THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 231 No. 4726 22 September – 5 October 2023

SMEE & MODEL ENGINEER Celebrating 125 years A Joint History of Model Engineering

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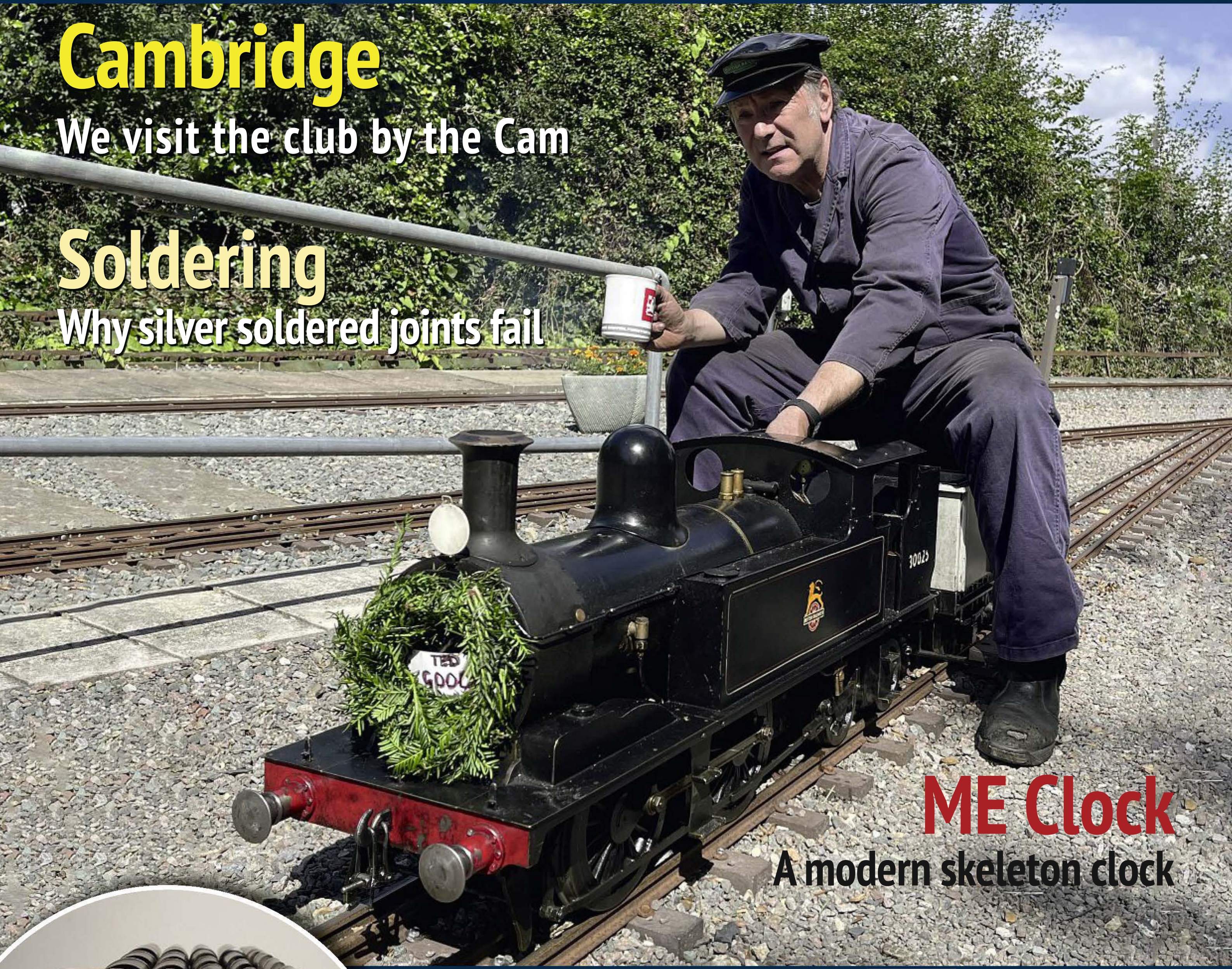

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Published by Mortons Media Group Ltd,
Media Centre, Morton Way, Horncastle, Lincs LN9 6JR
Tel: 01507 529589 Fax: 01507 371066

ISSN 0026-7325
www.model-engineer.co.uk

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PUBLISHING
Sales and distribution manager: Carl Smith
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Publishing director: Dan Savage

