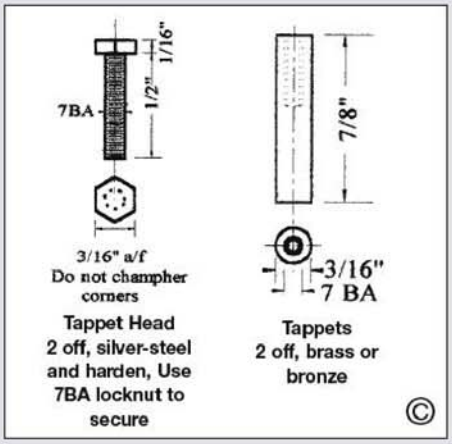
Stan Bray

suggests two ways of making the valves for this popular engine.

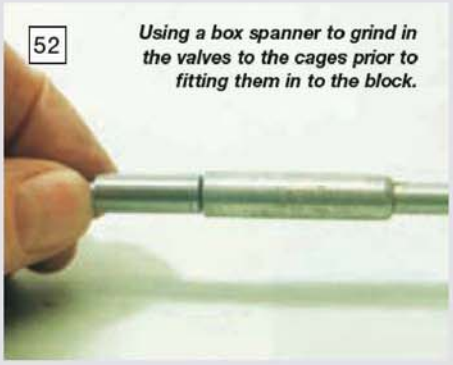
●*Part VII continued from page 19 (M.E. 4186 10 January 2003)*



Machining the the valve head using a knife tool and the top-slide set to angle of 45 degrees.



Left to right: Tappets, valve guides, valves and spring retaining plates await assembly.



Using a box spanner to grind in the valves to the cages prior to fitting them in to the block.

To get a very fine finish on the valve stems, if they are machined from the solid, it will be necessary to use a really effective steady and doubtless many readers will be familiar with suitable devices. The steady must travel with the tool and be capable of being adjusted to close proximity with the tool in use. Experience reveals that the usual type of travelling steady is not really suitable for this job. If the work is supported on the main diameter the steady will give no support whatever to the smaller one. If it is placed where the small diameter can be supported, then the steady itself may well prevent the tool travelling right up to the shoulder due to interference with the chuck.

In industry, a device that is often referred to as a 'box' would be used. It is not too difficult to make a simplified version of this in the form of a roller steady which consists of two adjustable rollers that line up exactly opposite the cutting tool. A point of interest here is that, despite what we read in technical manuals, when machining very small diameters it is a distinct advantage to increase the top rake angle of the tool. One reason for quoting a 10deg. top rake angle is to give the cutting edge sufficient support. There is generally less pressure when machining smaller diameters and a steeper angle provides more rapid clearance of the swarf. However, a *really* sharp tool is needed and it *must* be set at centre height.

Fabrication

An alternative to machining the valves from the solid is to fabricate; for most people this will almost certainly prove to be the easier method and has the advantage of making use of the ground finish on the silver-steel. Start by running a 5BA thread about 1/4in. long on a 2in. or slightly longer length of 1/8in. dia. material. Now take a piece of 3/8in. dia. silver-steel and drill and tap it 5BA to a depth of approximately 3/16 inch. Then, at the same setting, machine it to 5/16in. dia. for about 1/4 inch.

Machine the 45deg. angle next. There are two ways of doing this. A tool with a 45deg. approach angle can be set at 90deg. to the workpiece and wound straight in, or a normal knife tool can be traversed across the face with the top-slide set at an angle of 45 degrees. I chose the latter on the grounds that it was easier than grinding a tool to the necessary angle with a long enough cutting face for it to do the job in one go, and to be sure that it would be perfectly straight.

Finally, part off the chamfered piece, not forgetting to allow for the 1/32in. long parallel section at the top, and check that it will fit on the stem. It may be necessary to run the tap through again just to remove any burr that may have built up at the end of the thread. With the parts assembled, and having made sure that the head is fully screwed home, cross drill the stem for the pin that will hold the valve spring in place.

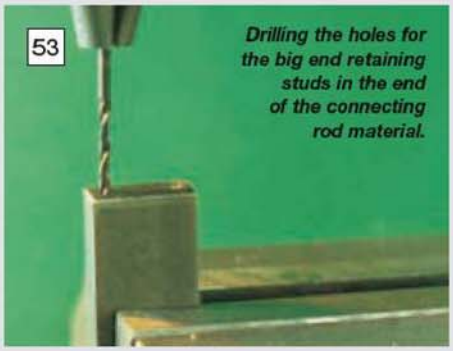
The valves now have their heads screwed to the stems and a length of thread sticking out of the top; this is fine and exactly what we need. Strip them down and soak them in a suitable degreasing agent to remove all traces of cutting oil and tapping compound. Lightly flux the threads, wiping off any surplus that gets onto the protruding length. Lay the stems on a firebrick so that they are flat and will not distort with the heat. Heat the head of the assembly and just touch it with silver-solder wire. Once the joint is made, and while the valve is still red hot, dunk it in some vegetable oil. I advise the use of oil for quenching because with the two different diameters there is a distinct chance of the stems cracking if quenched in water.

Be very careful when using oil as a quenching medium for hardening in this way as it is quite likely to catch fire. Use a container with as small a top and as deep as convenient for the job in hand. An empty baked bean can or similar is ideal. The depth allows the can to contain sufficient oil to cool the work off, while at the same time the surface area is limited thus restricting the area of flame. A shallow tin such as is used for sardines would result in there being insufficient oil, which will heat up and not harden the valves. Before starting, cut a sheet of steel to fit over the top of the container with a generous overlap. In the event of the oil catching fire, immediately cover the container to exclude air and extinguish the flames. It hardly needs for me to say that this operation should be carried out out of doors and not inside where a fire might be started.

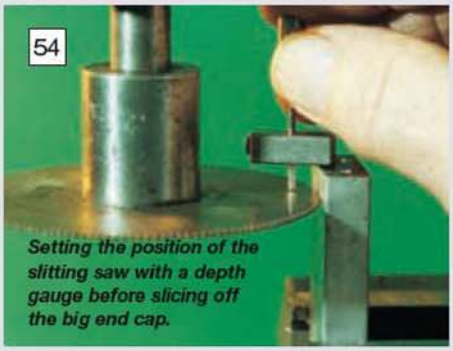
Grinding in the valves

No doubt many older readers will have ground in the valves of car engines and so will need no introduction to the method. The good old days (or were they the bad old days?) of having to de-coke cars on a regular basis are now long gone. Thinking about them invokes memories of changing kingpins on a Christmas morning so that the car could be used for the journey to work on the day following Boxing Day. Recollections include the replacing of pistons on long stroke engines, where the only way to get them in was by working them round the crankshaft from underneath the car that was standing on blocks of wood in the street, while it was pouring with rain. What would today's safety officers think about such antics? Modern motor cars are difficult to work on without specialist equipment, so younger readers are unlikely to have ground in valves before.

Clean up the valves with fine emery cloth, just enough to remove the discolouration caused by the heating. Then fit a 5BA nut onto the length of protruding thread and tighten it. Slip each valve into its guide after applying a fine grinding paste to the 45deg. angle. Depending on the surface, a regular brass cleaner such as Brasso will



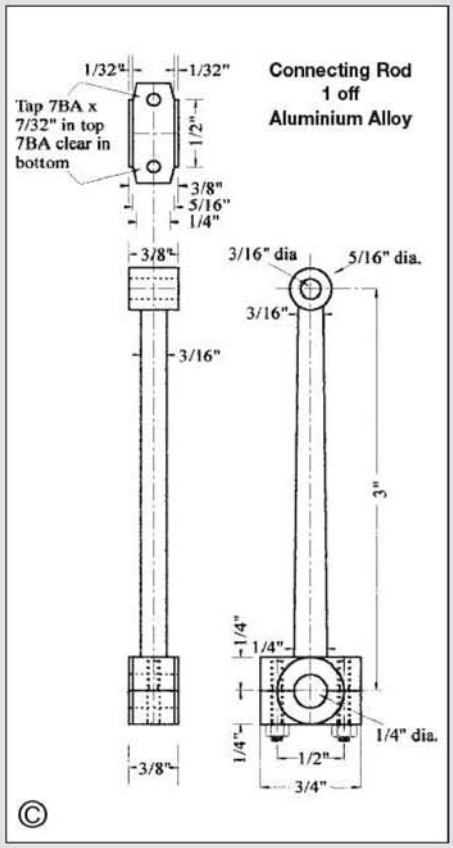
53 Drilling the holes for the big end retaining studs in the end of the connecting rod material.



54 Setting the position of the slitting saw with a depth gauge before slicing off the big end cap.

55 Cutting off the big end cap. The thickness of the cap is measured from the top of the slitting saw.

56 Milling the connecting rod to produce the reduced centre portion.



57 Setting the material up in the vice to produce the tapered con-rod profile.

probably be quite coarse enough for the job. If the surface is uneven, something a little coarser may be required; a household scouring powder such as Ajax mixed with a little oil can be quite good for the purpose. If the worst comes to the worst and the surface is really bad, it may be necessary to resort to valve grinding paste available from a motor accessory dealer. Some readers may already know that this is supplied in a double-ended container with a coarse grit at one end and fine at the other. Use the fine grit only, the coarse grit is far too rough for this job.

Use a box spanner or nut spinner to rotate the nut, starting with a circular movement and following with a back and forth rotation first one way and then the other. The valves and the guides will eventually take on a uniform matt appearance; when this is evident all round both surfaces the valve can be considered to be a good fit. The surplus grinding paste should be completely removed by washing off using white spirit or similar, but do make sure that every trace of the abrasive is removed. Once ground in, each valve is individual to its own guide, so do not allow them to be mixed up under any circumstances.

Unscrew the 5BA nut used to grind in the valve and remove the surplus thread on a grinding wheel.

Tappets and spring retainers

The tappets are simply lengths of 3/16in. dia. brass or bronze tapped 7BA x 3/8in. at one end which should present no problems. The original drawings show no more than that and it can be assumed that 7BA bolts are to be used for adjustment. Ordinary bolts are likely to wear rapidly when in contact with the valve stem, so it will be as well to make special ones from silver-steel and harden them. Do not chamfer the corners as is usual for a bolt, but leave the top flat in order to provide a larger bearing surface. An ordinary 7BA lock nut can be used to hold things secure after adjustments have been made.

Likewise, the spring retainers are quite straightforward. The 1/4in. dia. recess is designed to accept the pin that fits through the valve and thus prevents it from coming out. The 7/32in. step is to hold the spring; this diameter may have to be adjusted to suit the springs used. Suitable springs will doubtless be available from the suppliers of the castings; they fit into the retainer and over the thin section of the valve guide protruding below the cylinder block.

Connecting rod

The original drawings show an aluminium alloy connecting rod with no separate bearings. It is understood that this approach has been adopted commercially in full size engines with reasonable success. Although slightly overwidth, a length of aluminium alloy bar was supplied with the castings, obviously for this purpose. However, the specification of the material is not indicated and we cannot therefore be certain of its properties. The quality of the supplied material is also open to doubt concerning its ability to take the continual wear to which it will be subjected. An obvious problem with this configuration is that once the bearing surfaces begin to wear, the entire connecting rod must be replaced. Nevertheless, it may well suit some readers to make it in this fashion, and if so it is basically a fairly straightforward job. Cautious readers may wish to make the con-rod from steel if they prefer.

On the particular model being described, it was decided to retain the aluminium alloy con-rod but to fit bronze bearings which can be replaced, should the need arise, without having to start all over again. Apart from making oversized holes, construction of the actual connecting rod remains the same and so making replaceable bearings involves little additional work and the method of construction is identical.

Begin by squaring off both ends of the blank, a job that can done either in lathe using a 4-jaw chuck or on the milling machine. Then, scribe a line centrally along the length of the strip and another centrally along one edge. At 1/4in. either side of the long centre line, drill holes 7BA tapping size approximately 31/64in. deep plus the width of the saw blade to be used to cut off the top section. Then, open out to clearance size 1/4in. deep plus the saw blade width and tap the bottom part of the holes.

Mount the job in the milling vice, making sure it is perpendicular, and fit a suitable slitting saw to the mandrel. Using a depth gauge, or similar to measure the distance, position the saw so that the top of the tooth set is exactly 1/4in. below the edge and then slice off the top part. Screw the two pieces back together ready for the next operation. Mark out the big and little end bearing positions at 3in. centres. Drill and ream a 5/16in. dia. hole to accept the big end bearing (or drill and ream 1/4in. dia. if you are working to the original design).

The hole can be machined either in the drilling machine or by mounting the part on the lathe faceplate — probably the better plan. I used my 4-jaw chuck but this involved reversing one jaw to get the work to fit which meant using spacers to get it really square. If you use your drilling machine check that its spindle is set exactly at 90deg. to the table surface. Inexpensive drilling machines are not always beyond reproach in this respect. Again using your faceplate, drill and ream the 3/16in. dia. hole for the small end bearing, or 1/4in. dia. if working to the original drawings and if fitting a bearing.

The next job is to shape the rod; the taper on the sides can be set up with a protractor or combination square as shown in the accompanying photograph. We are now just left with the circular top which can conveniently be filed to shape or, if available, a rotary table can be used and the rounded end finished by milling.

● *To be continued.*

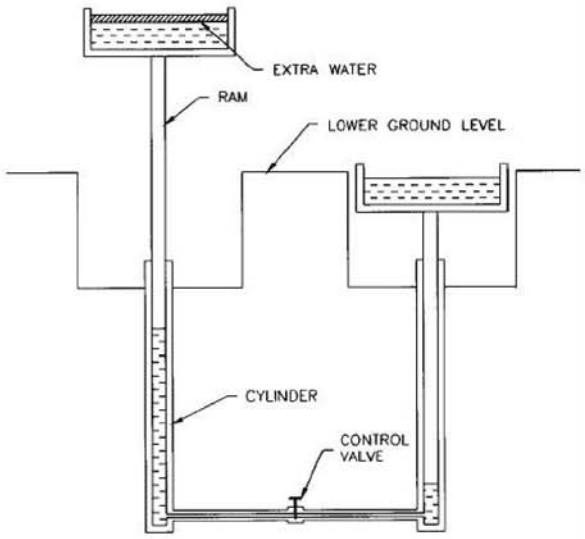
The bottom lift at La Louviere showing the three main parts: the upper and lower gate gantries and the central guide structure for the troughs.

EUROPEAN CANALS, SHIPLIFTS AND LOCKS

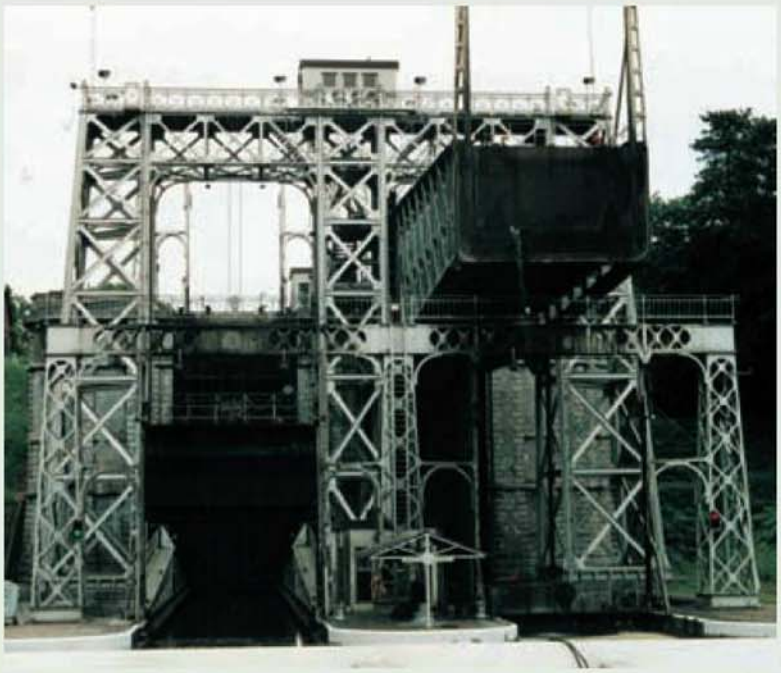
John Olsen
begins an illustrated tour in which he explores some magnificent Continental waterways structures.
●*Part I.*

European canals have developed quite differently to those of Britain. There is good reason for this since no part of Britain is particularly far from the sea while in Europe large distances must be covered, often over difficult terrain. Europe also has a number of large navigable rivers including the Rhine, Danube, Rhone and others. Being navigable by large vessels these may have encouraged the European nations to continue with larger barges. In Britain, after starting with a larger size, the familiar narrowboat standard was adopted. As a result, when railways came along the canals found it difficult to compete.

In Europe, the larger barges have been able to compete very successfully with both road and rail transport. Naturally, the particular niche in which they compete most successfully is long distance transport of bulk materials such as oil, cement and coal, but container barges are also to be seen. The largest barges, such as those seen on the Rhine, typically have a displacement of around 3000 tonnes. The most important waterways have been rebuilt to accommodate such vessels.



Sketch showing the important features of a hydraulic lift. The extra water in the upper trough provides the force necessary to raise the lower. When the gates are opened, the extra water flows away, and the trough now at the top receives extra water from the summit level.



An approaching boat's view of one of the shiplifts at La Louviere. This is the second from the top.

These lifts would be a challenging subject for a model. This is the central guide structure.

The top lift near Cantine des Italiens, showing the hydraulic ram.

Not all waterways have been rebuilt and so European canals have two faces. One is epitomised by the large modern canal or navigable river carrying a heavy traffic of large barges. The other is more like the British canal scene with a quiet canal used almost exclusively by pleasure craft wending their way through pleasant countryside. However, the maximum size of boats accommodated is likely to be large, at 300 tonnes, and the lock gates and mechanism are more likely to be of 19th or 20th century design rather than 18th.

Europe is by no means completely flat, and as a result the engineers have had to build some spectacular works to accommodate to the landscape. In these articles we will examine some of the more interesting works. It will be seen indeed that the European canals are still very much a living entity, since some of these works are still under construction.

La Louviere

Many British readers will be aware that the first major shiplift was built at Anderton in 1875. This was initially hydraulically operated, but the cylinders soon succumbed to corrosion due the presence of the salt that was mined nearby. As a result, the Anderton lift was soon converted to operate with counterbalance weights suspended from wire ropes. However, before this happened, the Anderton lift provided the inspiration for a spectacular series of shiplifts on the Canal du Centre in Belgium. It is pleasing to note that after many years of inaction, the Anderton lift has been the subject of a major restoration project including a return to hydraulic operation, and should soon be back in service.

The Canal du Centre links the Brussels area to the industrial region around Charleroi and Mons. In doing so it must pass over an area of high land. Initially the ascent and descent were carried out by means of locks. During the late 19th and early 20th centuries, the bulk of the locks on the descent in the area of La Louviere were replaced by a remarkable sequence of four shiplifts. These were built on the same principle as the Anderton lift, and since the water was free from salt, remain operational to this day in the hydraulic form. The first was built after 1888. I believe this was probably the upper lift, since the brickwork here is quite different to the stonework found on the remaining three, which were built between 1908 and 1917.

Since we will be dealing with a number of types of shiplifts in this series, it would be as well

Detail of the ironwork - there are plenty of rivets to count here!

to establish the basic principles here before going on. A shiplift consists of a large trough of sufficient width, length, and depth to accommodate the largest vessels using the canal. Each end is provided with gates of the vertical lift type. The end of the canal must also be provided with gates in the same way, so that when the trough is in position the pair of gates may be raised, allowing barges to enter and leave. This implies of course that the trough can be sealed to the canal in some reasonably watertight way at either the top or bottom position. The barge having entered, the gates are closed. The trough, water, barge, and all are then bodily lifted or lowered to the other level. The majority of the shiplifts we will explore use a vertical lift, but two instead move the trough up an inclined railway.

An important advantage of the shiplift is that the barge is not subject to the strains of being removed from the water, as it would be if only the barge was raised. A secondary advantage is that since a floating body always displaces its own weight of water, the trough will always weigh the same. It is generally simpler to raise and lower large weights if they can be counterbalanced, and having the weight remain the same eases this. This assumes that the trough is always filled to the same level, but it is usually necessary to maintain water levels on canals within close limits anyway. As we proceed, we will find that there are different approaches to the counterbalancing problem. Finally, the major advantage of the shiplift over the more usual lock is reduction in the water used for each movement through the system, and coupled with this a reduction in the time taken to pass through the lock.

A hydraulic shiplift does not simply poise the trough on the end of a giant hydraulic cylinder and then pump in or release water to raise and lower it. While an arrangement like this serves many garages well for hoisting cars, it probably would not scale well to the size required to lift a total mass of around a thousand tonnes through 16 metres. Instead, the lifts are built in pairs side by side. Each trough stands on a large hydraulic cylinder. The water space in the two cylinders is linked through a control valve. The two troughs, water, and barges if present thus balance each other. To provide the force necessary to move the troughs it is a simple matter to arrange affairs such that the top trough is filled to a higher level than the lower trough. An extra 100mm provides a weight of 75 tonnes, or a force of 750,000 Newtons.

Thus, once the gates are closed, it is a only necessary to open the connecting valve and allow water to flow from the cylinder of the descending trough to the cylinder of the ascending trough. An ascent or descent is only a matter of minutes, and compares very favourably to the time that would have been required to ascend the flights of locks that the shiplifts replaced.

Naturally, in practice it is not quite so simple. Hydraulic seals can leak, and with the best care, the levels in the canals can vary. While waiting for a barge to go through on one occasion, it was observed that a sluice was being used to lower the water level in a short section between the middle pair of lifts. Presumably this was to ensure the correct weight of water in the upper trough. Provision is also made for pumping water into the hydraulic system to make up for leakage. This is achieved by means of a pelton wheel driving a hydraulic pump. Water for driving the pelton wheels is taken from the canal. The upper and lower lifts are widely separated and so each has its own building to accommodate this equipment. The two middle lifts are closer, being less than a kilometre apart, and so they share a common building with two sets of plant.

A view underneath the trough at the top lift, showing that the seals between the trough and the canal do leak a little.

The Pelton wheel and hydraulic pump used to make up for any leakagein the hydraulic system.

The four shiplifts of La Louviere are a UNESCO world heritage site and are well worth a visit for enthusiasts of Victorian and Edwardian era Engineering. This is particularly so since there are two other modern shiplifts in the area (to be covered later in this series). This makes an interesting possibility for a long weekend visit from the United Kingdom. A commercial tour makes it possible to experience the two middle lifts without the necessity of providing your own boat. The lifts move with impressive smoothness and silence, the loudest noise being the dripping of water from various imperfect seals.

