MODEL ENGINEER

Vol. 198 No. 4291

19 January-1 February 2007

IMLEC 2007

M.E. INDEX JULY - DEC 2006

STEAM BOAT

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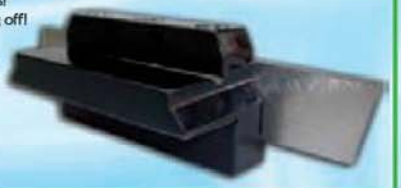

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MODEL ENGINEER

Published by
MAGICALIA PUBLISHING LTD.
Berwick House, 8-10 Knoll Rise,
Orpington, Kent BR6 0EL

Tel: +44 (0) 1689 899200
Fax: +44 (0) 1689 899266

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magicalia media

ISSN 0026-7325

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On the cover ...
H. R. H. Prince Edward driving John Lillington's 7 1/4 in. gauge SR 4-6-0 Lord Nelson at the then new track of the Ascot Locomotive Society. Since that time, it has had to re-locate due to the redevelopment of the new grandstand at Ascot racecourse. The fabulous new grandstand was completed last summer, and the new rail track will be in operation this year. The society has fingers crossed for another royal visit to mark that occasion. See letter on page 74.

(Photograph by Paul Reynolds)

TURN TO PAGE 108 FOR SUPER SUBSCRIPTION OFFERS

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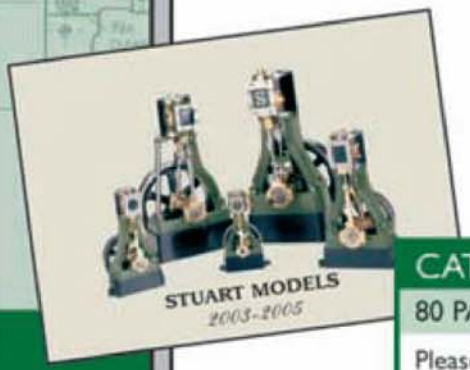

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SMOKE RINGS
With the Editors

Imperial denouement

We have been contacted by a number of readers expressing concern about European Union Directive 80/181. The publication *Motor Cycle News* has recently pointed out that the UK's derogation of this directive ends as soon as the end of 2009, and will make it illegal to market any item with packaging showing Imperial units.

This would suggest that it will no longer be legal to sell items like Imperial micrometers or taps and dies in imperial sizes. A ripple of concern has gripped the vehicle restoration hobby and the Federation of British Historical Vehicle Clubs has taken the matter up and will report as quickly as possible. One interpretation they place on the Directive is that it will not be illegal to sell a rule marked in inches but it will not be possible to accurately describe it as such on any label or packaging! Presumably a new 8tpi leadscrew for a Myford will have to become a 3.175mm pitch one.

More seriously, a report in the journal of the Institution of Mechanical Engineers, *Professional Engineering*, points out that the effects on UK manufacturing industry could be profound as valuable stock is rendered obsolete. Where it leaves pipe fittings made to British Standard Pipe Thread specifications, which is the EU standard, is anybody's guess.

Naturally, this Directive could have important implications for model engineering as many workers still prefer to use Imperial units and will continue to require the small tools and fasteners associated with those standards. Indeed, we know this to be true for some overseas readers, who favour the British threads for smaller work, and others who have no plans to go metric at all.

We will continue to monitor the actions of the FBHVC on this matter and would urge concerned readers to write to their MPs to express their opinions.

We should also like to ask the model engineering trade what it intends to do about this potentially serious issue. Can we at *Model Engineer* do anything to help?

Book it

The GWR Handbook 1923-1947, just published, is written by transport writer, David Wragg for Sutton Publishing. It does just what it says in the title.

Uniquely among Britain's railways, the Great Western Railway retained its identity from the time of its incorporation in 1835 until nationalisation in 1948. This was one of the great railways, so much so that for some enthusiasts it was the railway, even attracting such epithets as '*God's Wonderful Railway*', '*The Great Way Round*' and upon its demise '*Gone With Regret*' among the more dedicated. The Rev. Awdry once claimed that there were two ways of running a railway, the Great Western Way and the wrong way.

For many, the GWR was synonymous with holidays by the sea in the West Country, and for some of us the suburban run to school in the days before dreary Chelsea tractors, but it was originally formed to link London and Bristol. Even so, the amalgamations of 1923 saw the company absorb many smaller concerns, so that the post-grouping GWR was in some respects a different railway from that that had grown up during the nineteenth and early twentieth centuries.

This book looks at the history and achievements of the company. It includes photographs and diagrams illustrating the GWR's equipment and some railway stations, its network, shipping and air services, bus operations, including Western National, some comparative timetables showing progress between 1923 and 1938 (the last year of true peacetime operation), as well as lists of locomotives.

Steam into space... in an elevator

Shades of Arthur C. Clarke. Big prize money is available for the first 'space elevator'. Honest. We received a suggestion that model engineers might like to produce a steam or hot air powered version. Honest.

The competition, Elevator 2010, is sponsored by NASA, is to make a working model for the climber for the elevator. The goal is to produce a machine that can move up a 55 metre ribbon in 55 seconds.

The 'real' machine will be powered by the sun or laser light for a 62,000-mile journey. There's no reason why the energy shouldn't be used to boil water or power a hot air engine.

"*In the days of airships, the advocates of aircraft devised a new way to promote their (obviously impractical...) inventions. It was called an 'air show', and it had a dual purpose: First, these pioneers knew that they could explain airplanes all they wanted using equations and diagrams - it was not until they showed them flying that they really got their message across. Second, they recognized the power of competition - by bringing together airplane enthusiasts in a competitive environment, they were able to accelerate the rate of development beyond what was likely in the isolated confines of their shops*," say the organisers.

Their goal is to "*infect the engineering and science community with our passion for building the space elevator, thus making them ambassadors to our cause. As the fruits of their efforts take to the sky every year, we will have demonstrated the feasibility and sheer simplicity of the space elevator concept, and will have brought it closer to reality.*"

Total prize money provided by NASA's Centennial Challenges Program - is $4,000,000 over the next 5 years! Honest.

You can see details at **www.elevator2010.org**

What a chuffer!

We received a newspaper cutting about a poor model engineer who wanted to build a 7¼in. gauge railway in his garden in Nidderdale, in an area of outstanding natural beauty. Believe it or not the planning application was called in to be decided by a Government inspector after a planning appeal had been lodged. The local council turned down the application because it would unduly harm the residential amenity of the cottage next door.

The inspector duly visited the 'site' and came to his conclusions, some of which seem quite sensible. He concluded that the fumes generated would be no greater than from a domestic barbecue. He also opined that soot pollution would not be a problem to neighbours.

However, he sided with the objectors over the "*chuff, chuff*" noise and the use of a whistle. And he thought that repetitive circuits "*might*" cause some degree of annoyance to adjacent residents.

Despite this, the inspector gave the go-ahead.

But he imposed nine conditions!

The trains can only run clockwise (is this a response to the well-known anti-clockwise chuf enhancement ?) and can only be run by members of the family.

They have to use smokeless fuels, and only one locomotive can run at a time. They cannot run for more than four hours in any one day, and not at all after 8pm. It can only be used for up to 25 days a year, and not on successive weekends. Details of construction will have to approved by Harrogate Borough Council.

So model engineers beware. Chuff, chuff, whoo, whoo, is strictly *verboten* in Harrogate. Keep the neighbours happy. Build a 9-cylinder rotary instead.

George Golightly at an earlier IMLEC. He gives details of this year's event in Llanelli on page 76.

POST BAG

Hello again?

SIRS,- Keith Wilson's claim in *M.E.* No.4287 that one of his 7¼in. GWR King locomotives hauled the British Ambassador round the Los Angeles track in 1980 or 1981 fails to qualify in my reckoning. Echills Wood were continuing tradition, when carrying Princess Anne in 1984, but the first was probably when King George V and Queen Mary travelled on the 9 ½in. gauge Treasure Island Railway at the British Empire Exhibition in 1925.

King George VI, when Duke of York, drove *Northern Chief* on the 15in. gauge Romney Hythe and Dymchurch Railway in August 1926. But is this a miniature railway as understood by model engineers?

The 7¼in., 5in., and 3½in. multi-gauge railway, built at Heatherdown Preparatory School, Ascot by Ascot Locomotive Club, had the honour of being opened by Prince Edward on 20 July 1980, when he drove the late Henry May's 5in. gauge LNER B1 Class locomotive, *Nyala*. Prince Andrew also visited the railway as an 'old boy' and the station and signal box were named 'Princes'.

Loss of site resulted in the founding of Ascot Locomotive Society in 1988 and a move to Ascot Racecourse. On 21 May 1995, Prince Edward, accompanied by Miss Sophie Rhys-Jones, as she was then, made an official visit for the purpose of naming the new terminus station. He accepted an invitation to drive John Lillington's 7¼in. gauge SR 4-6-0 *Lord Nelson*, which is now stabled at the Great Cockrow Railway. Photo by Paul Reynolds enclosed (*reproduced on the cover. Ed*). *The Court Circular* informed the media, and photographs appeared in the next edition of *Hello!* magazine.

Realignment of the racing 'Straight Mile' in 2004, to facilitate rebuilding of the Ascot grandstand, resulted in this railway being re-located to the other side of the coach park. Limited operation will start in Spring 2007 and, when developed, there may be another Royal opening.

Ascot Locomotive Society occupies a secluded Crown Estate site with no liability to provide a public service. We operate the railway monthly for the collective pleasure of ourselves, family and friends. Members may use it at other times if they wish. Phone Derek Alford on 01244 482485 for members hip details.

Derek Alford, Berkshire

ED: We look forward greatly to visiting the Royal rails later in the year.

Electrical power supplies for workshops

SIRS, - Several contributors, including the late T. D. Walshaw (Tubal Cain), have recommended the installation and use of 3-phase electrical supply in the amateur's workshop, if at all possible. As I am now in the process of setting up a future retirement workshop I would like to seek advice on this subject.

In his excellent October 2004 article in *M.E.* 4231, David Sharman explored the subject of 3-phase electrical supply for the amateur's workshop and outlines several methods of achieving this. One other possibility now occurs to me that wasn't covered in the article, the use of a portable generator.

The proposed site for my new workshop is some 300ft. from the main house and anyway I would prefer a 3-phase supply rather than single phase over such a distance from the house. My present employment in the Middle East has a regular availability, or so I am assured by the electrical contractors, of 3-phase 220V.

Could any reader with a deeper electrical experience than mine, comment on whether a 220V 3-phase electrical supply for a lathe etc., and single phase for lighting etc., from a portable generator is a practical project and where a suitable generator could be obtained.

Mr. Wells, Essex.

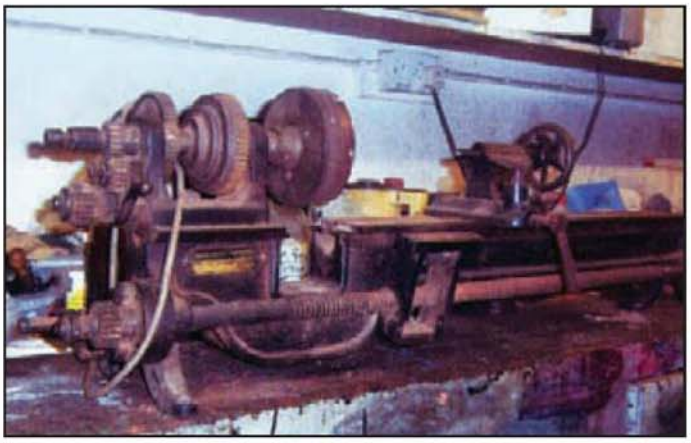
Machine vice design

SIRS, - Interesting as the article on the new design of machine vice (*M.E.* 4284, 13 October 2006) was, I feel it cannot pass without comment. One thing that was drilled into me when I was an engineering apprentice was the importance of rigidity in any machining operation for accuracy and rapid metal removal.

Having examined the vice at a recent show it seems to me that rigidity is something it does not have. When a part is gripped in a vice for a milling operation the set-up should be arranged so that the cutting forces are predominantly directed into the fixed jaw. This basic requirement is not met because the vice does not have a fixed jaw. This is, I believe, a fundamental flaw with the design. I am also concerned as to how carefully the clamping force on the work piece has been matched to the force available to hold the jaws in position. I can see this becoming a problem if the M8 bolts are inadequately tightened.

A second point worth mentioning is the position of the vice on the worktable of the mill. It appears to be at the mid-point in the x direction. I have noticed this in many of the pictures used to illustrate machining set-ups. Why not mount a machine vice near one end of the table? The other end could have, for instance, a rotary table or be left clear. I feel sure none of us spend as much time in the workshop as we would like, any ideas to speed up work are always welcome. Another reason to do this is to spread the wear on the slides as evenly as possible.

John Crocker, Swindon.



The Colchester Brittania lathe for which an apron and cross slide are needed.

Colchester *Brittania*

SIRS, - I work with the Carlisle branch of *Tools for Self Reliance*. We refurbish hand tools, pack them into kits and send them out to developing nations.

Recently we were given three wood turning lathes; two were proper wood turning lathes and were duly dispatched.

The third was a Colchester *Brittania* which had been converted to a wood turning lathe by removing the cross slide and apron. We felt that it had little utility in that capacity as it was probably limited to spindles and small objects. Therefore it was decided not to send it. However, it was felt that it would be better if it could be converted back to its original purpose but the apron and cross-slide are not amongst the box of accessories which came with the lathe, so the hunt is on to try and find these missing parts.

The lathe is in reasonable condition and by the look of it, probably spent a great number of years not being used but accumulating sawdust distributed by the other two lathes. All three came from a small firm.

If any reader can help or point me in the right direction I would be obliged.

J. M. Barber, Cumbria.

Snails

SIRS, - Regarding the problem with snails and signals at Cambridge MES, I suggest that the club sprinkle salt or rock salt around the bases of the signals.

Furthermore, bare copper wire from electric cable can be formed and placed around the base of each signal in a complete circle. Snails and slugs do not like crossing the bare copper wire.

Trusting this information will be useful to those affected.

John Price, Swansea SME.

Whitworth spanners

SIRS, - In issue 4285, 27 Oct, 2006, in *Club Chat* Mr. John Hawley has a query about Whitworth Nut sizes.

On page 4, Chapter 11 of Tubal Cain's *The Model Engineers Handbook* he gives a succinct description of Whitworth spanner sizes. Having used 'Whit' spanners in the long past the two sizes at the head of each spanner end indicated a Whitworth size and a BSF size of nut.

I hope this helps Mr. Hawley out.

Harry Kennedy, County Durham.

Cheap CAD

SIRS, - The recent review of

TurboCad was interesting, but readers may be interested to know there are even cheaper alternatives. One is A9CAD (download as freeware from **http://www.a9tech.com/** or Google A9Cad). It cannot handle 3D drawing, but has all the functions necessary for engineering drawing, and it can read and write AutoCad compatible files (*.DWG and *.DXF) files. It also seems to be able to load almost any other drawing or picture file (jpg, bmp, etc) but this does not seem to be documented anywhere. Files can also be exported as *.emf files (extended metafiles) which can be read by Word or Excel (see below)

Also like TurboCad, it has a 'bigger brother', with more functionality, but this as always, costs money (but only 25 Euro as opposed to TurboCad Pro V12 at £547!)

Many users may already have the second alternative - this is the Draw function contained in Microsoft Word and Excel (View/Toolbars/Drawing menu). This looks deceptively simple, but it has many useful functions, and many people may already have this on their computers. It is not specifically designed for CAD, but can be used to produce good quality 2 and 3D drawings.

Note that there are progressive improvements in newer generations of the Windows operating system. It is possible to draw almost any shape, and scale to precise sizes using the Draw/Grid function, which allows a visible scaling grid to be displayed, or objects to be drawn in precise units of size, with 'snap' functions, alignment functions, spacing functions, rotation, and so on.

It is also possible to select 'standard' shapes ('autoshapes') and distort these to produce other shapes. There are multiple 'line' and 'line end' possibilities, colouring possibilities and so on.

It cannot handle layers, but sets of objects can be grouped (or ungrouped) and handled as single objects, so some of the flexibility of layers is possible. There is also a simple 3D function, which allows objects to be shown in 3D, rotated, coloured, rendered as different materials, and lit from different angles. I can recommend both of these for the relatively impecunious, with the usual disclaimer (I have no connection with either company).

Keith Wardill, by e-mail.

The label on the steam blower restored by Philip Bellamy.

Warco lathe modifications

SIRS, - I recently bought a BV20 lathe from Warco, their service and delivery were excellent. The lathe was far better and more accurate than I had hoped for, the only difficulty I had with it was the usual one of having to use a spanner to tighten the tail stock. That was easy to convert to cam lock.

The other two small difficulties were with the chuck. The problem is that the M6 socket head screws in the back plate are in counter bored holes. The hex key provided is difficult to locate in the socket and the screws are impossible to remove with your fingers once loosened.

I cut a piece of 14mm hex brass 7mm thick, drilled a 1/4in. hole through its centre and pressed a piece of 6mm hex key 12mm long into it with my horizontal press (vice). I then silver soldered it in place.

In use, insert the hex into the socket and loosen with a14mm open-end spanner, once loosened the screw can be turned with your fingers.

The chuck key provided is too short and it will scrape the paint of the head stock, so make or extend the chuck key at least 100mm long (4in.) it will then be a joy to use.

Bill Kirkby, Co Clare, Ireland.

Curly steam blower

SIRS, - I have just received issue *M.E.* 4284, 13 October 2006 and read the article concerning the steam-operated blower.

A very good friend of mine the late Jack Strickland, also made such a blower system, however this tends to predate that given by LBSC. When I was presented with this blower it needed repair as it had not been used for very many years. The 'meths' container was an old Cherry Blossom shoe polish can which had rusted through in several places.

I decided to repair the entire unit so made a new 'meths' can from 0.8mm brass by spinning the blanks to shape so that the lid was a light push fit on the lower part.

Now to the interesting part and that is the label made by Jack, giving his name and then address in Birmingham as well as a list of the locomotives that he had built, the first being *Mollyette* in 1944 and the penultimate the *ADA 111* in 1950. As far as I can remember the *ADA* was a model of the Longbridge works locomotive, which was an American built 0-6-0 along the lines of the GWR 1500 class but had sloping tank tops like the 5100 class. I do not remember the last locomotive the 'Pennsy C Class'. As you can see he was quite a prolific engine builder.

Perhaps there is another reader who can throw more light on these locomotives and blower unit.

Philip T. Bellamy, Switzerland.

Sliding jaw calliper micrometer

SIRS, - Referring to Mr. Jolm Korber's letter on Shardlow micrometers (*M.E.* 4286, 10 November 2006) I am sure he will be delighted with his GKN-Shardlow sliding jaw calliper micrometer as it will get into places where the ordinary hand micrometer cannot. However, with this type of micrometer having sliding jaws with measuring anvils not co-axial with the micrometer spindle, it does not obey Professor Abbe's Principle of Alignment for Measuring Instruments. Professor Abbe's (Carl Zeiss) Principle of Alignment states *"the measuring instrument should be so designed that the distance to be measured represents a straight line extension of the scale or whatever standard is being used"*. The most common example of an instrument complying with this is of course the ordinary hand micrometer. Where the standard is the micrometer screw and the work piece between the anvils is dead in line with the micrometer screw. Designers always try to achieve this. Unfortunately the Shardlow sliding jaw micrometer with the extra guiding spindle causes the measuring anvils to be even further from the micrometer screw axis than the single spindle sliding jaw calliper micrometer.

Derek Pearce, Middlesex.

Corrections to drawings

SIRS, - If I may be allowed to clarify part of my letter published in *M.E.* 4286, 10 November 2006 in response to Nemett's reply.

I wrote that I kept a list of purchasers of drawings sold to my own designs. Nemett observes that *"If builders notify the designer of any problems found. ... etc. then errors get put right"*. I found this not to be the case. Of the 130 plus sets of drawings of the American 4-4-0 sold in the period 1992 to 2000 only six builders offered meaningful comments and corrections.

In my experience accuracy of published drawings receives much criticism at club level yet few of the complainants will actually put forward a design of their own; such attitudes seemingly spilling over into *"I've sorted the problem for myself, why waste more of my precious time telling others?"* Sad, very sad.

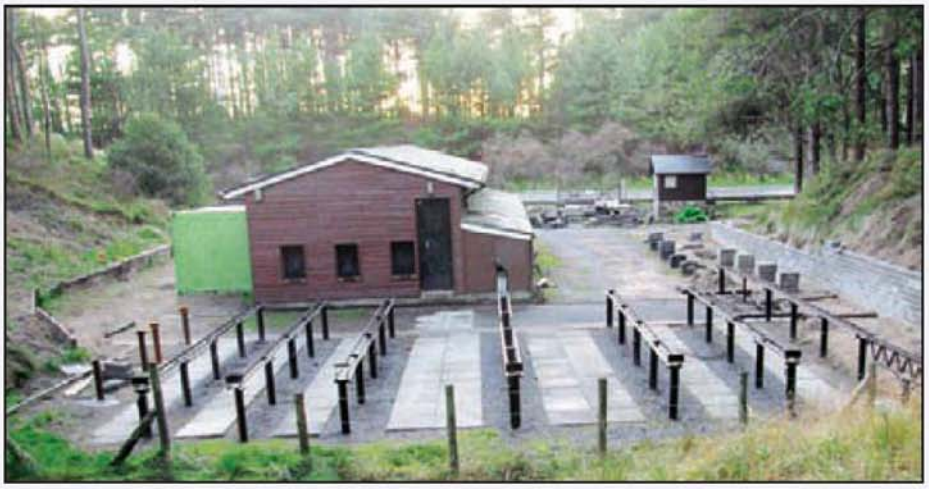
David Piddington, Birmingham.

I agree with David's comments, the corrections will only get done if the designer is notified. My point was that if designers are notified there is little excuse for not applying the corrections because with CAD drawings the amount of work involved is often very small and we do not get into the situation of having to re-draw a complete sheet to apply a small correction. – Nemett.

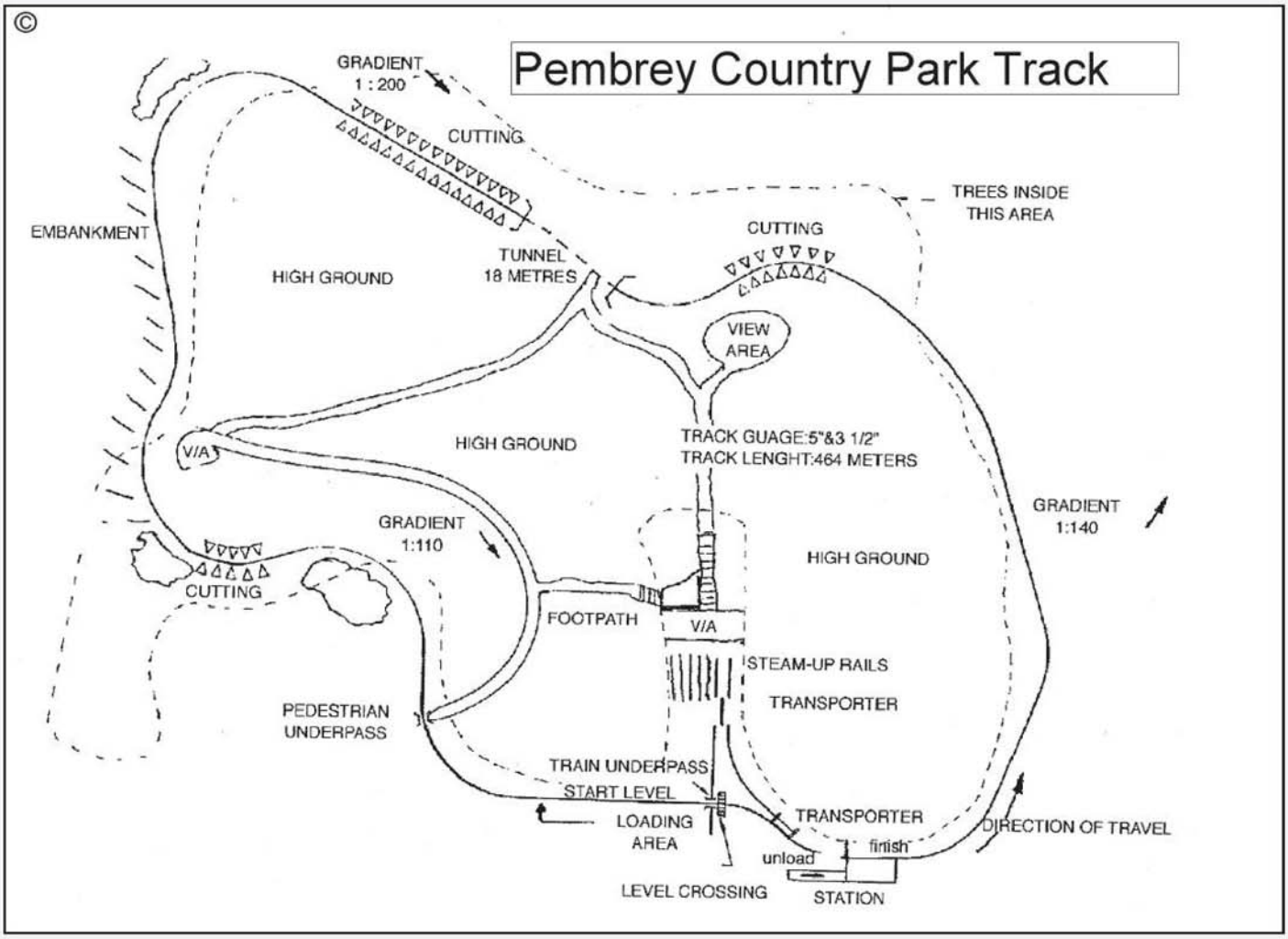
IMLEC COMPETITION 2007

George Golightly
provides a preview for the 39th International Model Locomotive Efficiency Competition to be held at Pembrey Country Park, Llanelli on 7/8 July 2007.