SUBSCRIPTION
Full subscription rates (but see page 426 for offer): (12 months, 26 issues, inc post and packing) – UK £128.70. Export rates are also available, UK subscriptions are zero-rated for the purposes of Value Added Tax.
Enquiries: subscriptions@mortons.co.uk

PRINT AND DISTRIBUTIONS
Printed by: William Gibbons & Son, 26 Planetary Road, Willenhall, West Midlands, WV13 3XB
Distribution by: Seymour Distribution Limited, 2 East Poultry Avenue, London EC1A 9PT

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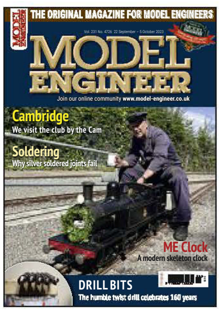

ON THE COVER...

Jeff Bolton drives Ted Goode's 7¼ inch gauge Isle of Wight O2 locomotive at the Cambridge MES track (photo: Jocelyn Fung).

This issue was published on September 22, 2023.
The next will be on sale on October 6, 2023.

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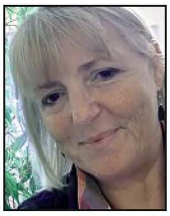
SMOKE RINGS

MARTIN EVANS
Editor



DIANE CARNEY
Assistant Editor

Dartmouth museum

David Hulse collection

Garden Rail Show

LOWMEX

Sydney Live Steamers

I receive a lot of newsletters from various clubs and these invariably contain something of interest. The latest from the Sydney Live Steam Locomotive Society in Australia informs me that they are celebrating their 75th anniversary this year. So – happy birthday to a very lively and productive club!

Atmospheric Engines

These were the forerunners of the later high-pressure steam engines and relied on the pressure of the atmosphere rather than steam pressure to supply power. If you have been following Ron Fitzgerald's series on the Steam Engine over the last several months you will be well 'up to speed' with them!

David Hulse has spent the last 52 years building a series of models of atmospheric engines chronicling their development through the 18th century until they were superseded by the high-pressure engine, pioneered by Trevithick, Watt and their associates. The first commercial atmospheric engine was constructed by Thomas Newcomen in South Staffordshire in 1712, beginning the 'steam age' and powering the industrial revolution. David is exhibiting his collection of eight engines at Dartmouth – Thomas Newcomen's birthplace – starting this month. The engines are to be displayed permanently at the Dartmouth museum (www.dartmouthmuseum.org).

Newcomen engine modelled by David Hulse (photo: David Hulse).

More information about the engines can be found at www.davidhulse.co.uk

Ted Goode - Cambridge

I recently attended the celebration at the Cambridge Model Engineering Society of long-standing member Ted Goode's life and work and you can read all about it starting on page 437. As mentioned in the article, Kathy Goode would like to pass on a few of Ted's engines to good homes and has now provided me with further details. Three locomotives are currently available: a 5 inch gauge 'Pansy' locomotive with driving trolley and two 7¼ inch gauge locomotives – an Adams radial tank and a 'Dart' locomotive (GWR 1400). The former of these two has an out of date boiler certificate and the latter is almost mechanically complete and ready to paint. Any enquiries should be made through me in the first instance.

Garden Rail Show

Meridienne Exhibitions are pleased to confirm that the Midlands Garden Rail Show will be taking place on Saturday 2nd and Sunday 3rd March 2024 at the Warwickshire Event Centre.

This event attracts nearly 2,000 enthusiasts from all over the UK and offers visitors the opportunity to see layouts in the larger gauges and scales including Gauge 1, O Gauge, G Scale and more.

Once visitors have been inspired to build their own layout, they can visit nearly forty specialist suppliers at the show who are more than happy to guide them in the right direction of the best product to purchase.

Save the date now to avoid disappointment and for further details on the exhibition and suppliers attending see www.midlandsgardenrailshow.co.uk

Two Show Month

Where did the summer go? We are now heading inexorably into autumn but one consolation is that there are two shows to look forward to, both in October.