Vital statistics

The lift of all four lifts is around 17 metres, with the total for the four being 70 metres. Barges of up to 300 tonnes are accommodated. As mentioned, the total weight of the trough and contents is about 1000 tonnes. I did not time the ascent but would estimate the total time from entry to exit to be of the order of five minutes or so. Most of this time is spent entering and exiting and closing or opening gates. It will be appreciated that a pair of lifts interconnected in this way ensures that there is always a trough ready for an arriving barge, and a pair of barges can pass in opposite directions simultaneously. On the other hand, in the event of any serious problems it is quite probable that no traffic would be able to pass in either direction. This means that for the canal management an arrangement that permitted both lifts to work independently could be attractive. The Anderton lift as rebuilt in 1906 did provide for the two troughs to move independently, since each was very like a standard building elevator on a grand scale.

A normal lock to raise or lower similar barges through the same height would require of the order of 12 to 13 thousand tonnes of water for each motion. Since the lift only requires 75 tonnes to accomplish the same end, it can be seen that a considerable economy is achieved. In fact, the lifts replaced flights of locks. A flight of locks will use less water than a single high lock, at the expense of a considerable increase in the time taken. Thus, shiplifts are attractive from several points of view. They save water and they save time. The time saved is important to the individual barge, but may also contribute to an increase in capacity for the whole canal, if there are no other bottlenecks elsewhere. For modern canals the saving in water is not as important as it used to be, since it is more feasible now to use high capacity pumps to return water to the upper level if necessary. The saving in time is likely to be of more importance than ever.

The design of each of the lifts is similar but there are detail differences. In particular, the upper lift provides a means for an access road to cross the canal. This is accommodated by a step in the brickwork at the high side of the lift about halfway up. The canal crosses the roadway by means of a pair of short aqueducts. The remaining lifts have stonework facings, and the lower lift also provides for a road, in this case by a tunnel through the stonework just upstream of the lift.

A manually operated opening bridge between the shiplifts in La Louviere.

A feature of the canal between the upper and the upper middle lifts is a movable road bridge. This is cranked out of the way by hand by an operator. While the bridge is opened he is stranded in the middle of the canal.

Getting there

La Louviere can be found near the A7 between Mons and Charleroi. Take exit 21 and proceed to the south. At the time of my visits the intersection under the aqueduct for the new canal was in a rather confused state and will almost certainly have changed by now. You need to pass under the aqueduct and proceed to the left towards La Louviere rather than to the right onto a bypass. After a short climb the street descends and a steel arched canal bridge will be seen near the bottom. Turn left onto Rue Tout y Faut before the bridge and proceed along the road parallel to the canal to the Cantine des Italiens on the right. If you pass the shiplift or come to the steelworks you have passed Cantine des Italiens. This restaurant is a base for a combined water/land excursion that takes you to the two middle lifts along the towpath by means of a rubber wheeled train. The equipment room is visited, then the excursion returns by boat using the two middle shiplifts. Some tours may proceed in the opposite direction.

The upper lift is within walking distance from the Cantine des Italiens. Car parking, picnic area and toilet facilities are provided, as is a restaurant. Credit cards are not accepted for the tour (usual disclaimer applies). The open season is from May to October. At the ends of this season, tours are only available on weekends or public holidays while in the summer season from mid June to September they are open every day. It is suggested that you contact them in advance to check availability and times. Since all the lifts are freely accessible you can see them perfectly well without having to pay for a tour, if you so desire. Incidentally the Cantine des Italiens takes its name from the fact that Italian prisoners of war were confined here after the Second World War.

The four lifts are widely separated, making for a long walk if you try to visit them all on foot. Those wishing to visit all four by car would be well advised to obtain a local map. For a visit to just the top lift you could park near the restaurant and walk to the shiplift. If you choose to take the excursion you will see and travel on the two middle lifts, and the Cantine des Italiens is very close to the top lift. Having covered three, a visit to the lower lift may conveniently be combined with a visit to the new shiplift at Strepy-Thieu, to be dealt with in our next article.

Another attraction in the vicinity that I did not visit myself is a 19th century colliery museum at Bois du luc. The pithead gear for this is visible from the middle lifts. From the limited information that I have available, it appears that it may be of some interest to model engineers.

Contact details

Cantine des Italiens, Rue Tout-y-Faut 90, 7110 Houdeng-Goegnies, Belgium. For excursions tel: ++32-64-847831; fax ++32-64-281101. For accommodation and reception tel: ++32-64-284337; fax ++32-64-281101.

Return excursion to two shiplifts and equipment room takes approximately 3 hours. The cost per adult was 9.92 Euros in 2001.

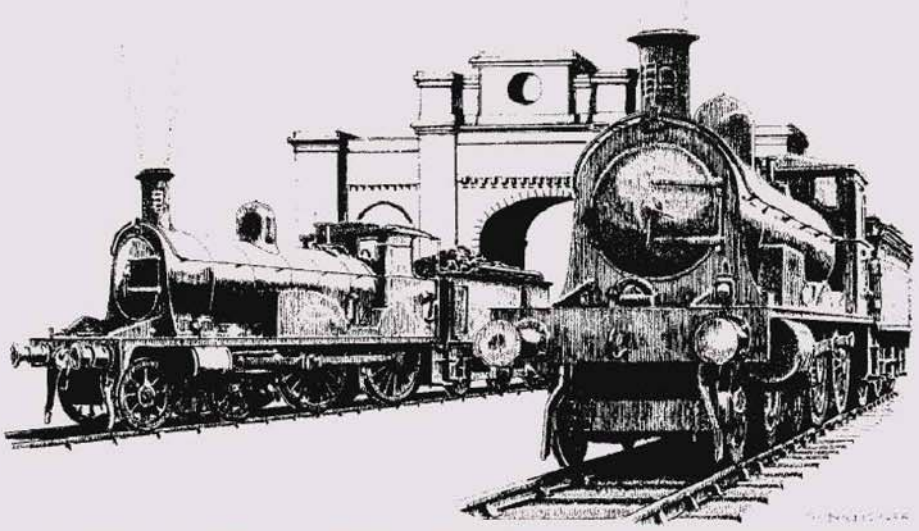
Ecomusee Regional du Centre Site Minier du Bois du Luc, Rue St Patrice, 2b, 7110 Houdeng-Aimeries (La Louviere), tel: ++32-64-282000; fax: ++32-64-212641.

●*To be continued.*

Neville Evans

discusses the construction of the cab for the 'Loch' and, prompted by a reader's letter, presents some accounts of travel with the Great Western Railway.

●*Part XXIII continued from page 28 (M.E. 4186, 10 January 2003)*



THE HIGHLAND RAILWAY JONES 'BIG GOODS' & LOCH 4-4-0

LOCOMOTIVES IN 5in. GAUGE

Little remains to be said about the 'Loch' cab, except to stress the point that although it seems very similar to that of the 'Big Goods', it is in fact different in many small dimensions, as well as the obvious differences in the splasher arrangements. The 'Loch' splashers are flush with the outside of the cab. This results in some rather tricky fitting work in this area, so be prepared to do a spot of assembly in LBSC's proverbial 'stout card', using the resulting parts as patterns to cut out the side sheets. The inside of the splasher is underneath the seat and so is not visible. I shall detail said splasher and then leave it to the whim of the individual builder whether or not to incorporate it. The seats of both locos will be detailed in the 'blobs and gadgets' section.

Penrhos Grange

The next sheet for this loco contains the drawings for the frame stretchers. Most of these sections can be built up from steel angle and plate and are quite straightforward. This doesn't mean that the greatest care shouldn't be taken in their manufacture however, as the frames and stretchers are the basis of the whole locomotive. Any errors here, even small ones, will throw out the whole of the line-up of the engine, so take great pains to ensure that the stretchers are completely parallel in the sides and that the angles themselves, that is the bits that actually bolt onto the frame sides, are really parallel to one another. Don't forget that if you are one degree out on one side, then the cumulative error is two degrees, which is far too much. I'm sorry if I seem to labour this point, but it really is of major importance.

Another potential source of disaster is that of building in a slight lozenge into the frames, so that one side is a little further forward than the other. This potential problem is the chief reason why I specify a large, rectangular block of brass to use as a drag box. If this piece is carefully machined and screwed accurately to one side of the frames, the other side can be put into place with great precision.

I have taken to using 'instant glue' when pre-assembling, prior to spotting through holes and suchlike. The great advantage that this method possesses, over cramping, is that large cramps are rather heavy items, as well as being bulky and awkward. There is also the risk of distorting the frames due to even slight over-tightening. I find that constant use of engineer's squares of appropriate size, especially across the sides of the hornblocks, is the best method of ensuring precision. The final check is to assemble the wheel sets and to make sure that the wheels themselves are completely parallel to the frame sides. If they are, then congratulations are in order. If not, then fix it.

Readers letters

I was pleased to receive a copy of John Hurley's letter the other day. It's always a pleasure to see the reminiscences of someone who was actually there, on the job, so to speak. All I can say is that I look forward with the greatest of interest, to further contributions from John. A thought that exercises my mind somewhat however, is that all these people who have written about the Great Western 4-6-0s seem to have a different tale to tell, as well as different explanations for the various phenomena associated with these fine engines. Simon Bowditch has done a great deal of research in the last few days and has come up with the following.

From *Portraits of Western 4-6-0s*
by Kenneth H. Leach

"Altogether I had 77 trips on Granges, on some of which I drove part of the way and fired the rest, so that I drove thirty-seven times and fired fifty times, riding altogether on forty-two out of the eighty engines of the class. My experiences ranged from some of the roughest engines I have ever ridden on to some of the sweetest. Altogether, I gained quite a fair knowledge of the class, though none of my trips was of long duration.

"My first ride, on No. 6832 Brockton Grange, *was impeccable. It was on a down express from Chippenham to Bath, and No. 6832 ran freely, without any knocks or rough riding, and steamed well to the regular fireman's firing. I was only a looker-on on this early trip of mine, but it gave me a most favourable impression of the class. Our maximum speed was about 70mph.*

"Things were very different on one of my later trips, this time from Bath to Chippenham on an up express. I had expected to see a Castle or perhaps one of the 'Warships' diesels, but instead the train drew in with an inexpressibly filthy No. 6876 Kingsland Grange *at its head, and a woebegone Percy Palmer (not Cyril Palmer, whose photograph appeared in* Portraits of Kings*) at the regulator.*

His engine on the down train had failed and he had had to take No. 6876 for the return trip; she proved to be a shockingly rough engine, though she steamed all right to my firing. But Percy, who always sat in preference to standing, was most miserable and I guessed he was intending to lose time on the journey as a reprisal for being given such a rundown engine at Bristol!

"Whatever the reason, our maximum speed between Bath and Chippenham was only 58mph instead of the usual 65 to 70; and because the seats on Great Western engines were plain hardwood — not padded as on LNER A4s — one's spine felt every jar of a roughriding engine.

"My most exciting trip was on an even rougher engine, No. 6859 Yiewsley Grange, *which had for some time been restricted to goods work, as being unfit for passenger work. Nevertheless, she arrived at Chippenham one evening on a down express (normally a Castle working) with a Bristol spare-link driver. He obviously wasn't frightened by a rough engine, for he ran into Chippenham, the first stop from Paddington, several minutes early, having taken only 91 minutes for the 94 miles, start to stop. The load was, I think, not less than ten bogie coaches.*

"I was invited up, and grabbed the shovel as soon as we got the 'Right Away'. I could see from the way the driver got away that I was going to have a busy time, and it was soon clear from the very rough way the engine rode that I should do well to heap on to the fire all the coal we should need to the Bath stop, before we entered Box tunnel. This was important, for if the driver continued his style of driving on the 1 in 100 downhill through the tunnel, I doubted whether I should be able to stand up on the footplate to fire. And soon it was clear that he was!

"At the entrance to the tunnel the knock on the worn big-ends of the connecting rods reverberated 'bang-a-bang-a-bang' quickly enough, but as we accelerated this changed to a rapid 'bang-bang-bang', much faster than one could articulate it.

"I checked the speed after leaving the tunnel and it was, according to my note 85mph — this on ▶

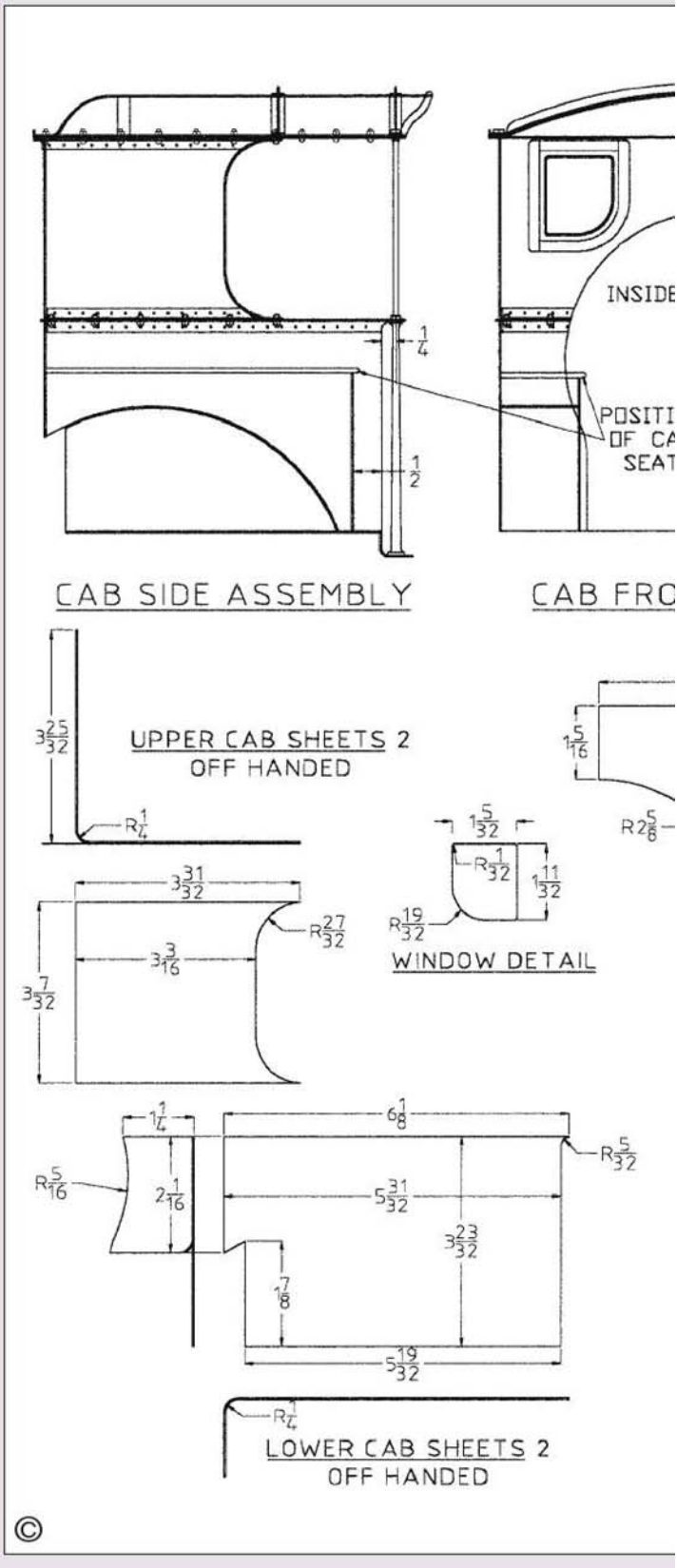
a rough engine at 10mph over the speed restriction round the curve at Box. I did a further check on speed a mile further on and we were still doing 84mph; on the level, too! so never let it be said that Granges weren't free running locomotives."

From *Cleaner to Controller Volume 2*
by W. J. Gardner
"Oscillation problem with '10XX'
'County' Class 4-6-0

"Throughout my career I have always been prepared to experiment in order to improve on existing practices. One of the observations that I made during this period was that the new tenders that came attached to the recently introduced '10XX' 'County' class 4-6-0 always appeared to be too closely coupled to the leading coach of the train. The evidence for this lay in the fact that the buffer springs were being over compressed but various enquiries assured me that they were the same standard Great Western design that we had always used. I remained unconvinced because when coupling up to a train with a standard Collett-designed 4,000 gallon tender it was standard practice to leave four threads of the screwed portion showing between the knuckles of the coupling. If this standard was applied when coupling up a '10XX' class it appeared much too short as the engine had to ram hard up against the train in order to lift the coupling over the hook of the coach. I expressed my thoughts to Fred Mogg and he agreed to have a look after I had coupled up. I cleaned and oiled our tender coupling until it worked really smoothly and Fred backed the engine up to the train so that the buffers just touched. He then blew up a vacuum so that the brakes were off on both the engine and the tender. This meant that when I had hooked the coupling over the coach I could tighten the adjusting screw as far as I was able to and see how much I had compressed the buffers. Fred came back and observed this because he wanted to assure himself that the train was securely attached to the tender. When I had coupled up the vacuum pipes it was possible to see that there were six threads showing between the knuckles of the coupling. From that time on I always made sure that there were six threads showing when coupling up a '10XX' class to a train.

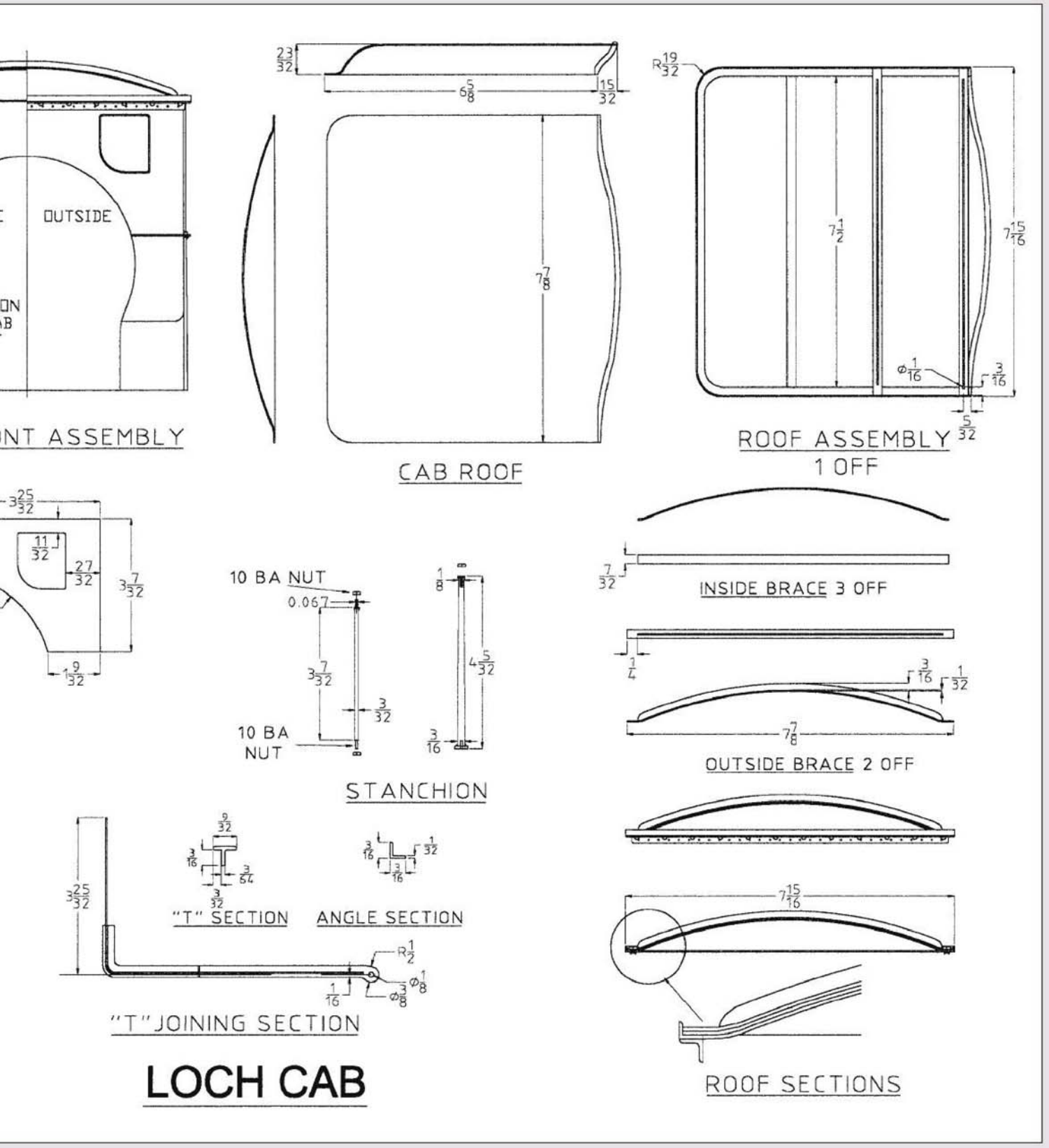
"Having arrived at Plymouth one day in 1947 with the down 'North Mail' we were waiting for our return working with the 11.05 am Penzance to Paddington service which was due to depart at 1.55pm. Our locomotive this day was '10XX' class No. 1017 County of Hereford *and it was all prepared ready for us to take off shed. But I made a point of going around the back of the tender to clean and oil the tender coupling before we left Laira to run back down to North Road. By 1.30pm we were in position and waiting the arrival of our train and at 1.48pm it ran in behind a '68XX' 'Grange' class 4-6-0. As soon as it had cut off and gone to shed, our ground disc signal was lowered and we set back onto our eight-coach train. I got down and coupled up leaving six threads showing between the knuckles of the coupling and when I climbed up onto the platform I found myself staring into the face of running inspector Button of Newton Abbot. He had observed me coupling up and wanted to discuss what I had done. Fred now joined the inspector and myself on the platform and we explained our practice to him. He told us that there had been many complaints of rough riding and of fore-and-aft oscillation in trains that had been hauled by '10XX' class engines. He doubted if our small adjustment of the tension in the coupling would make any difference but he said that he would be riding in the second coach of the train to see if he would experience any irregular movement worth reporting. He instructed Fred to pay no attention to his presence in the train and to drive just as he would do normally.*

"Having been given the 'Right away' from the guard we pulled out of North Road with the full 280lb. of boiler pressure showing on the gauge. After one or two revolutions of the driving wheels Fred closed the cylinder cocks and before we got to Mutley tunnel the exhaust from our chimney was lovely and clear with not a hint of damp steam showing. We drifted down the gradient past Mannamead signal box and on to Lipson Vale and Laira. I had the blower turned on slightly while we were drifting under light steam in order to keep the firebox as hot as possible but as soon as we passed through Tavistock Junction I turned it off because the exhaust sharpened on the approach to Plympton and became a beautifully crisp staccato bark as we got stuck into Hemerdon Bank. The high working pressure of these engines coupled with the original single chimney resulted in a remarkable exhaust sound. I continued to shovel coal into the white hot firebox and the effect was magic. Even with the exhaust injector full on since passing Laira the safety valves erupted after we had climbed only the first few chains of the 1 in 41 gradient and the roar of steam escaping at 280lb. coupled with the sheer volume of the exhaust created a crescendo of noise that will never be heard again. Fred set the reversing gear in 35 per cent cut-off and with the regulator wide open we stormed up Hemerdon in fine style. Even though the safety valves closed before we reached the summit of the climb, the pressure never dropped below 270lb. The rest of the run to Newton Abbot was uneventful and when we had stopped at the platform Mr Button came forward and complimented Fred on the run. He also said that my theory on the adjustment of the coupling screw might be the answer to the problem because he had felt no fore and aft oscillation, or any form of rough riding, during the run up from Plymouth."