Well here we are again, IMLEC and this year the Llanelli Society of Model Engineers have the pleasure of hosting the competition. I find it hard to believe that 10 years have past so quickly since we last hosted the event in 1997. Over the last few years the 3½in. and 5in. gauge railway have been totally rebuilt using bull head flat bottom rail supported by UPV sleepers, and I am confident that the society will host a very good weekend for the competition. Visitors will have to pay on entry into the park, charge is per vehicle, so there will be no additional entrance fee into the event itself. There will be IMLEC programmes available at a competitive price.



We are situated in a 550-acre country park and have ample space for caravans and tents sited close to the railway. Just a few minutes walk from our location you will find seven miles of golden West Wales sand and sea. The beach has been awarded the Blue Flag for many years. The park is on a cycle path that runs along the coast up to Llanelli on the east and to the west, the town of Kidwelly, which boasts a well-preserved castle. For those ladies whose favourite pastime is shopping there is within easy striking distance the historic county town of Carmarthen. It has a good selection of high street stores as well as the more traditional type of shops; there is also an open and covered market. Llanelli, to the east offers good facilities and the close-by Trostre development has good parking. The road to Llanelli along the Millennium Coastal Park is very scenic. Llanelli also has The Jack Nicolas Golf Course, opened in



2004, which hosted the Woman's European Championship for the second time in 2006. There are plenty of eateries to suite all tastes.

Robert Rayner is in charge of caravanning and camping, visitors wishing to make use of these facilities on the weekend should contact him on 01554-835286 to secure a place for themselves.

The competition

This will be run on the 5in. and 3½in. dual gauge raised track and will be open to applicants on a first-come, first-served basis by application form only which should be completed in full in order to be considered and accepted. A strict time line will be observed on all entries.

The competition will be restricted to a total of 24 measured runs using the usual practice of a coupled Dyno car to the engine with the driver sitting on the dyno car front seat.

No initial circuit run will apply and a full coal fire at the start will be observed.

A full set of rules will be sent to successful applicants on acceptance to the competition. Coal supplied will be Anthracite in a choice of three sizes.

The number of 3½in. gauge engines will be limited to six for the competition.

Entrants will be considered based on previous performance as a Driver/Engine combination and any combination having previously being placed first in any IMLEC competition will be placed in the previous winners category for this competition.

In the event of getting more applications than can be run as planned stand by reserve engines will be considered from applications in strict application order and the applicant for the competition will be notified if he falls into that category. The applicant can then decide if he wishes to accept or decline and in that event the next person on the reserve list will be offered the same option.

Ticking the appropriate box on the application form can show an interest in a reserve place. A maximum of four reserve entrants will be held but does not guarantee a measured run in the competition.

Prizes will be awarded to winners of four categories:

All previous winners 5in. - one prize
Winner 5in. - First /Second /Third
All previous winners 3½in. - one prize
Winner 3½in. - First/Second.

Entrants for the competition may apply for an entry form from:

Robert T. L. Rayner, 100 Dolaufan Road, Burry Port, Llanelli SA16 ORG; tel: 01554-835286. Or: Dennis R. Pearson, 142 Heol Bryngwili, Cross Hands, Llanelli SA15 6LY; tel: 01269-842085.

E-mail: **Bufferbeam@AOL.com**

Note: - This request is for an application form only and will not be classed as an acceptance for the competition. An application form will be sent by post for completion and return.

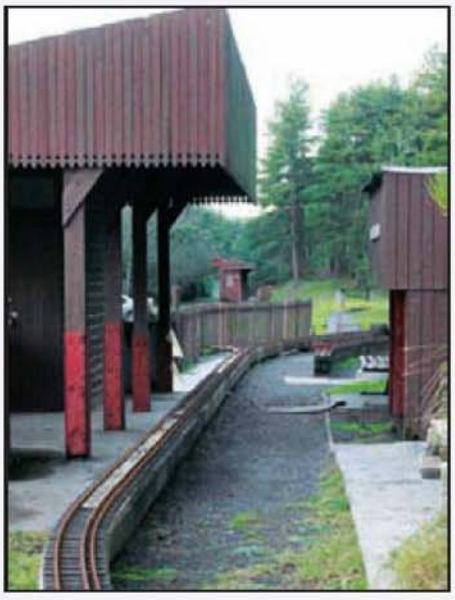
Acceptance will only be considered by our receipt of a completed application form with all details requested completed. A brief description of the entry and potted history of the driver is also required.

Any previous IMLEC Winners should also declare the year and details of their winning entry. This will assist us in the correct category placement in the competition.

Acceptance of entry will be notified and maps, rules and weekend information will be sent to the applicant.

Unsuccessful applicants or reservists will also be notified of their position.

We thank you for your assistance and hope that you will appreciate the changes that have now been introduced to make the competition fairer and more flexible to give everybody a chance.



I/C TOPICS

Nemett
sums up the correspondence on stoichiometric ratios; describes an interesting home-made spark plug and comments on some other I/C related items.

The recent discussion of stoichiometric ratios resulting from the query by John Pitkin (*I/C Topics, M.E.* 4275, 9 June 2006) and my original comments have produced a wide range of responses and I thought it would be a good idea to try to sum up the results.

The original query asked *"what was the ratio expressed in terms of volume, not mass, of unleaded petrol to air for stoichiometric ratio?"*

The resulting responses contained two basic values for the answer, one approximately 60:1 and the other 9000:1, so why the large difference?

I think the answer to that question is that those who arrived at the figure of around 60:1 treated the fuel as a gas and used the fact that one *mole* of a gas occupies 22.4 litres at standard temperature and pressure (STP). The problem with doing this is that the fuel is a liquid at STP and thus cannot obey the laws applying to what are known as *ideal* gases. The fuel may possibly be in a gaseous state when in the cylinder, but the pressure and temperature are then nowhere near the STP values of 0deg. C and 760mm of mercury (1 atmosphere) pressure.

Those who treated the fuel as a liquid obtained a ratio of approximately 9000:1 which I think is the correct value for the conditions outside the cylinder. As several readers with experience of fuel injection systems pointed out, this does enable the fuel and air to be metered before going into the cylinder albeit by having a computer which does some very complex calculations to allow for the effects of inlet temperature and pressure. A couple of readers pointed out that fuel injection systems also meter the products of combustion in the exhaust and alter the fuel/air ratio based on this. This seems to imply that the ratio is not very reliable in the first place.

There was widespread agreement that even if the correct ratio is achieved, combustion will almost certainly not be complete because of the incomplete mixing of the fuel and air in the cylinder. In practice this means that for highest power output, the amount of fuel will need to be more than that indicated by the stoichiometric ratio with the opposite being true if the best fuel consumption is to be achieved.

All of this is also affected by the amount of oxygen in the air (dependant on humidity and barometric pressure among other things) and the composition of the fuel used.

To sum up, the ratio can be expressed in terms of volume and this is useful in calibrating fuel injection systems but introduces a great deal of complexity and extra variables into the calculations. For a given fuel the ratio expressed in terms of mass is independent of these variables.

Having gone to all this trouble, the problem of mixing the fuel and air in model engines still remains. As one reader pointed out, *"the carburettor is the real problem because it cannot correctly meter the fuel except over a very narrow range of speeds and loads. If someone came up with a scaled down fuel injection system for model engines you would see a dramatic improvement in power output and fuel efficiency."*

I will leave this discussion here unless there are any other useful points to publish in the future. Perhaps John Pitkin will let us know the reason for his query? I should also thank all those who wrote in about this topic.

I/C engine drawings

I have been reminded about a website which has drawings of some interesting engines including some by Hubert Schillings. The site is **www.vth.de** and you will need to follow the following links on the menus to get to the correct page: *modellbau; onlineshop; bauplane; sonder bauplane; motoren und dusen.* As you will have gathered the site is a German one but has an online ordering facility.

There are several interesting engine designs on the site from single-cylinder 2-strokes up to V12 4-strokes. The reason I was reminded of the site is that it also has drawings for a miniature fuel injection (*einspritzenlage*) system by Schillings. News of any experiments by readers with fuel injection systems will be very welcome.

The kit of parts for two circular discharge spark plugs.

Circular discharge spark plugs

I am in the process of trying out the circular discharge spark plug kit produced by Woking Precision Models, now part of Hemingway. One reason for the trial is that these plugs are somewhat cheaper than buying the normal type of spark plug in 1/4 x 32 sizes, important if you are building a multi-cylinder engine.

The principle is that instead of the normal point electrodes, this type has a larger disc shaped electrode which when assembled provides a circular gap for the spark to jump.

The idea is that this is less likely to oil up in our cool running engines and provides more reliable operation particularly for slow revving stationary engines.

I think the reason for this is that even if part of the circular gap does oil up, oil is an insulator so the spark will jump across any point with no oil thus firing the engine and probably burning off the oil in the process.

The plug comes as a kit of materials (enough for two plugs) and drawings. The user has to machine the parts and they are then glued together using a high temperature epoxy adhesive (JB Weld is recommended).

The materials supplied comprise a length of mild steel hexagon for the body, some mild steel round for the electrode, pre-cut ceramic tube for the insulator, brass round for the terminal nut and copper washers (**photo 1**).

The parts are machined (**photo 2**) which proved no problem other than how to measure the bore of the ceramic tube to get the correct fit for the electrode. In the end I tried several twist drills until I found the best fit and used this to set the electrode size. Ceramic tube is fragile stuff, so be careful with this and be gentle with the micrometer when measuring the outside diameter.

The first assembly operation is to assemble the centre electrode to the ceramic tube (**photo 3**)

The finished spark plug components with a 5p coin for comparison.

The centre electrode bonded into the ceramic insulator.

The finished spark plug showing the annular spark gap.

using the high temperature JB Weld epoxy. The items must be thoroughly degreased before this is done and any adhesive round the electrode circumference must be removed.

Once the epoxy has set, the assembly is glued into the body using the same adhesive and using a feeler gauge to set the gap at 0.35mm (14thou). Again make sure no adhesive is left in the gap.

The finished plug is finished off with a terminal nut and washer (**photo 4**). I have not tried the plug yet but will report results in due course.

Next engine design

I have had several suggestions for the next engine design and am looking for more. The suggestions so far include an in-line 12-cylinder (I think he was joking!), a horizontally opposed sleeve valve twin (with supercharger), a V-twin, a flat twin and an in-line twin. I favour a twin but am undecided on the layout or valve gear at the moment.

I am currently drawing up a cylinder assembly which could be used on a variety of engines so keep the ideas flowing. Remember that the design is intended to move builders gently on to more complex engines after the single.

Readers' engines

I have received several progress reports from some of you who are busy building the NE15S and include some examples here together with a couple of other engines by readers.

John Brown has been busy in Perth, Australia and sent details of progress so far (**photo 5**). John has guaranteed his picture gets published by standing it on a copy of *Model Engineer*!

John Brown's NE15S displayed with the cam drive components.

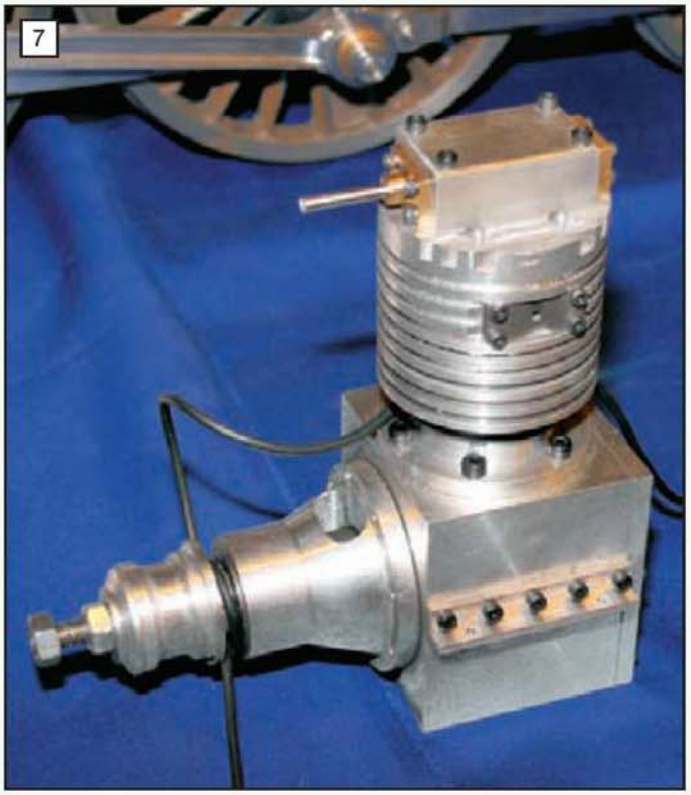
The next engine is the water cooled version (**photo 6**) from Robert Manley of the Reading Society and so is very close to home for me. As befits a proper apprentice trained man, Robert's engine shows excellent workmanship and I look forward to seeing it run. Robert has altered the flywheel design to incorporate a wide cord pulley for winding the cord round. One point to make about this arrangement is to avoid using a long starting cord (two or three turns should be enough) and not to wrap the cord round the hand to gain extra purchase because, if the cord does not free cleanly from the flywheel when the engine starts, it will pull your hand into the flywheel and bite!

The next example (**photo 7**) was at the Bristol Exhibition and I think is by James Dunkerly, although I am not absolutely certain of this because the engine was not labelled. James has chosen to use bronze or gunmetal for the crankshaft bearing housings and possibly plain bearings.

Please keep the reports and photographs coming in, it is nice to see how others are progressing with the design.

The next engine example is not an NE15S, but is the crankshaft/connecting rod/piston assembly for a miniature Rover V8 engine being ▶

Robert Manley's water-cooled NE15S showing the fine workmanship so far.



The first NE15S at an exhibition? This one by James Dunkerly seen at Bristol.

Mike Perry's Rover V8 crankshaft assembly and bearing shells (on left).

constructed by Mike Perry, also of the Reading Society (**photo 8**). Mike has used steel connecting rods with fitted bearing shells and this should be an interesting engine when it is finished. Perhaps the constant exposure to my missionary zeal for I/C engines is having an effect on the Reading crowd?

The final engine is a very nice 5cc water-cooled compression ignition engine (**photo 9**) by Malcolm Beak of the St.Albans Society.

Dry liner for NE15S

Malcolm Beak has also suggested an alternative dry liner cylinder jacket for the NE15S. Malcolm is concerned that the wet cylinder liner in the water cooled version may corrode in use, making removal difficult. I have produced an alternative design (**fig 1**) for those who prefer to go down that route. Use this drawing in conjunction with the original to get the full dimensions.

I have used the original wet liner design on a couple of engines and have never had any problems but we all have our own preferences, so the choice is yours.

The method of construction is similar to the air-cooled cylinder jacket but the fins are replaced with a length of aluminium or brass tube Loctited in place to provide a water space. I have drawn 1mm thick tube but thicker walled tube could be used if desired and would make the water pipe fixing more secure.

The tube should be left slightly long and cleaned up after the adhesive has set. I suggest that the water pipes are threaded into the jacket and fixed with Loctite for security.

The other alternative is to make the whole jacket out of brass and soft solder the parts together. The extra weight will not matter in a boat or vehicle.

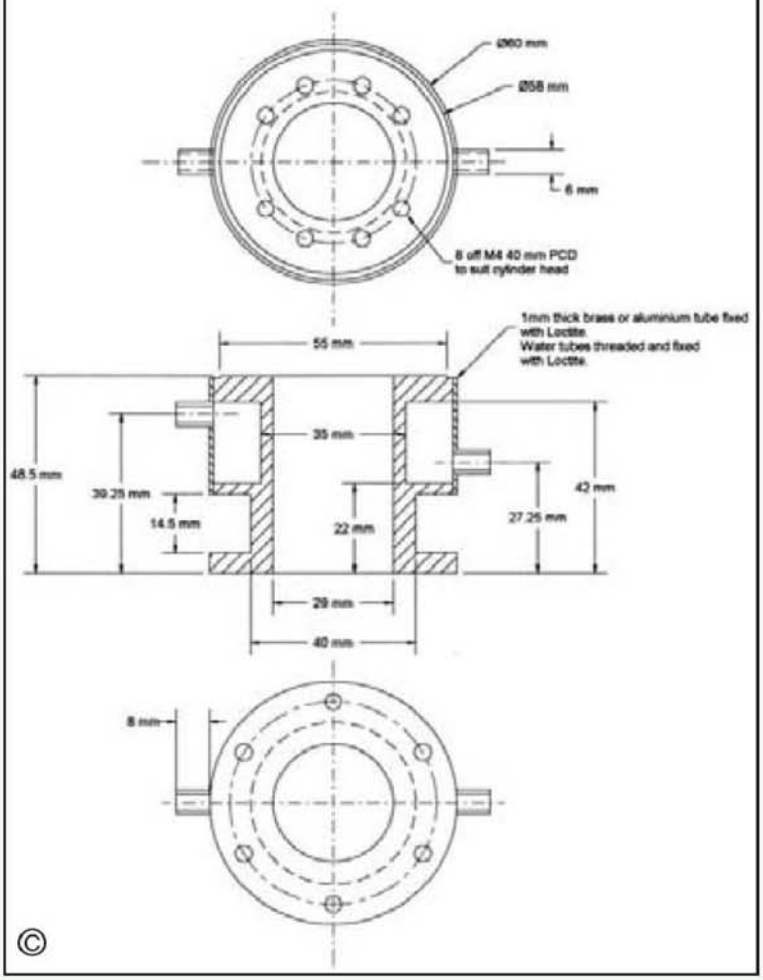
Those who wish to convert an existing jacket to a dry liner version could bore out the jacket and Loctite a piece of thin tube in place which is a close fit on the liner. Again I suggest a piece of tube with 1mm wall thickness, but no thicker in this case.

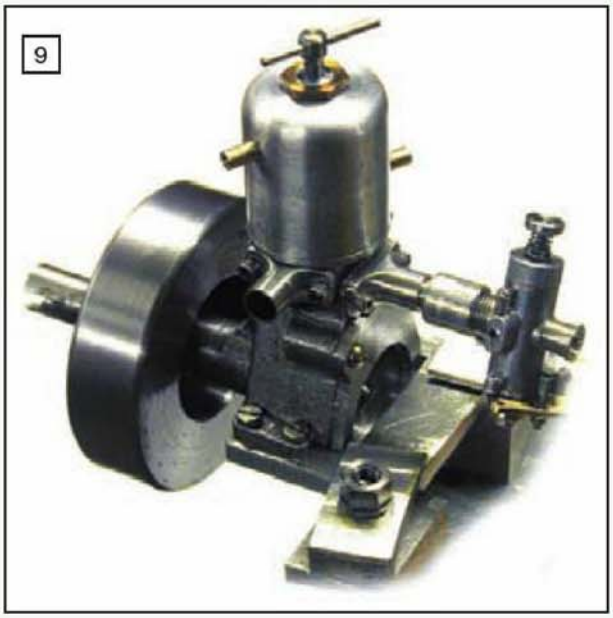
I also suggest that the existing liner be bored out only to within about 3mm of the top face so that the inserted tube does not break into the cylinder liner seating face.

Sealing the Hall Effect sensor on the NE15S

I have received a letter from John Korber regarding the use of silicone sealant to fix the Hall Effect sensor into the housing. John rightly points out that the silicone sealant sold for use in the home gives off acetic acid as it cures which will corrode the sensor terminals. The correct sealant to use is that sold for electrical purposes by stores such as Maplin. I thank John for pointing that out. On the prototype I used epoxy adhesive which is probably easier to obtain for most people and has no such problems.

FIG 1: THE ALTERNATIVE WATER-COOLING CYLINDER JACKET WITH A 'DRY LINER'





Malcolm Beak's neat 5cc compression ignition engine.

EDWARDIAN ELEGANCE: THE LONDON AND NORTH WESTERN RAILWAY

AND GEORGE WHALE'S 'PRECURSOR' 4-4-2 TANK LOCOMOTIVES

Ron Isted

concludes this short series on one of the finest from the 'Premier Line'.

●*Part II continued from page 756 (M.E. 4289, 20 December 2006)*

The basic colour scheme for LNWR locomotives dates back to 1873 and is often quoted as *"blackberry black"*, but this appears to be a modern description never used by the company itself, at least to my knowledge. The black certainly contained an element of blue, and was of excellent quality, giving a superb high gloss finish, aided by several coats of varnish: it has been claimed that the painting process occupied as much as four weeks - hardly a case of Crewe 'doing things on the cheap' as suggested by the company's detractors. The lining was in three colours, first a 5/8in. bluish grey, edged on the inside by an 1/8in. yellow line, followed by 1 1/2in. (also quoted by some authorities as 1 5/8in.) of black and finally a 5/16in. vermillion line. Corners were a simple curve. The full lining applied only to the sides of the tender or tank and bunker, plus the cab side sheets; elsewhere the yellow was omitted, while the boiler bands consisted of just two 5/16in. vermillion lines. Wheel splashers also carried two vermillion lines, one immediately next to the edge trim and the second some way further in - the exact spacing seems to vary, judging by photographs and probably depended on the size of the splashers. The footplate valance carried the blue/grey line at its lower edge, bordered with vermillion, and the background to the number plate was vermillion. Everything else, apart from buffer beams and burnished steel fittings like the smokebox door hinges, was unlined black - no lining on footsteps, wheels or axle ends for example. Front buffer beams were vermillion, edged with a half inch wide black line, and were decorated with a quarter inch wide black line forming a central rectangle with rounded corners. Buffer stocks were also black, with a single vermillion line round the rim. Tank locomotives carried the same colour scheme on the rear buffer beams, but on tender locomotives, they were plain black - presumably it was regarded as politically incorrect for any North Western tender engine to be seen working a train tender first.