There is, as you know, the Midlands Model Engineering Exhibition, at the Warwickshire Exhibition Centre from the 12th to 15th October, which is already inscribed indelibly in your diaries. If you live in The East, though, there is also LOWMEX, the Lowestoft Model Engineering Exhibition, to be held again this year at the Energy Skills Centre of the East Coast College in Lowestoft. This is – to borrow popular advertising language - 'probably' the biggest model exhibition in East Anglia. It takes place on the 28th and 29th October, starting at 10am, and entry is £5 for adults and £2 for children. Details of how to get there may be found at www.lowmex.co.uk

IMLEC 2024

There is currently a requirement for a club to host IMLEC next year. We've had a number of events in the south lately so ideally I would like a club in the north to volunteer, although that is simply a preference, not a requirement. A raised track is preferred, of a reasonable length (say 1/3rd of a mile or so), supporting 3½ and 5 inch gauge locomotives. A dynamometer car is needed, of course, but there are many of these available around the country so the possession of one is not necessarily a prerequisite.

It's no use pretending that hosting IMLEC does not involve a lot of effort and commitment from a club but on the other hand the consensus is that it is a very rewarding experience.

Responses please to your ever-hopeful editor.

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
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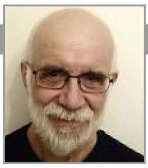
Radial Valve Gears Again

PART 9 – SISSON'S VALVE GEAR



Duncan Webster sheds light on what is often seen as a complex subject.

Continued from p.373
M.E.4725 September 8

Back at the beginning of part 6 (fig 29, M.E.4723, August 11), the possible use of Watt's #1 straight line linkage as a valve gear was mentioned. *Voilà*, Sisson's valve gear, see **fig 48**.

The only references I've found to this gear are given at the end of this article. From these two sources I find that Sisson's gear was invented in 1885 and that Sisson was *'a very clever engineer and prolific inventor, [and] was primarily concerned with small and medium sized marine engines'*. He was not perhaps over keen on his own valve gear as I've found lots of pictures of Sisson's engines with Hackworth and Stephenson's gear, but not one with Sisson's gear.

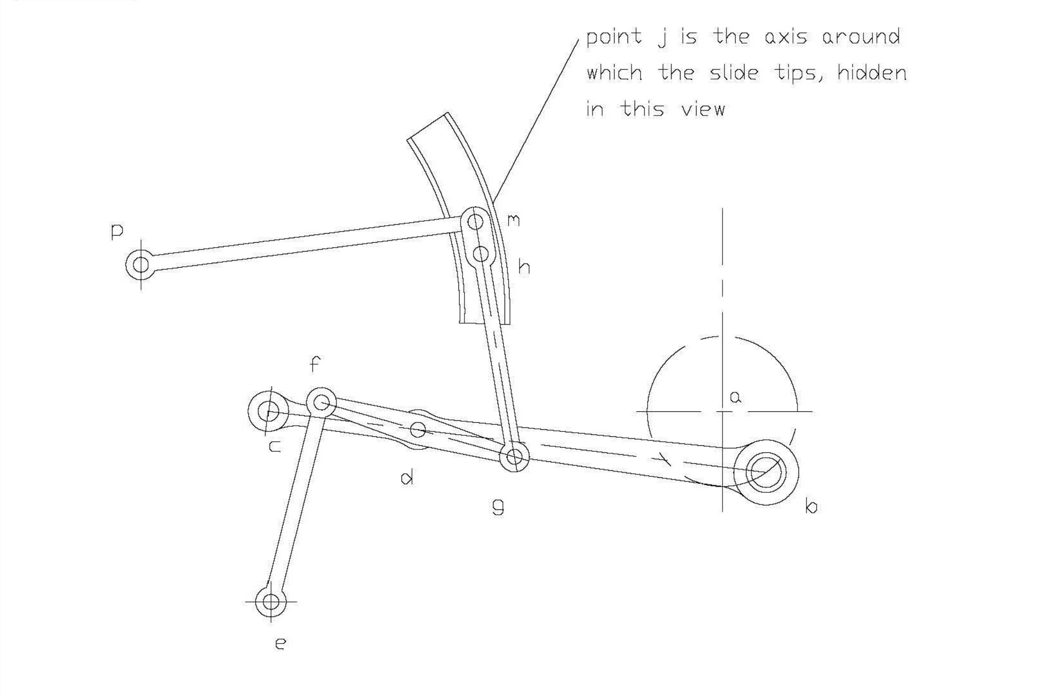
It will be noted that the vertical movement of the bottom end of the vibrating lever *g* is much larger than that of the drive pin on the connecting rod *d*. For this reason, point *d* is much closer to the crosshead than was the case in Joy gear. The force required at *d* to drive the gear will similarly be larger and any wear at this point will be magnified. Care should therefore be exercised in this gear to ensure adequate bearing areas. As drawn, the gear suffers from the same problem as Brown's in that the valve rod slopes downhill, in this case quite steeply because the valve rod is shorter. This could be ameliorated by arbitrarily moving point *f* upwards, and moving *j* downwards - more on this later.