The following is a brief excerpt from
On Engines in Britain and France
by P. Ransome Wallace
Chapter 5: *Plymouth to Penzance*

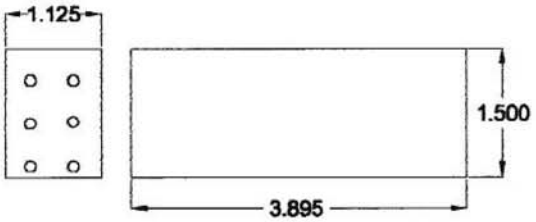
"Talking to the men about the merits of various engines on this road, I was left in no doubt that the '68XX' class, the 'Granges', were the best engines they had ever had for the job, and they



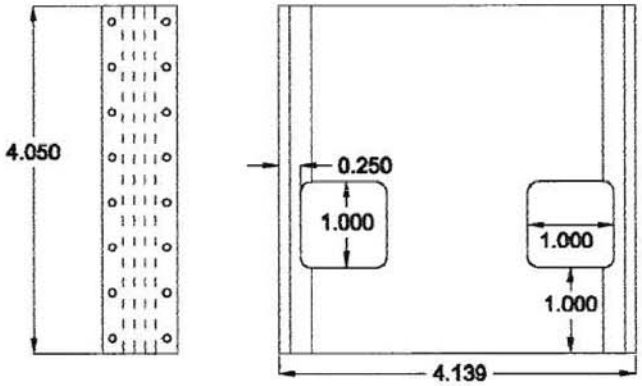
greatly preferred them to the 'Counties'. As with all of the long stroke Great Western 2-cylinder engines, it is not wise to use a shorter cut-off than twenty per cent, and on 6801, twenty-five per-cent was the highest notch she would accept without noticeable oscillation."

To sum up, most people confirm the fact that GWR 2 cylinder 4-6-0s tend to run rough at under 25% cut-off. Is this due to over-high compression with low clearance volumes, or could it be due to water droplets being compressed in the cylinders? Given the length of the stroke and the low superheat on these locos, the steam could be getting quite wet at the end of the expansion phase. Water droplets could be trapped during the compression phase of the cycle. The cylinder relief valves were sometimes used as an indicator as to when to lengthen the cut-off, and as it happened, these locos seemed to run just as economically with comparatively early cut-off and reduced throttle openings. It would appear that the GWR 4-6-0s which were conceived over 100 years ago suffered from a few basic faults, in that they were given too much compression and not enough superheat, in fact as built they had no superheat at all. Some men complained of the rough riding of the Saints, criticising unacceptably high levels of vibration and poor balancing, others, Deryck Goodall's father-in-law for example, loved them; they were his favourite engines. What is the answer? I don't know. Probably maintenance at its best kept the problems in check. All rough locos rode roughly.

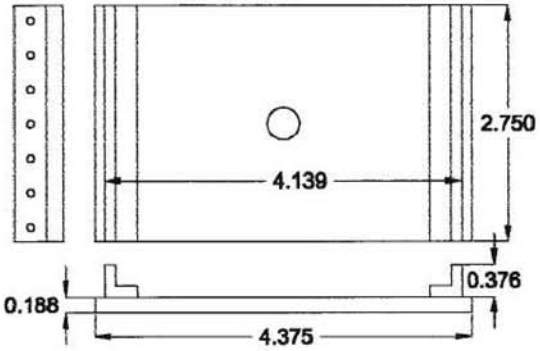
●*To be continued* ▶



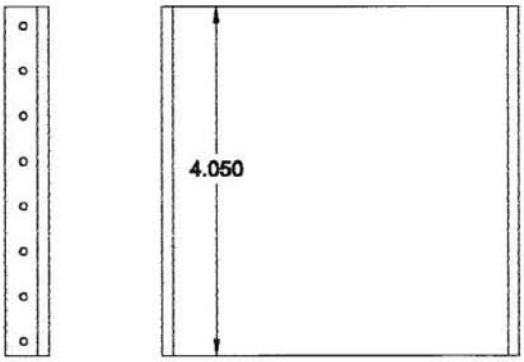
A) BUFFER BEAM STRETCHER
BRASS BAR

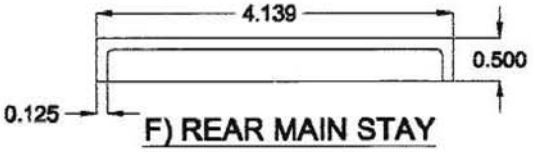


E) FRONT MAIN STAY

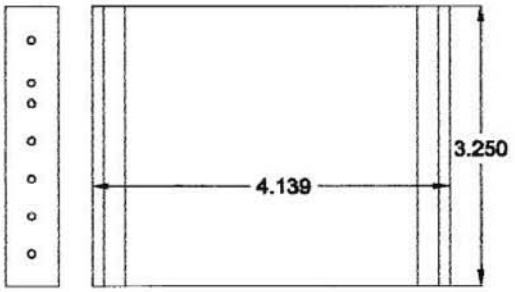


BOGIE STAY

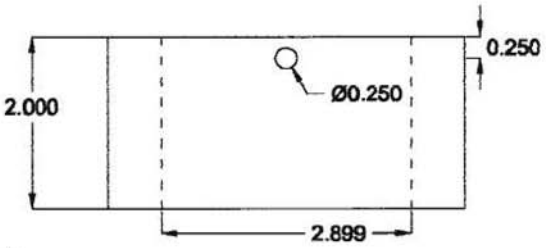


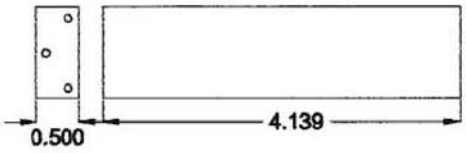


F) REAR MAIN STAY

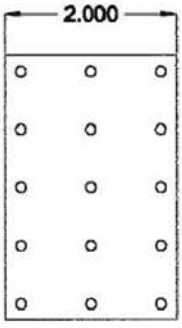


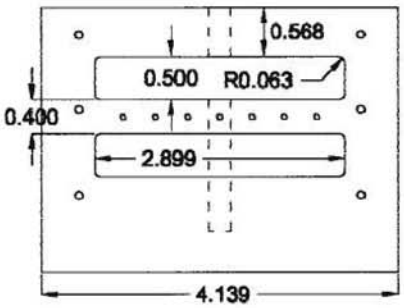
C) HORIZONTAL STRETCHER

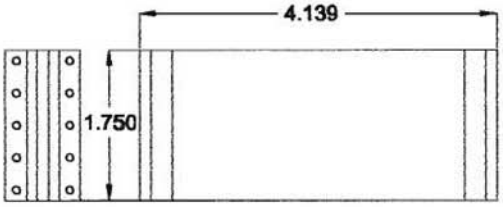




D) LOWER STRETCHER BRASS BAR







G) REAR LOWER STRETCHER

H) DRAG BOX BRASS BAR

ALL IN B.M.S. OR CASTINGS UNLESS OTHERWISE STATED
MARK OUT HOLE POSITIONS AND SIZE FROM FINISHED FRAMES

6868 *PENRHOS GRANGE* STAYS AND STRETCHERS

The Author's Metro *to which he has fitted a gas firing system which is only evident on close inspection.*

GAS FIRING FOR MINIATURE LOCOMOTIVES

C. H. Jones BSc Hons MIEE
of Worcester and District Model Engineering Society

describes his experiments and successes with LPG as an alternative and clean source of thermal energy.

In this article I have attempted to highlight the use of alternative fuels in the firing of live steam model railway engines. Of these, theoretical and practical attention is given to the use of bottled Propane gas and its advantage over liquid fuel in this application. Details are also given of the construction of a suitable gas burner that can be adapted to fit most 3½ and 5in. gauge model configurations. Special consideration is also given to the ergonomic and safety aspects of using this fuel.

The coal fired engine

As a relatively new recruit to the ranks of model engineers, I have been very impressed with the abilities of some of the local club stalwarts with their green, if oily, fingers. With only a periodic helping of coal and water, and effortless ease, they fire up their engines and carry an impressive public load throughout club open days. This seems to be down to the quality of workmanship and years of experience.

Being rather short on both these attributes, my own results have had shortcomings. On only a few memorable occasions have I been able to complete a non-stop traverse of the club track without my creation requiring to stop to 'get its breath back' at least once. This is mainly due to my not being able to maintain a satisfactory fire when on the move. Admittedly the firebox is small and the gauge 3½in., but then others have managed it.

Much of the romance and nostalgia of the vintage railway engine is the smell of smoke, the clouds of steam, and the soot. This is very attractive to the onlooker and the dyed-in-the-wool steam enthusiast. At the end of a steaming session, when the owner is faced with his 'pride and joy' coated in abrasive oily soot, a smokebox and firebox full of ash, plus a suspicion that the boiler tubes are blocked with soot, my own heretic reaction is to wish for another fuel that would ease some of these chores.

Alternative fuels

The two obvious fuels to consider are paraffin and bottled gas. Both, I am sure, have been successfully used by other workers in the model field. Unfortunately the results of their endeavours seem neither to have been widely used nor publicised. At the risk of 're-inventing the wheel' I decided for my own satisfaction, and in the spirit of the hobby, to investigate their possibilities.

Oil firing of full-size railway boilers has been a practical proposition back into the 19th century, requiring steam or compressed air to vaporise the fuel. In his book *Model Steam Locomotives* Henry Greenly gave burner designs for large scale models, but these do not seem easily adapted to club size models. Alternatively, in his *Live Steam Book* LBSC gave details based on a design by Carson. This required the paraffin to be pressurised by means of a hand pump, then pre-heated before being discharged through a jet as vapour, where it was ignited. As with a blow lamp, once lit it was self sustaining as long as the fuel pressure was maintained.

The construction of a Carson burner that would fit my 'hack' engine proved quite satisfactory, but lighting it *in situ* was very difficult. LBSC implied that he lit his burner in isolation and then offered it up to the fire box — not easy when adapting a coal fired boiler, but it can be done. The one hazard that made me set the burner to one side for further consideration was the prospect of what would happen if it extinguished when on the move. The thought of large quantities of liquid fuel at just below flash point, spraying onto the motion and track bed, would be a Safety Officer's nightmare.

The principle of gas firing

The second option is the gas fired boiler. Again Greenly made a passing reference to the practical possibilities. His major point was that, there being no fire bed and hence little radiated heat transfer, most of the heat is transferred to the water by conduction from the heated gas products. These are mainly air passing through the boiler tubes. To prevent possible blow-back, it is essential that the correct air movement is initially established by means of an auxiliary blower before the gas is turned on.

Bottled Butane and Propane fuels with similar calorific values are both available in pressurised liquid form. The second is preferred for brazing due to its much lower boiling temperature on release.

A view of the straight gas burner with protective shroud as fitted by the Author to his Rob Roy

This allows latent heat of evaporation to be obtained from the surrounding air. The ensuing gas is hence at ambient temperature with the full bottle pressure available.

Limitations of the standard gas burner

My experience in the use of gas burners extends to the silver-soldering of several model boilers from the virgin copper sheet. This gave me a good insight into what they would and would not do. First, there is a large difference in heating a mass of copper to red heat for brazing over a short period of time, and heating a copper container of water to boiling for an extended period. Also, the flame from a standard brazing burner becomes unstable and extinguishes when in a confined space. This I found, often to my cost, when trying to braze inside a firebox.

Experiments with my range of Sievert standard burners indicated that this was the nature of the type. The constriction upsets the flame front, that is, the distance between the gas exit jet and the point where the gas/air mixture is correct for combustion. Part of this air was drawn in through the small radial holes around the jet, while the balance was drawn in by the burning gas mixture as it exited the main burner orifice. This caused the long blue roaring flame typical of this type of burner. Such a flame is very suitable for heating small areas to high temperatures as in brazing, but not for a large area such as a water jacket.

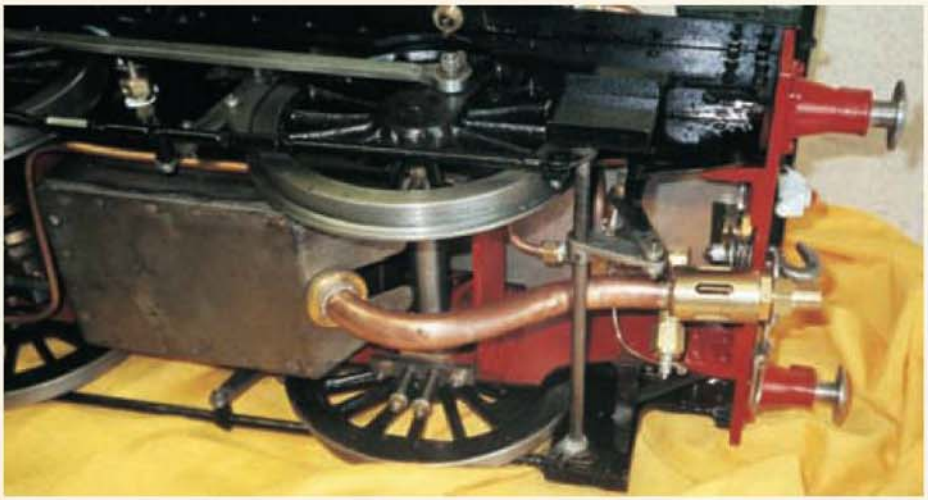
Burners suitable for steam boiler application

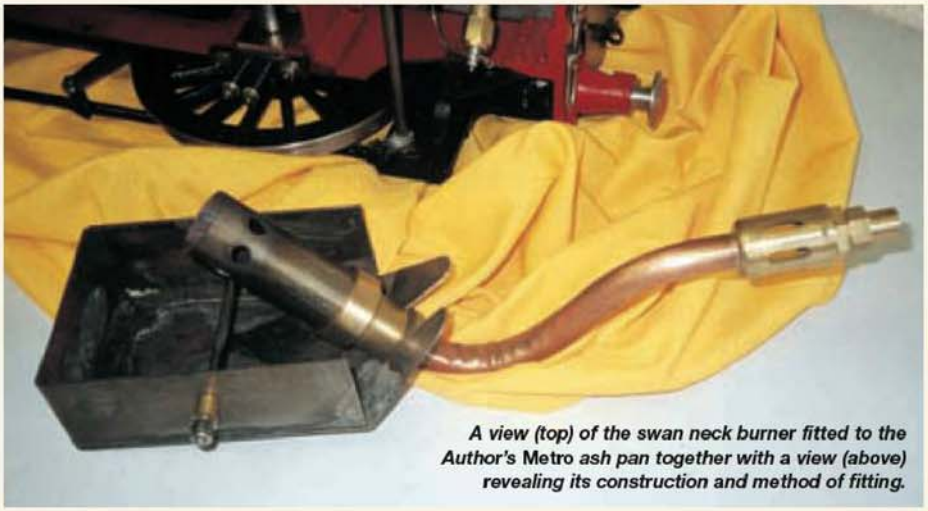
A range of Sievert burners which do not exhibit this flame front instability and give a more diffused flame are catalogued as Cyclone burners. These I have used to braze the inside of fireboxes without the problem described above. The burner is physically much longer than the standard type of the same thermal rating. The radial holes around the jet are much larger to provide all the air needed for combustion. This could theoretically allow the gas/air mixture to burn close to the jet. Under normal use, the flame front is contained within a sleeve at the output of the burner. The sleeve also contains an axial ring of large diameter tangential holes. These cause the gas/air flow to exhibit a swirling motion producing a wide diffused flame. On several occasions I have used such a burner to test fire a new boiler by holding the burner through the firehole.

Developing a suitable burning

The above results seemed to be very promising and worthy of further experiment. If this was to be based on more than 'it looks alright' and intuition, the following points had to be addressed:

1: What size of burner do I need?
2: Could I make such a burner whose gas consumption is known and is suitable for a range of boiler sizes?
3: What would be the gas consumption at various pressures?
4: Could I carry enough gas for at least an hour's activity?
5: What extra controls would I need?
6: Could I carry out only reversible modifications to the engine should I wish to revert to coal?
7: Would it be safe?





A view (top) of the swan neck burner fitted to the Author's **Metro** *ash pan together with a view (above) revealing its construction and method of fitting.*

The over-riding question to be answered was the quantity of heat required. This was to maintain a given boiler at operating pressure and provide dry steam at a constant rate. With the efficiency of a full-size engine at less than 10%, theoretical treatment of fuel consumption for a miniature replica would be highly suspect. The efficiency could be at least an order worse than its full-size counterpart. This is due to non-scale losses from glands, valves and lagging and, need I say, workmanship.

A working value can be obtained from the results of IMLEC trials documented in past copies of the *Model Engineer*. As these results are spread over a range of sizes of models and loads, they give a good average on which to base a realistic fuel consumption. The 1992 trials, for example, gave a spread over 23 models with thermal efficiencies between 0.3% and 1.9%. The coal consumption varied between 1lb./hr. for 3½in. gauge *Juliet* to 3lb./hr. for a 3½in. gauge *Atlantic*. In each case the locos were well loaded.

Taking the coal calorific value as 14,800 BTU/lb. and a consumption of say 1½lb./hr., the typical boiler rating is about 22,000 BTU/hr.

Equating this to the equivalent in Propane gas:
Calorific value of Propane:
= 2,500 BTU/cu.ft.
1lb of gas occupies:
8.6 cu. ft. at NTP,
hence 1lb. of gas produces:
8.6 x 2,500
= 21,500 BTU.

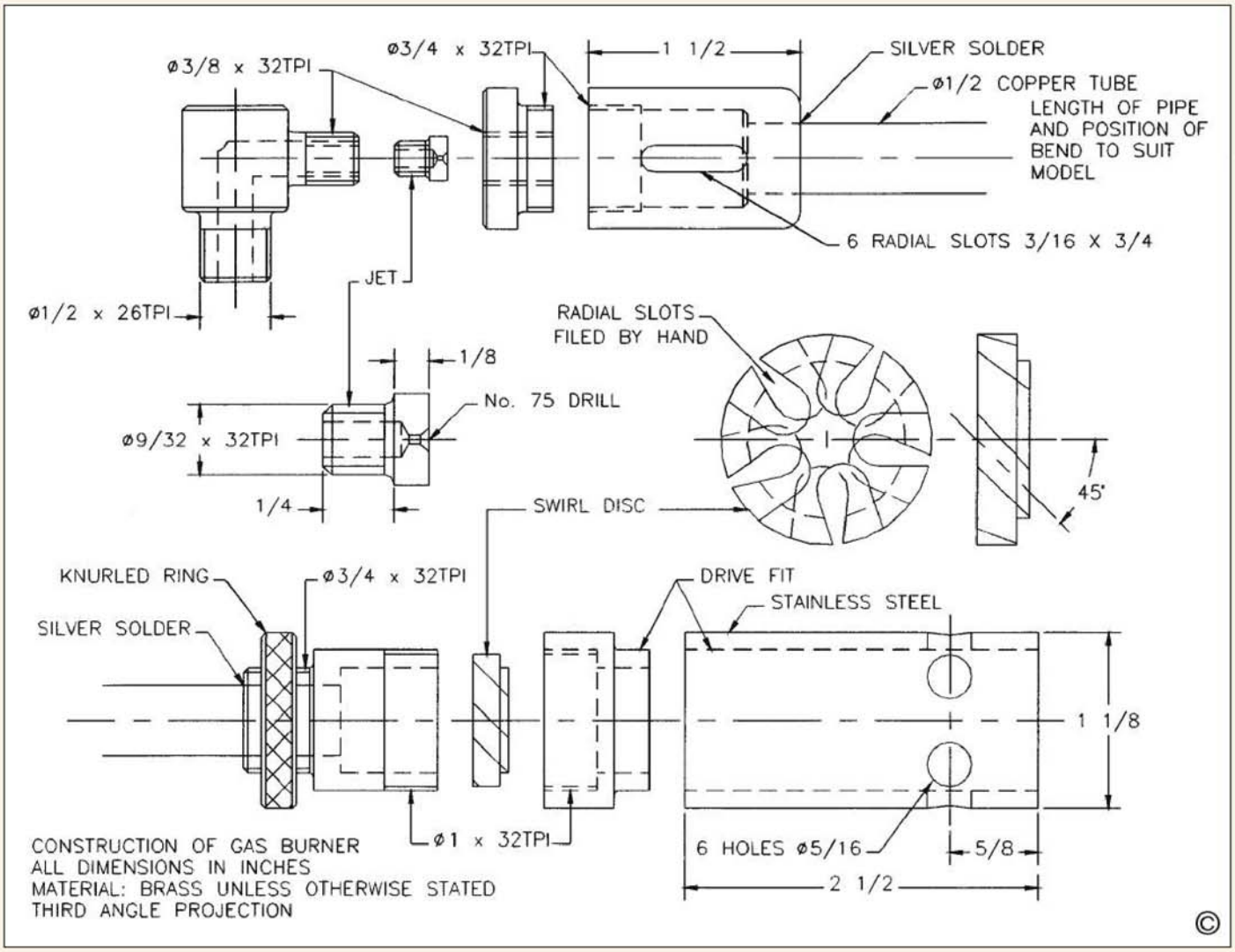
Such a boiler would require a gas consumption of approximately 1lb. per hour. A 3.9Kg gas bottle, which would fit easily on the driving truck, would be adequate for several afternoon's entertainment.

The nearest Cyclone burner to this rating in the Sievert catalogue is the Type 3525 rated at 43,000 BTU/hr. at a gas pressure of 30psi (2 bar). This unit is unfortunately too long to incorporate easily within my *Rob Roy*, either through the firehole or from beneath into the ash pan.

Discussing this limitation for my application with the technical department at Sievert, they suggested that the unit could be derated and shortened without drastically upsetting its operation. This would be subject to some experiment. Its construction was from extruded brass tubes with a stainless steel output sleeve. The jet was also easily unscrewed and removed. Unfortunately the threads used in the burner assembly, except for the jet, were non-standard. Hence a replica was made from scratch using 26 and 32tpi. threads.