Until the advent of the Precursor Tanks, the LNWR had never even considered anything so plebeian as painting the initial letters of the company on the locomotive tank or tender sides to provide evidence of ownership, although a quarter of a century earlier, Webb's 'Cauliflower' 0-6-0s had gained their nickname through carrying the company's crest on their driving wheel splashers, the first engines to be thus adorned. Incidentally, this unauthorised (and therefore completely bogus) heraldic device is an example, or more accurately half an example, of one of the North Western's really bizarre little eccentricities: the design existed in two distinct versions, one used on rolling stock, (**fig.6**), the other, shown in **fig 7**, on certain locomotives, including the 'Cauliflowers' already mentioned, and the Precursor Tanks. Apart from quite

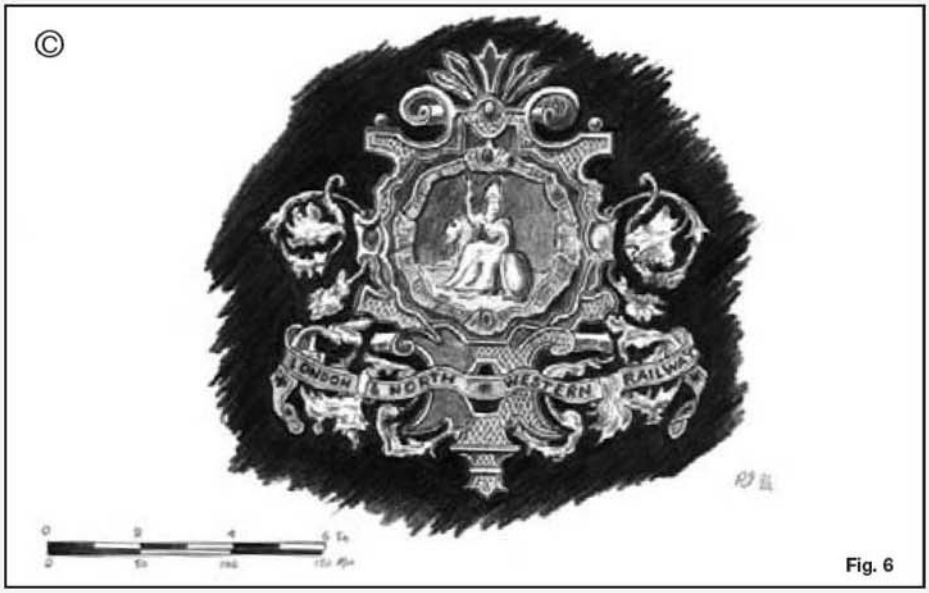


Fig. 6

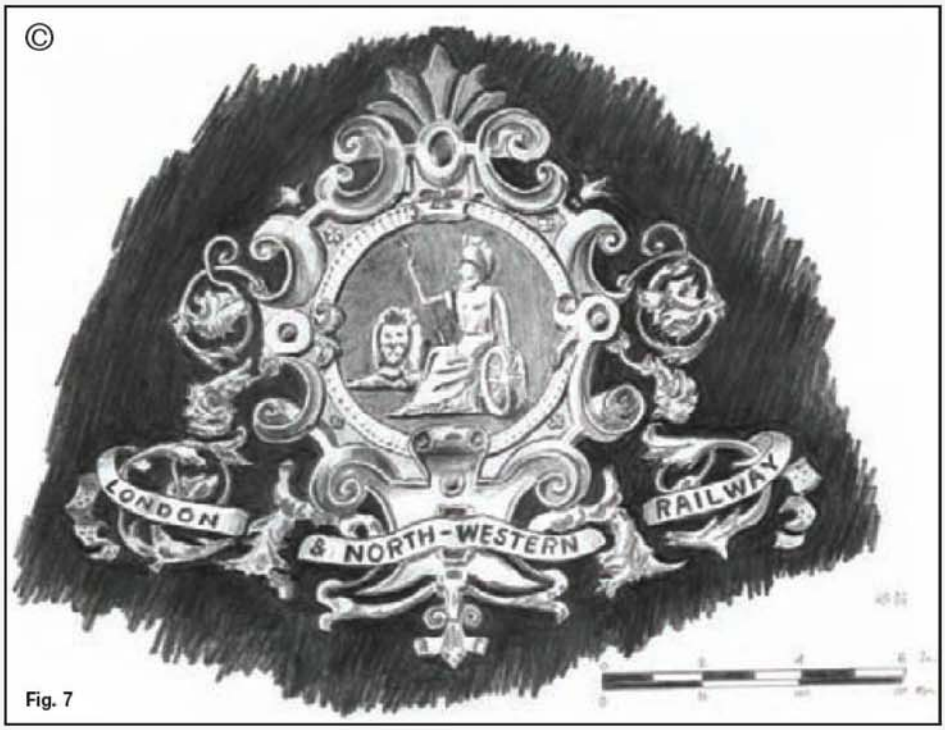
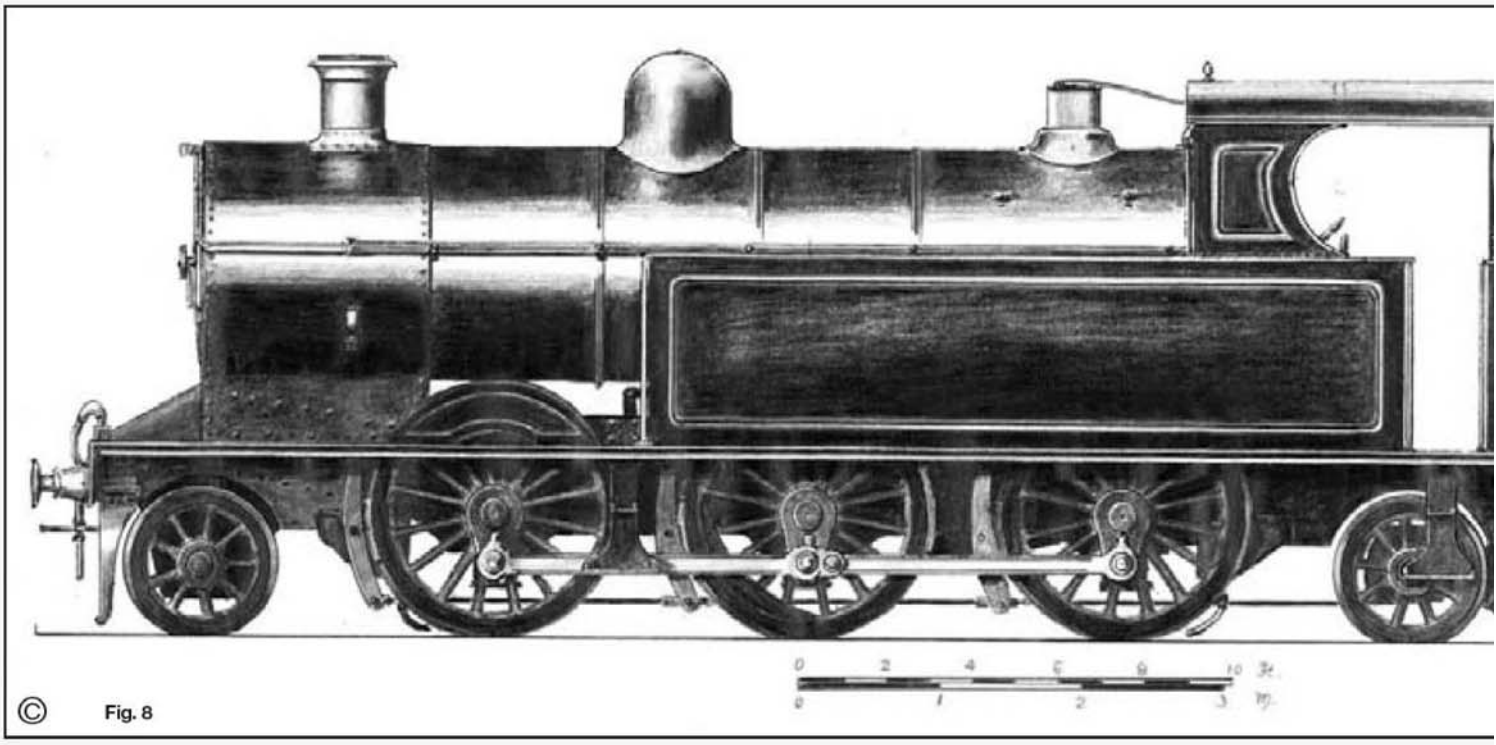


Fig. 7



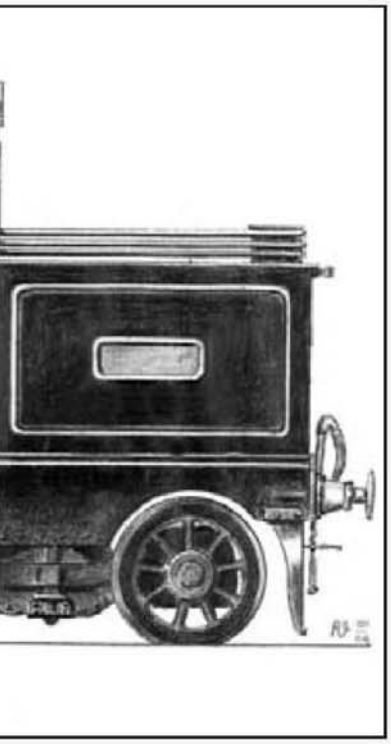
© Fig. 8

substantial detail variations in the ornamentation, the most obvious, and totally irrational, difference between the two designs is that on the locomotive version, as can be seen in fig. 7, Britannia's face is in profile, while her lion is staring straight 'at camera'; in the alternative form used on coaches, her large and furry feline friend is in profile, while she herself is giving us the old full frontal (facially, of course). Is she welcoming the customers on board the train, I wonder? If so, one can only assume that in the locomotive version, Leo is intended to frighten off any unauthorised visitors to the footplate, although he looks much too contented and soporific to indulge in such aggressive behaviour. I can offer no other reason for the variations and at this distance in time, I doubt that we shall ever discover who dreamt up this particular example of pseudo-heraldic lunacy, but it all adds spice.

When the first Precursor Tank, No.528, emerged from Crewe in May 1906, it was the first North Western engine ever to carry the company's initials on the side tanks, in 7in. high gilt letters as shown in fig 1, beneath the armorial device (locomotive version, featuring profile Britannia/ full frontal lion, as in fig. 7, of course). All fifty engines were similarly adorned, but strangely, no other class was ever turned out in this exact style. The 4-6-2Ts built from 1910 onwards were the only other locomotives to carry the company's initials, but in a much larger and unsubtle version than on the four-coupled engines. Another innovation on the Precursor Tanks was the inclusion of the building date (month and year) on the engine number plate, the company's initials being omitted therefrom, and this design of plate became standard for future construction. Two months after the final new Precursor Tank emerged from Crewe Works, George Whale, like his predecessor, had to retire for health reasons at the age of 69, and followed Francis Webb's example by moving down to the south coast, though many miles further east, to Hove. Unfortunately, he enjoyed only a few months of well-earned retirement before he died in March 1910.

I am not sure whether George Whale or his successor, Charles Bowen Cooke, initiated the design work on a passenger tank locomotive substantially larger than the Precursor Tanks, but in October 1909, the Crewe Drawing Office produced a very sketchy outline diagram, published in the *Model Engineer* ten years later, of a chunky looking inside cylinder 2-6-4T. From this I have prepared **fig 8**, in the hope that it may be of interest to someone wishing to build a really off-beat model - figuratively speaking, of course, although having heard the exhaust of one or two small engines fitted with Joy valve gear, perhaps that was an unfortunate choice of words. The coupled wheels are shown on the diagram as 5ft. 8 1/2in. diameter, an unlikely dimension to find on a document from the LNWR Drawing Office in view of my earlier comments, and the carrying wheels are 3ft. 3in. - the D.O. wasn't going to get caught out a second time! The 19 x 26in. cylinders drive onto the centre pair of coupled wheels, and it seems to me that some nifty design work would have been needed to prevent the various bits of the Joy valve gear (assuming the engine was thus equipped) from wrapping themselves round the leading coupled axle. Probably for this reason, the cylinders are twice as steeply inclined as on the Precursor Tanks, at approximately 1 in 8, but it still looks like a mighty congested 11ft. 2in. between the cylinder centre line and driving axle. The North Western 0-8-0s had a similar layout, but for them the situation was easier, because the axle was about eight inches lower due to the smaller wheels. The wheelbase of the proposed 2-6-4T is 6ft. 9in. + 7ft. 3in. + 7ft. 3in. + 6ft. 8in. + 6ft. 3in., total 34ft. 2in., or just 1ft. 6 1/2in. more than the Precursor Tanks, while the overall length is nearly a foot less. More importantly, the maximum axle loading on the proposed engine was estimated at only 15 tons (on the driving axle), compared to the 19 tons 15cwt on both driving and coupled wheels of the 4-4-2Ts, which would have given it a much wider route availability. On the other hand, the grate would have been steeply inclined in order to clear the rear axle, and although no figures are quoted on the Crewe sketch, I would have thought the grate area would have been considerably smaller than on either the Precursor Tanks or the Bowen Cooke 4-6-2Ts built from 1910 onwards. The grate area on these latter engines was in fact 6% larger than on the 4-4-2Ts and this may have been the main reason for not going ahead with the 1909 design.

From January 1923 and for the first five years under their new LMS masters, the Precursor Tanks were entitled to the full crimson lake colour scheme, but only six of the 50 engines are known definitely to have carried it, of which just three, Nos. 6819 (LNWR 2446), 6827 (LNWR 2077) and 6829 (LNWR 2228) belonged to the group with 3ft. 3in. carrying wheels. I will stick my neck out and admit that if I were building a Precursor Tank, I would be sorely tempted to deck her out in that beautiful colour scheme, surely one of the most attractive ever, but I have no doubt that most Premier Line fans will be horrified at such heresy. And many older readers of this magazine will no doubt remember two superbly finished 5in. gauge North Western locomotives, a fine Precursor Tank built by George Cashmore and a magnificent Jumbo built by Bill Finch, both of which looked very fine in LNWR black (the engines, not the builders). However, just in case anyone feels the same as I do, basic details of the LMS colour scheme between 1923 and 1927 are as follows: the crimson lake was officially identical to that used by the former Midland Railway and described in *M.E.* 4230, 17 Sep. 2004, although the new company probably could not afford to take quite so long over the process, and the lining was much simplified. The red was applied to boiler, tanks, bunker, footsteps and footplate valance, although the top of the footplate was black, along with the smokebox, wheels and cab roof. The lining on the boiler consisted only of a single yellow line between smokebox and barrel, while cab-side sheets, tanks and bunker were edged in black, with a yellow line between the black and main crimson lake area. The locomotive number was in very elegant gold leaf numerals, either 14in. or 18in. high: a photograph of LMS No. 6829 (LNWR 2228), still retaining LNWR pattern headlamp sockets by the way, shows the larger size numerals, but whether



this was true of all those which received the crimson lake, I do not know. The figures were shaded below and to the right in black. Some, including 6829, received smokebox number plates, but these were later removed. The rather boring crest of the new company, 14 1/8in. diameter, was carried on the side of the bunker, and this was initially the only indication of ownership. In 1927, the decision was made to restrict the crimson lake to top link passenger engines only, and the Precursor Tanks spent the rest of their existence in black, at first with a very simple vermillion lining, but later in unrelieved black, apart from vermillion buffer beams and the lettering and numerals.

George Whale's Precursor Tanks certainly earned their keep, at first on suburban and semi-fast trains around London, the Midlands and the North West, but in the 1930s, when the Stanier 2-6-4Ts arrived in large numbers, many of the North Western 4-4-2Ts were either withdrawn or transferred to Carnforth and North Wales. Although spare boilers had been built as recently as 1934, the slaughter in the 1930s was relentless, and the last pair of these very elegant locomotives was sent to the torch in February 1940. Had they only survived another decade or so into Nationalisation, they might actually have ended their lives in a colour scheme almost identical to that in which they began their existence, as British Railways revived the former LNWR scheme (although using inferior materials) for all its mixed traffic and secondary passenger locomotives. Included in this classification were the Midland Compounds, the former much vaunted 'Crimson Ramblers', so perhaps the Premier Line did after all have the last laugh - the shades of Francis Webb and George Whale must surely have uttered a ghostly chuckle at the sight of Derby's pride and joy clad in the colour scheme of its arch rival, Crewe!

London and North Western Railway 4-4-2T ('Precursor Tanks'): Dimensions.

Note: these are intended specifically for use in building a miniature version, so 'internal' dimensions, such as heating surface and internal diameter of boiler sections are omitted. The figures for 3 1/2in. and 5in, gauge have been calculated to the nearest 1/64in., using 3/4in. and 1 1/16in. to the foot respectively. For Gauge One, halve the 3 1/2in. gauge figures, for 2 1/2in. gauge, halve the 5in, gauge figures, for 7 1/4in. gauge, double the 3 1/2in. gauge figures. Dimensions in brackets are generally considered impractical for a working model.

Description	Full size	3/4in. scale (3 1/2in. gauge)	1 1/16in. scale (5in. gauge)
Length over buffers	43ft. 2in.	32 3/8in.	45 45/64in.
Length of main frame	39ft. 3in.	29 7/16in.	41 45/64in.
Height to top of chimney (with capuchon)	13ft. 4 1/2in.	10 1/32in.	14 7/32in.
Width over footplate	8ft. 2in.	6 1/8in.	8 43/64in.
Width over front & rear buffer beams (maximum width)	8ft. 3in.	6 3/16in.	8 49/64in.
Height to top of footplate	4ft. 5in.	3 5/16in.	4 11/16in.
Width of cab	7ft. 2in.	5 3/8in.	7 39/64in.
Width of bunker and side-tanks	7ft. 3in.	5 7/16in.	7 45/64in.
Length of cab roof	7ft. 2in.	5 3/8in.	7 39/64in.
Thickness of main frames, all sections	1in.	(1/16in.)	(3/32in.)
Distance between frames, front and rear sections	4ft. 0in.	(3in.)	(4 1/4in.)
Distance between frames, central section	4ft. 2in.	(3 1/8in.)	(4 27/64in.)
Total wheelbase	32ft. 7 1/2in.	24 15/32in.	34 43/64in.
Divided into: radial truck wheelbase	6ft. 3in.	4 11/16in.	6 41/64in.
rear truck wheel to driving wheel	8ft. 10 1/2in.	6 21/32in.	9 27/64in.
driving to rear coupled	10ft. 0in.	7 1/2in.	10 5/8in.
rear coupled to radial wheel	7ft. 6in.	5 5/8in.	7 31/32in.
Diameter of coupled wheels (20 spokes)	6ft.. 3in.	4 11/16in.	6 41/64in.
Throw of crankpins	1ft. 0in.	3/4in.	1 1/16in.
Diameter of radial truck and rear wheels (10 spokes)	*3ft. 3in.	2 7/16in.	3 29/64in.
Pitch of boiler above rail level	8ft. 7in.	6 7/16in.	9 1/8in.
External diameter of smokebox	5ft. 8in.	4 1/4in.	6 1/64in.
External diameter of boiler over cladding	5ft. 6 1/2in.	4 5/32in.	5 57/64in.
Length of smokebox	3ft. 9in.	2 13/16in.	3 63/64in.
Diameter of smokebox door	4ft. 7 3/4in.	3 31/64in.	4 15/16in.
Height of chimney (including 1 1/2in. capuchon)	1ft. 11 1/2in.	1 15/32in.	2 5/64in.
Cylinder bore	1ft. 7in.	1 3/16in.	1 11/16in.
Piston stroke	2ft. 2in.	1 5/8in.	2 19/64in.
Length of connecting rod	7ft. 0in.	5 1/4in.	7 7/16in.
Position of correcting link connection (from big-end)	4ft. 3in.	3 3/16in.	4 33/64in.
Length of correcting link	1ft. 1 1/4in.	53/64in.	1 11/64in.
Length of anchor link	3ft. 1in.	2 5/16in.	3 9/32in.
C/L cylinders to driving axle	12ft. 0in.	9in.	12 3/4in.
(Cylinders inclined downwards towards crank-axle at 1 in 16.)			

*Diameter of radial truck and rear wheels was 3ft. 9in. on first 30 locomotives.

References

1: Crewe drawing No. 28852: GA side elevation and plan of *"6' 0" Four Wheels Coupled Side Tank Engine"*, National Railway Museum ref 4/GW/11177. Although signed by G. Whale on 31st March 1906, this drawing, fortunately for us, shows the later version of the Precursor Tanks with 3ft. 3in. carrying wheels and additional clearances.

2: Crewe drawing No. 28851: Seven cross sections, including full cab layout, complementary to above. NRM ref 4/GW/11162. Same notes apply as ref. 1.

3: Crewe drawing No. 28817: *Side outline drawing*. Although it shows the later version, it carries the number of the prototype locomotive, namely 528.

4: *Locomotives illustrated* No. 147, January-February 2003: *L & NWR Passenger Tank Locomotives*. J. W. P. Rowledge, pub. RAS Publishing. Excellent photographs, well reproduced and lists main dimensions, withdrawal dates etc.

5: *Model Engineer and Electrician* 335, 26 September 1907. Very informative article by H. Greenly, including detail drawings and photos, of the later version of the Precursor Tanks.

6: *LNWR Portrayed*. Jack Nelson, pub. Peco Publications 1975. A real 'must have' book for anybody wishing to model anything connected with the North Western, including signals, architecture and rolling stock. The locomotive section contains excellent drawings, very fully dimensioned, of details almost certainly not available anywhere else, e.g. chimneys, safety valves, blower valves, lubricators, beading details, smokebox door fittings, etc. Its value may be judged by the fact that last year I bought a secondhand copy for £10 and have since seen one on E-Bay for £30!

7: *Model Engineer* 2460 and 2461, 15 July and 22 July 1948. LBSC: Joy valve gear for 5in. gauge 4-4-0 *Maid of Kent* and 0-6-0 *Minx*.

8: *Model Engineer* 3514, 3515, 3516, 6 June, 20 June and 4 July 1975. Don Young: Joy valve gear for 3 1/2in. gauge Midland 0-6-0.

9: *Model Engineer* 3907 and 3908, 18 October and 1st November 1991. Martin Evans: Joy valve gear for LNWR 0-8-0. Slide and piston valve versions, although the slide valve version is rather suspect.

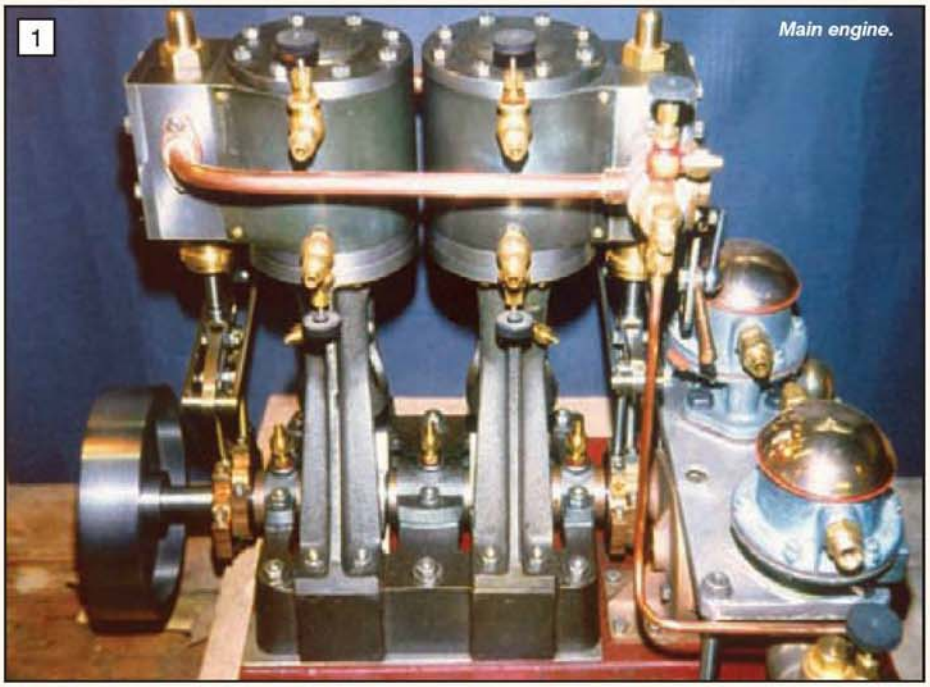
10: *Model Engineer* 3640, 5 September 1980. D. Webster: Analytical approach to Joy valve gear design.

11: *Locomotives Worth Modelling*. F. C. Hambleton, pub. Percival Marshall, undated (?1950). Contains much useful LNWR material, mainly from Webb era, including excellent detail drawings.

Michael Duggan

had dreams of gliding down the river so set about building a steam propulsion unit for a punt.

●*Part I*



A MARINE STEAM PLANT

The concept was thought about years ago, but until I retired in 1979 it was not possible to actually start making the plant, although I had a splendid workshop and tools and made many things, including models. The basic idea is to drive a 23ft. 6in. punt by steam, and to be transportable the punt is in two halves bolted together, the machinery and driver in the aft section, and two passengers in the forward section. I had visions of gliding down a river (the Wey navigation) on a fine sunny afternoon, but had no idea at that stage of the weight, space, or some of the practical problems. The plant should be almost silent as it is a condensing unit.

Most of the machining has been done on a Myford ML 7 long bed lathe, a Tew and Gautry raised cenre-height conversion, four chucks, a vertical slide rest dividing head etc and all the milling has been done on the lathe.The general layout is shown on the schematic diagram in **fig 1**, and I have used Imperial units as much as possible. Over 1,530 studs, bolts and nuts, and 70 brass cones and nuts have been made so far. These are made to the old standards and are of phosphor bronze, stainless steel or brass. Mild steel items were often supplied with the engine castings, and brass nuts are available commercially, but they are often chamfered on both faces.

Main engine

I settled on a 2-cylinder, double-acting engine, 2¼in. bore with Stephensons link motion for reversing and driving a 13in. propeller. The castings, materials, and most of the bolts were supplied by Stuart Turner at Henley-on-Thames and the engine is nominally 3shp at 100psi, 50deg. of superheat, and 1000rpm, **photo 1**. The stroke is 2in. and the engine 13 5/16in. high.

The engine has a 2:1 gearbox which drives two feed pumps, two air pumps, and a lubricating pump whose stroke can be varied. The L.O.

Main engine sight glasses and L.O gravity feed.

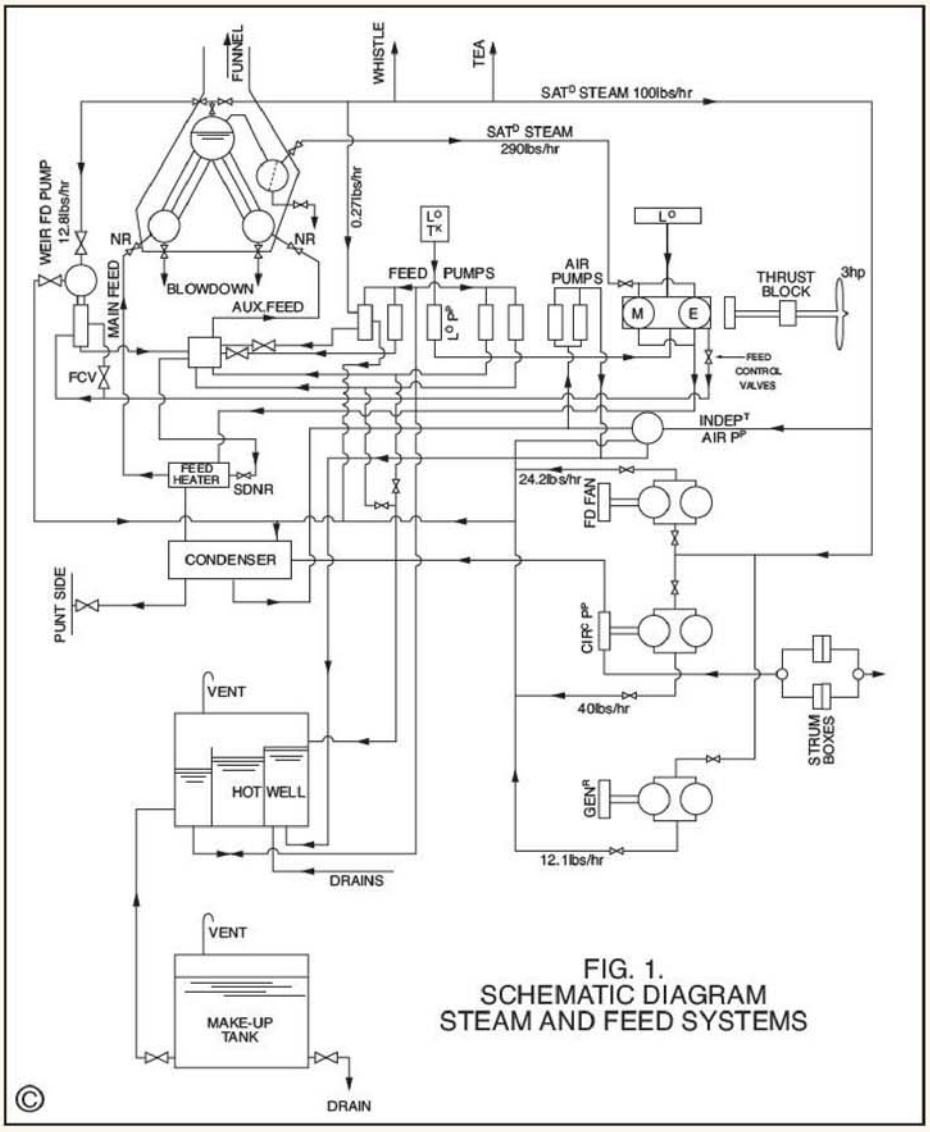


FIG. 1.
SCHEMATIC DIAGRAM
STEAM AND FEED SYSTEMS

Cast iron shaft coupling and flywheel.

pump draws its supply from a small copper tank and is fitted with a sight glass, which can be seen in **photo 2**. This was a standard engine at that time and was known as the Swan, but I added several items and notably each of the main bearings and the columns are lubricated by gravity via independent sight glasses (photo 2), the drains are all collected for passing to the hot well, as in normal Marine practice, and a marine type 4in. flywheel is fitted, **photo 3**.