It might be thought that I am being pedantic over the valve rod sloping downhill but it must be remembered that this causes the slide to be tilted at mid gear, by as much as 5 degrees for Sisson's gear. This means that in full gear the slide is tilted at 25 degrees instead of 20, leading to increased loading and wear. On an engine with relatively short stroke, all this would not apply.

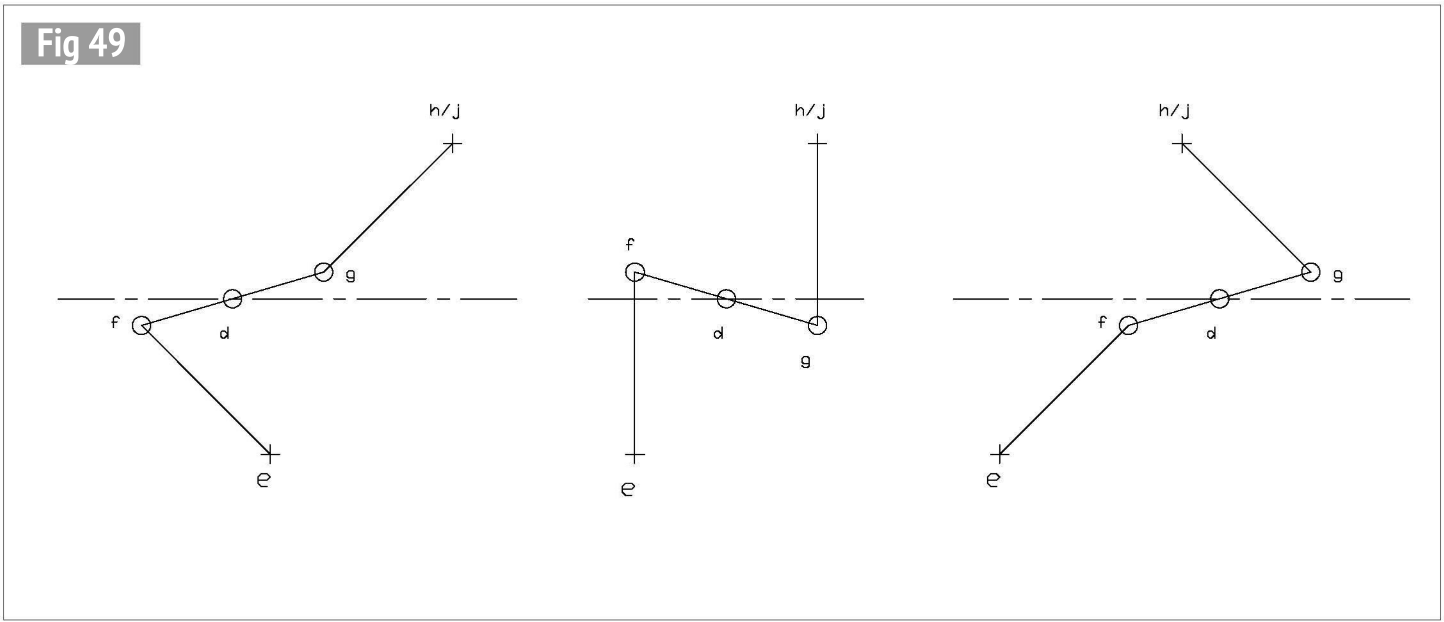
Design methodology

Layout of this gear is dead easy - not many formulae and those involved are simple by the standards of what has gone before. At the moment I see no advantage in not having

Fig 48



Sisson's valve gear.



Straight line linkage in Sisson's gear.

df = dg. First thing to do is to calculate the position of *d*. Use the equation for *cd* from part 7 (M.E.4724, August 25) but then, because the vertical movement of *g* is double that of *d*, halve the length you've just calculated. Then derive the lengths of the vibrating lever *gh* and *mh* using the graphical routine from previous episodes - I won't describe it again. To reduce any angularity errors caused by inclination of *fdg*. I suggest that we position *j* and *e* such that points *f* and *g* move equally above and below horizontal as the crankpin moves along its mythical horizontal path, as shown in exaggerated form in **fig 49**. It could be quite difficult to arrange this mechanically, as the pins at *f* and *g* cannot go straight through. I must admit that I have never seen a real example of this gear, even photographs are elusive. More on this later.