This new burner was made approximately half the length of the 3525 and with a straight tube. The length reduction was made in the mixing tube between the jet mount and the cyclone diffuser. The jet size was kept standard with a 0.025in. orifice. It gave an ideal flame pattern which filled the firebox, and could not be extinguished either by draught or when enclosed within the boiler. With the engine on a test stand, it raised steam within five minutes at a gas pressure of 20psi. Also with the motion turning at track speed, it kept the safety valve at blow-off until boredom set in.

The method of mounting the burner allowed it to be easily removed if required. The firehole door was removed and the burner rested between the hole and the rear cab wall, where it was clamped. The latter had been previously cut low



to enable easy firing with coal and access to the backhead. The clamp had a concentric sleeve around the burner which allowed the latter to be withdrawn from the firehole for lighting. The grate was also removed but the ash pan retained. This was filled with heat resistant board which reflected heat back up to the boiler crown.

Unlike firing with solid fuel, no draught was required through the ash pan since all air movement came via the burner. A further modification was the fitting of a shroud around the burner within the footplate area. This protected the drivers fingers when operating the backhead controls, and restricted the heat loss through the annular gap between the burner and the firehole.

Practical measurements of burner operation

Unlike the use of solid fuel, gas firing with known jet pressures and size enabled simple experiments on the steamability of a given boiler/burner combination to be made. These can be realistic figures of how much burner heat is actually absorbed by the water to produce steam. The balance of the heat is lost by conduction from the boiler shell. Any scale lagging has little effect on this loss, being purely cosmetic due to its thinness.

The temperature rise of the heated water and boiler shell are directly proportional to the heat rate of the burner and the length of time of heating, i.e.:

$$H = (Tb - Ta) \times We \times R$$

where:

H = Total heat absorbed by water and shell.
Tb = Temperature at end of test.
Ta = Temperature at start of test.
We = Weight of boiler shell and water content.
R = Time of test.

but:

$$We = Ww + (Wc \times S)$$

where:

Ww = Weight of water.
Wc = Weight of copper shell.
S = Specific heat of copper.

hence:

$$H = (Tb - Ta) \times (Ww + Wc \times S) \times R$$

Equation (1)

Using the *Rob Roy* boiler, the safety valves and inner steam dome were removed and the shell completely filled with water. A thermometer was secured in the steam opening in the water. With the burner lit at a known gas pressure, the water temperature was recorded at five second intervals up to the boiling point. The accompanying graphs show the heating curves produced with 30 and 20psi burner pressures. The best fit heat rate slopes were 98deg. F per minute and 86deg. F per minute respectively.

Substituting in equation (1) with following parameters:

Weight of boiler shell Wc = 6.5lb.
Weight of boiler water Ww = 1.9lb.
Specific heat of copper S = 0.1

$H = (98 \times 60)\ [1.9 + \{6.5 \times 0.1\}]$
$\approx$ **15,000 BTU/hr. at 30psi.**

$H = (86 \times 60)\ [1.9 + \{6.5 \times 0.1\}]$
$\approx$ **13, 200 BTU/hr. at 20psi.**

Turning now to heat loss due to conduction. Theory shows that heat loss from a surface of area A sq.ft. and of lagging thickness Xft.:

$$= K \times (A/X) \times [Tf - Tg] \text{ BTU/hr.}$$

where (Tf - Tg) is the temperature drop across the lagging thickness and K the thermal conductivity of the lagging.

The lagged boiler area of *Rob Roy* is about 1sq.ft. and the lagging (K = 0.4) is 0.2in. thick. With the boiler operating at 80psi, steam tables show the water temperature to be 324deg. F. The low ambient temperature of, say 70deg. F around the lagged boiler causes rapid heat dispersal due to convection.

Hence heat loss:

$$= \frac{0.4 \times 1 \times \{324 - 70\}}{(0.2 / 12)}$$

= 6,000 BTU/hr.

Total heat supplied by burner at 30psi:

= 15,000 + 6,000
= **21,000 BTU/hr.**

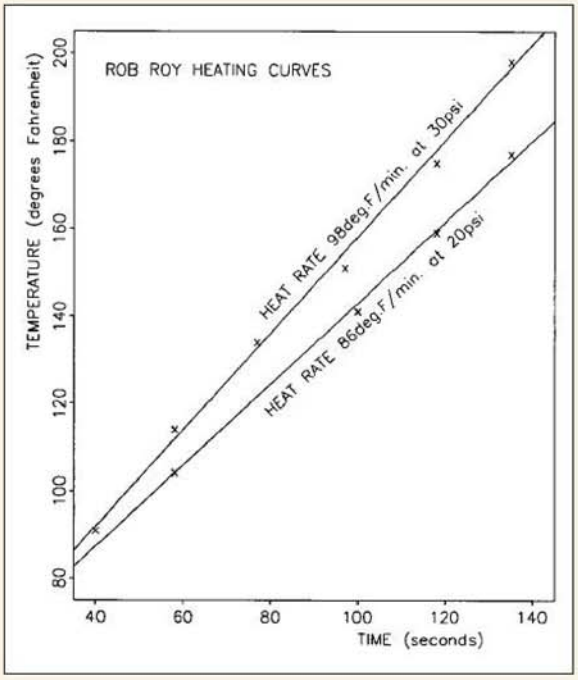
Total heat supplied by burner at 20psi:

= 13,200 + 6,000
= **19,200 BTU/hr.**

These results compare favourably with those for *Juliet* detailed earlier on solid fuel.

All of the above tests used the jet size of the Sievert 3525 burner, with an orifice of 0.025in. diameter. The classic theory for air or steam through nozzles cannot be applied to a fluid such as propane or to such a fine orifice. The best that can be done is to extrapolate from a known measurement, assuming a direct relationship between gas flow and orifice area. The gas flow ▶

Components of the Author's swan neck burner showing the jet assembly and cyclone axial ring.



through this jet quoted by Sievert is 800g./hr. or 43,000 BTU/hr. at a pressure of 30psi. This could be reduced to say 25,000 BTU/hr. with a jet diameter of:

0.025 x (25,000 / 43,000)
= **0.015 inch.**

Practical considerations and common sense would indicate that reducing the gas pressure rather than the jet size is the best way to restrict burner output, assuming the limitations of this application. It also assumes that flame stability determined by the gas:air ratio is maintained. Sievert quote for propane a wide gas:air combustion mixture range, with between 2% and 10% gas content. The latter gives considerable latitude to the burner air orifice size, even with the gas pressure range envisaged. This has resulted in a non-temperamental unit whose parameters can easily be reproduced.

Driver gas regulator

A suitable driving regulator was adapted from a stop valve removed from a discarded steel propane gas bottle. The two retainer pins under the knob were temporarily driven out and the valve stem fully unscrewed. The valve body was then mounted in the lathe and the boss which originally entered the bottle turned down to remove excess brass, and externally threaded for fixing to a mounting bracket. Its centre hole was also enlarged to take a suitable pressure gauge. Care was taken not to drill too deeply and damage the valve seat.

The collar on the original output boss was sawn off and the remaining stem turned parallel and threaded to form the new input to the valve. The new output was now taken from the original overload pre-set safety valve boss. To dismantle this, the plastic cover was prised out and the internal flange unscrewed. This, with the exposed spring and plunger, were discarded. The exposed internal thread was not very deep, so it was extended down to the seat. This gave a gas tight joint with a reducer that connected it to the output hose. The valve stem was then refitted and the two pins replaced ensuring that all swarf and dust had been removed. The modified valve now formed an in-line regulator with the pressure gauge monitoring the output pressure.

Operation and safety factors

With the pressure gauge fitted to the above gas regulator, the burner output can now be easily adjusted from the pilot flame up to the full rating. Driving experience will indicate the best position. With plenty of heat available on demand and a relatively short heating time constant, compared with solid fuel, the boiler can be 'perked up' very quickly when load demands. It can also revert to pilot when stationary.

Safety is an overriding factor, especially when the public are in close proximity; bearing in mind that a model in steam requires respect whatever fuel is used. Minor gas leaks are easily detected by smell and, as the operation should be out of doors, are soon dispersed with little risk. Gross leakage, such as from a split hose at derailment, is another matter. It is essential that a hose failure valve is fitted at the gas bottle stop valve. This will instantantly cut off the gas flow under these conditions.

The major hazard is the slow insidious leak over a prolonged time. In a confined space, such as the model engineer's workshop, it can mix with air at a much lower concentration than used in the burner and form an explosive mixture. The rule must be to check for leaks regularly and to store gas bottles out of doors.

When used to fire a locomotive, the bottle should be carried at the rear of the driver's truck. It must be mounted vertically with the stop valve at the top or it will eject liquid fuel rather than gas. When running, this valve is kept fully open. The gas regulator and pressure gauge are mounted at the front of the truck, easily accessible to the driver, with a detachable pressure hose connected to the burner. A ferrule and cone connection are recommended for this hose, though a snap-on could be used as it would be protected by the hose failure valve at the bottle. Whatever connections are used there is always a risk of undoing hoses without the gas turned off. Realistically, as with all the other dangers of our hobby, one must be careful.

On the positive side, the work load for the driver can be reduced. There seems now little need to use the steam blower provided the firehole is covered. Full attention can now be given to the water level and steam pressure gauge.

Adapting the burner to other models

To the purist, the sight of the footplate of a model dominated by a gas burner is anathematic. I must admit that it does detract from the spirit of the model, so I have given some thought to how it could be made less intrusive. With a recently completed 5in. gauge *Metro*, I was loath to soil its pristine paintwork with oily soot. I decided to design a suitable burner that would satisfy both my critics and myself. This engine was not easy to fire through the firehole with any fuel due to the restricted cab size and rear coal hopper. To overcome this, a burner was fabricated with a swan neck. It was mounted with the jet assembly under the rear buffer beam and the flame shroud within the firebox, passing through the ashpan. A modified ashpan was fitted to which the burner was clamped. This was the same size as that for solid fuel but there was no grate. Instead it was filled with heat reflecting material.

The burner was lit through the firehole and the door kept subsequently shut. With the much larger firebox, the flame was further diffused by means of a ring of holes around the lip of the burner shroud. This produced a ring of flame that impinged on the firebox walls. These holes also effectively shortened the flame front so that the lip of the shroud became red hot giving some radiant heat.

A cursory glance at the model gave little indication of its modification. Only a close inspection behind the brake gear, when on the track, showed the gas jet assembly and pipe to the boiler shroud. The latter was easily removed by dropping the modified ashpan as in the original design.

With this burner, the shroud is now at 45deg. to the boiler axis rather than inline as with *Rob Roy*. The auxiliary blower, plugged into the chimney as in normal coal firing practise, is recommended when firing up. This will eliminate blow-back and singed fingers. The resulting bang from a weak mixture on initial lighting up can be a little scary if not expected, though the only damage will be to one's pride!

I apologise to readers for not using the now universal metric system instead of pounds, feet and degrees Fahrenheit in my boiler thermal calculations. Most model engineers of my generation accept and use metric weight and length, but are more at ease with the British Thermal Unit than the kilogram Calorie, and I number myself among them.

I should like to thank Lister Gases of Wednesbury for their interest and advice on the modification of their Sievert Cyclone burner. I also acknowledge my fellow Worcester club members whose constructive criticism I appreciate.

ROAD STEAM

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

Martin Wallis

considers some alterations to the appearance of this popular model before continuing with the valve gear components.

●*Part XXXIII continued from page 33 (M.E. 4186, 10 January 2003)*

I have been corresponding on and off with Doctor Figureau in France on model road steam topics, most recently on engine aesthetics. For his interest, and mine, he 'amended' two of the *Little Samson* pictures using a graphics package on his computer; these are shown in **photos 1a** and **1b** (as original) and **photos 2a** and **2b** (with modifications). There are two changes. First the front axle and wheels have been brought forward to a position under the smokebox rather than under the boiler. The positioning of the front axle under the boiler was intended to make the engine more manoeuvrable in confined stack yards. The set back front axle was popular with very early engines of many makes but was retained into later production models by both Savages and Fowells. I tend to agree with the good Doctor that the axle does look better situated further forward. It would also give that necessary extra room should belly tanks be desired. The second change is the removal of the canopy, our doctor describes it as 'horrible'. I rather like it and would disagree with him in this. For me the wavy-edged canopy side boards add character, even if little room is left for sign writing.

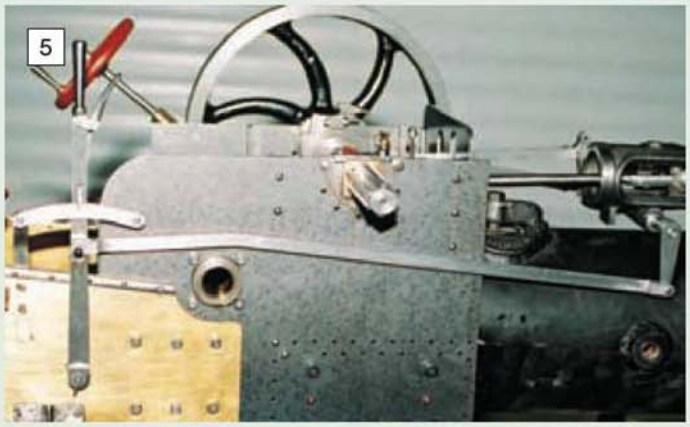
Anyway, we must get back to constructional matters. The reversing lever, reach rod, weighshaft and arms, lifting links, valve spindle and rods, and the slide valve itself complete the valve gear repertoire. The drawings for the weighshaft and arms, together with the lifting links, were included in the last instalment. As good a place to start as any is at the back, and working forwards this puts the reversing lever at the top of our agenda.

Reversing lever

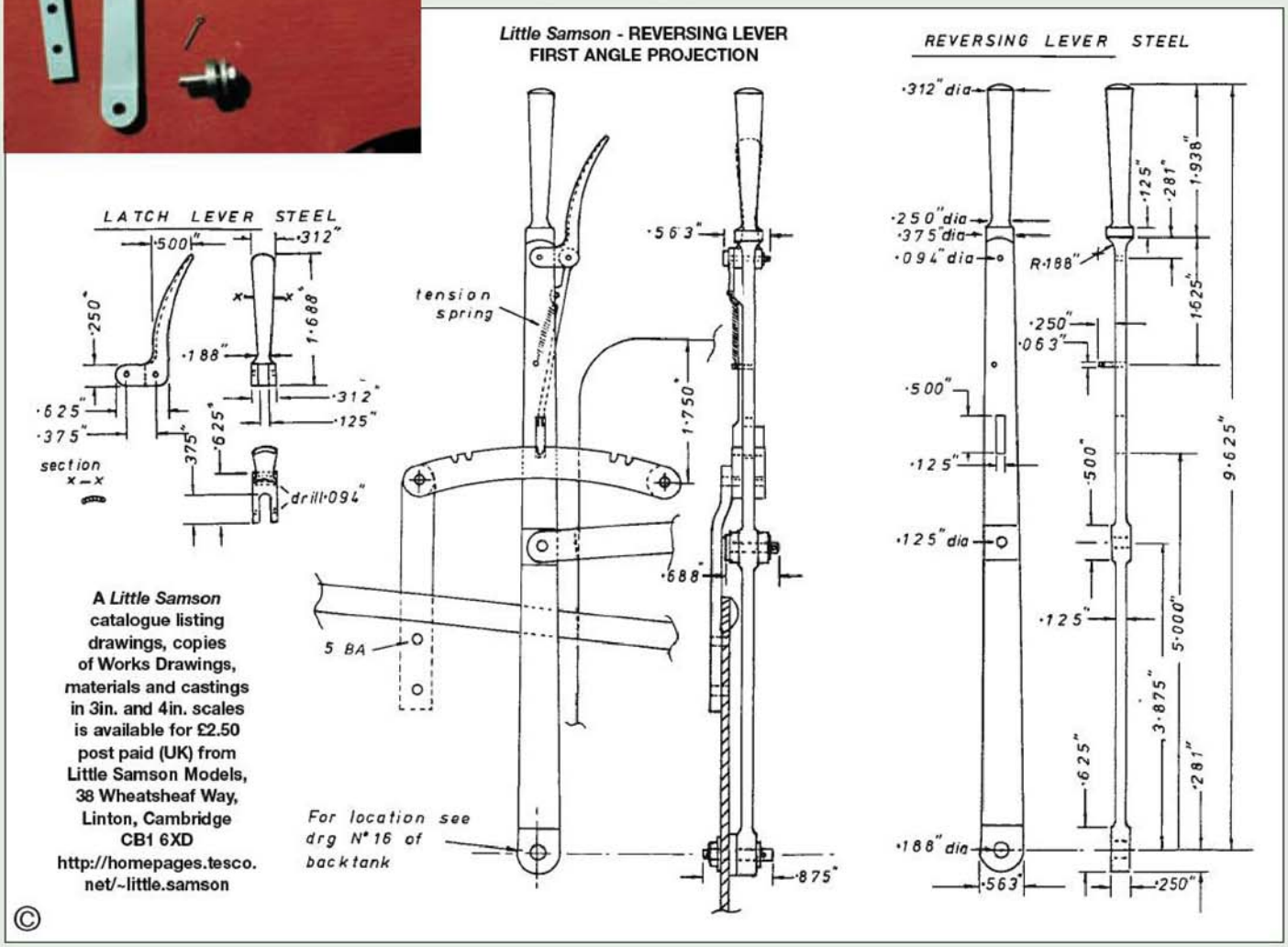
This is quite long — some 10in. in 3in. scale. To make it, most folk silver-solder the round handle onto a flat piece of rod. My choice, however, would be to take it from the solid, starting with a piece of round or square steel bar, preferably free cutting, if available. If the hole in the lathe mandrel is big enough, the lever may be poked up it and the round handle turned. If not, a bit extra can be left on the length for a centre drilling for tailstock support; the extra bit is then sawn off afterwards. Turning from the solid makes it easy to put in the 0.188in. radius under the handle. A fair bit of milling is then required to get the rectangular section for the rest of it.

The two curved quadrants may either be filed to shape or machined on the same jig as used for the expansion link, the radius this time being significantly less. The latch handle is certainly best taken from the solid and is much more work than at first appears, involving a lot of fiddly milling, filing and polishing. The small spring that pulls it shut is the sort that can be retrieved from a ball point pen. At this stage the central slot for the latch may safely be cut but the remaining slots are best left until the valve gear is assembled so that their exact position can be clarified *in situ*.

Top left and right: Two pictures of a completed 3in. scale Little Samson. (Photo: S. Nipper). Above left and right: The same two pictures as edited by Dr. Figureau in France and discussed in the accompanying text.



Left: component parts of John Freeborne's 4in. scale Little Samson *reversing lever. Centre: the driver's end of John's reversing lever; note the beautiful finish. (Photos 3-4: P. Kybert) Right: the reach rod spans the gap between the reversing lever and the drop arm on the weighshaft. The upward kink is to clear the second shaft. Much of the reach rod ends up behind the second shaft gears and inside the gear casing. (Photo: S. Nipper)*



Reach rod

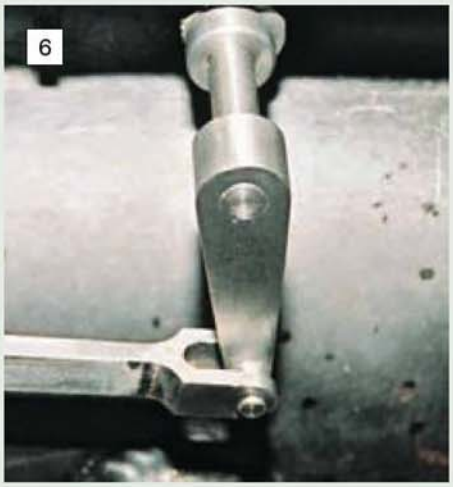
This is the long rod, with forks at both ends, which connects the reversing lever in the cab with the weighshaft drop arm under the motion. The layout is shown in **photo 5**. Its making is best left until after a trial assembly to confirm the distance required between the two forks. It is well worth preparing a dummy rod which is no more than a length of strip with a hole drilled at each end. This is used to establish the centres of the two holes and the extent of the bend required in the rod to clear the second shaft. Once these distances have been determined, the real rod can be made with confidence.

Determined builders could take the reach rod from the solid, which is not as bad as it sounds if your milling machine has power feeds. It is the sort of job that can be working away in the background while you are, say filing and polishing the latch handle.

Weighshaft arms and lifting links

Here again, I would recommend that the weighshaft arms and lifting links are taken from the solid. The resulting job will be much neater and will not take too long to complete either by lathe work or milling. If lathework, the piece of bar is set up in the 4-jaw chuck (**photo 7**), and chewed away at until the job is complete. Remember to have a radius on the end of the tool to give the fillet radii needed.

I must admit that I find the inevitable intermittent cut on a job like this jars my nerves so I would opt for milling. A rotary table is required and the last few cuts around the boss need to be done with a ball nosed cutter to get the all important radii. A peg in the middle of the rotary table picks up the centre of the boss. The two lifting links may be made in the same way, clearly the two lifting links must be the same length, so one could be jig drilled from the other or both indexed along using the feedscrew dials/digital



Close inspection of the forked end of the reach rod reveals a tiny witness line of the silver-solder fabrication. Note the snug fitting key. (Photos 6-7: S. Nipper)

readout to drill the second hole. A lifting link is shown under construction in **photo 8**.

The weighshaft itself is a straightforward turning job. Aim for a snug but not tight fit in the trunk guide casting. The two levers are best finished to a firm push fit, which is easy on the end of the weighshaft with the shoulder. However, since the levers were probably reamed with the same reamer as was used for the hole in the trunk guide casting this may present a problem at the expansion link end as the weighshaft has to go through the trunk guide casting before it fits into the lifting arm.

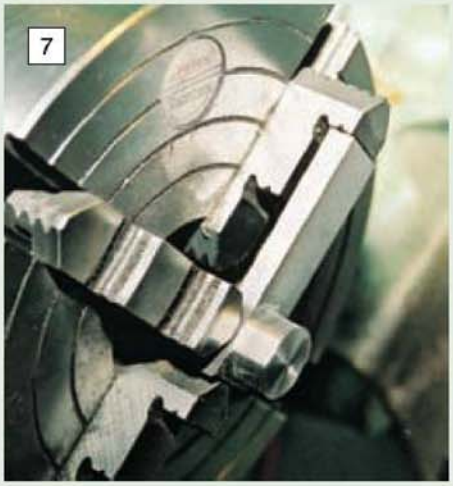
Valve spindle and rod

The last few little bits to be made before a trial assembly can take place are the valve spindle and valve rod. The valve spindle is illustrated in **photo 9**. The valve rod is made from stainless steel and is 0.188in. dia. in 3in. scale and 0.25in. in 4in. scale. It is important that the threads are concentric to the rod, and at the very least should be done from a tailstock die holder in the lathe. To guarantee concentricity and to save wear and tear on the die (stainless can be hard going) I would first screwcut most of the thread and only use the die to chase down the thread to tidy it up.