One of the difficulties I had was cutting the internal slot for the keyway on the flywheel. Essentially a slotting machine is required, so I got this done in a precision workshop nearby.

Another item I added was a steam separator (**photo 4**) close to the stop valve as described by K. N. Harris on page 129 of his book. One of the unknowns I decided was the amount of carry-over from the boiler, particularly when starting. This is made of brass and silver-soldered with bolted covers, and the drain goes to the hotwell too. A detail drawing is shown as **fig 2**.

The stop valve is a 3/8in. needle valve designed for 150psi steam. It is hoped to control the speed

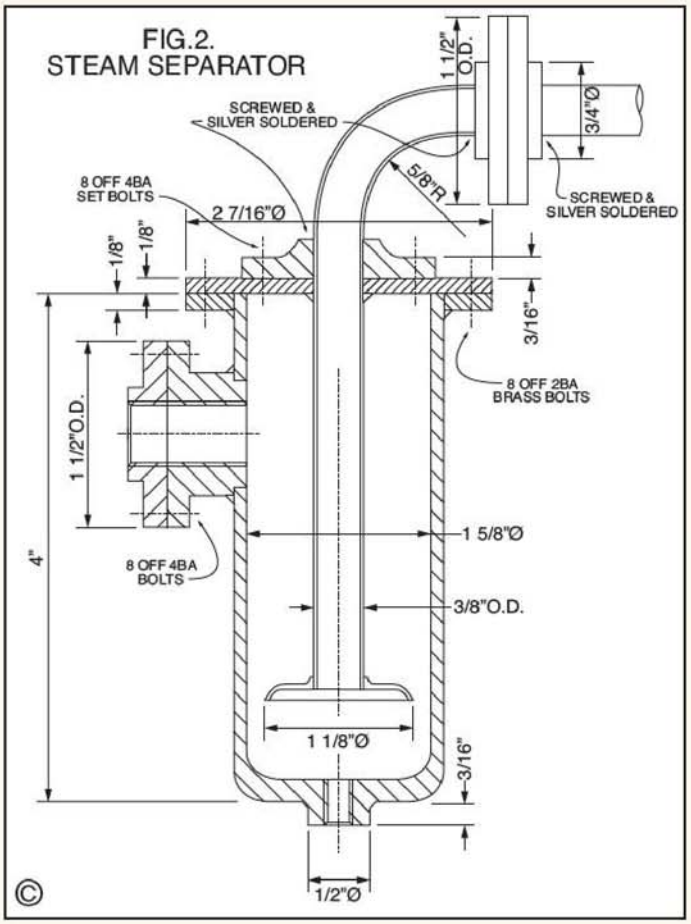
Steam separator.

of the engine with this and the slide valve mechanism. This was all fairly straightforward but it took me two years to carry out the machining and fitting. The stop valve handwheel is painted green in photo 2.

Boiler

I was swayed by my apprenticeship, sea service in the war and subsequent experience to construct a Yarrow 4 drum boiler. This has two water drums, a steam drum, and a superheater drum and is fired from one end. The boiler is made in copper and silver-soldered. The superheater is all of stainless steel and the seven tubes are all flanged and argon- arc welded. Details are shown in the two drawings (**figs 3** and **4**), and it will be noticed that the evaporation is given as 345lb/hr, but it is capable of 400lb/hr if needed. I estimate that the main engine may consume 252lb/hr at 1000rpm.

To make the dished drum ends I had to make four special dies and they are shown in **photos 5** and **6**. These took me



Die for steam drum ends.

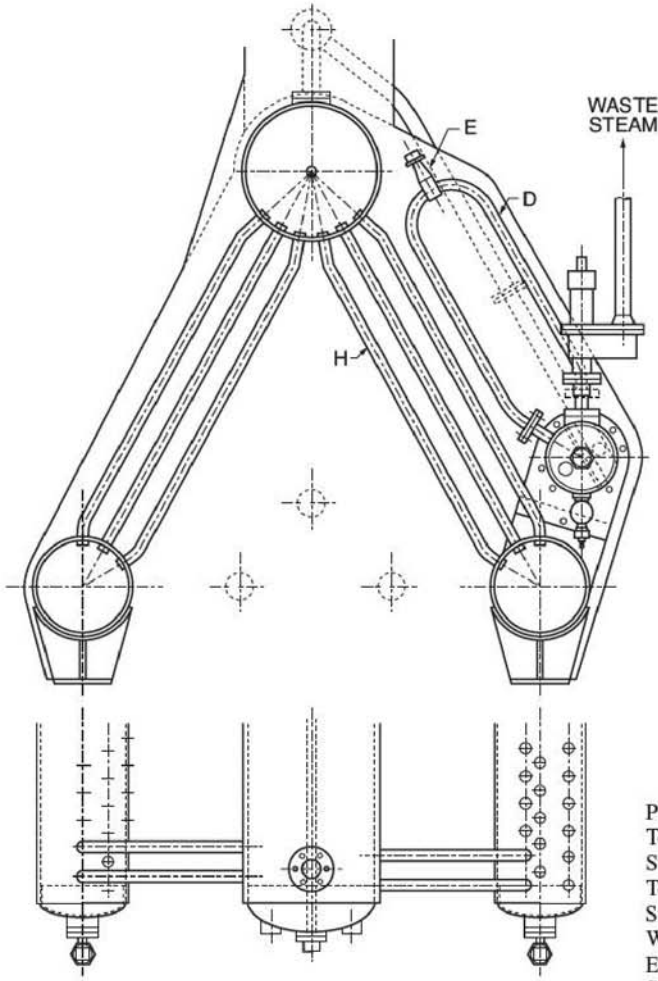
Die for water drum ends.

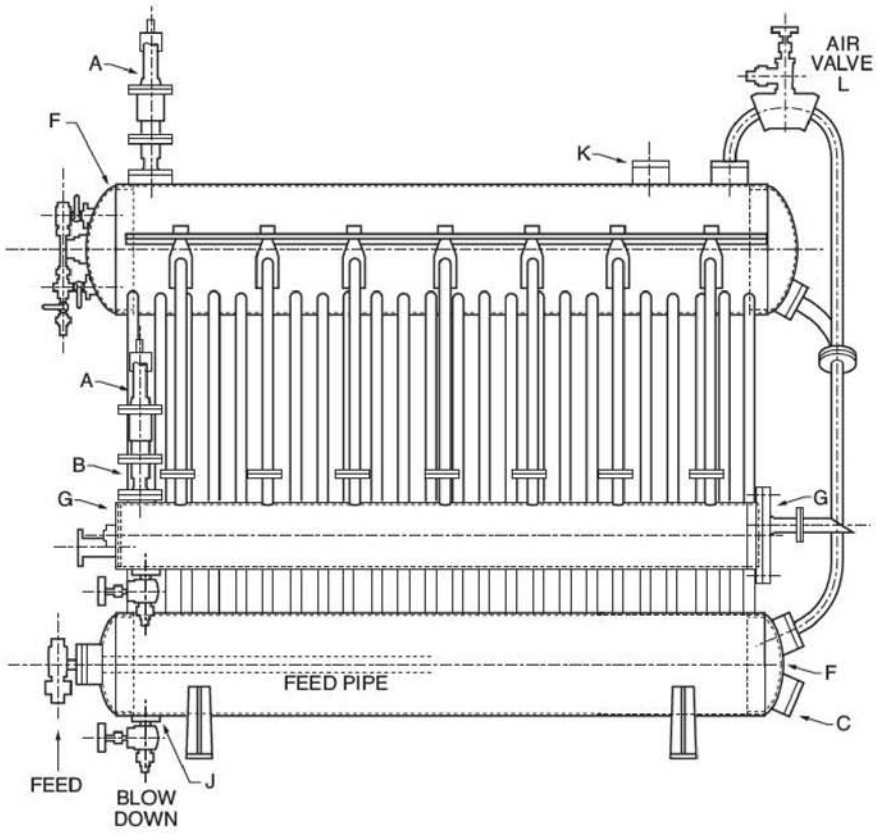
three months as they had to be precise and were a precision job. I used a 10 ton fly press, annealed the copper (the steam drum ends are made of 13 gauge copper) but they were pressed in half an hour. The inspector was delighted with them. There are no signs of cracks or thinning on any of the radii so the clearances must have been correct.

The next problem was the 142 tubes. There are three rows of 7/16in. tubes in each bank but for ease of carriage home the supplier made them the precise length, but straight, for both the straight and curved tubes. This may have been a mistake for I had to put them in the lathe anyhow and then realised I would have to make a jig to bend all the curved tubes! This took me some time, the jig is shown in **photo 7**, but it worked and no tubes were wasted. The holes in the drums were drilled and reamed on the lathe, but a suitable clearance allowed the silver solder to run through and fillet.

To set up the drums and tubes in exactly the correct position for silver-soldering I made a triangular, adjustable frame at each end, similar to the practice in a boiler shop, **photo 8**. This was made of mild steel and each rod had a 3/8in. L-H and R-H thread, and the mild steel plate at each end of the steam and water drums machined to fit them ▶

Tube bender.

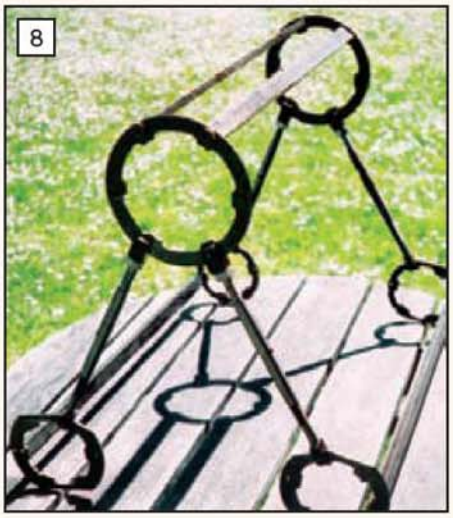




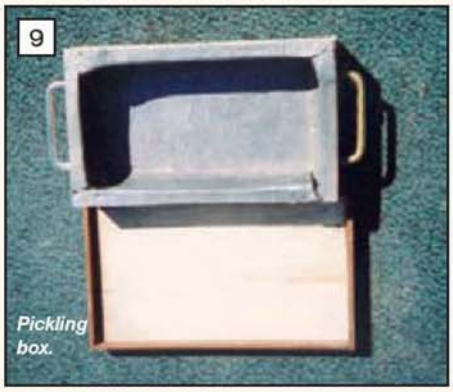
Pressure	100 psi
Total Surface Area	2750 sq ins
Superheater Surface Area	275 sq ins
Total Volume	1034 cu ins
Superheater Volume	1063 cu ins
Weight of Water at @W/L	2943 lbs
Evaporation	345lbs/hour
Steam rate	4 cu ins/min/100 sq ins
Total Weight (empty)	60-67 lbs
Factor of Safety(stn drum)	7.4
Number of Tubes (6.1637)	142

Item	Material	
Steam drum	solid drawn copper	5" o/d x 5.815 I/D 13g
Water drums (2)	solid drawn copper	3 3/8 o/d x 3.25" I/D 16g
Drum ends (6)	solid drawn copper	0.10" ≠ 13g (0.092)
Generating tubes	solid drawn copper	142-7/16" o/d x 20g
Superheater drum	18/10SS 304	2.50" zz x 0.064" 16g
Superheater baffle	18/8 E.N. 58 rolled	1/8" thick
Superheater tubes	STM 8.269 316 ss	3/8" o/d x 4.036" .20g
Safety valve body	cast phos bronze	
Safety valve spindle	18/8 ss. bar EN 58	
Downcomer pipes	solid drawn copper	1/2" o/d x 0.040" .19g
All bushes	Phos bronze bar	
Feed pipes	solid drawn copper	3/8" o/d x 0.040" .19g
Steam drum stay	phos bronze bar	5/16" o/d
Superheater bolts/studs	EMS 303 ens&R	Bar
Satd stm bolts/studs	phos bronze	Bar

FIG. 3. 'YARROW' BOILER

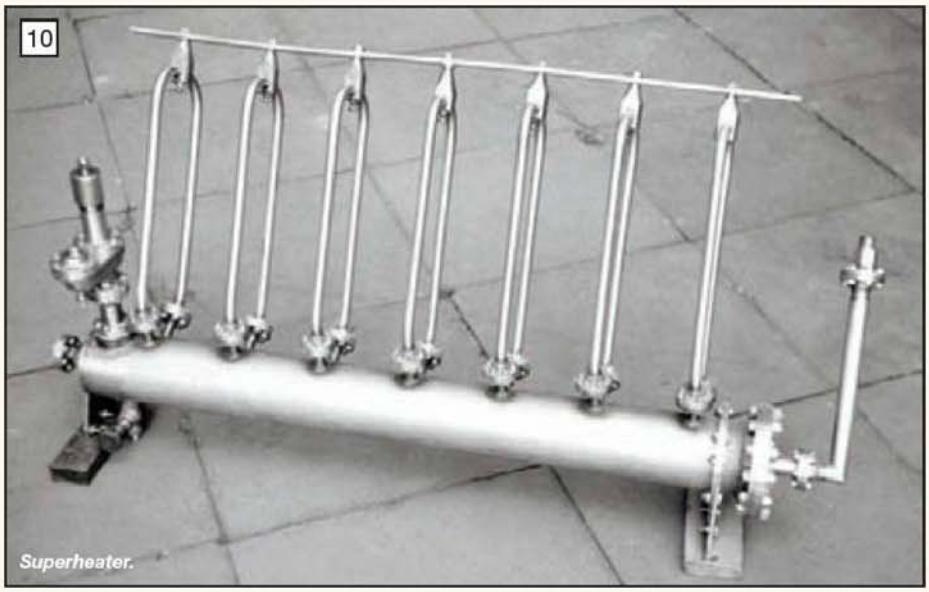


Adjustable frame for boiler.

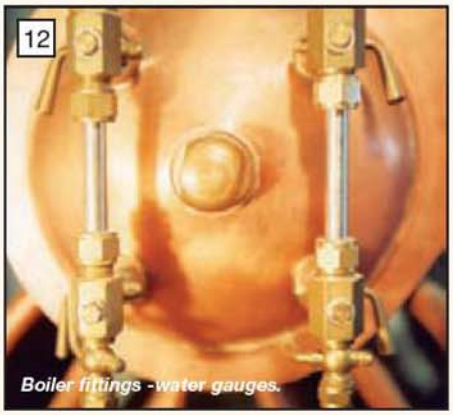


Pickling box.

Superheater - first attempt.



Superheater.



Boiler fittings - water gauges.

exactly. For pickling, as the boiler was 2ft. long, a clean plastic water tank was used. For the smaller items I made a lead lined box with lid, **photo 9**. Mr. A. W. Thorne of Southern Steam Services silver-soldered all the tubes, drum ends, and pads as I had not suitable equipment for this size of job.

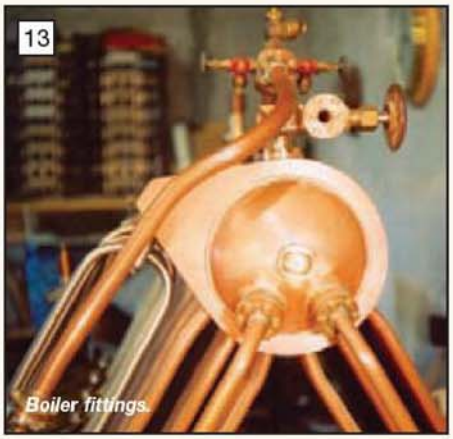
The superheater (**photo 10**) (drawing in *part II*) required quite a lot of lathe work, not the easiest of materials. Also I had to do quite a bit of experimental work how to make and bend the 3/8in. tubes, **photo 11**. The welding was done by a young chap as I had not the special equipment, argon-arc, or expertise. I tested this in a tank of water to 210psi and found seven small leaks but after re-welding it was perfect. The possibility exists of increasing, or decreasing the number of tubes if my extensive calculations are proved incorrect. An internal stainless steel baffle extends the full length of the superheater drum, and is made of 1/8in. stainless steel plate, and machined in the lathe using a sandwich of wood. Details of the superheater will be shown in **fig 4**.

The boiler is fitted with two-three cock water gauges (**photo 12**), two blow down valves, a main and auxiliary feed non-return (clack) valves which distribute the relatively cold water in each of the water drums. These drums are also fitted with a mud plug each. All the pads are made of phosphor bronze and the steam and water pads, the tie rod, and fittings occupied me for the evenings of one winter. I have fitted two downcomers in case improved circulation is required, but I have since learnt from someone who worked for Lloyds Register for years that many full-scale boilers were not fitted with these, although Thorneycrofts fitted them for some time early on. Circulation was found adequate in the generating tubes alone. Some of the details of the fittings may be seen in the photograph, **photo 13**.

Two safety valves are fitted. They are from patterns I made (**photo 14**) and are of phosphor bronze metal and of the marine type (**photo 15**), with a lot of help from various articles and books such as the B.O.T rules, *M.E.* 3847 and the Mechanical World Year Book, (see references). The one on the steam drum is set to blow at 100psi and the one on the superheater is set at 105psi. In each case the drain is led back to the hot well and the waste steam to a single solid drawn 3/4in. brass pipe up the funnel.

Each of the four stools bear on transverse 'I' beams fabricated from 1 1/4in. and 1 x 1/8in. stainless steel flat bar and welded. It is drilled with 1/2in. holes for bilge water to pass through. Although it is a cool position I anticipate it is ripe for corrosion from the bilge water, moisture, and difficult to access. The holding down bolts are also made of stainless steel and I have calculated the expansion/contraction to be a maximum of 3/32 inch.

●*To be continued.*



Boiler fittings.

Safety valve patterns.

Safety valve in situ.

LETTERS TO A GRANDSON

M. J. H. Ellis

moves from simple sound to the food of love.

●*Number 97*

Dear Adrian, My last letter ended with a reference to the trombone, and this reminds me that in the early 1950s I had in my section of the office an elderly gentleman named Bill Rees, who earlier in his life had been a soldier in the Regular Army. He played the trombone in the regimental band, and when in happy mood, he could be heard playing an imaginary trombone, accompanied by appropriate noises. The trombone contains a long length of comparatively small-bore parallel tubing, and I suppose that this facilitates the production of a wide range of the overtones of the fundamental frequency of the instrument given a certain position of the slide. Mr. Rees said that he had been the envy of the other trombone players, who frenziedly worked the slides of their instruments in and out; whereas he had learnt how to blow an appropriate overtone, and only needed to move his slide gently to and fro. He told the tale that when a certain piece came to an end he aroused the ire of the bandmaster by finishing on a note at odds with all the other bandsmen. With increasing exasperation, the conductor drew his attention to this several times over, whereupon Mr. Rees expostulated *"But I am only playing what the music says, Sir!"* The conductor replied, *"Bring it here, let me see it."*

It was then discovered that when the music had last been put away a fly had been trapped between the pages, and now squashed flat, looked exactly like the note which Mr. Rees had been playing. 'A blot on the bandscape', one might say!

I have taken the following definitions from *Rudiments and Theory of Music*, published by the Associated Board of the Royal Schools of Musics:

Musical Sounds are named, in ascending order, from the first seven letters of the alphabet, A - G, and these are repeated to represent the same notes at higher or lower level.

Octave (eight) is the term given to the next sound, either above or below, which has the same letter-name, such as A - A, D - D, etc.

Admittedly, the book would be used in teaching children, but it does illustrate the difference in approach between the artistic and scientific disciplines.

However, to return to the subject of pitch, with which I was dealing in my last letter, I can now give you the following information:

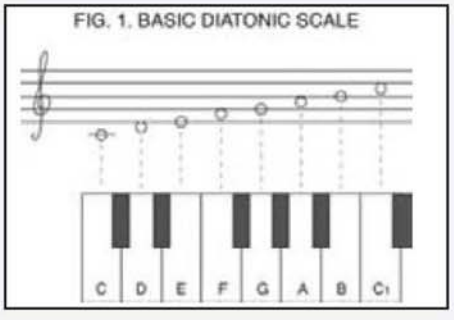
In 16th century England, it appears that a state of anarchy existed, as the pitch of domestic keyboard instruments was about three semitones lower than they would be today, while church music was pitched around two semitones higher. I am unable to quote any authority for saying this, but I have the idea that as time went on the pitch of instruments gradually tended to rise. Until scientific equipment capable of measuring frequency accurately became available, I don't see how any figures could have been arrived at until perhaps the 19th century. That would be consistent with the fact that it was in 1859 that it was agreed in Paris, and later confirmed in Vienna in 1885, that A should be standardised as 435 c/s. The present standard, 440 c/s. was agreed in 1939 and confirmed in 1960. This is only speculation, but I would not be surprised if the need for standardisation only arose because of the great increase in mobility which came with the railways.

I mentioned briefly in my last letter that the Greeks observed that if the length L of a stretched string was reduced by a simple fraction, say $^1/_4$, the note which it now sounded when plucked was concordant with the sound of the whole string. We know now that if the tension in the string is unaltered the frequency of the sound which it emits is inversely proportional to its length. Thus, if its effective length is reduced by $^1/_4$, it now becomes L x $^3/_4$, and the frequency of the note which it sounds goes up in the ratio of 4/3. If the two notes are heard together they blend in pleasing concordance; and the reason for this is, that the two notes have a number of overtones in common. In the example which I quoted, let the two frequencies be f and 4/3 x f, then the frequencies of the common overtones will be 4f, 8f, 12f, and so on.

How much of it was due to good luck, and how much to good judgement, I don't think is known, but I am now going to show you that the Greek scale of eight notes (including the octave) had a firm harmonic basis.

We have seen that any note we please is actually only one member of a closely-knit family of octaves, with the common factor that their frequencies are all in the ratio of powers of 2: 1 ; 2 ; 4 ; 8, and so on. Any two notes in an octave sequence are bound to be concordant; but, more than that, any two notes will harmonise if their frequencies bear a simple ratio to one another. The simplest ratio, after that between octaves, is 3/2. The diagram which I sent with my last letter (reproduced as fig 1) shows the scale devised by the ancient Greeks, as represented by an octave of eight white notes, C to C' of the organ or piano keyboard. An arbitrary starting-point has to be selected, just as a zero-point has to be defined on the scale of a thermometer, and this is done by making the first note on the left, middle C, the key-note. This series of seven notes, (not counting the octave C), was all that the Greeks used, but they provided for variety by creating seven modes, each starting from a different note of the series. What seem to me rather fanciful emotional associations were attributed to the different modes, in the same way as artistic people imagine a range of emotions to be evoked by different colours. The modes fell out of use long ago, but the Ionian mode, based on C gave rise to the modern major scale, and the Aeolian mode starting from A, was transformed into the minor scale. At the same time, and as we shall see later, the introduction of further notes, those corresponding to the black keyboard-notes, made it possible for a major or minor scale to use any of the notes of the thus-extended series as its key-note.

FIG. 1. BASIC DIATONIC SCALE



The note, the frequency of which is 3/2 times greater than that of C is G, and its frequency will be 256 x 3/2, = 384 c/sec. By virtue of its important position in the scale, this note is known to musicians as the dominant. This would be a convenient point at which to mention that the musical interval, i.e. the difference in pitch between two notes is denoted by the number of notes in the scale involved in getting from one to the either (both notes concerned being counted). In this instance, these notes are C, D, E, F and G, that is, five notes and so the interval is a fifth, in this example, to be precise, a perfect fifth.

Another simple ratio is 4/3, and 256 x 4/3 = $341^1/_3$. This is the frequency of the note F. Suppose for a moment that we had asked ourselves the question *"What would be the frequency f of a note such that its dominant would be C' (frequency 2 x 256, = 512 c/sec.)?"* Since 3/2.f = 512, f = 2/3 . 512, = $341^1/_3$, exactly the same figure as we have just arrived at for F. It is for this reason that the technical term for F is the sub-dominant, and not (as I used to think in my ignorance) because it is next below the dominant, G.