Because of the inherent symmetry of this gear, the length of the anchor link *fe* is the same as that of *gh*, and the vertical position of *e* is a mirror of *j*. Link *fg* wants to be as long as possible but point *f* is close to the little end *c* (in fig 48), so *df* will have to be less than *cd.* Choose a nominal value for the time being.

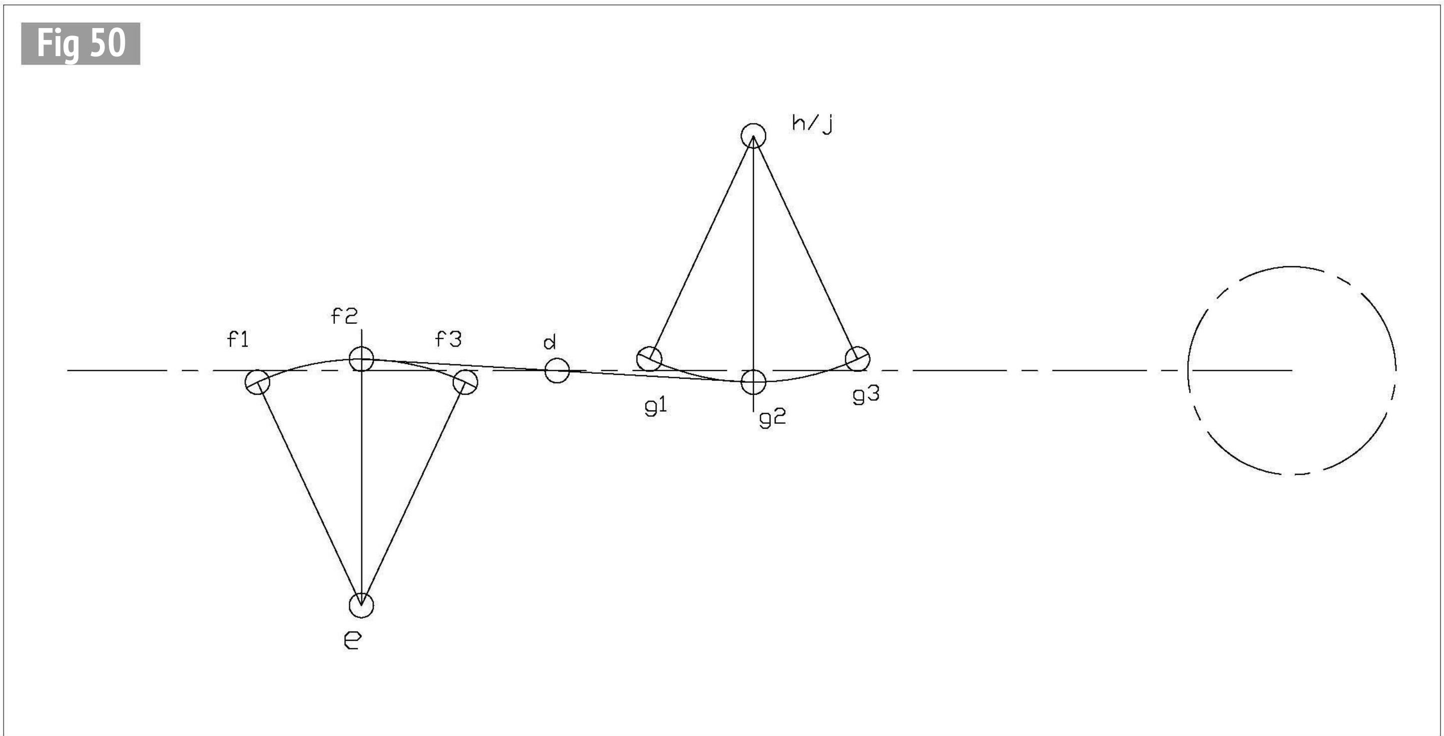
Next we need to fix the horizontal positions of *j* and *e* (in fig 48). Point *j* is positioned to the left of *a* by