The two weighshaft arms then need to be keyed to the weighshaft at 90deg. to each other as indicated in the drawings. In 3in. scale these keys are 0.094in. square and are quite fiddly to cut. A small slot drill is needed for the keyway in the shaft and a small slotting tool to cut the internal keyways. The exact size of the keyway is not important as long as it is in proportion.

Fixing the eccentrics to the crankshaft

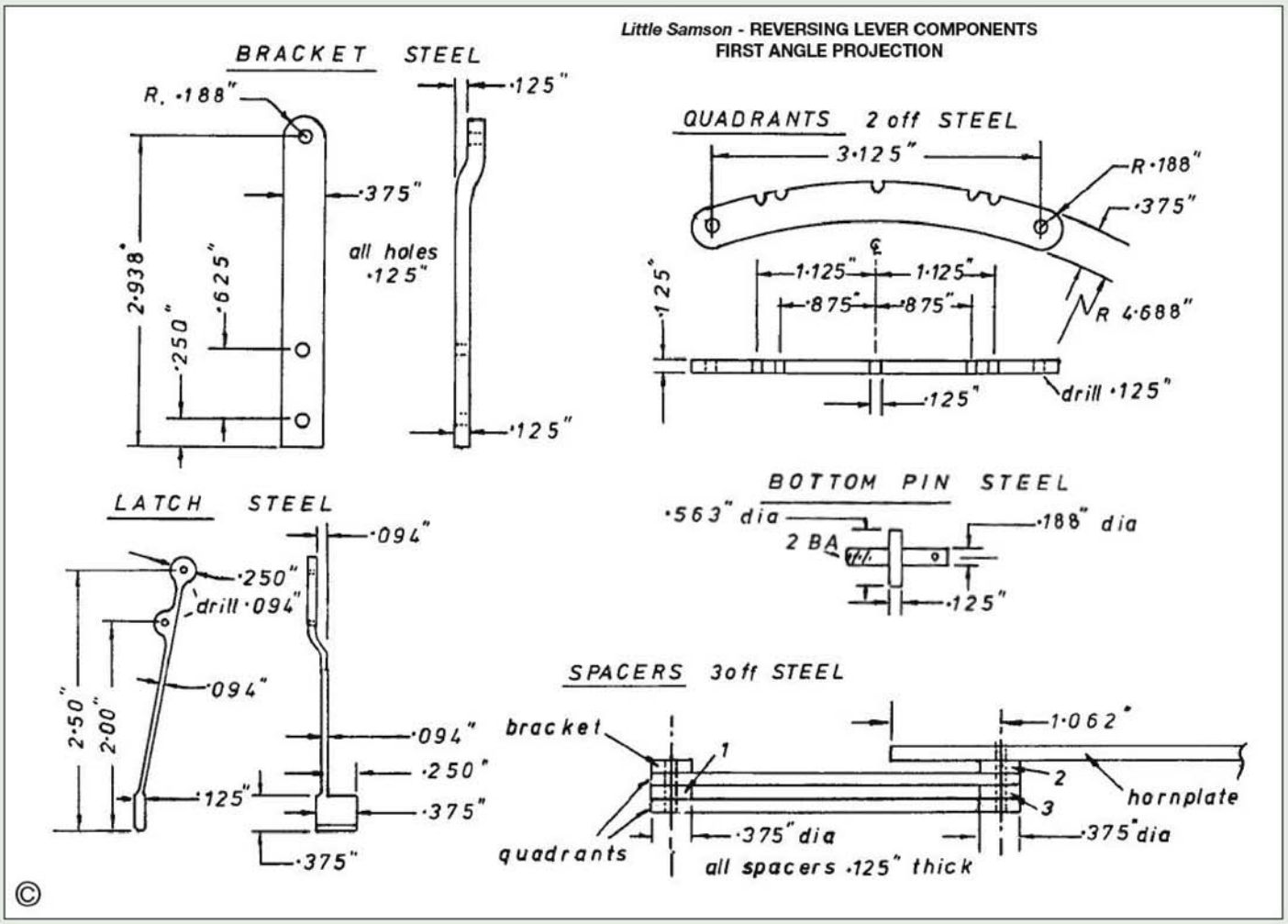
The drawings detail a keyway cut in the crankshaft and a keyway in each eccentric. The magic angle of 21deg. must be carefully fed into the machining operations and, *hey presto*, everything should all work wonderfully. Using keys and keyways leaves no room for any adjustment, a situation with which some folk are happy. Others, and to some

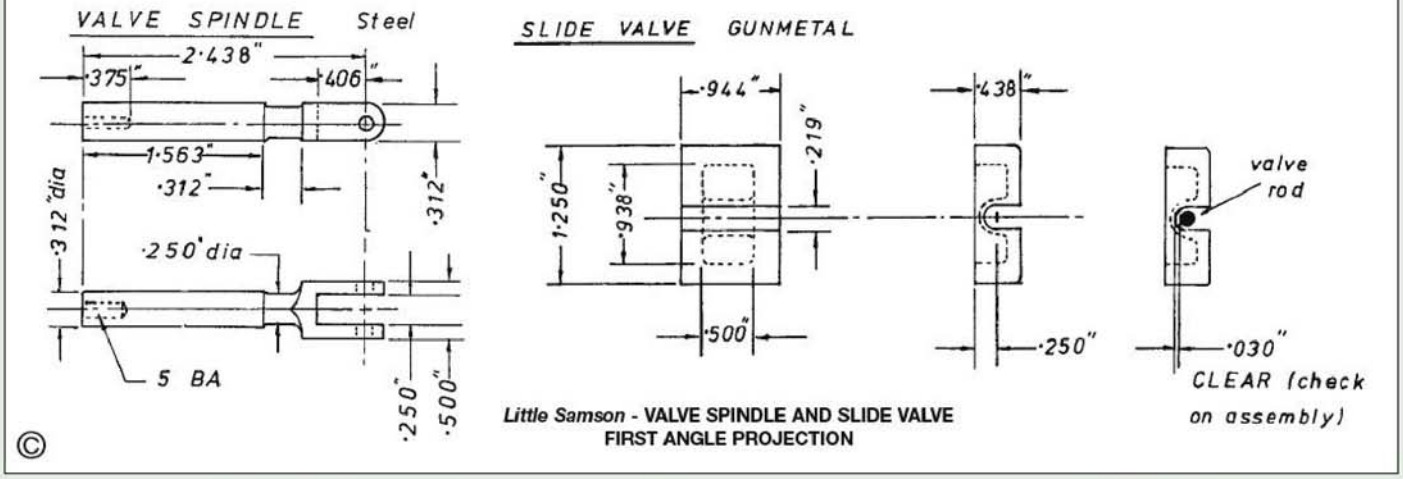


Here Stan is making one of the weighshaft arms using the 4-jaw chuck. Enough metal remains in the billet to turn it around (and end for end) to turn a similar but smaller boss for the weighshaft end.

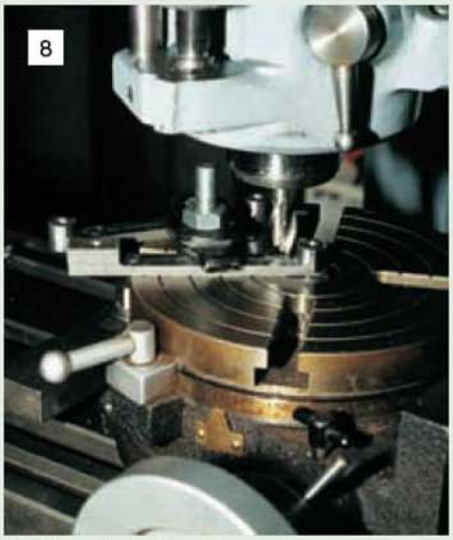
extent I include myself, feel much more comfortable with the notion of being able to fiddle about a bit, i.e. advance or retard the eccentric to see what happens. You can feel when an engine is happy; it ticks over sweetly, pulls well, notches up and generally does what an engine ought. Conversely, there are some engines out there that need a valve gear transplant. I swear that on one I know the steam is not being admitted until the piston is half way down the stroke, and goodness knows what the exhaust arrangements are!

If you are of the 'fiddling about' persuasion you need two grub screw holes in each eccentric. One ▶





Little Samson - **VALVE SPINDLE AND SLIDE VALVE FIRST ANGLE PROJECTION**



An alternative to the 4-jaw chuck set up shown in photo 7 is to mill the parts using a fixture mounted on a rotary table.

The completed valve spindle. (Photo: S. Nipper)

Cutting the keyway in the eccentrics using a milling machine slotting head and a rotary table to deliver the 21deg. angle. (Photo: B. Camps)

is for a grub screw with a brass pad underneath it. The brass pad is to prevent the grub screw damaging the crankshaft and this is the screw to be used when setting up the engine. When satisfied, the other hole is used with a grub screw that is of the 'pointy end' variety. Screw this one in just enough to leave a neat little dimple on the crankshaft. Do not just do the second grub screw up for all you are worth or a burr will be thrown up which will make the impending disassembly very difficult.

The eccentrics are then removed, these little dimples are then used like centre punch marks and the shaft is gently drilled with the clearance drill for the grub screw to a minimum depth consistent with grub screw contact to its full diameter. The eccentrics may them be reassembled, the drilling picked up and the grub screws tightened fully.

Trial assembly

Before first assembling the valve gear it is wise to remove the connecting rod. This will make it much easier to feel any tight spots and then track down the culprit. With the reversing lever in its mid position the die block should be in the middle of the expansion link. If it is not, the length of the dummy reach rod may have to be adjusted accordingly. Remember the length of the reach rod, 17in. in 3in. scale, is for guidance only and the drawings do say 'take length from job'.

Turning the motion over in mid gear will result in some movement of the valve spindle, but not very much. With the reversing lever fully forward the die block should bob around in the top of the link, but at no point actually make contact with it. The same applies for reverse and the bottom of the link. When you are satisfied that all is well, the remaining slots may be marked off from the latch and cut in the reversing lever quadrants.

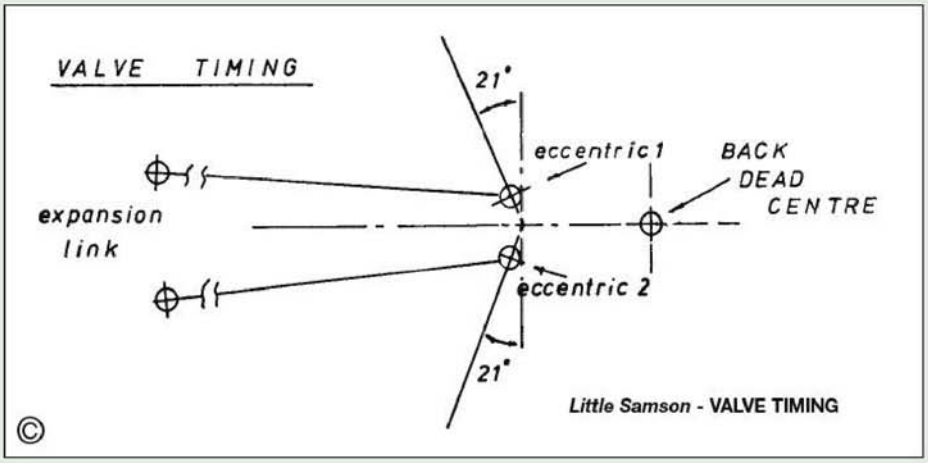
Setting the slide valve

The slide valve is milled from a piece of bronze, care being taken to follow the dimensions, in particular keeping it symmetrical so that the exhaust beats will be even. To set the slide valve to give equal port openings and thus deliver equal amounts of steam to both sides of the piston, first put the engine in full forward gear. By adjusting the nuts and locknuts each side of the slide valve the valve is moved to show equal openings at both ends of its stroke. This is best judged by using number drills or 0.1mm increment metric drills as gauges to measure the width of the port revealed at maximum stroke of the valve.

The acid test is to them pull the reversing lever back into reverse and to see if they remain exactly the same. If they are not it follows one of the eccentric rod assemblies is longer than the other. Should this be the case do not worry, establish which rod is the longer, and by how much, and machine off the required amount from the flat face on the eccentric strap where the rod bolts on. If such adjustments have been made the two sets of rods will need to be numbered or marked in some way to ensure on that on subsequent occasions they are assembled in the same order.

The timing of the slide valve will come from the position of the eccentrics. As a general rule the slide valve should just 'crack to steam' at dead centres. Next time we will deal with the regulator and run the model on air, always an exciting and memorable event.

●*To be continued.*



Little Samson - **VALVE TIMING**

KEITH'S COLUMN

SAINT CHRISTOPHER

A GWR LOCOMOTIVE for 7¼in. gauge

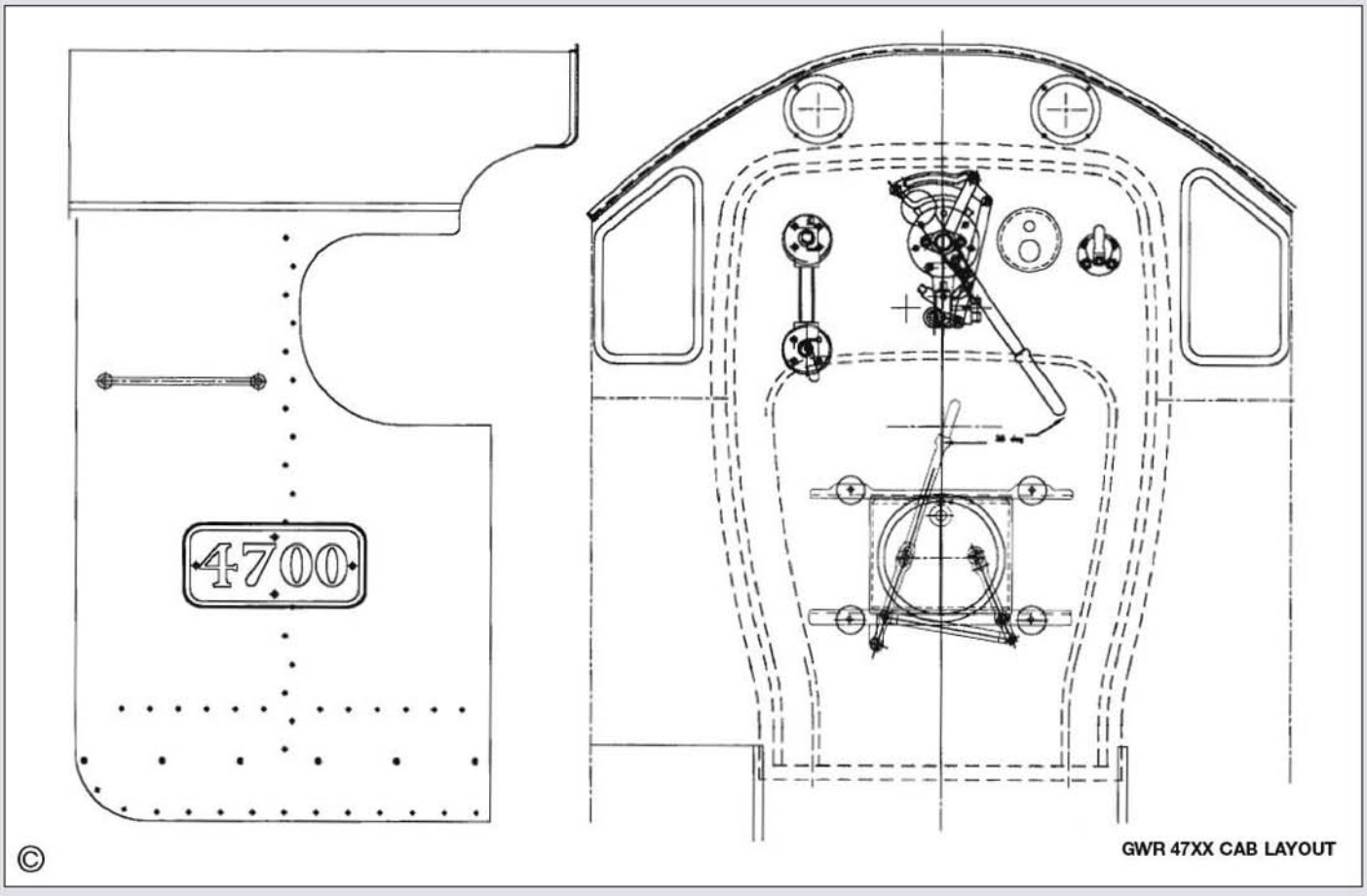
Keith Wilson
continues with work on the cab and takes time out to consider some of the problems of judging exhibition models.

●*Part XXXIV continued from page 38 (M.E. 4186, 10 January 2003)*

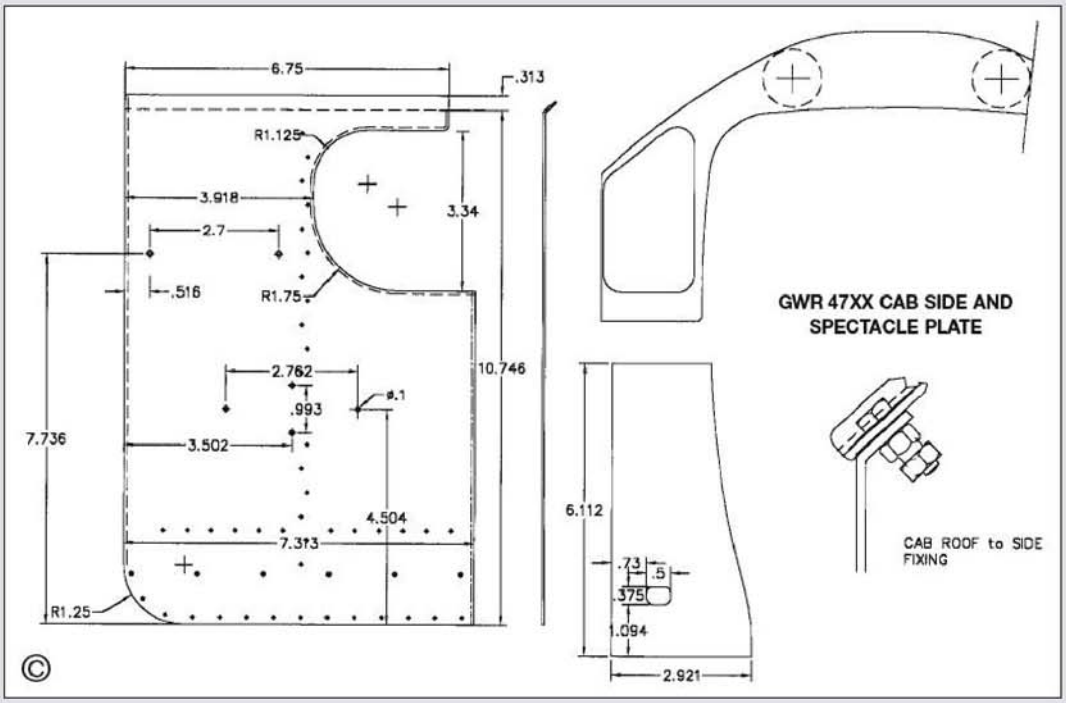
"Bear courteous greetings to the accomplished musician outside our gate, and convince him, by means of a heavily weighted club if necessary, that the situation he has taken up is unworthy of his incomparable efforts."

The 47 cab is similar to that of the Saint so most of the constructional description will fit both. Both were by Churchward, who was one of the few Chief Mechanical Engineers, on any major railway who actually spent lots of time in the drawing office. Some were notoriously lacking in this respect, so when in the books so-and-so locomotive is described as designed by x, even in Churchward's case this is only a way of expressing the opinion of the author, however customary this way of expression became.

Anyone who has much drafting experience will know that the true basic designer is the nut behind the drawing board — or in modern times the automaton behind the AutoCAD. Although Churchward is credited with the design of both the 47s and the *Great Bear*, the initials on the 47xx General Arrangement drawing are quite clearly F. E. G., with a rather squiggly initial-set below that could be interpreted as F. W. H. As far as I know, the *Great Bear* G/A was by F. W. ▶



GWR 47XX CAB LAYOUT



Hawkesworth (I do not possess the G/A of this loco) and the King G/A was by Sam Ell.

I do not for one moment want it to be thought that I am trying to denigrate Churchward's part in these designs, but he didn't actually draw up the parts. In case anyone thinks that I have got this cab wrong and that a screw reverse was used (it is so shewn in one useful reference book) well, although I probably haven't got it exactly right, I certainly haven't got it wrong in any major sense.

The 47 cab is somewhat roomier than that of the Saint except perhaps vertically, for the 47 cab floor was very high and it was one of the easiest things you can imagine to crack your head on the cab roof 'lobe' where it sticks out. I've done it!

Incidentally, a full size 47 is on the drawing board (not mine) and is planned for construction in due course partly from ex-Manor/43xx/Prairie wheels and bits. 'Twill be a fine sight. The Great Western Society (which I helped to start, more years ago than I care to remember!) has recently announced this.

The cab roof is different and is not by any means a simple roller job for the curves in it. A jig or template will be required anyway for the big cross-brace: kill two stones with one bird and save a bit of time using this jig. It will match the spectacle plate top anyway; this of course applies to the Saint cab roof as well. I have not yet drawn these items.

The 47xx footsteps have my attention this time; once again these writings will cover the Saint steps. There is more to these matters than meets the eye, such is oft-times the case in locomotive building.

The actual steps are mostly tin-bashing, even if it is really brass-bonking or steel-smashing. We need two pairs of 16swg blanks just over $1\frac{1}{2}$in. wide, one set $4\frac{5}{8}$in. long and the other $4\frac{1}{16}$ inch. I shew two little holes in each, this helps in getting reasonable corners. After drilling (you certainly can't do it before!) cut away the little square bits on two corners. Grip a blank in a vice with smooth jaws (see later) with the two corner cut-outs in line with the top of the jaws and hammer over the flange all the way along. Then in a like manner, bash over the ends to form the finished shape (but not the size as yet!) Rest downside-up on a firebrick, or other brazing surface, apply flux and silver-braze the corners to form one solid mass.

After pickling, rest right way up on a flat surface and mark off the back to size, $\frac{13}{32}$in.; then repeat the process for the correct width of the step — in this case $\frac{11}{16}$ inch. File or Linish to final size, and there are your steps. Incidentally, the same process will apply for the tender steps.

Smooth jaws?

Most, if not all bench vices come with serrated jaws, hardened, and of course will grip like no-one's business, but with soft materials and bashing about, you will be left with serrated metal bits. So you can either cover the jaw with standard clams, which in my experience do not last very long, or remove the serrated jaws and replace with jaws made up from fairly heavy bars of mild steel. I use 1in. square for an 8in. vice with jaws 6in. wide.