Consider now this simple ratio, 5/4. 256 x 5/4 = 320, which is the frequency of the note E. The interval between C and E is a major third, and because it is half-way between the key-note C and the dominant G, E is called the mediant.

One further simple ratio remains to be dealt with, 5/3. This gives the note A, with a frequency of 256 x 5/3, = $426^2/_5$ c/sec. A is called the sub-mediant, because it lies mid-way between C' and the sub-dominant F. By the way, the interval between A and C' is a minor-third, the smallest of concordant intervals. The frequency ratio is 2/(5/3), = 6/5.

We have now accounted for six of the notes in the octave, leaving D and B, which are derived, not from the tonic C, but from its near relation, the dominant, G. In the key which has G as key-note, the dominant is D', with a frequency of 256 x 3/2 x 3/2, = 576 c/sec., so making D next above middle C 576/2, = 288 c/sec. Similarly, the mediant is B, with the frequency 256 x 3/2 x 5/4 = 480 c/sec.

I said in my last letter that I would make a study of the extent to which concordance would occur between the notes of a scale of 19 notes. I have accordingly compared the frequencies of the notes of the equal-temperament scale of C with those of an equally-tempered scale of 19 notes covering the octave C to C' I found that the notes E, F, G, and A (which in the scale of C are the principal concordant notes with me Keynote C) had counterparts in the 19-note scale with frequencies within less than 1 per cent. The results were as follows:

E 0.4 % ; F 0.2 %; G 0.87 %, A 0.83 %. Roger Penrose's statement was therefore correct. And at this point, I think you are entitled to a well-deserved rest!

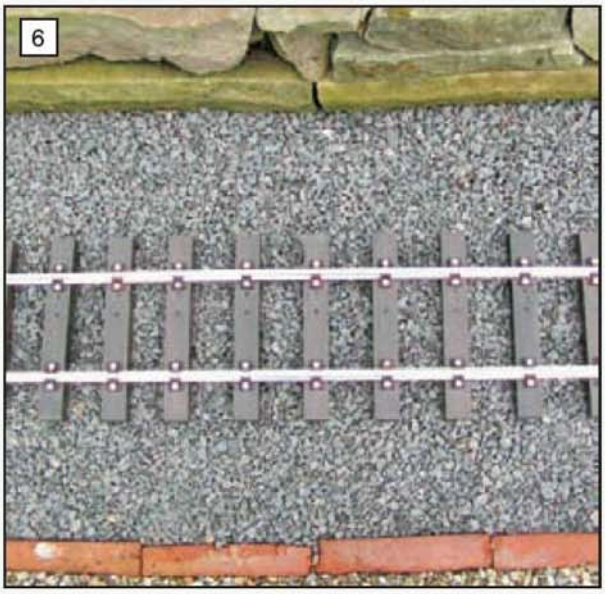
Your affectionate Grandpa.

ONCE I BUILT A RAILROAD...

Tony Finn

continues to describe how he constructed a 5in. gauge track in his garden using commercial components.

●*Part II continued from page 731 (M.E. 4289, 20 December 2006)*



Nice looking track! The first length assembled. Note the colour of the now rain-washed ballast.

I went to the Harrogate Exhibition in 2004 with the intention of buying track kits and I was also intending to buy the rail in 4-metre lengths. I was advised against this by one supplier, PNP, who said that longer lengths would give me more expansion problems. In the event, I found that PNP were offering a nice 5% Show discount on a complete package of what I wanted, and I could order it for delivery three months hence and still get the show price without paying for it up front.

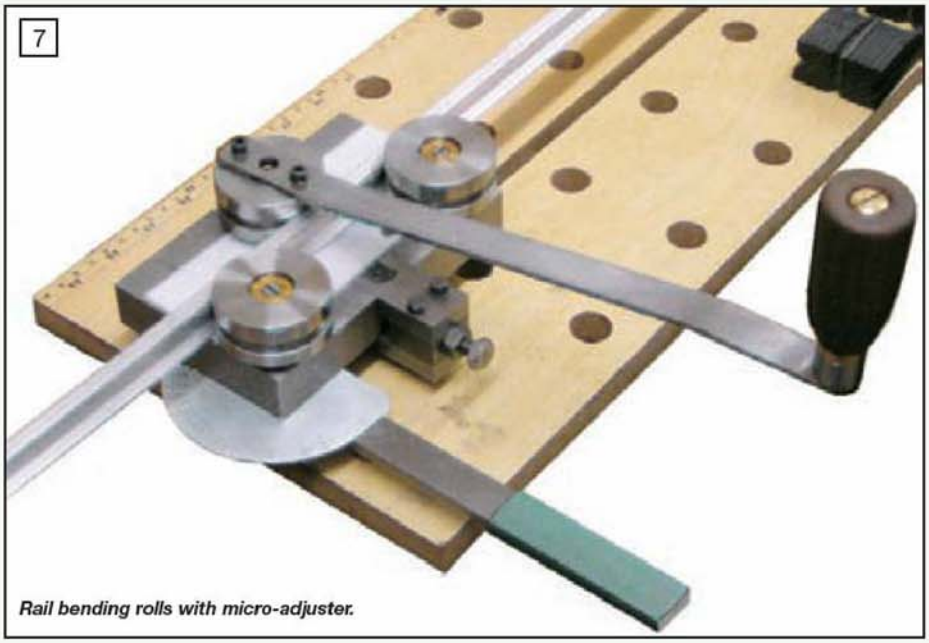
Track building begins

I was very much enamoured of the PNP sleeper system, with the offset pips and >> arrows, on the plates under the chairs: if both sets of >> arrows on the pip plates face inwards, you have automatic gauging to 5 inches. Point one outwards and you have an increase of 1/32in.; both outwards will give you 1/16in. increase. I used 1/16in. on the 18ft. radius, and 1/32in. on the 25ft. used as a transition curve into the 18ft. radius curves, and also on the 28-30ft. radii: this last is used on the up-and-down curves. So, faced with the deterrent prospect of otherwise having to drill 4,800 holes to jig, as against 3,200 ready-positioned ones, it was an easy decision to make: I placed the order. Not necessarily the absolute cheapest, but certainly less messy than buying from a lot of different sources, and there was not that much in it, anyway.

In mid-August, it all arrived: four packs of rail, separate for ease of carrying, 66 2.5m lengths in all, ended up on the dining room floor, together with eight large cardboard boxes containing 800 sleepers, 1600 chairs and their locating pips, 3200 screws, and 66 sets of fishplates with their screws. I didn't have the rail bending rolls then, so I put together one trial straight section on a board on the dining room table whilst the August rain poured outside. I couldn't wait to see what it looked like on the ballast, (**photo 6**). PNP do not have a rail bending service, as do some suppliers, but the cost elsewhere is £1 per rail length, so there was a further saving of about £50 from making and using one's own bending rolls.

Bending the rails

On the subject of track bending, Neville told me how he had done it. He also used 5/8in. aluminium rail, and made a bending machine, of which he gave me details and photos. You can buy one already made - I saw one at Harrogate - but it was £65 and I wasn't greatly impressed, so I decided to build my own (**photo 7**). Neville said that it was hard work to use, as he had pushed the rail through the rolls by hand. My block has about the same size and wheel spacing as his, but his wheels are smaller, and his is designed so that the rail rubs along the surface of the block which is bound to create extra work to overcome friction. I deliberately raised my wheels up, and inserted a Teflon slipper plate on the block for the rail to rub on, which eased things. I spoke to Jeff Price of Miniature Railway Supply Co. who advised me to make the wheels as large as possible to reduce the contact angle when feeding the rail in to make it take up, and to fit a handle about 1ft. long to turn the wheels. This was very good advice, as it is very easy to bend the rails with my rolls. Neville told me that the original phosphor bronze bearings on his had picked up on the shafts so he had replaced them with ball races which solved the problems. Mine are Oilite bushes 3/4in. long by 3/4in. diameter, pressed into bored holes in the rolls, and they have performed well. The 1/2in. shafts are silver steel, not hardened.



Rail bending rolls with micro-adjuster.

The amount of offset (versine) of the chord from the circumference, which is the amount the middle wheel must protrude into the line of the outer ones to achieve a curve of 18ft. radius, is readily calculated using Pythagoras or trigonometry, and is only about 0.011in. A spreadsheet program made calculation and graphing of this dimension for different radii easy (**fig 4**). Another way I found later to get the versine is to use the formula $V = L^2 \div (8 \times R)$ where L is the length of the rail, and R is the radius of curvature: this is accurate as long as L is less than 0.5R. In practice it was necessary to increase this a bit because the aluminium has a certain amount of spring back. The coarse adjustment is made by turning the lockable screw on the back which slides the middle wheel, but there is also a fine adjustment on one side wheel, which has an eccentrically mounted shaft which is adjusted by the rotation of the lever and locked. This gives 0.040in. of movement, but the dial is graduated for 0.020in., the equivalent movement of the middle wheel against the middle of the chord. This seems to work quite well, and I found the fine adjustment useful. The coarse adjustment bolt is 20tpi.

Another spreadsheet program calculated the versines for an 8ft. chord of the 2.5m length of rail for different radii, and this was marked off as shown in **fig 5**, on the middle of the edge of the 8ft. chipboard on which I was assembling the sections, allowing me readily to check the radius of a rolled rail. I rolled the inner and outer rails to the same (centreline) radius, on the ▶

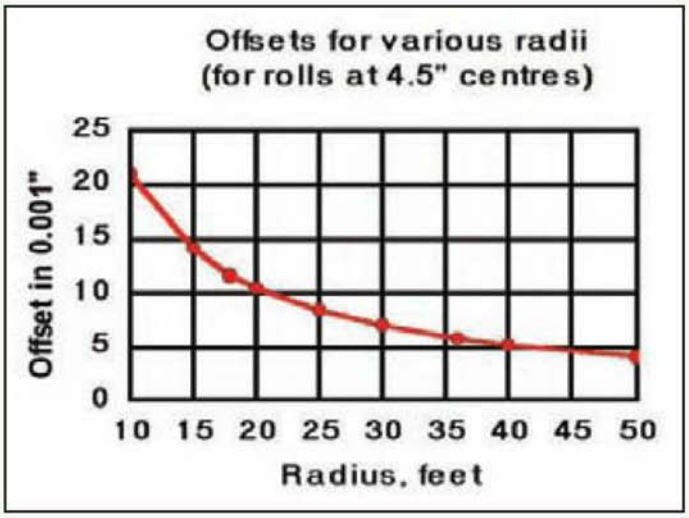


Fig 4: Offset of the centre roll for a given radius. In practice the roll needs to be wound further in, because of spring in the rail, so this is only a guide.

Set-up in the milling machine for cutting the fishbolt slotted holes. Note the gauge, with brass distancing pip at the right-hand side, for the outer hole.

principle that one rail would spring inwards and one equally outwards on assembly, and this proved to be the case. The rail took on a certain amount of helical twist when rolled, due to its unsymmetrical cross-section, so I re-rolled it in the opposite direction to counter this. Most of the curved pieces of rail were railed back and forth in this way several times, until well work hardened. Despite the rail running tightly across the base of the rolls, there was always a certain amount of residual helical twist, but in practice this didn't seem to be a problem when the track section was assembled. Somebody told me that I would have to cut both ends of the rail sections off because the rolls can't curve the first and last bits to enter them. I worked out the deviation caused by this small straight and it is only a few thou, insignificant in this context, and certainly not noticeable at 18ft. radius (although Jeff Price said that it would be at 10ft.). Yet a third computer program calculated the amount to be cut off the inner rail before bending, to match the ends to a given radius after bending. This worked surprisingly well, and I think I only got it wrong once. After shortening the rail, the slotted holes for the fishplates were made prior to bending.

One thing I had thought of making was a punch for the rail end holes, which are slotted to allow for the expansion movement. You can get the rails already punched, at a cost, but you can't punch both ends of the curved sections until the inner rail has been cut to length. I drew out a tentative design, but it seemed a lot of work to make in gauge plate, so in the end, I tried cutting the slotted holes with a slot drill on the milling machine, and this proved so easy that they were all done this way, using a jig and a gauge (**photo 8**). I drilled the first hole through with a 3/16in. slot drill, then moved the rail in the vice by an appropriate amount, using the gauge, before cutting the other half of the hole. This left a double cusp in the middle of the slot, which was then removed by quickly repositioning the rail again and making a third cut. The gauge is set to move the rail by about 0.1in. giving a slotted hole of about 0.270in. long. With M4 bolts, this allows an endways movement of about 3/32in. on each rail end, or just over 3/16in. across the joint, and this seems to have been enough. At least, I haven't seen any significant movement due to uncontrolled expansion. The gauge is 3/4in. wide, the distance between the fishplate hole centres, and its full width gives the distance to move to mill the second hole. The brass bolt head on the side gives the additional distance for making the second cut of the second hole. This may sound laborious, but in practice I could cut the two slotted holes in less time than it takes me to describe it. If you haven't got a milling machine, the same simple jig set-up can be used on a bench drill, as there isn't any sideways cutting to give problems, but you would still have to use a slot drill and not a normal twist drill.

The M4 bolts supplied with the fishplates have an oval part under the head which locks them in the punched oval hole in the fishplate, so no spanner is needed on the inside of the rail. The nuts are nyloc, which allows easy adjustment of the required slackness: I tighten them fully, then back off by two flats, with the result that the fishplate supports the rail joint firmly but the rail can still slide as it expands and contracts. The sliding face of the fishplates were greased with graphite grease. Neville told me it was important that each rail joint was supported by a sleeper underneath the joint, but I have found that this isn't so with the heavy-duty steel fishplates I chose to use. It might be a different story with the lighter gauge fishplates on the market, and

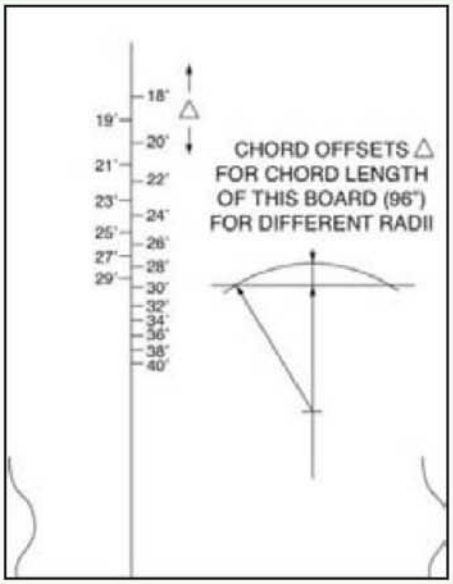


Fig 5: Versines marked on the middle of the track board edge.

personally I would see that as false economy. When using this track system, with flat bottom rail in chairs, it doesn't represent full size practice anyway, so scale appearance is not an issue.

During the winter of 2004-05, I put together most of the track sections. Being weatherproof, once I had assembled a section, it could be stored outside. To assemble a section, 28 sleepers and 56 chairs and their 'pip spacer plates' were counted and put ready. Chairs were slotted onto the rail lengths and roughly spaced out, and then their pip plates inserted, with the moulded-on arrows pointing in the appropriate direction. Assembly was started by screwing chairs to a sleeper at each end, and two in the centre. The spaces between these sleepers were then progressively filled with the remaining sleepers by systematically halving each gap. A track gauge is helpful here, and I made both a fixed gauge, and a rolling gauge, the latter having adjustable pieces on it for use on the over-gauged curved sections. As track gauges are essential when building pointwork, these were the first tools to be made. A simple gauge was used to get the sleeper spacing correct. When I first started assembly, I was using the drill point 7mm A/F hexagon head screws provided, but one of the pre-moulded holes in the sleepers was over a rib in the underside, and the screws would not penetrate the rib, stripping out the holes instead, so I found I had to drill these holes through before the screws could be tightened. I pointed this out to PNP, who had not come across this problem before, but Paul Norman quickly sourced some new screws with sharp non-drill points and this solved the problem altogether. The new screws were 1/4in. A/F rather than 7mm which proved an advantage, since a hexagon bit adapter can be used to drive them home instead of a 7mm socket: being smaller, it fits the narrow space next to the rail much more easily than a 7mm socket.

My fixed rate electric screwdriver proved inadequate for the job, and I obtained a new one with adjustable torque: this was ideal for the purpose, and I now regard it as an essential tool for anyone building track using this system. The hexagon bit adapters are really too soft for this job and they eventually wore out, the ends being machined off progressively until there was no longer enough hexagon socket left. I made new socket bits from silver steel. The circumference of a hexagonal bar is three times the distance point to point. Divide this by π to get the diameter of the hole to be drilled in the silver steel bar. The

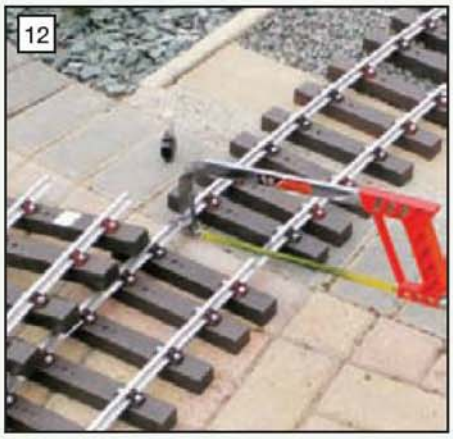
The ash pit before installation. All photos: Tony Finn and Geoff Thorne.

Track laid across the back lawn and the ash pit now installed. The points are not yet built.

Summer 2005 -track laid across the front lawn but not yet ballasted up.

hexagon was first forged roughly, and then finally over a 1/4in. A/F Allen key on the anvil, before hardening. A piece of 1/4in. A/F bar (usually the drive end from the defunct adapter) was force fitted into a round hole in the other end of the bit, and served to fit in the drive socket of the screwdriver. These bits, easy to make, also wore but much more slowly than the hex adapters.

With the winter over, I had a pile of 2.5 metre track sections ready to lay, and these were quickly laid on the parts of the formation that had already been completed. Once the track laying had nearly reached the patio, I needed to fit an ash pit. This had to be in the section common to the circuit and the up-and-down section. The ash pit (**photos 9** and **10**) is about 6in. deep and the sides are made from cuts of an 18in. paving slab. The corners are pegged together with 6mm stainless steel pegs, and this rectangle rests on a

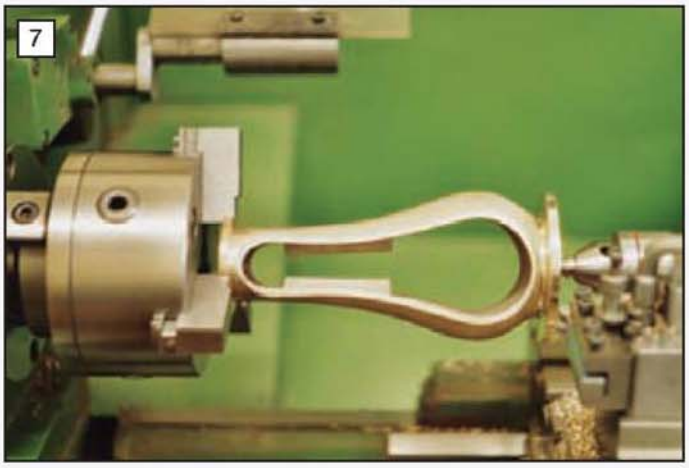


Cutting the last section of track to length.

full paving slab set in the ballast, with the surrounding ballast holding it all in place. I made a frame of 1 x 1in. steel angle set apart to match the rail gauge, and to this were fastened two hardwood lengths of sleepering to which the rails are clipped on the inside with clips made from bent Meccano angle brackets, and stainless steel dome head screws and washers on the outside. This has proved very satisfactory, as long as the fire is quenched straight away.

The western part of the formation was built across the front lawn (**photo 11**), and was by now a well-practised operation: I dug a small soak-away at the low point in the front lawn into which to drain it. The track sections crossing the newly block-paved drive were made and laid and the final closure piece of the loop was cut to size on 27 July 2005, (**photo 12**)

●*To be continued.*



The bottom flange can be machined using the 3-jaw chuck fitted with soft jaws. Tailstock support is again needed.

The fixed steady is brought into use again when boring the hole in the bottom flange.

JAMES BEGGS AND CO. BOTTLE FRAME ENGINE

Anthony Mount

completes the main frame before moving on to the bearing pedestal.

●*Part III continued from page 739 (M.E. 4289, 20 December 2006)*

Now the top recess can be machined and the neck of the casting bored to size. Now for the tricky bit, change to a self-centring chuck and use soft jaws that can be machined out to receive the top flange. Give tailstock support as shown in **photo 7** and bring the bottom flange edge to finished diameter. Set up the fixed steady on the freshly machined flange edge and remove the tailstock support. Another photograph (**photo 8**) shows this arrangement. The extended base can now be machined away to give a finished flange thickness, at the bottom, of 5mm and the bottom should be bored out to 40 millimetres.

I deviated from the drawing slightly as I had plenty of thickness on the bottom flange, so I machined an additional 50mm diameter spigot 3mm long on the bottom that located into the base cone, which was bored out to 50mm instead of 40mm to receive it.

The next machining operation is the most difficult one on the main frame and that is to machine the slide bars. They are cast integral with the frame so to get at them means going inside the frame with the cutter.

Setting up is of paramount importance, as the slide bars need to be equidistant both ways from the centre line to line up with the piston rod. Turn the casting so that the slide bars are lying horizontal, a parallel between the table and the underside cut out flange will help to orientate the casting, and then clamp the frame to the table, which is more easily said than done. I used studs and large washers each end to clamp the casting to angle plates, which were then bolted to the milling machine table, see **photo 9** for this set up. A square off the side of the table can be used to set the angle plates square, which should also line up the centre line of the column with the long axis of the milling machine table.

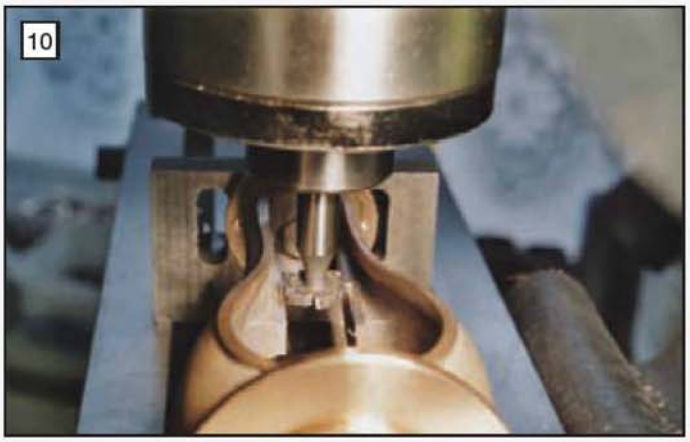
Use an edge finder to pick up one of the turned flanges on its outside diameter and then, by using co-ordinates, find the centre of the casting and zero the dial. You can now keep the faces of the slide bars an equal distance from the centre line but do not forget to allow for any backlash in the feed screw.

You can also check the axis of the frame by using a piece of plain rod in the drill chuck and positioning it so that it just touches the base diameter, zero the dial, move along to the top and feed in the table by 14.5mm and the rod in the chuck should just touch the side of the top flange.

Use the side of an end mill to machine the faces of the slide bars, and change to a Woodruff cutter to machine the edges, which can be seen in **photo 10**. The Woodruff cutter can be positioned by first lining up the bottom of the cutter on the edge of one of the turned flanges. You know the diameter of the flange so you can calculate how much to drop the cutter down to machine the top edge of the slide bars. Then, to machine the underside, you drop the cutter down the thickness of the slide bars plus the thickness of the cutter.

A small job to finish off the slide bars is to file a chamfer on the lower ends to ease entry of the cross head and to give clearance to the connecting rod. You will know if the slide bars are correctly located when you come to fit the piston rod to the cross head. All is not lost if it is out as the hole in the cross head can be drilled offset, though it will mean the cross head can

A photo showing the set up approach used when mounting the main frame on the milling machine.



Machining the edges of the slide bars in the main frame on the milling machine using a Woodruff cutter.

only be fitted one way. **Photograph 10a** shows the cross head being spotted by a drill passing through the bottom cover which is being used as a locating jig.

While set up on the milling machine the pocket for the bearing pedestal can be machined in with a 6mm end mill, this operation is shown in **photo 11**. Position the cutter on the centre line of the casting and machine down to the top face of the bottom flange. Stop just short of the face and set the stop. Then machine either side of the centre line to the full width of the pedestal. Be careful to take equal amounts off either side. Take a finishing cut along the bottom to bring it flush with the flange face.

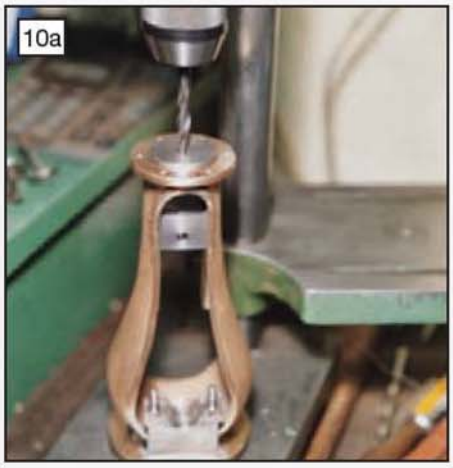
Before removing the frame undo one of the angle plates and scribe a line across the bottom of the frame along the centre line. This operation is shown in **photo 12**. Replace the angle plate and remove the other angle plate and scribe another line across the other face.