j.x = - bc + cd + dg

and *e.x = - bc + cd – dg*

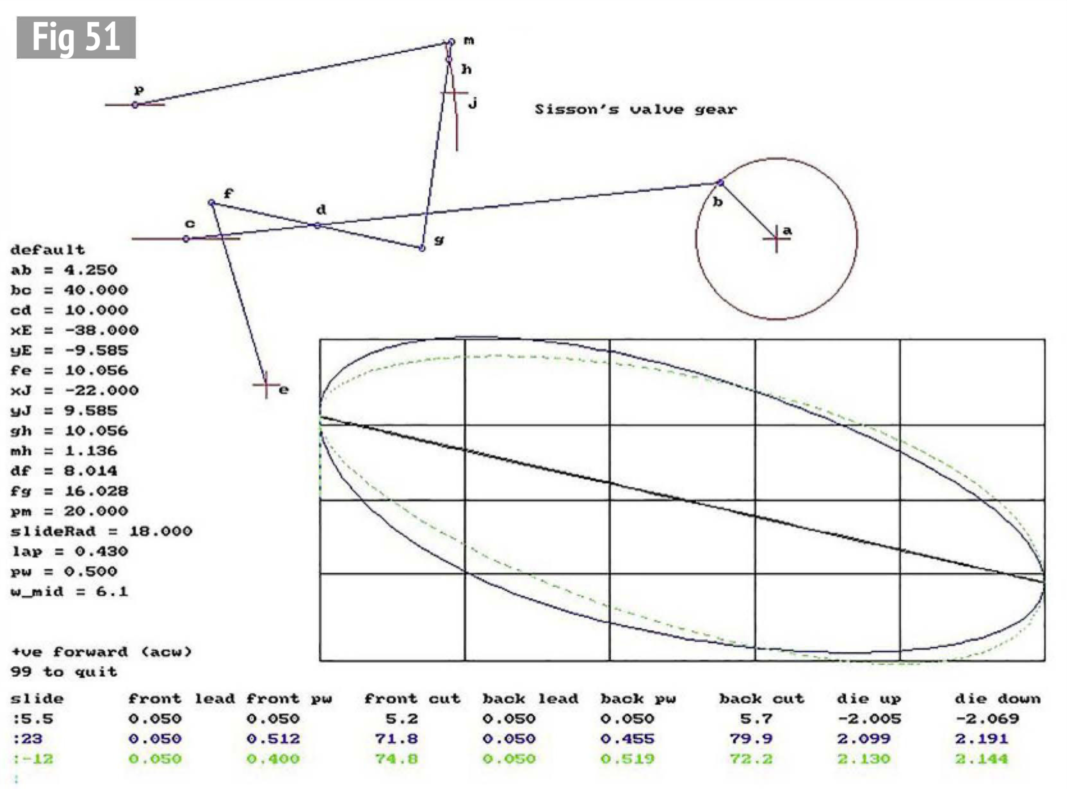
(note that x or y components are denoted by .x or .y after the point.)

Both values are negative because they are to the left of the origin (crank centre). This makes life easier in the computer model. Now to derive the height of *j* and *e.* On your drawing of the vibrating lever mark points *h* and *g1, g2, g3*. Draw a horizontal line to be vertically half way between *g2* and *g1, g3*. Then copy the whole thing to the left by *fg* and mirror the new bit about this horizontal line. Reference to **fig 50** will possibly make this clearer.