To unscrew the supplied jaws, make up a special heavy-duty screwdriver by cutting the blade off a bought screwdriver, leaving a stub blade about 4in. long. Silver-braze a piece of 1in. hexagon material, and you have a superdriver. With the opposite jaw of the vice preventing the blade popping out of the slot, a hefty spanner will shift the screw quite easily, but remember as the screw unscrews the vice jaws must be opened a bit to clear things. If you take care to get the cut-off ends of the smooth jaws square with the rest of the jaw, and also protruding an inch or two each side of the vice, then you will find that many holding-for-bashing jobs are much easier.

It is safest to locate the holes to rivet the steps to the backplate in the steps; I will not trouble you with describing how this may be done. I should have dimensioned these on the steps, but I see that it has been done on the backplate. For technical reasons, the drawings have to leave here well before the text and photographs are sent 'down the pipe' (e-mail) and that is an unfortunate handicap that so far has proved insuperable.

The Hanging Plate (official name) looks like a piece of $\frac{3}{4}$ x $\frac{3}{8}$in. angle; anyone who wants to get a piece and bend it to shape is welcome to try, be my guest, but you might well retain sanity a bit longer by fabricating it out of two separate bits.

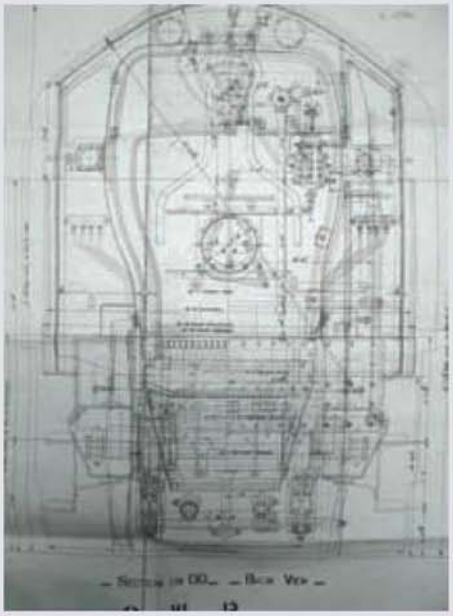
As well as riveting the steps to the backplate, boost up the joint by solder, weld filler or even Araldite. It will pay, for even though we do not normally use these steps to gain access to the footplate, it is quite surprising how often they get kicked; rivets by themselves will soon work loose. I have not specified any particular material for steps or plate, it doesn't seem to matter if it's brass or steel, but soft-solder is not too happy on steel, however well prepared. With Araldite, provided there is no grease or oil involved in the joint, mix the stuff up, apply it, and warm up the joint — an electric paint-stripper is ideal — and watch the stuff liquify and penetrate the joint. If you haven't a paint stripper, pinch the wife's hair dryer, but play fair and look after it.

Do not omit the stiffening bracket bracing the backplate to the frames; the aforementioned kicking plus any derailments will rapidly fold up the backplate. If possible the backplate could well be made from 2mm or even $\frac{3}{32}$in. material. Note that the rivets on footplates are $\frac{3}{32}$in. roundheads.

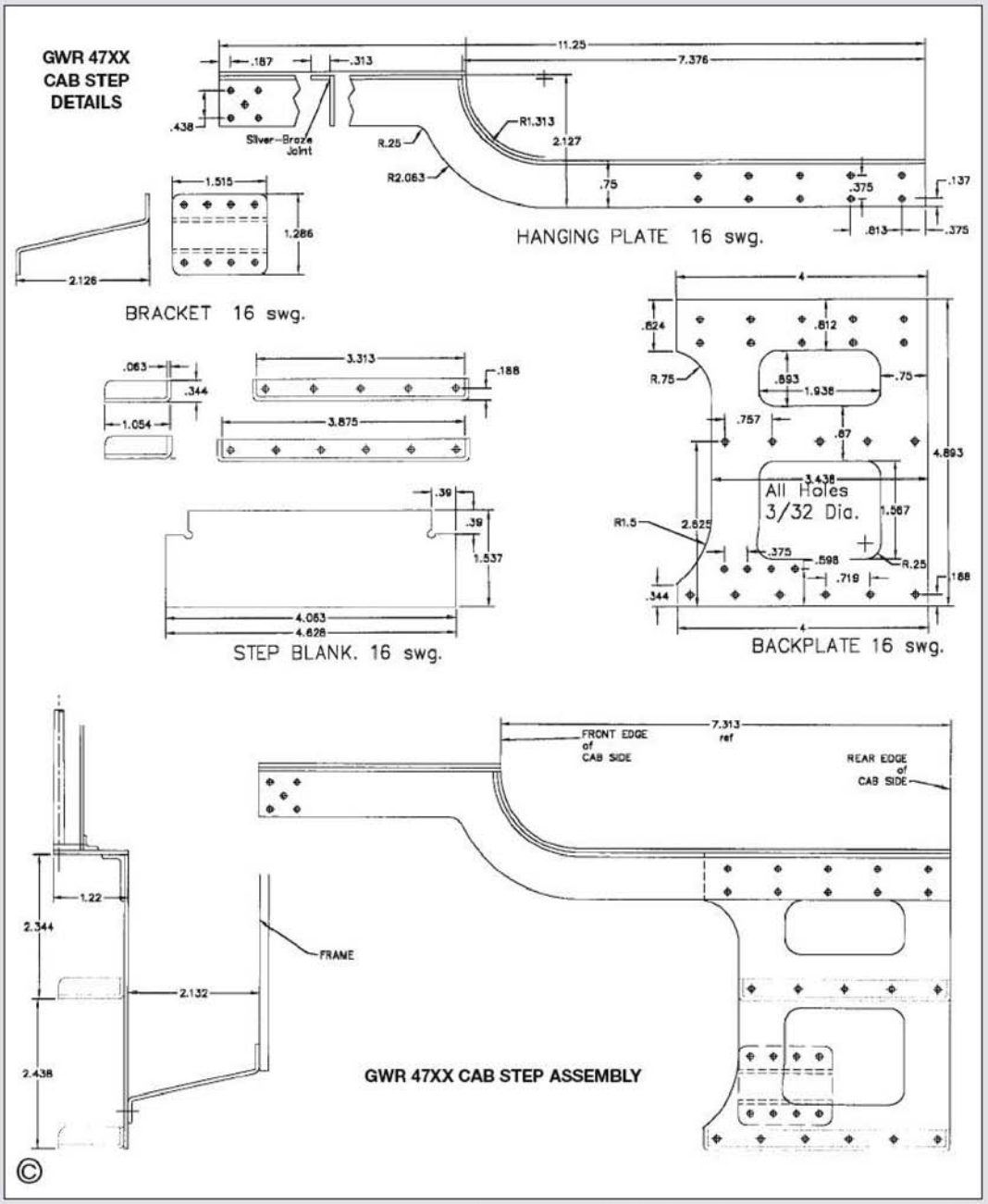
Cab side

I have tried to get these correct, but as can be seen from the photograph, numerous small rivets are visible, some of them I can explain, but not all. To the right of the power and route classification 'D' are two small rivets in a horizontal pair, further on are two larger ones in a vertical pair; these latter are for the fireman's seat, although just how often it could be occupied legitimately while on a trip is open to question.

The Spectacle Plate is missing its dimensions (my fault) but as can be seen is very flimsy if made completely as drawn, but I will give better advice when I deal with cab windows, in themselves flimsy but necessary. Note the little inset drawing 'cab roof to side fixing'. The purpose of this is



Swindon 47xx backhead drawing.



obvious — once it has been explained.

The long 3/8in. long bolts (7BA,) with two nuts apply to the rearmost fixing point; the front ones use 1/4in. long bolts with single nuts. The reason for the long bolts is simple; they will take the outer ends of the whistle chains. These chains can, of course, be fixed in 'scale' positions, but if they are then it makes for a tricky job to drive, for they can so easily catch your fingers when you aim to use any of the backhead controls. If fixed via the roof bracer (details later) they are not only easier to use but less intrusive. One of the very finest models I know suffers from this, but it's a matter of choice.

Footplates

An interesting point in the picture on the left can be seen just to the right of the water gauge. There are two pipes almost exactly the same profile snaking down from just under the cab roof, curving to the left by the water gauge and then straight down past the firehole doors.

Many pictures have been published over the years shewing footplates; these are understandably taken from the centreline of the locomotive; thus these pipes would not be very obvious separately. They are not too obvious on the Swindon drawings. They were injector steam pipes, but one was for normal working and the other was for use to supply supplementary steam for working with the exhaust steam injector. As far as I know, only the Kings were fitted with injectors that changed over automatically from live to exhaust steam (and vice versa).

Curly did some experimental work on such injectors, but old square cube is overwhelmingly against us here, for not only do we use far more oil in proportion to size, but it is far harder to get the exhaust steam clear of this oil. One of the things to avoid is oil in the boiler. At a semi-informed guess, this difficulty would go up twice as the cube of the scale factor so instead of linear (7.8) it would be 7.8 cubed (475) times as much oil in proportion but 475 times harder to get rid of it, this totalling up finally to a probable 3700 times; I can't see any way of overcoming this problem.

Hanging down over the side is the flexible hose used for many footplate cleaning purposes, as well as damping down the coal in the tender (laying the dust if you prefer). Note that the vertical cab handrail sticks out sideways rather than being in line with the cab sides.

A matter of judgement

This reminds me of a not-often realised fact. If you want to see the very best in models at any exhibition, go to the individual club stands and have a good look. Many's the time have I found examples of locomotives that make some of the winners look quite poor. Another point. Would it be possible to have a rule that any exhibit may only have one trophy at any one time? I ask this because once when shanghaied into being a judge I had very great difficulty in getting a fair settlement.

There were good prizes, one for the best 3 1/2in. loco, one for the best 5in. loco, one for the best 7 1/4in. loco. So far, so good (so what?) but there were prizes for the best locomotive, and the best overall item in the exhibition; to say nothing of best airplane, best boat, finest showpiece exhibit and so on. These clearly give clashes, for the finest showpiece and best overall item had to go to one and the same item. In fact, one exhibitor ended up with four prizes!. I am not for one moment suggesting that they were not deserved for we (there were two judges on the day, but one insisted on remaining anonymous) went very carefully into every exhibit. In fact, because there was only the one prize, we ended up by trying to find the slightest fault between the two best entries. We eventually decided that one of them had a cab handrail that was not perfectly horizontal! Shews how hard it can be to judge fairly.

● *To be continued.*

Martin Evans
recalls the introduction of the International Model Locomotive Efficiency Competition and his new role as Editor of *Model Engineer*.

●*Part III continued from page 21 (M.E. 4186, 10 January 2003)*

HRH The Duke of Edinburgh and the late Kenneth Garcke, then Chairman of BET, examine a model of a destroyer at the Model Engineer Exhibition.

EARLY DAYS

It was in the early 1960s when I was serving as Technical Editor that the idea of an international model locomotive competition first entered my head. I thought it a very good idea that some of the beautiful model locomotives on view at exhibitions could be seen at public running and in some form of competition. Furthermore, a locomotive competition would undoubtedly help to increase sales of model locomotive designs. I put my idea to Editor Leslie Howard, but he did not seem very enthusiastic; he said that he would consult LBSC. A few days later, Howard said that he had discussed the competition idea with LBSC who, he said, thought that putting locomotives in competition with one another on a performance basis would lead to accusations of unfairness and possibly even to ill-feeling between drivers. I could not understand this attitude as in competitions in the sporting world, ill feeling between the competitors must be very rare. However, as Howard would not approve, the matter had to be dropped.

But a few years later, speaking from memory I think it was 1965, I had become Editor so I thought the matter of a competition might be brought up again, and not having to 'by-pass' Leslie Howard left me free to take it up with Managing Director, 'Dickie' Laidlaw-Dickson. Dickie was certainly rather more enthusiastic about the idea than Howard had been, but he brought up several objections to the scheme. For instance, who was going to pay for it? Who would tackle the necessary extra advertising, essential if the competition was to get a start? If I undertook to deal with the day-to-day running of the events, how would my regular work on *Model Engineer* magazine be affected?

After much discussion, Dickie agreed that I could go ahead subject to certain restrictions, such as the financial side must be handled by myself together with what secretarial help was available without taking on extra staff. Furthermore, if the running of the competition were to lead to the *Model Engineer* being published late, I would have to agree to dropping the competition even if preparations were well in hand. I thought it was a stiff order, but I decided it was worth a try! Dickie Dickson was a hard master but a very fair one; I didn't think that we were likely to fall out over the idea. Thus was I.M.L.E.C. born!

It was about this time that the dispute between LBSC and Editor Leslie Howard took place which led to LBSC ceasing his contribution of locomotive articles on a regular basis. Regarding the actual locomotives to be described, this had always been decided through a friendly chat over the telephone. The custom had been for LBSC to let Howard know in good time exactly when he would finish the 'current' article, so that drawings could be completed and copies despatched to Howard also in good time for Howard to complete his 'schedule'. In this particular case, Howard had asked LBSC to describe a fairly simple engine for 3½in. gauge, as he thought that rather too many 'big' engines had been described over the previous six months. Now, I can only assume that LBSC must have said something along the lines *"Okay, I will see what I can do."*

Some weeks now passed when one day a large packet arrived on Howard's desk and, on being duly opened, Howard was staggered to find not drawings of a simple 4-4-0 or something of that sort, but drawings of a very big 3½in. gauge engine indeed. Again speaking from memory, it was for a 4-6-4 or 4-8-4, far from the simple engine that Howard had been expecting!

Howard immediately telephoned LBSC and demanded to know why he had been sent drawings of a big 4-8-4 rather than the simple engine which he thought had been agreed. LBSC was unrepentant and in any case, Howard would have to accept the big engine now as there would be no time to prepare drawings of a simple engine, and there was also the matter of the articles which were already at an advanced stage. Howard now insisted that he could not, or would not, accept the big engine, so the only way out would be to have a 'lull' in the LBSC series, say eight weeks or so, to give LBSC time enough to prepare a simple engine design, the big engine to follow afterwards. LBSC would not agree to this, for one thing the loss of earnings would have hit him rather hard. Following further discussions over the telephone, neither side would give way, and eventually LBSC told Howard that unless he accepted the big engine, he would not be prepared to contribute any further to *Model Engineer*; in other words some 30-35 years of regular locomotive articles would have to come to an end.

As this provoked no response from Howard, nothing happened for a few days. Eventually it became known that LBSC had written to Kenneth Garcke, Chairman of the Electrical Press Group appealing for support. Kenneth Garcke wrote back to LBSC explaining that an Editor must always have full control over the contents of his magazine, and while he had a great deal of sympathy for LBSC's predicament, it would not have been right for him to interfere in any way.

Thus it came about: LBSC ceased his contributions to *Model Engineer* for some years until, due to the take-over of the Electrical Press Group (which included the other magazines, books, etc.) by the Argus Group, then based at Watford, great changes took place.

During the time between my joining *Model Engineer* and the take-over by Argus, it had often occurred to me that the Electrical Press people must have been running at a loss. When one considered the very large staff involved just to publish *Model Engineer*, the very easy-going attitude, the lack of any firm control, etc., it did not surprise me when one day a chauffeur-driven limousine arrived at Noel Street, and who should alight but Kenneth Garcke and Secretary. The two then commenced a very thorough inspection of all the offices under the control of Electrical Press, including the basement.

About a week after Garcke's visit, it was announced that the company were leaving London and would take up occupation of a large mansion at Maidenhead. Many changes were to be made, the basic change of course being the change from Electrical Press control to Argus control. Then, only a few days after our arrival at Maidenhead, we heard that the whole of the staff of *Model Engineer* were being dismissed excepting only myself and our draftsman, Mr. Pedder!

The late Laurie Lawrence, who took over the editorship of **Model Engineer** *after my retirement, at the regulator of the 'M.A.P. Special'.*

Appointment as Editor

Knowing, by this time, something about the working of *M.E.*, I was not altogether surprised at the severity of the change. I could imagine that control from the top would now be much stronger than before. Although the headquarters of Argus were then at Watford a batch of nearly new offices had been taken at Hemel Hempstead. One very large and pleasant office, on the first floor over a batch of shops, had been allocated for the Editor of *Model Engineer*, and smaller offices had been allocated for the Editors of *Model Railway News, Model Boats, Electronics*, etc.

Only two days after the exciting events just described, the new Managing Director, Dickie Laidlaw-Dickson, sent for me, and explained that I was to be in charge of *Model Engineer*, a lady secretary had been appointed and Mr. Pedder was to continue using my office. At first, I was not too happy about the new arrangements. What did Dickie mean by *"being in control"*? This sounded very vague to me and did he mean that I was to be Editor of *Model Engineer* with the normal editorial powers or not? Somehow Dickie seemed a bit reluctant to really get to the point. Naturally there were a lot of questions that had to be answered but, after some three-quarters of an hour's discussion, the matter was settled and I was appointed with full editorial powers!

Time waits for no man and immediately after my discussion with Dickie, I realised that the next issue of *M.E.* was 'looming'. As can be imagined, things were very hectic for the first week, and led to my being very late leaving the office (normally 5.30pm but for those days, it was nearer 8.30pm!) Incidentally, on this matter of working hours, only a few days after the events just described, I happened to overhear Dickie talking with one of the other Editors; they were discussing arrival and leaving times, and I heard Dickie say that if the Editor concerned could not get through his work by 5.30pm each day, he must be a very inefficient Editor. I duly took note of this management edict and from then on I vowed always to leave the office at 5.30pm sharp (although of course it mean taking some work home with me).

The Percival Marshall stand at one of the Model Engineer Exhibitions held at the Horticultural Hall (1961).

It was not long before a little trouble arose. My secretary was clearly not up to the job, the wrong letters were being put into the wrong envelopes, and the small amount of filing had already gone wrong. So I did the only thing possible — I gave her the sack. Of course Dickie quickly heard of it and suggested that it was not my job to sack staff. After some amicable discussion, Dickie and I agreed that in future, I would be allowed to sack and appoint my own editorial staff as required.

One of the most important tasks for a newcoming editor is to establish good relations with one's printers, blockmakers and advertising people. Here I was very lucky. I had not been installed more than a day or two, when I received a visit from the Managing Director of the local company which was supplying printing 'blocks' for *M.E.* as well as for some of the other magazines. He proved a most helpful man indeed, especially when a few days later it was decided that, in addition to dealing with the editorial pages of *Model Engineer*, I was to be responsible for cover pictures, and at that time I had no knowledge of colour printing. However, our block-making friend knew all about colour printing and his advice was quite invaluable.

In an earlier article, I mentioned that when at the London offices at Noel Street, which is only a stone's throw from Oxford Street, we used to receive quite a large number of *Model Engineer* readers who had come over from Australia, South Africa, USA, etc. and wanted to discuss matters with the Editor (who at that time was of course Leslie Howard). At Hemel Hempstead this did not continue at anything like the number of visits to Noel Street and was something that I did rather miss; however, there was the opposite advantage that there was much less interference with work!

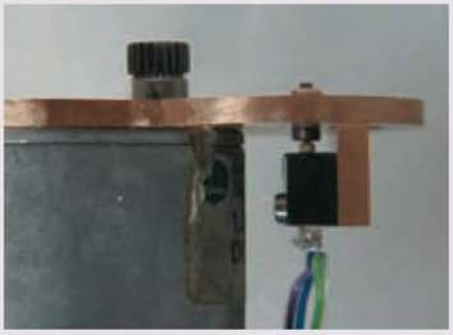
I must now mention some of the interesting people I met during my stay as Editor of *M.E.* I think it was only a few weeks before we finally left Noel Street that a certain gentleman had called and wanted to be introduced to someone who could both design and build some gauge '0' live steamers for an outdoor railway that he intended to build. So of course Howard brought the gentleman in to discuss the matter — fortunately I happened to be in the office at the time. The gentleman turned out to be M. Charles Ritz, the Chairman of the Ritz Hotel Group (which at that time included the London Savoy). Quite a small man, impeccably dressed as one would expect. Charles Ritz spoke perfect English and he and I quickly got our heads together over my drawing board.

It seemed that M. Ritz had a large gauge '0' electric railway in an upper room of his Ritz hotel, but now wished to enter the field of steam. His aim was to have an outdoor line built for him on an acre or so of land which he had purchased near Paris.

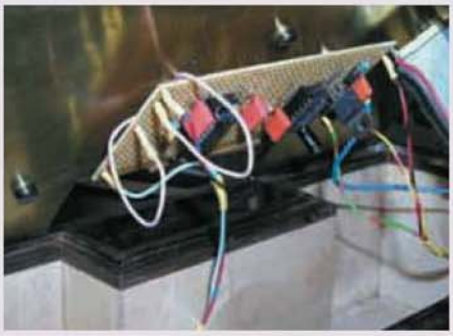
What M. Ritz wanted therefore was a gauge one live steamer, with proper multi-tubular boiler but fired by propane or butane. By a stroke of luck, a suitable small company immediately came to mind: Severn-Lamb Ltd. of Stratford-upon-Avon. I had known Mr. Lamb of this firm partly owing to the fact that he was a patient of my brother who at that time was a doctor practising in Stratford.

When I explained the possibilities to M. Ritz, he became quite enthusiastic and asked me if I could accompany him on a visit to Severn-Lamb's premises right away, yes that very day! I seem to recall that this discussion took place around 10.30am on a weekday, so there would have been plenty of time to get to Stratford and back that same day. I said that provided my Editor had no objection, I could join M. Ritz with his proposed visit to Severn-Lamb's premises. So about two hours later saw M. Ritz and myself in a first-class carriage *en route* to Stratford-upon-Avon.

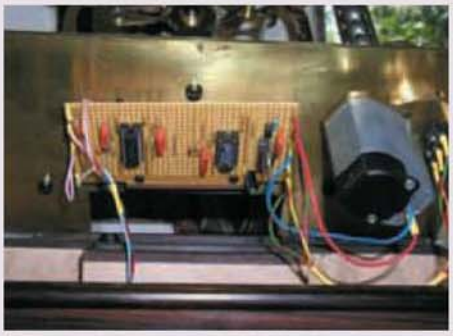
●*To be continued.*



The micro switch and operating plunger mounted on the Archimedes screw drive motor mounting plate.



A view of the electronic control board. Although this may seem daunting for some builders, its construction is really quite simple.



This view of the motor control board shows how it is mounted in relation to the Archimedes screw drive motor which it controls.

A FERRIS WHEEL CLOCK

Richard Stephen

fits the motor and micro-switch and builds the control circuit.

●*Part XII continued from page 24 (M.E. 4186, 10 January 2003)*

Attach the spacer to the base and assemble the Archimedes screw in the lifting tube, only fitting the cover at this time. The ball races should also be fitted. Attach the lifting tube to the base. At this stage the screw arbor will extend below the spacer. The arbor should be turned down to fit into the 2mm dia. hole in the motor mount. The 2mm dia. end of the arbor is not necessary as a pivot, the two ball races are more than adequate support for the screw. However, it does provide a measure of extra support and assists in the positioning of the motor and depthing of the wheel and pinion.