If you are building the engine with two pedestals within the frame turn the casting over and re-set with the machined pocket on a parallel. This will orientate the casting. Tighten the bolts against the angle plates, then pick up the edge of the flange as before to use co-ordinates to find the centre of the frame, then the pocket for the bearing pedestal can be machined.

Last job on the main frame is to drill and tap the stud holes. It will probably be easier to make up a drilling jig to locate the top holes, as these jigs can be drilled in the dividing head, ensuring the correct positioning of the holes. However, you already have one in the form of the cylinder top cover.

The top cover can be fitted to the top of the frame and two of the holes can be lined up with the scribed centre line, clamp the cover in place and spot through for the stud holes. Remove the cover and drill and tap M3 (5BA).

If you have forgotten to scribe the line all is not lost. Use a length of, say, 25 x 6mm mild steel bar and stand this vertical against the frame with the inside face pushed against the pocket seating for the pedestal. A small square can come off the face of this bar lying on top of the top cover and the blade of the square can be used to line up with two of the drilled holes in the top cover, clamp in place and spot drill, remove the cover and drill through the flange.



The cross head being spotted by a drill passing through the bottom cover.

Take care as the drill passes through as it is close to the root curve of the frame and the drill might snatch.

For the bottom stud holes, if you have drilled eight equally spaced holes in the bottom drilling jig, then two can be lined up with the scribed line and the four adjacent ones used to drill the holes. However, a drilling jig for the base is not essential. If you bolt the frame to the milling machine table upside down see **photo 12a**, after you have fixed the pedestal in place, a straight edge can be held against the pedestal face and lined up by eye with one of the T-slots. This may sound a bit hit and miss but you will be surprised how accurate the eye can be in a situation like this.

My drill chuck has a tapered body that starts just a little smaller than the 50mm hole in the frame base, this was used to locate the centre of the frame then co-ordinates were used to position the holes in the base, the three fixing holes for the pedestal being counter bored at the same time. I was very pleased when offering up the pedestal, that had also been drilled using co-ordinates, that everything lined up exactly.

I have shown two tapped blind holes through the frame at the top of the slide bars, these are for oil cups screwed in from the outside. The drilling of these holes can be done while the frame is clamped between angle plates and a square off the milling machine table with the blade against the pedestal will square the frame up and co-ordinates can be used again to find the centre of the frame, see **photo 12b**.

When fitting the pedestal to the frame it can be bedded in on a thin layer of epoxy filler, this will squeeze out as the screws are tightened and if you use a spatula with a rounded end to remove it you will automatically form a curved fillet. When this is cleaned up with abrasive paper after it has hardened it will look as if it is all one casting after it has been painted.

Bearing pedestal (part 03)

The bearing pedestal comes as a separate mild steel, laser cut blank, though it appears in the old engraving that it was cast integral with the base on the full size prototype.

It is much easier for us to look on it as a separate component and far easier to machine as a separate item. Laser cutting leaves the edge slightly undercut so start by machining the bottom of the blank flat to fit onto the base, and bring it to finished length at the same time; the blank is supplied a little over length. The undercutting is hardly noticeable on 8mm thick material but, even so, better to machine the bottom edge than to have the pedestal trying to imitate the Leaning Tower of Pisa.

Drill and tap the stud holes at the bottom and for the bearing cap at the top, these are best positioned using co-ordinates. Clamp the pedestal in the machine vice of the vertical milling machine. Use an edge finder to pick up the face and one edge and drill the holes. The top two are tapped M5 (2BA) for the studs, the bottom four are tapped M4. I have used a metric thread here, as Allen cap head screws are much cheaper in metric sizes. Draw file the curved edges and lightly radius the edges to finish off the pedestal blank.

Fixed to the pedestal is the bearing housing. In the full size engine the bottom half of the bearing housing was cast integral with the pedestal, but on the model it is a separate item.

Both halves of the bearing, which are identical, are water jet cut from mild steel plate. I have had them cut a little oversize to allow them to be machined to length. Start by running a file over the mating surfaces to ensure they are flat. Mine had a slight upstand at one position where the cut had ended. If you are unhappy with the finish a light cut can be put on with an end mill to clean up the mating surfaces.

The pocket for the bearing pedestal being machined into the main frame with a 6mm end mill.

Scribing a line across the bottom of the main frame along the centre line using the surface gauge.

Above: Drilling the main frame base.
Right top: Drilling the mounting holes for the slide bar oil cups.
Right bottom: Boring the separate pedestal bearing in the lathe.

Take equal amounts off each end to ensure the bearing is central. They can be clamped in the machine vice of the vertical milling machine overhanging the edge of the vice, and the side of an end mill can be used to machine the ends of the caps.

While still clamped in the machine vice the holes can be drilled. Again co-ordinates make positioning the holes simple. The top-bearing cap can also be drilled and tapped in the centre for an oil cup.

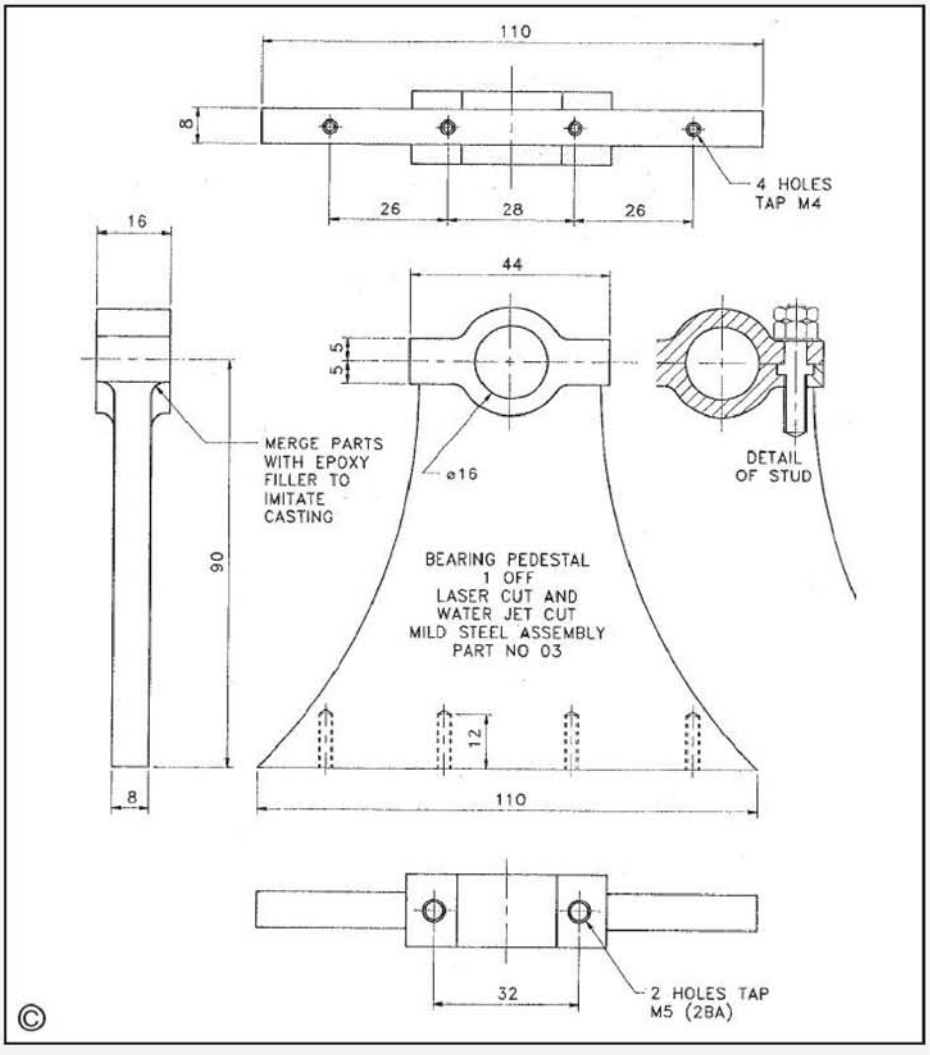
Using temporary screws, bolt the two halves together and set up in the 4-jaw independent chuck with the centre hole running true. Check now that the outer edges are also central. If they are not centralise the housing by the outside and ignore the eccentricity of the bore, the bore can now be machined to 16mm diameter with a short stiff boring tool as seen in **photo 13**. Chamfer both edges of the bore.

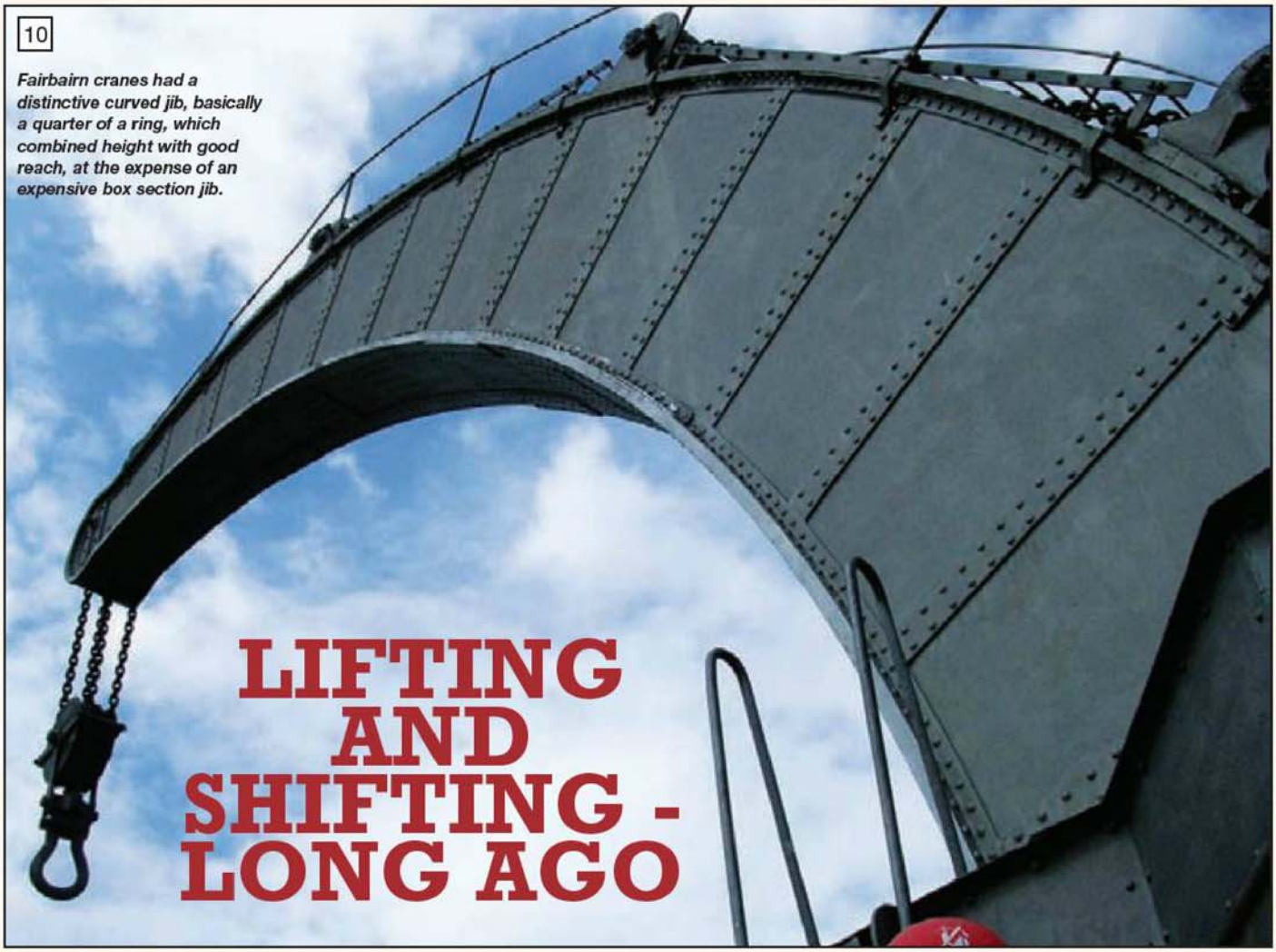
The actual bearings are made from bronze. Both bearings are flanged both ends. To follow the prototype the bearings should be of the split type. Soft soldering together two slabs of rectangular bronze, hold in the 4-jaw independent chuck and turn down to 20mm diameter. Recess the middle to fit the bored out size in the caps and bore out the bearing to fit the crankshaft, and then part off.

However, as the crankshaft is made from parallel material we can cheat there and make the bearings as solid shells. Making them is a simple turning process. Just hold a length of bronze bar in the lathe chuck. Face off, centre and drill down 11.5mm diameter. Then with a chucking reamer bring to finished size at 12mm. If you do not have a reamer then use a boring tool to open out the drilled hole to fit the crankshaft.

A drawing and more details of these bearings will appear later in this series so let us concentrate on finishing the pedestal first.

●*To be continued.*





10

Fairbairn cranes had a distinctive curved jib, basically a quarter of a ring, which combined height with good reach, at the expense of an expensive box section jib.

LIFTING AND SHIFTING - LONG AGO

John Ditchfield

presents more on dock side cranes and other related topics from the fascinating history of heavy lifting.

●*Part IV continued from page 748 (M.E. 4289, 20 December 2006)*

In the previous issue we looked at dock side cranes, with special emphasis on those big imposing iron tripods known as sheer legs. These were relatively simple devices, but required the ship to be carefully manoeuvred below the crane's hook. The last quarter of the 19th century saw the introduction of very large dock side cranes with the ability to slew. However, their capability for picking and placing the load was limited by the fact that the jib's angle was usually fixed (that is to say, the jib could not be luffed). They took up less space than sheer legs, and also they allowed loads to be deposited over a much larger area of the quay side than did sheer legs. As an example of early, large slewing jib cranes, Cowans Sheldon produced 130 ton machines in the early 1890s for Cessnock Dock and Finnieston Quay on the Clyde. For the Cessnock crane, the weight of the supporting masonry was no less than 4,300 tons, and this was on top of supporting concrete cylinders of similar dimensions. The crane slewed on massive tapered roller bearings. The Finnieston crane was eventually replaced by the hammerhead crane that stands today as a reminder of Glasgow's industrial past.

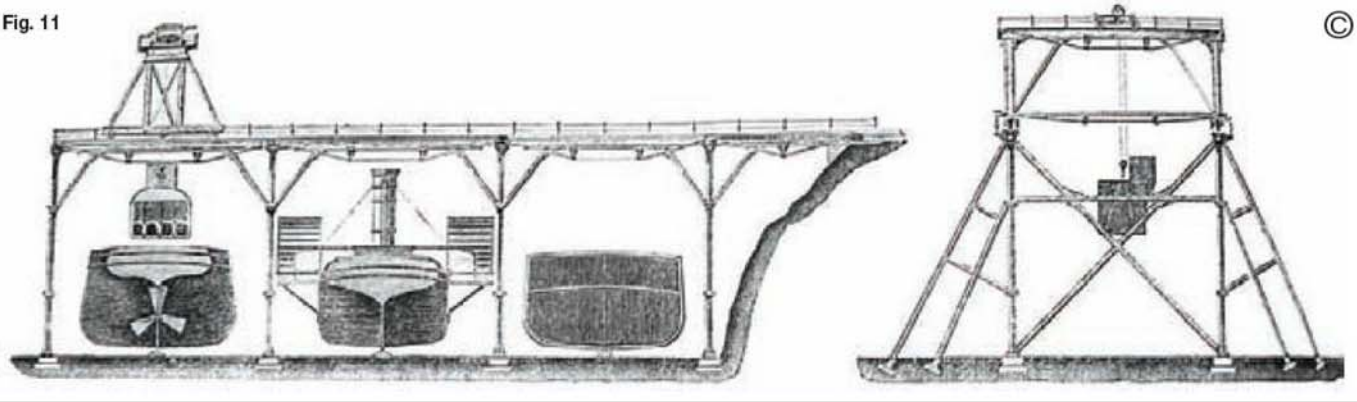
At least one medium-sized Victorian dock side steam crane has survived intact in the UK, this being the Fairbairn-type crane built in 1875 by Stothert and Pitt for Bristol Harbour. Fairbairn cranes had a distinctive curved jib, basically a quarter of a ring, which combined height with good reach, at the expense of an expensive box section jib (**photo 10**). Large Fairbairn cranes obtained their stability from a spigot delving deep into the wharf. This arrangement minimised the crane's 'footprint'. The Bristol crane was not one of the largest, with a capacity of only 35 tons, but it has survived in excellent condition and is still occasionally steamed for demonstration purposes. It is also one of the few cranes to feature rose motifs in the cast iron window frames! Fancywork is not something normally associated with Victorian crane cabs. More typically, a crane cab looked like a rushed assembly of off-cuts from a corrugated iron shop, or alternatively like a large garden shed with lengths of ironwork protruding.

A much larger, 100 ton capacity Fairbairn-type crane could be seen at Hartlepool until 1975, while a smaller, 30 ton hand operated version has survived at Dover. This was made by the aforementioned Easton, Amos & Anderson Ltd. I recently came across a very similar one, albeit motorised, in the time-warped *Arsenale* in Venice. More impressive was a neighbouring 160 ton capacity hydraulic crane built by Armstrong, Mitchell of Newcastle c.1885. Visitors to Venice should note that the *Arsenale* is only open to the public on special occasions. There's an excellent maritime museum next door to ease the disappointment of finding the Arsenale inaccessible. To avoid the disappointment of finding the museum closed, go in the morning.

I will end this section on seaside lifting equipment cranes by briefly mentioning floating cranes. These were mainly used as substitutes for or alternatives to large quay side cranes or for fitting-out in shipyards, and for assembling other large cranes, or for fishing heavy objects out of Davy Jones' Locker. I will make no attempt to trace the development of these ungainly monsters, but I was surprised to learn that a massive steam powered, paddle-propelled example was in service for raising sunken ships as early as 1850. This was known as Bishop's Floating Derrick, and was built by Thames Ironworks of Blackwall. The crane's main structure was an 80ft. high iron tripod, and this was surmounted by a 50ft. high king-post. A horizontal boom, 120 feet long, was attached at mid-span to the main column.

A similar concept was adopted by Isaac Newton (no, not that one) for the New York Docks' floating 100-ton crane built by Delameter Iron Works in 1872. The main structure was in the form of a 'pyramidic frustum', a sort of wigwam shape. Like a Dalek's body. For those unfamiliar with Daleks, think pepperpot. So, the crane's body was like a pepperpot. Made from timber rather than glass, but it did have lots of sash windows. Above this protruded a tall tubular king post, assembled from iron tubes 40in. diameter. Above all this was a flagpole for the Stars and Stripes, further reducing the danger of the crane being mistaken for an incoming hostile warship. The king post revolved in two ball ▶

Fig. 11



bearings. A horizontal jib projected in either direction from the top of the timber tower, and this was braced from above and below by bars and wire ropes. Strangely enough, the carriage (crab) was not mounted on wheels and rails, but slid along the beam, being faced with wooden (ash) pads and sliding on brass plates attached to the crane's beam by countersunk screws. Digression: An American account of the crane refers to 'counter screws', which made me realise that 'countersinking' was originally applied to the brass counters of shops, banks, etc.

Newton's crane was described in detail in *Engineering* in 1873. The article's author was favourably impressed, but criticised some earlier American attempts at 'Bishop-type' floating cranes. It is fair to say that this view was probably not merely chauvinistic, being influenced by the fact that a number *"had collapsed under moderate loads"*.

There is something disturbing about the concept of a structure with the appearance of a reduced Eiffel Tower perched on a raft. A floating crane does not conform with the dictum 'If it looks right, it is right'. It's not as though they were confined to the calm and shallow waters of docks and harbours. There was a tendency to build them in Europe and send them far away, as far as New Zealand, in fact. Apologies to our New Zealand readers for implying that they are far away. Ideally, floating cranes were despatched with their jibs removed, but this pre-supposed there was a way of refitting the jib at the contraptions' destination. Tall floating cranes sent across wide oceans are sometimes referred to as 'shipwrecks'.

I was amused by a 1901 account of a 100 ton floating crane built by Armstrong, Mitchell & Co., which stated that in the acceptance trials *"the speed over the measured mile was a little over 5 knots"*.

"Ready to go, chief?". "Ready, Cap'n? We're going flat out. Can ye no feel the vibration up there?"

Unusual shipyard crane

I had not intended to address the subject of shipyard cranes, other than those of the sheer legs variety, but my researches revealed an example which I think is worth highlighting. *The Engineer* of 23rd November 1866 described a crane installed at the Abden shipbuilding yard in Kircaldy (**fig 11**). The yard built vessels up to 2000 tons, and the East coast lacked a suitable crane for fitting out steamships of this size. The company's engine works were three miles away, and boilers and engines were brought by rail to the yard. Three adjacent slips were located 50ft. below, and a gantry was built across all three slips to accommodate an overhead crane running on rails 50ft. apart. These rails continued on land to meet the railhead and the overhead crane, of the gantry type, could pick up boilers and engines and place them in the ship. This allowed more fitting-out to be done before launch, and also allowed more of the enclosing plate work to be completed, stiffening up the vessel for launching. Readers may be less impressed by the fact that the crane was hand operated. Be impressed though, by the fact that the men on the cranks could lift and shift a load of 50 tons.

Chains and wire ropes

Regardless of the type of crane, chains were the medium of choice for lifting for a very long time. The longer the chain, the more relevant is the expression involving the words 'as strong as' and 'weakest link', and it is not difficult to see why multi-stranded wire rope came to supersede chains. Apart from the reduced chance of failure without warning, ropes will pass much more smoothly over pulleys than will a lumpy chain.

This chain is transmitting power from the worm wheel via the notched pulley.

Smoothness is particularly important with suspended loads, because of the impulsive forces that arise with any jerky movement.

Wrought iron chains held sway, so to speak, for many years, but they had an inherent deficiency, namely the risk of embrittlement. British regulations for the inspection and testing of industrial chains came into force in 1905, and these included requirements for annealing wrought iron chains (below a certain link size) at six-monthly intervals. This reflected the risk of embrittlement in service due to work-hardening. The heat treatment activity also burned off the accumulated dirt and grease, revealing the extent of any wear of the links. One test for embrittlement was to hold a link on an anvil with its major axis vertical, and strike it with a hammer. A case was reported of an embrittled 1/2in. dia. link being broken by a 7lb hammer dropped a mere 3 feet. Steel, especially of the older 'rimming' variety, was not immune from brittle failure. Wrought iron continued to be used long after steel became widely available. This was because of the difficulty in obtaining good quality welds in the steel links. Not that all chains links were produced by welding. Various methods were introduced for forming lengths of chain from solid bar, but that will have to keep for another time.

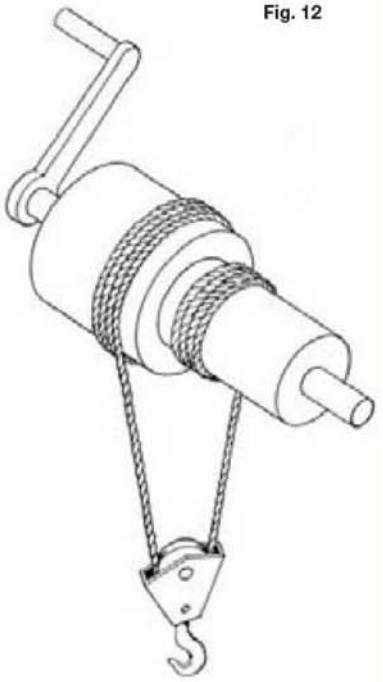
Steels chains are still widely used for many lifting applications, most commonly on 'chain blocks'. Incidentally, my 1 ton capacity specimen is surely a candidate for the grandest name for modest lifting equipment: 'The Hyper-Acme Chain Block'. Chains are clearly much more flexible than wire ropes of equivalent strength, which can be a definite advantage. Try storing a long, thick wire rope in a neat pile, or in a small box. Or in a bucket. Why a bucket? Well, periodically lowering the chains into a tank of lubricant was the best way of getting oil to the wearing surfaces. Chain slings can be more readily wrapped around awkwardly-shaped objects without damaging the sling (provided that suitable packing is used to separate the chain from sharp corners). For crane hoists, the difference in flexibility meant that cranes with wire ropes needed larger diameter drums and pulleys than did chain-equipped machines. I should mention that the drums of all but the humblest cranes had a spiral groove to offer reduced contact pressure on the chain or rope, and to ensure neat laying. Overlapping of the chain or rope was best avoided on the drum. Thanks to π, a surprising amount of chain or rope can be accommodated on a given size of drum. For example, if we wanted our overhead crane

to lift heavy loads through a height of 30ft., and if our drum diameter is, say 2ft., then five turns of chain or rope would suffice. However, it was usual to take the chain round a pulley attached to the hook, so as to provide mechanical advantage and reduce the load in the chain. This doubling means that we actually need 60ft. of chain to raise the load. Ten turns it is, then. However, the main hook might well have two pulleys, so the total chain length and hence the drum width, are further doubled. The Craven crane illustrated in *Part 1* had an additional hoist, smaller and faster, for quick lifting of light loads, and this has a single fall of chain attached directly to the hook, allowing its drum to be very compact.