Disassemble the arbor; you will not need to unscrew the lifting tube to do this. Reduce the end of the arbor to 2mm diameter. The clearance between the shoulder and the surface of the motor mount should be about 0.25mm. The arbor should also be reduced to 3.5mm dia. for a length of 11.75mm to fit the screw wheel. This gives a distance between the screw wheel and the motor mount of 3.5mm. Fit the wheel onto the arbor and secure it with a 2mm grub screw. To ensure that the wheel does not slip, a 1mm dia. hole is drilled into the arbor, its position being marked by filing a sharp point on the end of the grub screw mounted in the lathe. Slip the wheel onto the arbor and tighten the grub screw against the arbor marking the position of the 1mm hole. Drill the hole, reduce the end of the grub screw to 1mm and check that it locates in the hole.

Re-assemble the screw on its arbor in the lifting tube. Attach the wheel and secure it with the grub screw. Attach the pinion to the shaft of the motor and secure it in place with the grub screw. Position the motor mount on the spacer using the 2mm dia. end of the arbor to line it up. Clamp it in place. Before drilling the holes for the register pins it is as well to check that the wheel and pinion are meshing properly. Unfortunately it is impossible to see the wheels or to turn the Archimedes screw by hand. Connect the leads of the motor to a 6V battery and check that the screw turns smoothly with little noise. If it is noisy the depthing of the wheel and pinion will have to be altered. Unfortunately this means either making the motor mount again or drilling out the 2mm hole to 4mm diameter, bushing it and re-depthing.

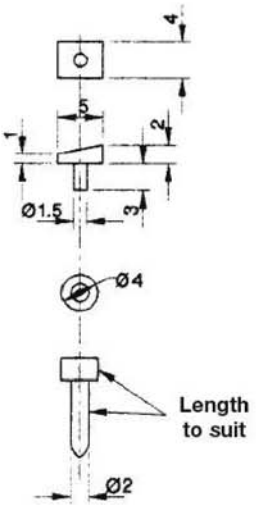


Figure 47 - Microswitch Ramp and Plunger

If the screw turns nice and smoothly mark the positions of the register pin holes and the holes for the two 2.5mm screws. To drill the holes for the register pins and the screws in the spacer you will have to take everything apart. Fit the register pins into the motor mount and tap the holes for the 2.5mm dia. screws. The motor mount, still in its original rectangular shape, can now be shaped to fit neatly around the motor and the spacer.

The time has now come to test the entire ball re-cycling assembly under power. Assemble the lifting tube and Archimedes screw, contacts, entrance track, vertical track, delivery track and motor on the base plate on the temporary base. Place four balls on the entrance track. Connect the motor to a 6V battery. Connect the blue lead to the negative terminal of the battery and touch the red lead against the positive. The screw should turn clockwise, pick up a ball and deposit it in the vertical track. Detach the red lead and add another ball to the entrance track. Lift up a second ball. Repeat until the vertical track is filled and the balls roll down the delivery track.

Fitting the 'off' micro-switch

The final mechanical component to be fitted is the micro-switch that turns off the motor after one revolution of the Archimedes screw. Suitable micro-switches are available from any good supplier of electronic components. One of the best is RS Components. I used the basic type V4 but any other similar micro-switch will do just as well. The photograph illustrates the mounting of the micro-switch. The switch is actuated by a glass hard steel ramp attached to the face of the Archimedes' screw wheel. As the wheel rotates a plunger in contact with the switch button is raised by the ramp closing the contact. The wheel continues to rotate until the plunger drops off the end of the ramp at which point the control board cuts off the power to the motor.

Remove the motor from its mounting. Begin by attaching the brass bracket on which the switch is mounted onto the motor base. When you buy the switch, be sure to get a copy of the dimensions and mounting details for it from the supplier. Before you attach the bracket ensure that the button on the switch will line up with the hole in the screw wheel for the actuating ramp. Drill and tap the holes in the bracket to attach the switch. Locate and mark the point on the motor base directly below the button. Drill a 3mm hole through the motor base for the plunger sleeve which is made from a scrap of brass rod and fixed into the 3mm hole in the base with Loctite. The plunger is made from a length of 4mm silver-steel rod. The ramp is made from a piece of 6mm silver-steel rod, glass hardened and polished.

Fix the motor base in position on the spacer. Mark the position of the hole for the ramp in the screw wheel using a short piece of 2mm steel rod, with a sharp point, fitted into the 2mm hole in the sleeve. Drill the 2mm hole in the wheel and fix the ramp in position using Loctite. Fix the whole switch assembly in place. The top of the plunger should just be in contact with the button. Adjust the length of the plunger so that as the wheel rotates the plunger is raised just enough to close the contacts and allow them to open again when the plunger drops off the top of the ramp. The end of the plunger in contact with the ramp is rounded and polished. The plunger can now be heated to a cherry red and quenched, polished and left glass hard.

This completes all the mechanical parts of the clock. All that remains is to make the electronic control board and a nice wooden base on which to mount the whole clock.

Electronic control board

Figure 48 illustrates the circuit diagram of the board used to control the motor. The advantage of using electronic motor control is that no levers are required to control the switching. This removes clutter and I feel improves the overall appearance of the clock. Readers who have little

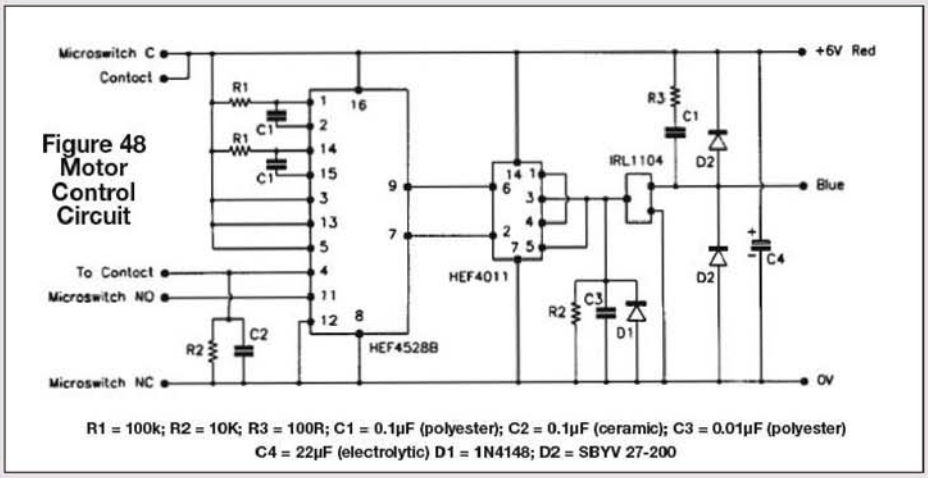


Figure 48 Motor Control Circuit

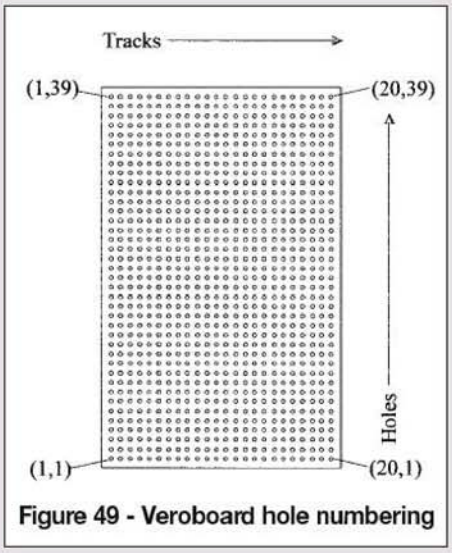


Figure 49 - Veroboard hole numbering

or no experience of electronics may begin to worry at this point. These readers can be assured that no knowledge of electronics is required to build the control board. Construction will be done entirely by numbers. The materials required are shown in the accompanying table and, since they are not costly, a few spares would not go amiss.

Assembling the board

The piece of Vero board used for the control board has 20 tracks and 40 holes along each track. The position of the various components to be soldered to the board will be denoted by the hole number followed by the track number with the board viewed from the component side (not the side with the copper tracks). The component positions are numbered beginning from the bottom left hand corner (see fig 49). Thus a resistor fitted at (10,12; 10,16) has to be soldered to hole 10 on track 12 and to hole 10 on track 16. Check the various connections against the circuit diagram (fig 48) as well as the functional data for each chip before you solder each component in place.

Begin assembling the board by soldering the two DIL sockets in place:

1: 16 pin: (31,14; 31,7; 27,7; 27,7)
(pins 1, 8, 9, 16)
2: 14 pin: (14,12; 14.6; 11,6; 11,12)
(pins 1, 7, 8, 14)

Before soldering the sockets in place, use the track cutter to cut the tracks between the pins of the sockets. To cut a track, place the point of the drill in the hole where the track is to be cut and twist. After cutting check carefully that no whiskers of track remain to cause a short circuit.

Insert and solder Vero board pins at the following points: (1,1; 1,5; 1,10; 1,18; 1,20; 40,1; 40,11; 40,18; 40,20).

A number of links will be required. Links are best made using tinned copper wire which has first been stretched to straighten it, each link being made to exactly suit the distance to be spanned. By this means, the job will be a lot easier, much neater and far easier to check. I find that a piece of masking tape is helpful to hold the link in place against the surface of the board when soldering. Link the following circuit points:

(5,1; 5,9), (8,11; 8,14), (9,4; 9,18),
(10,12; 10,18), (15,1; 15,6), (15,9; 15,12),
(16,8; 16,10), (17,10; 17,14), (22,6; 22,11),
(26,5; 26,9), (26,11; 26,14), (27,1; 27,10),
(27,14; 27,18), (32,1; 32,7), (32,12; 32,18),
(33,6; 33,8), (33,10; 33,12), (39,18; 39,20).

Link capacitors between the following points:

Metallised polyester:
0.1µF: (3,10; 3,13), (24,12; 24,13),
(34,13; 34,14).
0.01µF: (16,6;16,8).

Electronic control board components

1: 0.1in. pitch Vero board 2½ x 4in. with the tracks running along the length of the board (i.e. parallel with the long side).
2: DIL socket: 1 x 16 pin.
3: DIL socket: 1 x 14 pin.
4: Vero board pins: 1 pack.
5: 22swg tinned copper wire: 5 metres.
6: 1.2mm pvc coated stranded tinned copper wire: 1 metre each red, black, green and yellow.
7: Heat shrink tube: short lengths of 2.5 and 5mm.
8: Resistors (0.5W): 2 x 10k ; 2 x 100k ; 1 x 100R.
9: Capacitors: 3 x 0.1µF, 1 x 0.1µF (polyester); 1 x 0.1µF (ceramic), 1 x 22µF (electrolytic)
10: Diode: 1 x IN4148, 2 x SBYV 27-200.
11: Dual mono-stable multi-vibrator: 1 x HEF4528B .
12: CMOS gate: HEF4011.
13: Power MOSFET: 1 x IRL 1104
14: 4-cell battery holder to suit D-size cells.
15: Soldering iron and solder suitable for electronic circuit assembly.
16: Snipe nose pliers and flush cut wire cutters.
17: Veroboard track cutter or 4mm twist drill in a handle.
18: Electrical test meter (very handy if you happen to have one).

Ceramic
0.1µF: (35,7; 35,11).
Electrolytic
22µF: (-ve 8,1; +ve8,4)

Link resistors between the following points:

100R: (4,13; 4,18)
1k: (34,7; 34,11)
10k: (17,6; 17,10).
100k: (25,12; 25,18), (33,13; 33,18).

Solder the diodes between the following points. Consult the circuit diagram to ensure you solder the diodes the correct way round. To assist in this, unlike the co-ordinates of the rest of the components, the co-ordinates of the end with the bar are given first:

SBYV27-200: (4,10; 4,1) (5,18; 5,10).
IN4148: (18,10; 18,6).

Solder the power MOSFET at the following points:

(6,9; 6,10; 6,11) (pins 3, 2, 1 respectively)

Finally cut the tracks at the following points:

(8,6), (8,7), (8,8), (8,9), (8,10), (8,11), (8,12),
(11,4), (21,6), (21,8), (21,9), (21,10), (23,11),
(23,12), (23,13), (23,14).

That completes all the connections. You should now check very carefully the connections on the board against the schematic circuit diagram (fig 48). Check the underside of the board that all the solder joints are sound and that there are no short circuits.

The board should now be tested. If you have an oscilloscope available test the board with this first. Connect a spare microswitch to the board using some of the 1.2mm PVC wire. The microswitch has three terminals NO, NC and C. With the terminals uppermost connect the left one (NC) to 0V pin (1,1), the centre one (NO) to pin (1,5) and the right one (C) to +6V pin (1,18). When the switch is closed the i_{oB} input goes high (+6V) and only triggers monostable B on a high-low transition. This action turns off the motor. The ball contacts will be connected to pin (40,11) and to +6V pin (40,18). For the moment don't connect the contacts, rather two short lengths of PVC covered wire with the free ends bared. When a ball closes the contacts or you touch the two free ends, the i_{1A} input of the monostable A goes low-high. This will trigger monostable A and turn on the motor. Connect the terminals of the battery pack to the remaining +6V and 0V pins. Insert the two ICs into their respective sockets. The pin to the left of the notch on top of the IC is pin 1.

To test the circuit, clip the earth of the 'scope to one of the 0V pins and hold the flying lead of the 'scope against pin 7 of the HEF4528. The 'scope should register +6V. Briefly touch the two bare ends of the 'contacts'. This should produce a brief negative going pulse. Now hold the flying lead of the 'scope against pin 9 of the HEF4528. The 'scope should register +6V. Close the microswitch; nothing should happen, releasing the switch should produce a brief negative going pulse. Now hold the flying lead of the 'scope against pin 3 of the HEF4011. Briefly touch the bare ends of the 'contacts'. The 'scope beam should jump from 0V to 6V and remain there. Close the microswitch and release it. The 'scope beam should drop back to 0V as soon as the switch is released. The board can now be tested with the motor connected. Connect the blue lead to circuit board pin (1,10) and the red lead to pin (1,18) (+6V). Briefly touch the bare ends of the 'contacts'. The motor should begin to rotate anti-clockwise. Closing and releasing the microswitch should instantly stop the motor.

The control board is fixed to the underside of the brass base plate by two screws. These screw into a piece of Tufnol or other insulating material attached (glued with Araldite) to the brass base.

This completes the mechanical and electronic aspects of the clock. All that remains is to make the base and test the clock before you dismantle it and polish all the parts.

●*To be continued*

CLUB CHAT
With Stan Bray

Special Occasion at Ashton Court

Bristol SMEE members surprised Joan Williams with a special party to celebrate her 80th birthday. She drove the club's locomotive* Pegasus *with a full load of lady passengers (above) and spent some time at the controls of Vice President Bernard North's* Simplex, *(below). It is Bernard who can be held responsible for organising the surprise. Our third photograph (right) shows Joan cutting her cake. (Photographs by Dave Caseley)

UK News

In the late summer, **Bristol SMEE** held a very special event when members celebrated Joan Williams' 80th birthday. Joan and her husband had been associated with the society since the 1940s and when sadly he died, Joan continued with the club, helping at as many of the society events as she possibly could. Bernard North arranged the surprise party having told Joan that he and his wife Sylvia were taking her out to tea but had to call at the track on the way to deliver a sign. Upon arrival at the track Joan realised there was a party, but still did not appreciate that it was for her and that she had been 'set up'. Some 60 or so of her friends were present, the weather smiled and there was a large birthday cake for her to cut. She seems to have spent a large part of the day driving trains and is no stranger to steam or non-steam locomotives. It really was a special day for her and everyone present to remember and long may she continue her association with the society.

After many years as Secretary of **Tyneside SMEE**, Malcolm Halliday has decided it is time to take a break. Ian Spencer has taken his place and any communication relating to society matters should now be addressed to Ian at 39 Briardene Crescent, Kenton, Newcastle upon Tyne NE3 4RX.

The annual **Fylde SME** exhibition is scheduled for 5/6 April at the Marine Hall, and we understand that preparations are well in hand to make this an even better exhibition than previous ones. The event has been a highlight in the North West for a number of years now and is always well worth a visit.

Work on refurbishing the **Sutton MEC** ground level track came to a temporary halt while a pile of rubble was cleared. The rubble was all that remained of a retaining wall which has now been rebuilt to a standard sufficient to withstand a nuclear explosion! It was anticipated that the track would be replaced in its upgraded form in time for the annual post-Christmas running session. Items available for the club auction were augmented by material from a charity called Tools For Self Reliance. This charity accepts donations of new or old woodworking and engineering tools and distributes them to people not in a position to acquire their own. Items thought to be surplus to requirements are disposed of and in this case were being sold by the society. A good collection of drills, taps, dies, spanners, and the like, many of which were sold to members, resulted in a donation of £200 to the charity while club funds benefited by over £300 from the sale premium retained by the club for the disposal of items provided by members.

Since the last **Guildford MES** membership list was published in 2001, more than 30 newcomers have joined the society and, while many clubs continue to report an increase in membership, this could be something of a record. Those many readers who have visited the club site on one or other of their various open events will not be surprised to learn that still further improvements are under way. In particular, work by a dedicated band of Thursday toilers has resulted in new loading and unloading facilities for the models used on the raised track, as well as magnificent new carriage and engine sheds. The same gang are now busy working on new facilities for the ground level 7 1/4in. gauge track. Although originally intended as a one-off event in place of IMLEC, which had to be cancelled due to the recent foot and mouth disease epidemic, by popular request the society ran a second open efficiency trial, dubbed OMLEC, in 2002. With 22 entrants from various parts of the country, David James won with his 5in. gauge Britannia class locomotive. Dave Mayall won the 3 1/2in. gauge section with his model LMS 4F. As 2001 was supposed to be a one-off event, the prize-winners had been allowed to keep their trophies and so new ones were kindly donated by Bruce Davey, proprietor of Bruce Engineering.

Thanks to some dedicated work by a few members, **Colchester SMEE** now has three steam locomotives in working order. Many readers will be familiar with the problem that club locomotives are sometimes used by members who neither clean them down after use nor report any faults which might occur, thus leaving problems for the next person wishing to use the engine. In an effort to resolve this, the Colchester locomotives are either being kept in a locked box or stored with their grates removed so that anyone wishing to use them will first have to obtain a key or a grate. Users will therefore be known and presumably anyone failing to look after a locomotive properly will find future access difficult. Good progress is being made on the ground level track, with mass production of point motors about to begin. Parts of the motors are being made by members in their home workshops from materials supplied by the society, and the motors will be assembled when all the parts are ready.

A lecture on first aid by **North London SME** member Dr. Ian Johnson gave fellow members an insight into dealing with various injuries, both slight and serious. The subject was covered in depth and obviously with humour, thus ensuring that his advice was noted by all present. Several societies are now arranging such talks, which can only be for the good of the hobby. Even so, it is doubtful that many clubs have sufficient members available who are properly qualified to deal with emergencies should they arise. St John Ambulance Society hold regular courses at various levels and would be only too pleased to arrange a

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.

Stan Baker	*York City DSME*
Janet Gaal	*SLS Victoria*
Tom Gaulter	*Fylde SME*
Stan Massey	*Sutton MEC*
Albert Walton	*York City DSME*
Cliff Widmer	*British Columbia SME*
Danny Wilhelm	*British Columbia SME*
Bryan Whitman	*Colchester SMEE*

special one for a club, provided sufficient members were to attend to make the effort worth while. A certificate is awarded upon passing a short examination.

Although presently only at the planning stage, a fully automated signalling system for the raised track is to be installed by **City of Oxford SME**. As the track is continuous without pointwork, few problems are anticipated. Members also wish to fit such a system to the ground level layout but this will be complicated by junctions and the fact that the final layout of the station area has not yet been established. Experience from the raised level track installation will doubtless be valuable when work begins on the ground level signals. Train detection devices will be in the form of treadle switches, PIR sensors having been ruled out as they can be activated by anything moving in the immediate area, and track circuiting is considered unreliable because rust on the rails may interfere with the electrical signal. Following due consideration of in-house construction, it was decided to purchase the actual signal heads from Parkside Electronics. Made of polycarbonate, it is felt that they will have a good resistance to vandalism. The system will permit five trains on the circuit while leaving four sections vacant, thus ensuring a good safety margin. The only danger remaining will be caused by human error. Despite having to alter the dates through no fault of their own, the annual Dreaming Spires Rally attracted 24 visiting models, those travelling furthest coming from Cardiff and Leeds.

The annual **Bradford MES** competition was also very much a social event with the ladies maintaining a regular supply of tea and cakes while the awards were made and members discussed the models on show. The final results were as follows: *Hepworth Trophy* for best in show, and *Jack Ashworth Trophy* for best example of engineering, to Gary Park for a horizontal mill engine; *Tempest Trophy* for best marine model, to John Shelton with a fireboat; *Thornton Trophy* for runner-up to best in show and *Northcliffe Trophy* for best railway locomotive to Michael Turner for *Sweet Pea*; *Meeson Trophy* for best unfinished model and *Novice Trophy,* to John Mills for *Lion*; *Barber Tidswell Trophy* for best effort by an under 25 years old, to Daniel Murgatroyd for a wooden wheelbarrow; *Handicraft Trophy,* to Dr. Jim Jennings for a display of hand crafted metal and wooden spoons. The standard of workmanship was very high and appears to improve year upon year. The final touches are being put to a new display stand which will be in use at the Model Engineering Exhibition at Harrogate in May.

Signalling has taken priority during the winter for members of **Plymouth Miniature Steam** where the plan is to install a selection of very fine signals made for the society by late Chairman Jack Samuels. The first two Sundays of November saw a good start in the installation of 200 metres of cable. When all the cable is in place, concrete bases for the signal posts will be laid. Even though good progress is being made there is still a race against time to get everything ready for the summer, particularly as plans include building a signal box. Having enjoyed an encouraging influx of new members during 2002, including many younger people with little or no knowledge of engineering, the society has organised a form of apprentice scheme. The tools of late member Alan Cleaver have been generously donated to the society by his widow Barbara and will be used by those new to the hobby. We admire the scheme and consider those concerned to be particularly fortunate in that they will be able to decide exactly what tools they need to set up their own workshops while at the same time gaining guidance and experience in their use.

Following suggestions that the **Maxitrak Owners Club** should widen its horizons and become an open society rather than one limited to owners of Maxitrak models, a members' vote narrowly decided that the *status quo* should be maintained. An increase of 26 in the membership during 2002 may have been partly due to special events arranged for Maxitrak owners during the year. At one such event in Ipswich, 12 models were in operation although only two were steam driven. Several committee members expressed their wish to stand down at the AGM at which most posts were filled, but that of Chairman remains vacant. Secretary Eric Penn indicated his willingness to continue and remains in office.