Whilst bearing the tension of its load, a hoisting chain has to navigate the periphery of the drums and pulleys. The effect of a small diameter may be evident in the photo of the chain block (**photo 11**). This chain has to transmit power from the worm wheel via the notched pulley. Chain wear will occur when it rolls back and forth over the small diameter drum or pulley. Noting how the loaded chain changes direction as it goes round the pulley, it will be apparent that the small points of contact between adjacent links will be most vulnerable, with appreciable rubbing movement when the links pivot on each other. I should mention that the chain block is in scrap yard condition, but spruced up with a wire brush to have its photograph taken. If the wormwheel looks rather ugly, there is a good reason. The teeth are unmachined. 'Cheap' would have been in the maker's brief, and the wormwheel and notched pulley are cast in one piece. An interesting job for the foundry.

The later nineteenth century saw the adoption of a different type of lifting chain, sometimes known as a pitch chain or a Gall's link chain. This was similar to a bicycle chain, having steel plates and pins, but without the rollers. Manufacture would have been straightforward, with no requirement for skilled hammer welding as was the case with conventional chains. As an example of the use of such a chain, a large 60-ton Rotterdam docks jib crane built by Stückenholz of Germany had a Gall's chain of 6in. pitch with 2in. dia. pins. Such chains seemed to be more popular on what we like to call 'the Continent'. They were used in conjunction with sprocketed wheels rather than drums, so there was no need for a wide hoist drum. The use of pitch chains of this type was frowned upon by a correspondent to *Engineering* in 1882, who argued that the inner link was difficult to lubricate, and dangerous wear took place unseen. The letter writer was a lift (elevator) designer, and his readers no doubt had a healthier and longer life when they reverted to using the stairs rather than risking the lifts. This was before Mr. Otis introduced his safety elevator. The letter cited problems arising due to poor access for inspection, cleaning and lubrication, and quoted an example of a conventional chain that failed after two years' service due to the links having worn down to 1/16in. thickness. He was no fan of wire ropes, either, due to their short lives when used in conjunction with small diameter pulleys on lifts, where excessive bending of the rope occurred. Strangely enough, he was more disposed towards copper wire ropes.

Fig. 12



Differential pulley

Those sophisticated Ransomes & Rapier people were early advocates of wire ropes. On some cranes their sophistication was emphasised by incorporating a second drum of the 'fusee' type, as found on clocks, but somewhat bigger. This was all to do with allowing the jib to be raised and lowered without affecting the height of the hook. Digression: Ransomes were nothing if not adventurous. They built large Goliath 'pendulum' steam cranes for harbour construction. The special feature of these was the ability to swing a wagon load of stone out beyond the reach of the jib, and then tip the contents at the end of the swing. Ransomes & Rapier's products will be familiar to many older readers who studied popular engineering books (of the genre whose chapters were entitled *The Romance of the Safe Deposit* or *Triumphs of Irrigation*). However, I was not aware until I saw Ransomes & Rapier's 1888 catalogue that they made small railway trolleys with an unusual means of propulsion: a sail. Only £25, and I thought sailing was a rich person's pastime.

To go back to 'block and tackle', a device known as the differential pulley is more interesting than its name might suggest. I was probably introduced to such things in lessons on 'mechanics' many years ago, but I wasn't receiving. Invented by the ancient Chinese, it is a remarkably simple windlass with just two moving parts (or three if you class the rope as a moving part), which offered any mechanical advantage you cared to specify. **Figure 12** shows the principle. For lifting, the chain or rope is wound onto the larger diameter drum as for a simple winch. At the same time, the rope winds off the smaller drum, at a slower rate. Therefore, turning the handle raises the hook's pulley more slowly than would otherwise be the case. So, there's some mechanical advantage involved - to an extent dependent on the relative diameters - with a consequent increase in the weight that can be lifted for a given application of torque. Obviously, if the diameters were the same, much twirling would result in the load doing nothing but swaying slightly. The principle was applied in a more compact form in Weston's Differential Chain Block. I noticed that Tangye Bros. & Holman's 1876 catalogue offered a 10 ton chain block for only 400 shillings, that's £20. Oddly enough, a complete 10 ton floor-mounted winch could be had for only £10 10s, plus an extra £1 15s if you wanted deluxe bearing bushes made of brass. In addition you would have to buy the chain and the pulley block. Even so, it looks cheap. Do we really need that 10 ton manual overhead crane for the factory, at £220? Couldn't we get the carpenters to lash something up, and mount a hand winch on top? Of course not. We want the crane to serve for a hundred years or more. Besides, we don't want anything that would collapse and possibly injure a horse or damage some machinery. Such *ad hoc* cranes were, however, used on temporary outside work such as bridge construction. These might well be of the gantry type, made from massive timbers held together with big iron staples.

In the driving seat

Seat! I think not. Mr Gradgrind would not want his driver to be so comfortable that he might nod off at the controls. I previously described the control arrangements on some overhead cranes, and these fell into two basic categories which I will summarise. The Craven overhead crane described in *Part I* had three levers which moved up or down to push leather belts onto the appropriate pulley. A more widely-used alternative used three handwheels to operate clutches or friction gears for forward or reverse motion. Photograph 4 (in *Part II*) showed such an arrangement on a steam crane, where the clutch lever was activated by a leadscrew engaging in a nut in the forked lever. The leadscrew was turned by a handwheel. Variations on this theme replaced the leadscrew and nut by a worm and wheel sector arrangement, which involves much the same principle. Another type had a spur gear sector on the end of the clutch lever, and this meshed with a sector on a much longer lever wielded by the driver.

Jib cranes usually had additional levers or foot pedals for band brakes, and there may have been additional controls to alter (luff) the jib's angle. The foot brake usually took the form of a very long lever which tightened a band round a brake drum. The foot end of the lever often included a vertical rod with ratchet teeth to keep the brake held on, it being unreasonable to expect the driver to keep one foot on the brake while turning round and stoking and feeding the boiler. The length of the brake lever did not reflect the crane maker's generosity with iron, nor did it indicate a wish to provide light controls such that the driver might wear carpet slippers on duty. No, I think we can assume that the lever needed to be very long because band brakes did not always hold as well as might be wished, especially when worn.

The French maker Caillard was an early practitioner of ergonomics, the main controls for his jib cranes in the 1870s being limited to just two levers. The right hand lever was moved horizontally to adjust the steam throttle valve, upwards to raise the hook, and down to lower the load on the brake. The left hand lever controlled both slewing and movement of the crane along the rails.

●*To be continued.*

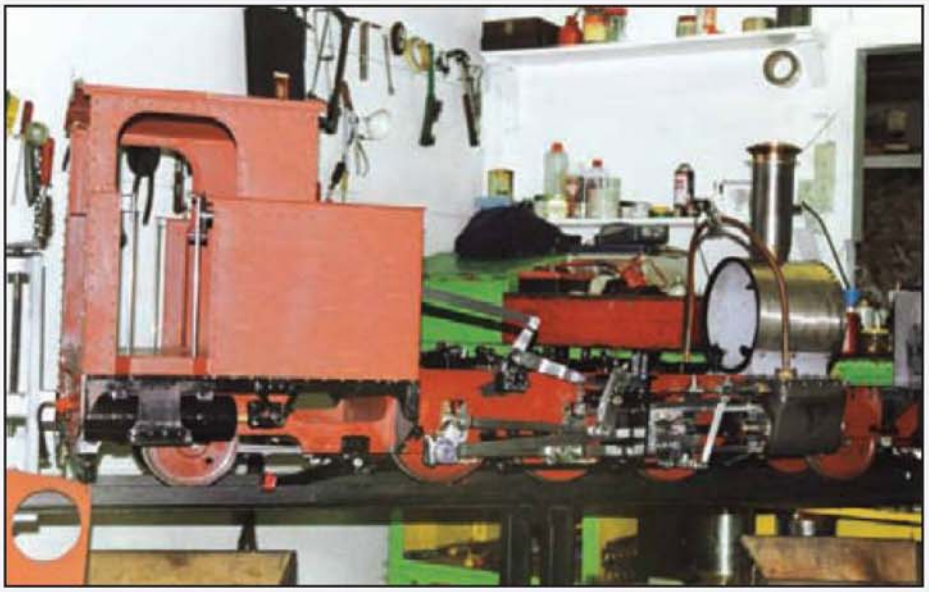
A 7 1/4in. 'VALE OF RHEIDOL' LOCOMOTIVE IN NEW ZEALAND

Stan Compton

describes the construction of a Welsh narrow gauge locomotive, on the other side of the world.

Just give a thought about someone living at the other side of the world who decides to build himself a working model of one of a small number of locomotives, designed by Davies and Metcalf to 1ft. 11 1/2in. gauge and built for the Vale of Rheidol Railway. Later in 1923, two more were built by the GWR in Swindon. The line climbs up the mountainside, at a ruling gradient of 1-50, from Aberystwyth to Devils Bridge in Wales. These engines only weighed 25 tons in working order and are still doing the work they were designed to do except nowadays visitors to the area are carried instead of the original loads of lead ore.

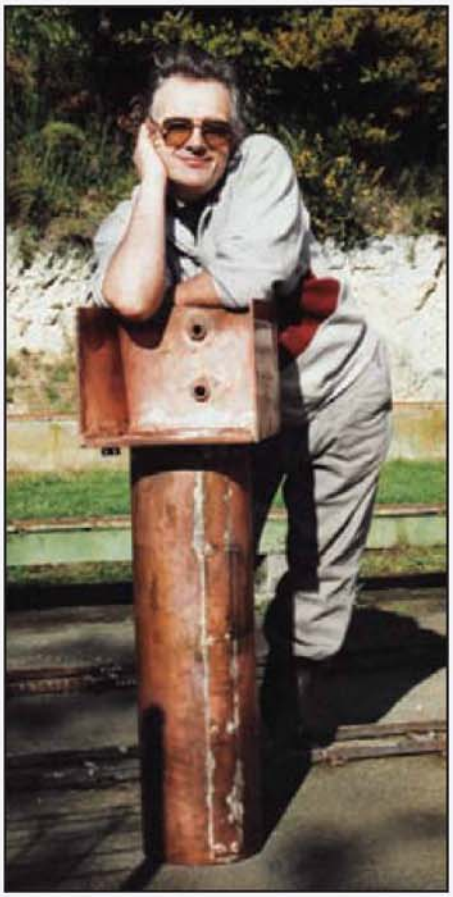
Many of us can get into the car and drive to this little railway to take photographs but, from a place as far away as New Zealand, one has to save up to take a trip to achieve this object. Possibly a once in a lifetime retirement trip with no chance to go back once construction had started to have another look. Peter was able to obtain a General Arrangement drawing made by the GWR Railway when the locomotives were built at Swindon. Now we all know that a G/A contains the 'bare bones' of a design, but working drawings are still required for construction. Also, a suitable boiler had to be designed to suit the engine. This was built to 3in. scale, with a length of 33in. and 8in. dia. and working pressure of 90lb sq ft. Some idea of the size can be gained by the photo of the builder standing behind the main barrel.



Waiting for a boiler.

Steel discs are suitable to machine the wheels on this model, besides steel wears better and gives a better grip than cast iron. Now to make a start cutting out the plate frames and stretchers. I recall examining a chassis for one of these locomotives on a siding at Aberystwyth and realised what a lot of extra work had been included in the various stretchers etc. This needs to be simplified due to saving space and the stresses in a model, even a large one, are nowhere near the full-size. Now to get busy on the interesting part, cylinders and motion with a bore of 2 7/8in. and stroke of 4 1/4 inches. A local foundry made an excellent job of the iron castings used on the project. Walschaerts valve gear is fitted, as per the original locomotive. Working springs also provide the right kind of suspension.

The copper boiler is built from 5 and 6mm sheet obtained from Australia. Peter was lucky to find someone who could share in the purchase of two 8 x 4ft. (2.4 x 1.2m) sheets of copper, one of each thickness. Designed using information from the Australian Boiler Code For Model Engineers it was a major job to form and silver braze such a heavy object. Of note is the external butt strap; this is a feature I approve of as a boiler inspector. Incidentally, there has been some correspondence recently about brazed boiler joints, usually the throat plate, with Sifbronze; but remember the heat to obtain fusion is such that some of the zinc is absorbed



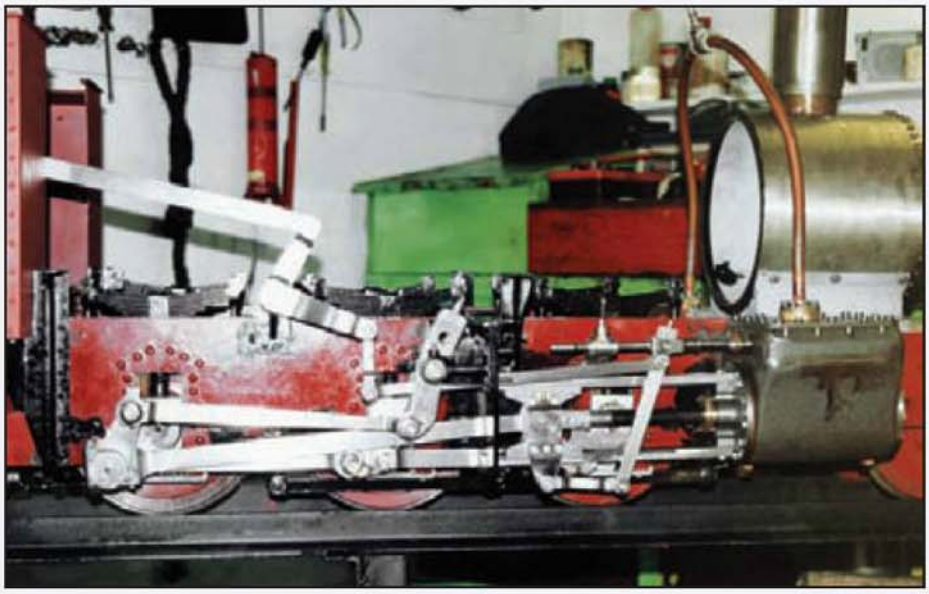
Peter Carr with his Boiler outer.

into the copper. As long as the boilers are blown down, to remove impurities, they last a long time. In our case Peter used only silver solder during construction of his boiler. A drum type smokebox simplifies construction, together with a parallel chimney topped with a handsome cap. The open-backed cab provides easy access to the fire, the original engine would have had a bunker provided for coal firing but, due to forestry restrictions, The Vale of Rheidol engines are now oil-fired, the same as those of the Ffestiniog. The very prominent side tanks are all brass with authentic close riveting, filled with water they add useful adhesive weight.

The finished locomotive is painted in Great Western Green and is named *Owain Glyndwr* as witnessed by the cast brass plates mounted on the side tanks as per original. An award was made to Peter Carr in New Zealand due to his excellent workmanship and the model is much admired wherever it is taken.

Now why should someone decide to build a working model of a small group of 2-6-2 tank locomotives that only ran on an obscure railway near the Welsh coast? Well, I was told by the builder that as a small boy he used to watch a programme on BBC Television called *The Magic Roundabout*. One day the Vale of Rheidol Railway was the chosen subject, and when he saw those 'chunky' green locomotives at work they formed a lasting impression in his memory. Later on, after many years in industrial engineering, he built a number of mainline locomotives in 5in. gauge. When subjected to the wear and tear of public running he realised the advantage of a narrow gauge prototype and, of course, the Vale of Rheidol locomotives were chosen.

Now was the time to take that trip home after many years living in New Zealand. At the main station in Aberystwyth, armed with measuring tape and camera, he started photographing the locomotive while it was gently simmering awaiting its return up to Devil's Bridge. The locomotive crew watched his activities with interest before asking what his purpose was. On being told that he intended to build a 7¼in. gauge model they laughed heartily. Little were they to know that here was someone who would actually complete the project! Peter's fifth locomotive project, it commenced in 1997 and was finally completed 2000.

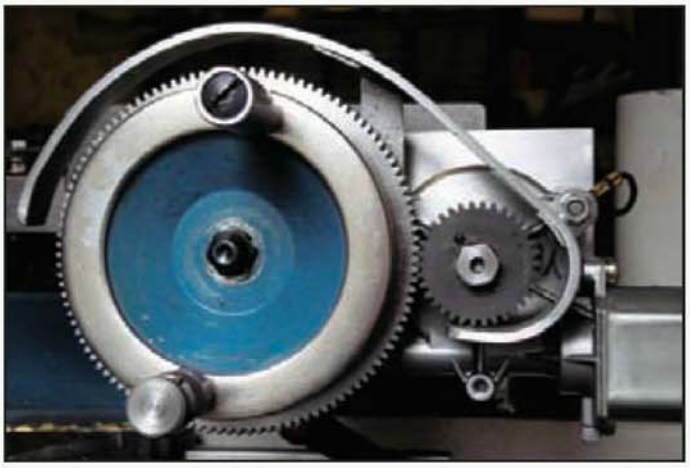


Walschaerts valve gear, just like the original.

Brake handle, buffers, and assorted other components ready for fitting.

Close up of one of the large cylinders, cast by a local New Zealand foundry.

A view of the installation on the author's milling machine. The spring loaded drive plunger is being operated.



A closer look at the feed system. The drive motor was from a van and drove the windscreen wipers.

FINE FEED SYSTEM FOR A MILLING MACHINE

A. J. Petrie

describes how he modified his Chester Champion milling machine to adapt it to his requirements and make it easier to use.

Some time ago I decided to invest in a new milling machine. After some thought, I chose the Chester Champion milling machine and was pleased with my purchase.

I had decided before purchase that some modifications would be required to meet my requirements. I also decided that, as far as possible, any modifications would be simply bolt on units as I did not want to alter the machine build in any way. These initially consisted of digital readout units being fitted to all three axes, a better spindle, better table locking system and also speed control. The better locking system was achieved by making extension pieces to carry adjustable clamp levers. This replaced the existing cap screws. The speed control arrangements were achieved by purchasing a 3-phase motor from Chester and simply fitting a Mitsubishi inverter unit.

After I had had the machine some time a friend suggested I should fit some form of automatic fine feed system to the X-axis. I toyed with the idea for quite some time but did nothing, however, on a visit to a mutual friend I found a small 12 Volt DC windscreen wiper motor and gearbox unit being discarded. The unit came from a small Japanese van. On returning home I found that the gearbox output was just over 20rpm, and could be reversed simply by switching the 12 Volt feed.

This prompted me to actually do something, rather than just look at it. In order to start I reckoned if I could achieve a feed rate of about 2in. per minute this would be a starting point. To achieve this feed rate a further reduction of approximately 3 to 1 would be required.

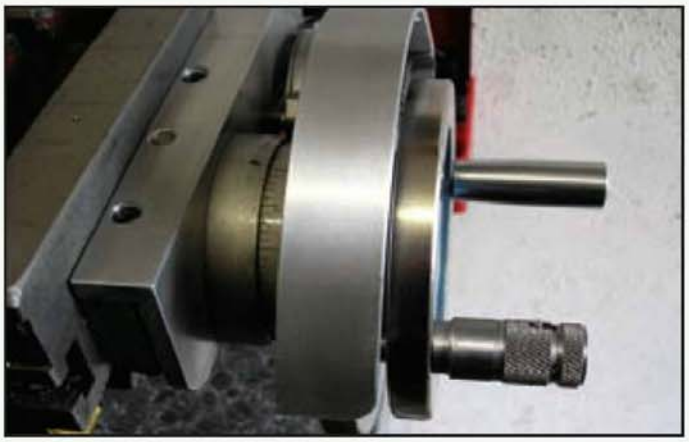
A look through the workshop 'stock' revealed two gears of 24DP that looked suitable at 110 and 34 teeth, thus giving me about the correct ratio. A piece of 2 x 2 x $^{1}/_{4}$in. drawn aluminium alloy angle was found at the same time, so I now had the basic materials to proceed.

After a bit of investigation, I noticed there is a boss on the inboard side of the X-axis handwheel. On removing the hand wheel and checking, I found it to be concentric to the feed screw centre line. I then bored out the 110 tooth gear to be a running fit on this boss (it could be bushed if you wish). The gear thickness was reduced to 0.005in. less than that of the boss length. This gave a free running gear mounted behind the X-axis handwheel.

The aluminium alloy angle was then marked out to give the correct pitch for the gears. I find the HPC gear catalogue invaluable for this type of data. The aluminium alloy angle was cut to the thickness of the feed screw end support and a slot milled in the skirt to clear the index boss. At this time a clearance hole was bored in the skirt to accept a boss on the gearbox. The mounting bracket was then marked out to take the two countersink mounting screws. Remember that access must be made for the oiling point on the feed screw bracket. The mounting holes were then transferred to the feed screw bracket, drilled and tapped accordingly.

Obviously, depending on what motor/ gearbox unit is used, the mountings will vary accordingly. The motor/ gearbox unit should be offered up and marked out accordingly for the fixing studs. To align the gearbox output gear and that of the X-axis gear, I found the use of simple distance pieces between the mounting plate and the gearbox brought the gears into line.

The large gear is fitted between the feed screw handle and the index dial and does not interfere with manual operation of the machine.



A simple guard has been fitted to prevent damage to the gears or the operator's hands.

At this point I now had a motor/ gearbox unit, mounted on the feed screw bracket, that would drive a gear carried on the handwheel boss. The use of the graduated dial for the table movement was not restricted in any way.

The next hurdle was to transfer the drive from the driven gear to the handwheel. This was simply achieved by the manufacture of a spring-loaded plunger mounted on the existing handwheel flange. The drive plunger, when released simply engages one of four drive holes made in the driven gear. It is worth taking the time to make a groove in the body of the drive plunger housing to accept the retaining pin when in the disengaged position. This is a precaution against accidental engagement.

It became obvious while constructing this feed system, that some form of speed control would be necessary. I found I had three options open to me. Option one was to make some form of speed control. There is a design available in the Nexus Publication, *Electric Motors In The Home Workshop* by Cox. This uses components supplied by Maplin Ltd. or similar ones could probably be supplied through RS.

Option two, comprises a ready built 6 -15 Volt DC speed controller available from Maplin at about £15.00. This controller would have to be housed in a suitable box and the direction control switch fitted on the motor side of the unit, as the unit is sensitive to polarity.

The electrical control system for the installation rests near the machine.

These options, of course need an independent 12 Volt DC supply transformer of about 2 - 3 Amps. The transformers used on the older model car or train systems are ideal, and can be picked up fairly easily for a few pounds.

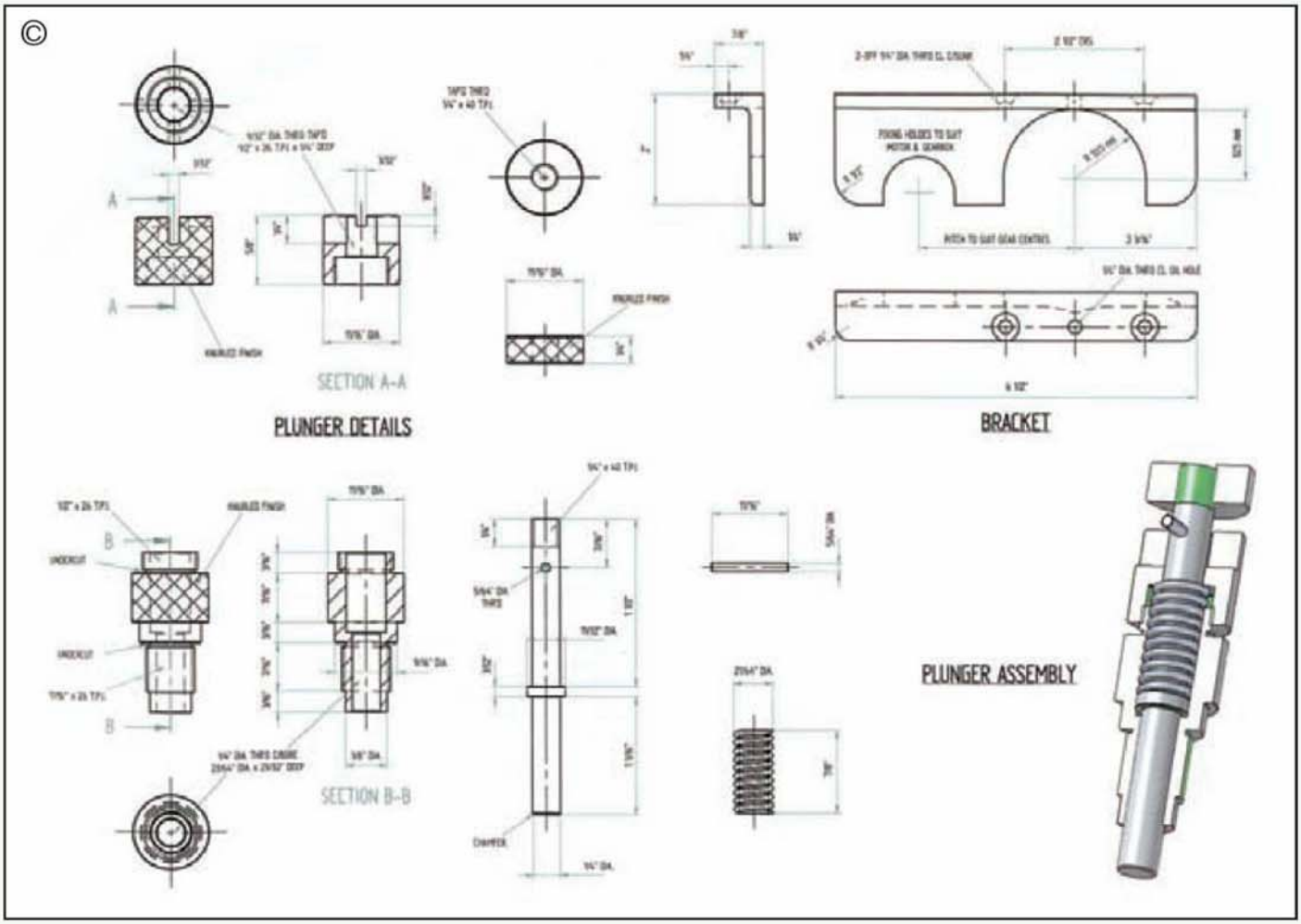
Option three comprises of a self-contained transformer and speed control unit. The unit I used was from a small 12 Volt DC mini tool variable power supply unit, giving a maximum output of 3 Amps. Although more expensive, it is more compact and is a sealed unit. I have used two toggle switches, one for the off and on function, the other for the left and right movement. A better system may be to use one on-off toggle switch. This would give all the functions in one switch. These transformer units are available from RS for about £70.00 although a cheaper 2 amp unit could be sourced.