More visitors than members attended the annual **Erewash Valley MES** bonfire night party. Nevertheless, everyone enjoyed the dumpling stew served as part of the proceedings. Rain set in shortly after the start of the event, but the only people to get wet were the three volunteer firework operatives; everyone else sheltered in the steaming bays or station. The new 2-6-0 locomotive *Polly* created a good impression when recently tested at the club track and appears perfectly capable of doing a decent job.

Some of the work on the ground level track at **York City DSME** has been held up temporarily (we hope) while planning permission is obtained, but progress is still being made where possible. The annual visit of children from the Minster School is a highlight both for members and children; the 2002 event was no exception, and everyone enjoyed a thoroughly good time.

Two-way radios have been purchased by **Rugby MES** to improve communications between the club's main gate and car park during public running sessions, with the aim of improving the organisation of car-parking. A public spirited member has taken the society's *Royal Scot* for rebuilding following its stripping down some years ago since when no further progress had been made. A decision will have to be taken concerning its boiler which may have to be replaced. The late Dr John Farrington's 7¼in. gauge *Romulus*, now donated to the society, is also undergoing a rebuild. During 2002, the club organised a number of days for disadvantaged children, including visits by 25 youngsters from the Rugby Autistic Society, youngsters from special schools and children from Chernobyl. A highlight associated with this kind of activity may have been when two members visited the Brooke Special Needs School in Rugby which caters for children with learning difficulties, many of whom are disabled. Because the children are so vulnerable, the school is maintained as a secure environment and the two members concerned had to be 'signed-in'. They took with them a Hornby '0' gauge railway, a 7¼in. gauge locomotive with a short length of track and a video programme. The children, who normally have an extremely short attention span, were apparently content to watch the model railway and have rides on the tender seat of the locomotive for relatively long periods of time and obviously had a day of great pleasure.

World News

South Africa

The building of shelves along one wall of the **Centurion SME** club library of has enabled their large collection of magazines to be displayed. Members can now find what they want without having to rummage through piles of them. In due course they will be sorted and ordered which will make matters even easier. As a change from the usual end of year party in the clubhouse, the club had a 'Bring and Braai Ride' which offered the best of both worlds: the chance to have a feast as well as to run trains.

Canada

When last we heard, work on the new **British Columbia SME** club locomotive, a model CNR Class F7, was nearing completion, requiring only wiring and painting to finish. Like many others in the club it is battery driven and 25 years experience in making such models means that members know how to get the best results. It seems that the secret is to use high-revving permanent magnet motors, geared down to give suitable track speeds. In the present case, the motors run at 5000rpm with a 12.5 reduction drive to the axles. With this configuration, even at relatively low speeds sufficient air is drawn through the cooling fans to prevent overheating. Lindsay McDonnell, a staunch supporter of this type of traction, has calculated basic running costs, comparing a battery electric locomotive with one powered by an internal combustion engine. Based on usage for 6 hours per day, 60 days per year, a Honda engine powered locomotive costs approximately $3276 to run while it costs only $117.37 to recharge the electric loco batteries; electric powered locos are also easier to run. Having worked out all this it then becomes obvious that, although happy to have this type of motive power for the club for the reasons given, Lindsay much prefers a steam locomotive himself, no matter what it costs to run!

Australia

Hornsby Model Engineers report that their winter public running sessions were well patronised ▶

despite concerns over bush fires. At one time it was feared that their annual exhibition, the latest to mark the club's 29th year, may have had to be cancelled because of the threat of heat from the fires, but all was well in the end. Although there were fewer railway exhibits than in previous years, the exhibition was of a high standard. Opened by Barry Glover, Chairman of the **Australian Association of Live Steamers** it is pleasing to report a good attendance. One reason for the reduced number of railway exhibits may have been the advancing age of some of the stalwarts — younger members are therefore being urged to get more involved in the next exhibition.

Regular gatherings of the 'Silvertops', older members of the **Steam Locomotive Society of Victoria,** continue to attract over 30 regular attenders. This leads to a good number of locomotives in operation as well as the completion of some of the jobs and construction work. Members are obviously keen as we have reports of over 50 in attendance for a normal club run and 43 for public running, with similar numbers reported for regular Friday evening meetings — certainly no lack of enthusiasm here! The club website at **www.slsv.co.au** gives details of their activities past, present and proposed, and reproduces some of the interesting articles to be found in their newsletter *Big Wheel News*.

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.

FEBRUARY

7 **Vale of Aylesbury MES.** *Chairman's Cup Competition.* Contact Clive Ellam: 01296-623433.
7 **Maidstone MES.** *Quiz Night.* Contact Martin Parham: 01622-630298.
7 **North London SME.** *An Evening with the Slot Car Section.* Contact Tony Dunbar: 01992-465625.
7 **North Norfolk MEC.** *G. Gurney: Clocks.* Contact Gordon Ford: 01263-512350.
7 **Portsmouth MES.** *AGM.* Contact Bob Aldred: 023-92-523366.
7 **Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
7 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
8 **Hornsby ME.** *Preparation Day for ILS 24hr Live Steam Run.* Contact Ted Gray: 9484-7583.
8 **Reading SME.** *Club Running.* Contact Graham Bustin: 01189-615450.
8/9 ***Festival of British Railway Modelling*** at Doncaster Exhibition Centre, Doncaster Racecourse. Advance booking (to 27 January 2003): Adults: £4.50, Children: £3, OAP: £4, Family (2+3): £15. Information and Ticket Hotline: 01778-391134.
9 **Durban SME.** *Bits & Pieces.* Contact David Martin: 031-5635755.
9 **Hornsby ME.** *Running Day.* Contact Ted Gray: 9484-7583.
9 **Sutton MEC.** *Track Day.* Contact Mike Dean: 0208-657-5401.
10 **Bedford MES.** *Arctic Engineering.* Contact Ted Jolliffe: 01234-327791.
10 **Erewash Valley MES.** *Bits & Bobs.* Contact Jim Matthews: 01332-705259.
10 **Frimley & Ascot LC.** *Meeting.* Contact Bob Dowman: 01252-835042.
10 **Melton Mowbray DMES.** *Video Night.* Contact Phil Tansley: 0116-2673646.
11 **Cardiff MES.** *Steam-Up & Family Day.* Contact Trevor Jenkins: 029-2075-5568.
11 **Dockland & E. London MES.** *Bits & Pieces.* Contact P. M. Jonas: 01708-228510.
11 **Manx Steam & MEC.** *Meeting.* Contact Mike Casey: 01624-861613.
11 **Sutton Coldfield MES.** *Dr. J. Penny: Something Astronomical.* Contact Roger Timings: 0121-308-5875.
12 **Chingford DMEC.** *Len Pearson: Visit to America.* Contact Martin Masterson: 0208-989-5552.
12 **St. Albans DMES.** *Frank Banfield: Film Show.* Contact Roy Verden: 01923-220590.
12 **Staines SME.** *Ingenuity Evening.* Contact Mike Kingham 01932-788793.
13 **Cardiff MES.** *Forum.* Contact Trevor Jenkins: 029-2075-5568.
13 **High Wycombe MEC.** *Andy Hopper: Model Aircraft.* Contact David Savage: 01494-527402.
13 **Leyland SME.** *Presentation of President's Trophy.* Contact Mark Entwistle: 01772-422411.
13 **N. W. Leicester SME.** *AGM.* Contact John Elliott: 01455-847040.
13 **Sutton MEC.** *Pressure Gauges Testing.* Contact Mike Dean: 0208-657-5401.
14 **Centurion SME.** *AGM.* Contact Rudy Du Preez: 012-9986780.
14 **Colchester SMEE.** *Auction.* Contact L. G. Hammond: 01376-511686.
14 **Hereford SME.** *Peter Judge: Jewellery – What it Means to Your Wife and Your Pocket.* Contact John Arrowsmith: 01432-265151.
14-16 **Brighton *ModelWorld*** at the Brighton Centre. 10am-5.30pm; Adult: £6, Child/Senior Citizen: £3, Family: £16. Contact Tim Steven: 01444-254057.
16 **Frimley & Ascot LC.** *Club Run.* Contact Bob Dowman: 01252-835042.
16 **Hornsby ME.** *Sailing Day – Fagan Park.* Contact Ted Gray: 9484-7583.
16 **N. W. Leicester SME.** *Running Sunday.* Contact John Elliott: 01455-847040.
17 **Leicester SME.** *George Gamble: Medals and How They Were Won.* Contact Raymond Wallis: 0116-285-8824.
18 **Basingstoke DMES.** *Stationary Engines.* Contact Ian Shanks: 01420-561741.
18 **Chesterfield MES.** *K. Hale: Silver Soldering.* Contact Mike Rhodes: 01623-648676.
18 **Nottingham SMEE.** *Gordon Smith: Safety Valve Design & Development.* Contact Graham Davenport: 0115-8496703.
18 **Romney Marsh MES.** *Richard Linkins: Railways Here and There.* Contact John Wimble: 01797-362295.
18 **Surrey SME.** *Paul Gammon: Superheaters.* Contact John Cook: 020-8397-3932.
18 **West Wiltshire SME.** *Chris Pulling: The Blackpool Tramway.* Contact R. Nev. Boulton: 01380-828101.
19 **Bournemouth DSME.** *Richard Knott: Video.* Contact Mike Baker: 01202-383653.
19 **Bristol SMEE.** *Auction.* Contact Trevor Chambers: 01454-415085.
19 **Chingford DMEC.** *Martin Masterson: Digital Photography Update.* Contact Martin Masterson: 0208-989-5552.
19 **Guildford MES.** *Bits & Pieces.* Contact Dave Longhurst: 01428-605424.
19 **Hull DSME.** *Jim Smith: 1:7 Scale WDLB Wagon.* Contact Brian Rylance: 01482-647032.
19 **Leeds SMEE.** *Les Davis: Last Days of Steam.* Contact Colin Abrey: 01132-649630.
20 **Cardiff MES.** *Mike Messenger: Colorado Narrow Gauge Railways.* Contact Trevor Jenkins: 029-2075-5568.
20 **Isle of Wight MES.** *Mike Favell: Railway Electrification.* Contact Ken Stratton: 01983-760762.
20 **Reading SME.** *Winter Talk.* Contact Graham Bustin: 01189-615450.
20 **Rugby MES.** *Les Arnold: History of the British Tractor.* Contact David Eadon: 01788-576956.
20 **Sutton MEC.** *Paul Bedford: Toys or Investments?* Contact Mike Dean: 0208-657-5401.
21 **MELSA.** *AGM.* Contact Graham Chadbone: 07-4121-4341.
21 **Rochdale SMEE.** *George Howard: More Rare Tools.* Contact Mike Foster: 01706-360849.
21 **Romford MEC.** *Charles Summers: The Lynton & Barnstaple Railway.* Contact Colin Hunt: 01708-709302.
21 **Romney Marsh MES.** *Video Evening.* Contact John Wimble: 01797-362295.
21 **Steam LS of Victoria.** *Meeting.* Contact Graham Plaskett: (03) 9750-5022.
22 **Chesterfield MES.** *Running Day.* Contact Mike Rhodes: 01623-648676.
22 **Hornsby ME.** *Family Day – Boiler Inspection.* Contact Ted Gray: 9484-7583.
22 **MELSA.** *Social Dinner.* Contact Graham Chadbone: 07-4121-4341.
22 **SM&EE.** *AGM.* Contact David Boote: 01202-745862.
22 **Steam LS of Victoria.** *Running.* Contact Graham Plaskett: (03) 9750-5022.
23 **Grange Community Ass'n** *21st Annual Modellers' Exhibition* at Grange Leisure Centre, Bepton Road, Midhurst, West Sussex. 10am-5.30pm. Adults: £3.20, Children: £1.20, Family (2+2): £7.50. Enquiries: 01730-816841.
23 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
23 **Steam LS of Victoria.** *Working Bee and Barbecue.* Contact Graham Plaskett: (03) 9750-5022.
24 **Bedford MES.** *Memories of Early Days at Summerfield.* Contact Ted Jolliffe: 01234-327791.
24 **Hornsby ME.** *Meeting - Social.* Contact Ted Gray: 9484-7583.
25 **Chelmsford SME.** *AGM.* Contact D. Blake: 01376-324205.
25 **Surrey SME.** *Bits & Pieces.* Contact John Cook: 020-8397-3932.
25 **Sutton Coldfield MES.** *Quiz Night.* Contact Roger Timings: 0121-308-5875.
25 **West Wiltshire SME.** *Social Evening.* Contact R. Nev. Boulton: 01380-828101.
26 **Chingford DMEC.** *Acorn Films: Narrow Gauge Films.* Contact Martin Masterson: 0208-989-5552.
26 **Staines SME.** *Jumble Sale.* Contact Mike Kingham 01932-788793.
26 **Teesside Small Gauge Rly.** *Meeting.* Contact Bill Foster: 01642-710198.
27 **Basildon DMEG.** *Meeting.* Contact Malcolm Burrell: 8 The Avenue, Billericay, Essex, CM12 9HH.
27 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-2075-5568.
27 **Leyland SME.** *The Idiot's Guide to Wheel Quartering.* Contact Mark Entwistle: 01772-422411.
27 **Sutton MEC.** *Non-Steam Night.* Contact Mike Dean: 0208-657-5401.
28 **Colchester SMEE.** *Models & Project Evening.* Contact L. G. Hammond: 01376-511686.
28 **Hereford SME.** *Geoff Tyler: Restoring a Burrell Traction Engine.* Contact John Arrowsmith: 01432-265151.

MARCH

1 **Cardiff MES.** *Steam-Up & Family Day.* Contact Trevor Jenkins: 029-2075-5568.
1 **SM&EE.** *David Abbott: The Construction of Model Boats.* Contact David Boote: 01202-745862.
1 **The Society of Ornamental Turners.** *Meeting.* Contact N. S. Edwards: 01234-359392.
2 **Frimley & Ascot LC.** *Running.* Contact Bob Dowman: 01252-835042.
2 **Hornsby ME.** *Sailing Day at Fagan Park.* Contact Ted Gray: 9484-7583.
2 **Ottawa Valley Live Steamers.** *Meeting.* Contact John Bryant: 761-1109.
2 **Rugby MES.** *Running.* Contact David Eadon: 01788-576956.
2 **South Durham SME.** *Running.* Contact B. Owens: 01325-721503.
2 **Surrey SME.** *Members' Steam-Up.* Contact John Cook: 020-8397-3932.
2 **Teesside Small Gauge Rly.** *Meeting.* Contact Bill Foster: 01642-710198.

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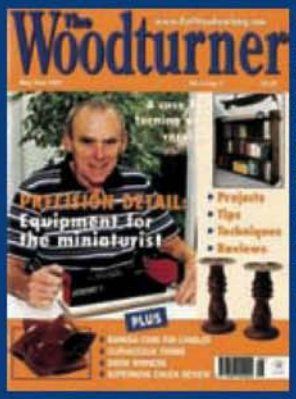

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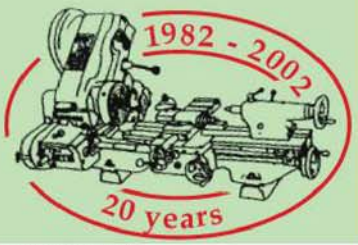

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VERTEX 6" - 8" - 10" ROTARY TABLES ..... ***NEW FROM*** £135
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MYFORD 254S REAR TOOL POST ..... ***NEW*** £40
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LOCKWOOD QUAD HEADED 3MT DIE HOLDER ..... ***NEW*** £40
LOCKWOOD TEST BAR / 2MT BOXED ..... ***NEW*** £39
LOCKWOOD TEST BAR / 3MT BOXED ..... ***NEW*** £42
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UNION TOOL AND CUTTER GRINDER STAND £135
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50 INT TOOLING; SELECTION ..... ***JUST IN***
STARTRITE 352 WOODWORKING BAND SAW £975
STARTRITE 14-S-5 WOODWORKING BAND SAW £775
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GABRO BF 620-2, 24" BOX AND PAN GENERAL USE FOLDER £325
MYFORD BURNERD GRIPTRU 3 JAW CHUCKS ..... ***BOXED*** £225
COLCHESTER / HARRISON D13 BURNERD 4 JAW 8" LIGHT BODY INDEPENDENT CHUCKS ..... ***BOXED*** £175
RJH 4" LINISHER / VERTICAL (BUILD IN EXTRACTION) £625
MICROMETERS AND ASSOCIATED MEASURING TOOLS ..... ***Still packaged as new***
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HARRISON L6 TAILSTOCK £245
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QUALTERS AND SMITH 6" Hacksaw £345
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DIE BOXES ..... From £45
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TRANSWAVE T2K-RT rotary converters ..... From £485
CROMPTON PARKINSON ¾ HP, resilient mount, Boxford / Myford Super 7 Type motor ..New £140

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Newall Measurement Systems

- 2-Axis DRO from **£615** inc vat
- Made in the UK
- 5 year No-Fault Warranty
- 10 micron Accuracy

Conquest Lathe

NOW INCLUDES TEST CERTIFICATE

£395

VARIABLE SPEED

*Price includes VAT & Delivery**

STANDARD ACCESSORIES

- 80mm 3-jaw chuck
- Q.C.T.P. with 3 Tool Holders

CHESTER U.K. LIMITED
MACHINE AND TOOLING SPECIALISTS

920 Lathe Deluxe

- Swing over bed: 229mm
- Swing over cross slide: 133mm
- Distance between centers: 500mm
- Spindle bore: 19mm
- Taper in spindle nose: MT3
- Motor: 3/4HP
- 6 Speed: 100-1800rpm
- Net weight: 100kg

STANDARD EQUIPMENT:

- 4" 3-jaw chuck with 2 sets of jaws
- 7" 4-jaw chuck with reversible jaws
- Steady rest • Follow rest
- MT2 Dead centre
- MT3 Dead centre
- 4-way tool post
- Face plate
- Tool Box & Tool Kit
- Tray & Splash guard

£699

*Price includes VAT & Delivery**

Model B-Super

- Swing over bed: 420mm
- Distance between centers: 500mm
- Mill drill spindle taper: 19mm
- Tailstock barrel travel: 80mm
- 7 speeds 160-1360rpm
- Swing over cross slide: 160mm
- Spindle taper: MT3
- Draw bar: M12
- Cross slide travel: 180mm
- Motor: 3/4HP
- Net weight: 155kg

STANDARD EQUIPMENT

- 4" 3-jaw chuck
- 2 dead centres
- 1/2 drill chuck
- Change gears
- MT3 chuck arbor

£699

*Price includes VAT & Delivery**

Centurion

- Swing over bed: 420mm
- Distance between centers: 520mm
- Mill drill spindle taper: MT3
- Tailstock barrel travel: 80mm
- 7 speeds 160-1360rpm
- Swing over saddle: 160mm
- Spindle taper: MT3
- Draw bar: M12
- Cross slide travel: 200mm
- Motor: 2 x 3/4HP
- Net weight: 230kg

STANDARD EQUIPMENT

- 4" 3-Jaw chuck
- 2 dead centers
- 1/2 drill chuck
- Change gears
- MT3 chuck arbor

£1100

*Price includes VAT & Delivery**

Champion Mill

- Drilling Capacity: 20mm • End Mill Capacity: 25mm
- Face Mill Capacity: 63mm • Table Size: 150x630mm
- Number of Speeds: 4 • Speed Range: 400-1640rpm
- Spindle Taper: MT3 • Tilting Head: 90° Left & Right
- Motor: 1/4HP

From

£585

*Price includes VAT & Delivery**

STANDARD ACCESSORIES

- 1-13mm Drill Chuck & Arbor

Eagle 25 Mill/Drill

- Mill/Drill Capacity: 25mm
- Table Size 190 x 585mm
- Fine Feed
- Number of Speeds: 12
- Speed range: 100-2150rpm
- Spindle Taper: MT3
- Spindle Travel: 100mm
- Motor: 1HP

Price

£699

*Price includes VAT & Delivery**

STANDARD ACCESSORIES

- 1-13mm Drill Chuck & MT3 Drill Chuck Arbor • Eagle Face Mill Cutter • T3 Tilting Vice • M12 Drawbar • NVR Switch Gear • Interlocked Chuck Guard • Manual and Parts List

Eagle 30 Mill/Drill

- Mill/Drill Capacity: 32mm
- Table Size 210 x 740mm
- Fine Feed
- Number of Speeds: 10
- Speed range: 80-2300rpm
- Spindle Taper: MT3
- Spindle Travel: 130mm
- Tilting Head
- Motor: 1HP
- High/Low Gearbox

Price

£899

*Price includes VAT & Delivery**

STANDARD ACCESSORIES

- 1-13mm Drill Chuck & MT3 Drill Chuck Arbor • Eagle Face Mill Cutter • V100 Machine Vice • M12 Drawbar • NVR Switch Gear • Interlocked Chuck Guard • Manual and Parts List

626 Turret Mill

- Milling Capacity: 25mm
- Drilling Capacity: 32mm
- Table Size 152 x 740mm
- Fine Feed
- Number of Speeds: 9
- Speed range: 190-2100rpm
- Spindle Taper: MT3 or R8
- Tilting Head
- Motor: 1HP

Price

£1340

*Price includes VAT & Delivery**

STANDARD ACCESSORIES

- One Shot Lubrication • Halogen Work Light • Machine Stand
- Drawbar • Manual and Parts List

Craftsman Gap Bed Lathe

- Swing over bed: 300mm • Swing over gap: 450mm
- Swing over saddle: 170mm • Distance between centres: 570mm
- Spindle bore: 36mm • Spindle nose taper: MT5
- Cross slide travel: 150mm • Compound travel: 89mm
- Tailstock barrel taper MT3 • Tailstock barrel travel: 92mm
- Range of speeds: 50-1250rpm
- Motor: 11/2 HP
- Netweight 398kg

£1550

*Price includes VAT & Delivery**

STANDARD EQUIPMENT:

- 6" 3-jaw chuck with 2 sets of jaws
- 8" 4-jaw chuck
- Steady rest
- Follow rest
- Stand • Face plate
- Splash guard
- Threading dial
- 4-way turret tool post
- 3MT dead centers
- T-Slotted cross slide
- Halogen work light

Super LUX Mill

- Milling Capacity: 25mm
- Drilling Capacity: 32mm
- Table Size 240 x 800mm
- Fine Feed
- Number of Speeds: 6
- Speed range: 95-1600rpm
- Spindle Taper: MT3
- Tilting Head
- Motor: 1HP

Price

£1500

*Price includes VAT & Delivery**

STANDARD FEATURES

- Powered Head Elevation • Cast Iron Stand
- Angle Tilting Head • Manual and Parts List

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