The finished drive unit I felt, required some form of guard to protect the fingers from the potential trap point between the gears. This was simply achieved by bending a piece of 1 x 1/8in. flat aluminium alloy to the required radius at each end, fixed by two simple brackets then making in-fill plates to cover the trap points. The in-fill plates have been left out of the photographs for clarity. A more elaborate guard could be made to suit the builder's own requirements.

I now have a very practical, variable, fine feed system for my milling machine. It was a very worthwhile and rewarding exercise. It gives a maximum feed of just over 2in. per minute and a minimum fine feed of less than 1/4in. minute. This speed range, I find covers all my requirements.

The only drawback with this set up is that the X-axis and guard sit higher than the table level. This however is no real problem to me. If I require the full table for whatever reason, I simply remove the gear and revert back to the standard machine. If this were an issue, I think it could be easily overcome by the use of smaller gears.

All the main parts required for this project are available from HPC Gears, Maplin Ltd. and RS. I have no connection with any of the above-mentioned companies.



KEITH'S COLUMN

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

Keith Wilson
continues his narrative on boiler construction but starts with a few recollections.

●*Part XXIX continued from page 763 (M.E. 4289, 20 December 2006)*

Watching the Friday 17th November 'Children in Need' program reminded me of one of those 'orrible things that can happen on live television.

The Wolverhampton Civic Choir was invited down to Pebble Mill to sing a chorus for this event; it was many years ago now. We were singing outside the building, and the piano was inside. Therefore, it was needful to set up two extra screens and cameras so that conductor could see pianist, and pianist could see conductor. So far, so good. We had as background a giant screen, lit by red, green and blue lamps; so that a 'back projection' picture could be shown.

Basses and tenors formed the back row as usual, with the more numerous sopranos and altos making up the front rows.

The work we were performing was an opening chorus by Gershwin, and not far into the work the tenors had a short pause and had to be ready to come in dead on time. Therefore, I watched the conductor closely and took a deep breath leaving mouth open ready to sing.

The main transmitting camera did a few quick scans of the first rows, and then went slowly along the back row; no prizes offered for guessing just who it paused on with peculiar look and open mouth! When I saw the recording after I arrived home I thought a few strange thoughts!

Reminds me of the time down in Devon when BBC Plymouth wanted to do a short news film on my workshop and engines. They sent along a camera team, producer, sound recorder and interviewer, the latter being Sue Lawley. We filmed for four hours to get a four minute film; they reckoned this was good value for time. The trouble that was taken to get everything dead right was quite surprising.

What surprised me was that Sue was doing a short announcement outside the house. Out in the country, had someone told me how difficult it was to get about 20 seconds silence from the surrounding area I frankly would have found it hard to believe, but it took four retakes to get it done.

Later, with Sue sitting on the tender, her microphone was in the coal space where the camera would not see it. The sound recordist had good headphones on and was juggling volume controls to get a good setting, when without noticing it Sue whanged the coal shovel on the microphone! The recorder's statement? I don't think I have heard such a fervently heartfelt *"Gawd Almighty!"*

Whilst things were being set up and adjusted, the producer and I swapped stories about filming cockups. One I liked the best was about a film that was needed showing a brand-new television mast. Unfortunately, the mast wasn't actually finished. Nothing daunted, an accurate scale model was knocked up and that was filmed. Again, so far so good. Nemesis struck on showing the film on television, for not until then was it noted that a fly had settled on the model during filming and no-one had noticed. Oops!

Valve gears

A public thank you to Don Ashton for an e-mail pointing out some errors in my recent remarks on valve gears - how I wish others who have spotted errors would do likewise! Herewith his full e-mail:

Keith,

I am rarely moved to write to M.E. these days and a personal e-mail is more appropriate to point that your current article concerning Walschaerts' and Stephenson's gear is confusing and inaccurate.

Walschaerts (and radial gears in general) you rightly describe as having constant lead even though this is not exactly so if we wish to be mathematically pedantic - the very small variation can be ignored.

As stated, the positive lead will allow steam into the cylinders at both ends in mid-gear, always assuming integrity of the rest of the gear, the valve and its setting.

Open rod Stephenson's gear designed for negative lead in full gear usually goes positive at around 50-odd % cut off (not 48mph!) and continues to increment positively to mid-gear, whereupon it, too, then opens the ports by that amount in mid-gear at each end of the cylinder.

This differs not from Walschaerts. Any gear designed to have positive lead steam will exhibit the same propensity in mid-gear. At dead centres, or thereabouts, you rightly point out that the amount of lead may be insufficient to sustain useful work, since no gear likes to function on a cut off of maybe 3% or less. This can be enough to start motion on a model jacked above the rail but the very early release would soon curtail movement. Work done is virtually zero, of course. Stood on the track it would doubtless not move at all. The other cylinder cannot help as the valve is closed.

Pearce favoured a long valve travel so that the exhaust release was at least 65% at 25% cut off and this was subsequently bettered. This and equality of events is the key to running at shorter cut offs without engendering lumpy effects, quite irrespective of the type of gear employed. GWR equality on Stephenson's gear was exemplary at less than 1% difference anywhere in the cut off range. Even their Walschaerts' arrangements, excluding the pathetic 15xx, were very carefully coerced (for that is what it takes in Walschaerts) into getting within 3% equality in full gear and a little better notched up. There is no simple and effective way of doing nearly as well with Walschaerts' as with Stephenson's gear correctly suspended, which counters your reflection that Walschaerts' is happier at shorter cut offs.

Put another way, if we deliberately set out to produce a set of both gears to behave as near identically at the valve as possible the Stephenson's would prove measurably better, though perhaps insignificantly in practice. No other gear can approach this whatever their protagonists claim.

Incidentally, the screen shots of Fink gear really ought to be acknowledged as belonging to Charlie Dockstader. Including the valve events would have revealed how abysmal they are. 'Lumpy' would hardly describe the running adequately!

Regards,

Don Ashton.

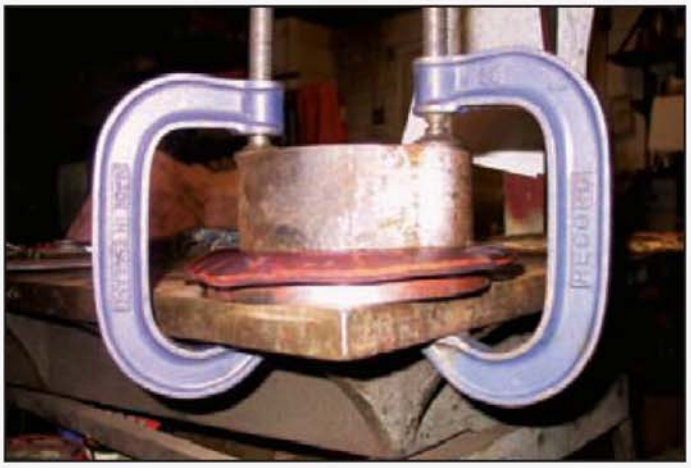
Don has obviously studied valve gears more extensively than I, and it was through his pamphlet works on both main gears that led to my work on pre-keying eccentrics and driving wheels so that I was able to push valve gear manufacturing a bit forward, with good results. Incidentally, Pearce was the valve gear wizard at Swindon. I suspect another reason why Fink's valve gear did not seem to come into locomotive practice is that, as you would have seen from the diagrams in my article, some parts would come below rail level or at least outside the loading gauge. It might well be possible to re-design it to avoid this, but other gears are easier to put on an engine. The effect on the gear of the springing of the locomotive might well be a significant matter - it certainly has an effect on Joy and Hackworth gears. Also, I knew not of the origin of the gear drawings shown, or most certainly would I have acknowledged the matter.

Not practical

It is my practice to copy the full-size locomotives as closely as is reasonably practical; I have yet to find adverse criticism for doing this. Sometimes it is not practical, for example we must build boilers from outside. Full-size boilers could be entered for interior pipe work, and inside a firebox was practicable, other jobs will come to mind. A connected matter is the reason for the abandonment of the saddle tank, for they had to have rivetting from inside as well as the easier rivetting outside; if you get a small enough apprentice to shove in through the filler cap.

Wilson's Words of Wisdom:

People would look around at everything that was going wrong and blame it on the fact that men had left the good old tried-and-true ways of their grandfathers. But, if those ways had been so fine then why were they discarded in the first place?



This photograph shows a plate-bashing operation under way and the set-up used to support the work.

The set-up used to get the tubes into tube plate and silver-braze them without drama.

What his ears must have felt like after an inside rivetting session I'd rather not know.

I understand that demise of the metadyne (have I spelled it right?) electrical control system on London's Underground was due to the retirement of the last engineer with long enough arms to replace worn-out brushes! Somewhere must be a designer with burning ears!

Some time ago I was invited to drive an outwardly nice-looking GWR locomotive at Stoneleigh. It ran very nicely in full forward gear - I did not get the chance to test reverse - but the slightest attempt at 'notching-up' shewed kangaroo water in the tender (or boomerang coal). The exhaust went haywire, and demonstrated something of the situation of driving through a ploughed field with no rails. What puzzled me most (and still does) is how to produce such an effect deliberately. It reminded me of the 1955 Royal Tournament show at Earls Court; when we had to march accurately over the ploughed-field surface of straw and horse dung twice a day for just under 3 weeks, playing assorted music at the same time.

Fortunately we were stationary for the big number; 'Finlandia' (Sibelius) with the rehearsals for this work at roughly four times per day we played it some 64 times. After 12 repeats I certainly did not need the written music! Being (then) just about 6ft. 2in. tall, it will come as no surprise that I played the piccolo!

Watt's pots never Boyle

One of the tricky jobs is setting the tubes into the firebox tubeplate. For a small boiler, setting the tubes into the tubeplate with tubeplate set in the firebox is possible but not over-easy, for to ensure that the silver-brazing material penetrates all through the joint parts of the assembly will have to be hotter than necessary. Bearing in mind that the tubes themselves are much thinner than the plate (they'd better be!) makes the chance of melting them somewhat more likely, for to get heat enough onto the inner tubes means playing the flame onto the outer ones. Easier than you might think to overdo the therms.

So one of the obvious ways of avoiding this challenge is to work from the inside of the box rather than the outside. I do not mean becoming a tiny midget, but do the operation before setting the tubeplate into the firebox. If the tubeplate is set up horizontally above the front tubeplate at about the correct distance above it, the tubes can be fed into the system with great ease. Remember that the tubeplate holes should be bigger than the tubes themselves - next size drill above is about right - the feeding in will not be difficult. Leave about 1/8in. of the tubes protruding inside the plate, as this all helps.

In the past, fitting the tubes into reamed holes was recommended, but even with about four notches round each hole to aid penetration is still not ideal. If the holes are one size larger as suggested above, then complete penetration is assured. Remembering that in such a case the silver-braze is in shear rather than tension, it follows that the joints will be that much stronger. Also, one of the snags in doing it the old way is that, due to the expansion of the plate, sure as 'shiretalk' one or more of the tubes will fall through, making life a bit difficult, for 'tis something of a nightmare to keep the joint hot whilst also lifting the errant tube(s) back into place. I've had some.

It is of course easy to make a pimple or two in each tube (pointing outwards) so that said pimple(s) will prevent the tubes from falling through, but you are still up to the trouble of getting sufficient heat onto the inner tubes. Of course, you could do the tubes one row at a time, wasting generous amounts of heat, but with the other method you can silver-braze and see all around each tube as you are doing it. Setting the tubeplate into the firebox unit takes a little care; for if you overdo the temperature a bit there is still the chance of a tube falling through. If you are worried about this possibility then a few odd bits of medal used to jam the tubes on the outside can prove economical in effort.

With a samovar of this size, pickling from black is strongly recommended (also if at all possible using an overhead hoist). For as mentioned recently, if a firebox and tubes assembly is put in too hot, you will certainly get jets of nearly boiling acid spurted out; if your face is in the way then hospital for you. With the hoist method at least you can keep yourself out of the way. Bethink you, if doing the dunking by hand and you get a good spurt of hot acid on you, there is a very good chance indeed of dropping the thing in, and then you'd know all about acid splashes! Although in theory the fumes from the process would be only water vapour, in practice they have some acid fumes present, so watch out.

But if used with a bit of that rare and badly misnamed attribute 'common sense' there is no real danger. It is good preparation to have some baking powder handy; as this is Sodium Bicarbonate it will neutralise any acid splashed on clothes or flesh. Also, when dealing with large very hot objects, a nearby bucket of cold water has its merits. Flesh being a poor conductor of heat, it follows that if you get a burn, it will stay hot and hurt for a good while, whereas quenching will stop the pain very nearly instantly, and keep further damage minimal.

It may seem obvious, but there can be very few vices capable of holding the former plates firmly enough for copper-bashing. Therefore, photograph of the bashing process may help ideas along. Other piccy shews setting of tubes into firebox tubeplate as described above.

Memory tip

It is clearly advantageous to have all the decimal equivalents of fractional dimensions; herewith a quick way of learning them - and the method applies to other lists as well. Write down the fractional sizes from 1/32in. up to 1/2in., of better still, up to 31/32 inch. Then write down the decimal equivalents. Write down again the fractionals, but this time the decimals from memory as far as you can, then fill in the blanks from the original list. Repeat a few times; you will soon find the writing down from memory list is getting much longer. It shouldn't be long before the memory list is full and you don't need the written list any more.

As an example of the benefits of this method, nearly 60 years ago I needed to learn the Morse code and the semaphore signal systems; I used the method on the train going to and from school, 2 weeks sufficed for both of them - one week each. Can't grumble at that, can you?

●*To be continued.*

CLUB PROFILE

Raising steam in the bay at Sunderland. Photo: Neil Read.

FORMED FOR "THE SONS OF GENTLEMEN"

Malcolm Stride
profiles the Sunderland Model Engineering Society, a long-established club on the coast in the north of England.

The 'home' of the Sunderland MES is Roker Park in Sunderland. This park was created in the 19th century when Sir Hedworth Williamson and the Ecclesiastical Commissioners gave 17 acres of land *"for the purpose of forming a Public Park and Pleasure Grounds for the free use of the people of Sunderland forever"*. The park was officially opened on 23 June 1880 and one feature was the lake specifically designed for sailing the model boats of *"the sons of gentlemen"*.

In 1931 a group of regular users of the lake decided to form a club and on 18 August of that year the 'Sunderland Model Boat and Engineering Club' was formally established.

During 1934, the local council drained and completely refurbished the lake, installing a concrete base and brick sides. It was officially re-opened on 3 November 1934 with a display of member's models.

Membership of the club continued to grow and by 1936 finances were available to erect a boat house at the lake where members were able to store their boats and hold meetings. As the membership grew, the member's interests widened to include steam locomotives and stationary engines. By 1944, the construction of a raised railway track was being discussed. Negotiations with the local council resulted in a disused tennis court being made available for this purpose.

This oval track, 220ft (67 metres) long with super-elevated radii of 25ft. (7.6 metres), was completed in just two years and caters for 2 1/2, 3 1/2 and 5in. gauge stock. The first locomotive ran on VJ Day, 15 August 1945, but it was not officially opened until the following June. The track is still in use today.

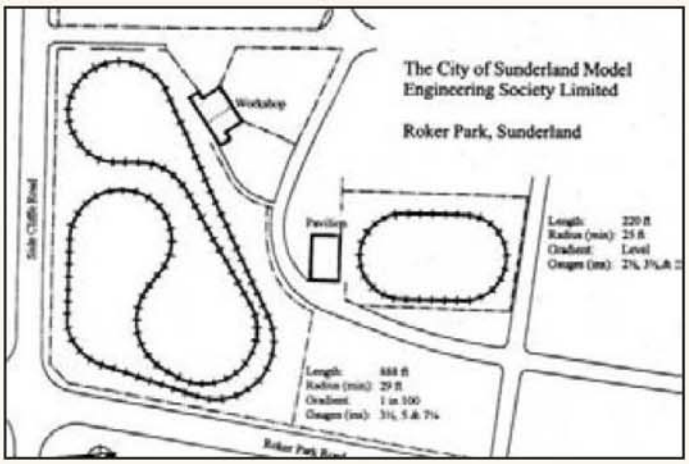
The late 1940s brought another area of interest - model cars powered by internal combustion engines. Members constructed a 'round the pole' racing track in Barley Mow Park in Sunderland which was officially opened on 2 June 1950. The members of the new Car Section entered and won many competitions with their models both in the UK and on the Continent.

By 1956, club finances were strong enough for a new wooden 'Pavilion' to be purchased and erected overlooking the small railway track. This became, and still is, the main clubhouse. To reflect the widening interests of the membership, it was decided at the 1957 AGM to change the name of the club to The Sunderland Model Engineering Society.

During the 1960s the Car Section declined until, in 1964, the Society had to give up the racing track at Barley Mow Park. However, the Marine Section began to thrive, especially when members designed a straight-running hull around a 34cc JAP engine.

In 1967 it was agreed with the local council that the Society would give train rides to the public on as many weekends as possible, consistent with safety. This practice continues to the present day.

Interest in locomotives continued to develop until, by the early 1970s, ideas for a new,



The twin track layout of Sunderland MES.

A view of the smaller track at Sunderland. Photo: Neil Read.

enlarged railway track began to be discussed. After lengthy negotiations with the local council, a site at the top corner of the Park was offered. The trees and slope of the ground made it far from ideal, but with a great deal of hard work and much moving of soil a suitable track was constructed. It was a long job - the first turf was cut on 4 July 1976 and the track was officially opened in July 1981

Also during the 1970s a ground level 3½in. gauge tram track, 69ft. long, was constructed within the small track area. This was subsequently extended in 1987 to provide a double track, allowing trams to run in both directions.

In the early 1980s members designed and constructed a Portable Railway Track. This provides a run of up to 160ft. and, like the large railway track, provides for 3½, 5 and 7¼in. gauge locomotives. It is used by members at numerous exhibitions and fairs around the region, spreading the name of the Society and bringing pleasure to many people, usually in aid of charities.

In 1986 the Society hosted the 'Curly Bowl' competition - for steam locomotives built to the designs of LBSC. In 1991, as part of the celebrations for our Diamond Jubilee year, the Society hosted the 'Martin Evans Rally' for steam locomotives. Following in this tradition, the society hosted the 'Curly Bowl' competition again in 2006.

Over the years the Society has entered display stands at a number of model engineering exhibitions - the Midlands Exhibition at Stoneleigh every year between 1990 and 1993, the Model Engineering Exhibition at London Olympia 1997/98 and 1998/99 and the National Exhibition at Harrogate every year since 1994. In 2006 a stand was entered at a new Exhibition held in Pickering and it is hoped to make this also an annual event. The Society holds Open Days every year in June and September when visitors from other Societies are welcomed. It is a major attraction to see traction engines on the Park pathways, model boats on the lake and locomotives on both tracks, as well as a display of member's models in the gazebo.

The Society also makes a special effort to support the Sunderland International Air Show each year by running an intensive service on the large railway track throughout the weekend.

It has become something of a tradition to run trains on the large track on New Year's Day and sometimes Boxing Day each year. This has resulted in significant donations to local charities and it is hoped to continue this.

For the future, the society hopes to see more use being made of the boating lake (especially steam boats) and the re-appearance of the trams, as well as the continued development of steam and electric locomotives and all the other varied interests of the members. It is good to see that the Society remains a vibrant and happy group with the younger members already looking forward to the Centenary celebrations in 2031!

The society caters for a wide range of engineering interests and welcomes enquires from visitors and potential new members. Those interested in obtaining more information should contact Secretary Albert Stephenson on 01249-299649. I am indebted to Albert who produced the notes for the a 75th anniversary guide from which the above profile was written.

Paul Stephenson steams his* Princess Marina *on the upper track during the Curly Bowl in 2006. Photo: Neil Read.

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.

January

19 **Newton Abbot & District MES.** *Meeting.* Contact Graham Day: 01626 772739.
19 **Romford MEC.** *AGM.* Contact Colin Hunt: 01708-709302.
19 **Romney Marsh MES.** *DVD/Video Evening.* Contact John Wimble: 01797-362295.
20 **York City & DSME.** *Auction.* Contact Pat Martindale: 01262-676291.
20 **Steam LS of Victoria.** *Club Running.* Contact Graham Plaskett: (03) 9750-5022.
22 **Bedford MES.** *Welding methods and techniques.* Contact Ted Jolliffe: 01234-327791.
24 **Bournemouth DSME.** *Annual Dinner.* Contact Dave Fynn: 01202-474599.
24 **Chingford DMEC.** *Alan Rose: 'Far Saltare' – An Update.* Contact Ron Manning: 020-8360-6144.
24 **Staines SME.** *Competition Evening.* Contact Stan Bishop: 01784-241891.
25 **Cardiff MES.** *Bits & Pieces.* Contact Don Norman: 01656-784530.
25 **Worthing DSME.** *Claire Hicks: Keep your pecker up.* Contact Bob Phillips: 01903-243018.
26 **Brighton & Hove SMLE.** *Maureen Dillon: The History of Lighting.* Contact Mick Funnell: 01323-892042.
26 **Newton Abbot & District MES.** *Dinner/Dance.* Contact Graham Day: 01626 772739.
28 **Steam LS of Victoria.** *Working Bee & Barbecue.* Contact Graham Plaskett: (03) 9750-5022.
29 **Canterbury DMES (UK).** *Ernie Millard & Granville Askham: Boiler Making & Tolerances.* Contact Mrs P. Barker: 01227-273357.
30 **Chelmsford SME.** *Club Members' Videos.* Contact D. Blake: 01376-324205.
30 **Taunton ME.** *Working Party.* Contact Don Martin: 01460-63162.
31 **Chingford DMEC.** *Brian Upson of Colchester SME: Top shed engineman.* Contact Ron Manning: 020-8360-6144.

February

1 **Cardiff MES.** *Erica Colket: Bats in Wales.* Contact Don Norman: 01656-784530.
1 **Westland & Yeovil DMES.** *John McDougal: Locos of The Beer Heights Railway.* Contact Gerald Martyn: 01935-434126.
2 **Maidstone MES (UK).** *Mike & Roger: Team Quiz.* Contact Martin Parham: 01622-630298.
2 **Portsmouth MES.** *AGM.* Contact John Warren: 023-9259-5354.
2 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
3 **Isle of Wight MES.** *Track & Pond.* Contact Malcolm Hollyman: 01983-564568.
3 **SM&EE.** *Prof. Peter Thomas: Building a Model Locomotive.* Contact David Boote: 01202-745862.
3 **York City & DSME.** *John Chambers: English Canals.* Contact Pat Martindale: 01262-676291.
4 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
4 **Steam LS of Victoria.** *Public Running.* Contact Graham Plaskett: (03) 9750-5022.
5 **Stamford MES.** *The Shuttleworth Collection.* Contact Derek Brown: 01780-753162.
6 **North Cornwall MES.** *Meeting & Maintenance Afternoon.* Contact Geoff Wright: 01566-86032.
6 **Romney Marsh MES.** *Tony Crowhurst: Slide Show.* Contact John Wimble: 01797-362295.
6 **Taunton ME.** *Quiz Night.* Contact Don Martin: 01460-63162.
7 **Bradford MES.** *Meeting.* Contact John Mills: 01943-467844.
7 **Chingford DMEC.** *Bits & Pieces.* Contact Ron Manning: 020-8360-6144.
7 **Leeds SMEE.** *Richard Gibbon: Brunell's USA Extension.* Contact Colin Abrey: 01132-649630.
7 **Staines SME.** *Dave Tompkins: A Talk on CAD.* Contact Stan Bishop: 01784-241891.
8 **Cardiff MES.** *Philip Javes: Tribological Tribulations.* Contact Don Norman: 01656-784530.
8 **Worthing DSME.** *Meeting.* Contact Bob Phillips: 01903-243018.
9 **Brighton & Hove SMLE.** *Keith Carter: Railway Branches & Byways.* Contact Mick Funnell: 01323-892042.
10 **Glasgow & S.W. Rly Ass'n.** *Alan Mackie: Signalling today on the former G&SWR.* Contact Bruce Steven: 0141-810-3871.
10 **SM&EE.** *Training Seminar.* Contact David Boote: 01202-745862.
11 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
12 **Bedford MES.** *J. Sinclair: A brief history of computing.* Contact Ted Jolliffe: 01234-327791.
12 **Erewash Valley MES.** *Bits & Pieces.* Contact Jim Matthews: 01332-705259.
12 **Saffron Walden DSME.** *Club Night.* Contact Jack Setterfield: 01843-596822.

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