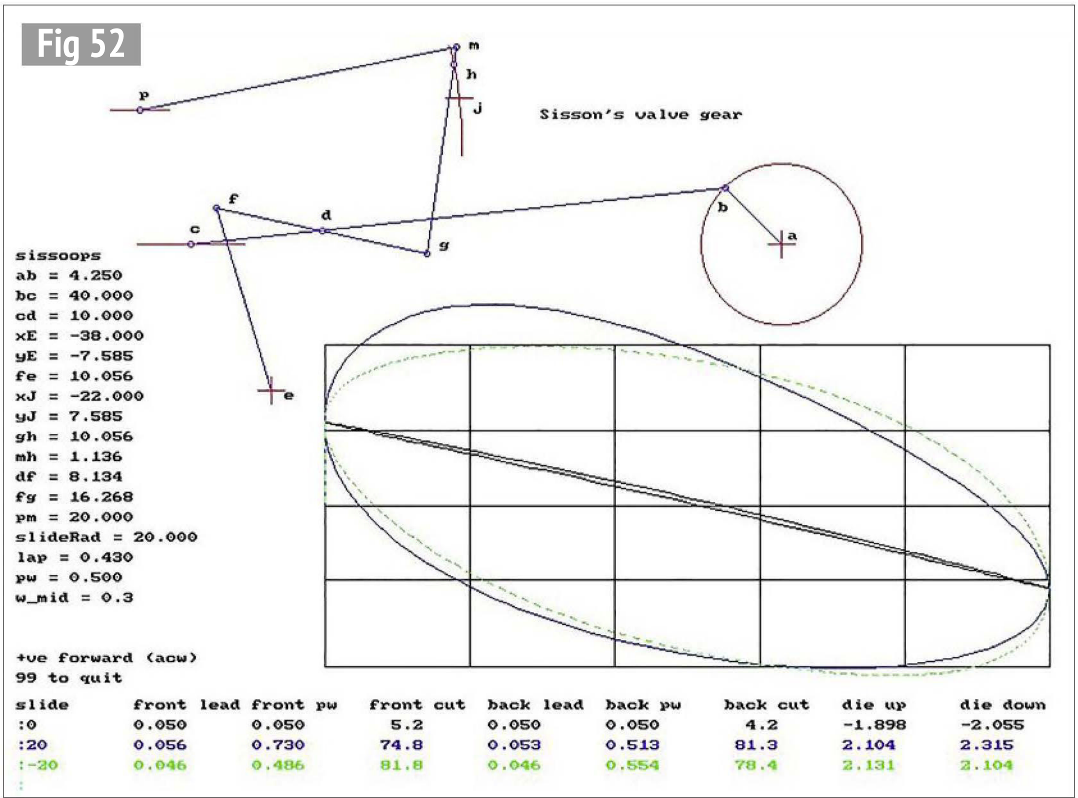
Geometry of the Sisson's gear.

Fig 51



Mid-gear performance.

Fig 52



Modified performance.

The actual lengths of *fg* and *df* and the heights *j.y* and *e.y* are then read off the drawing. I must admit that I haven't gone into the intricacies of calculating the 'best' slide radius but results with radius equal to *pm* are reasonable.

It doesn't take long to just change the slide radius in the model and try it until best results are achieved

Worked example

Take again the vital statistics of *River Irt* which were:

Ab = 4.25
B c= 40
Yvalve = 8.5
lap = 0.43
lead = 0.05
outphase = 0.774

The CAD will give us *gh* = 10.056, *mh* = 1.136

From the equation in part 7, remembering to divide by 2:

cd = (2 * 0.774 * 40 * 10.056) / ((1.136 + 10.056) * tan(20) * 2 * 4.25) * ½ = 8.992

This is a minimum value, so we can choose to make it say 10 inches. We can then choose a nominal length for *df* and *dg*, say 8 inches.

Use these values to create fig 50 and you will find *j.y* = 9.585 and measuring between *f1* and *g1* (or *f2*, *g2* or *f3*, *g3*) will give *df* = 8.014 and *fg* = 16.028

Results

Results are pretty good, see **fig 51** - to get best mid gear performance I set slideRad = 18.

Modifications

Earlier on I referred to the mechanical difficulty of arranging the pins at *f* and *g*. If we arbitrarily move points *e* and *j* closer to the horizontal, it could be possible to get *e* always above the connecting rod and *g* always below. Slight adjustment to *df* and *fg* is required. I've tried this, moving both by 2 inches. I'm not sure this would be enough but results are not good, see **fig 52**. For reasons I don't fully understand yet, back gear isn't so bad and of course in a launch engine you can chose to have what I've called back gear drive the boat forwards.

The next exciting episode will cover Greenly's Corrected Gear.

●To be continued.

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Ref 16. *Radial Valve Gears*, K.N. Harris, Model Engineer starting 7 Jan 1992

Ref 17. *101 Valve Motions*, Fred Jukes, Railway and Locomotive Historical Society Bulletin 88-91. Hard copy of these articles is available from www.rlhs.org, $65 plus postage from USA, or you can join for $65 per year and get the whole archive online.

A Dirty Tram - a Bit of Nostalgia PART 3

Ashley Best tells it as it was.

Continued from p.399
M.E.4725 September 8

Classic tramcar lining.

A lined out LBSCR locomotive.

Some Notes on Liveries

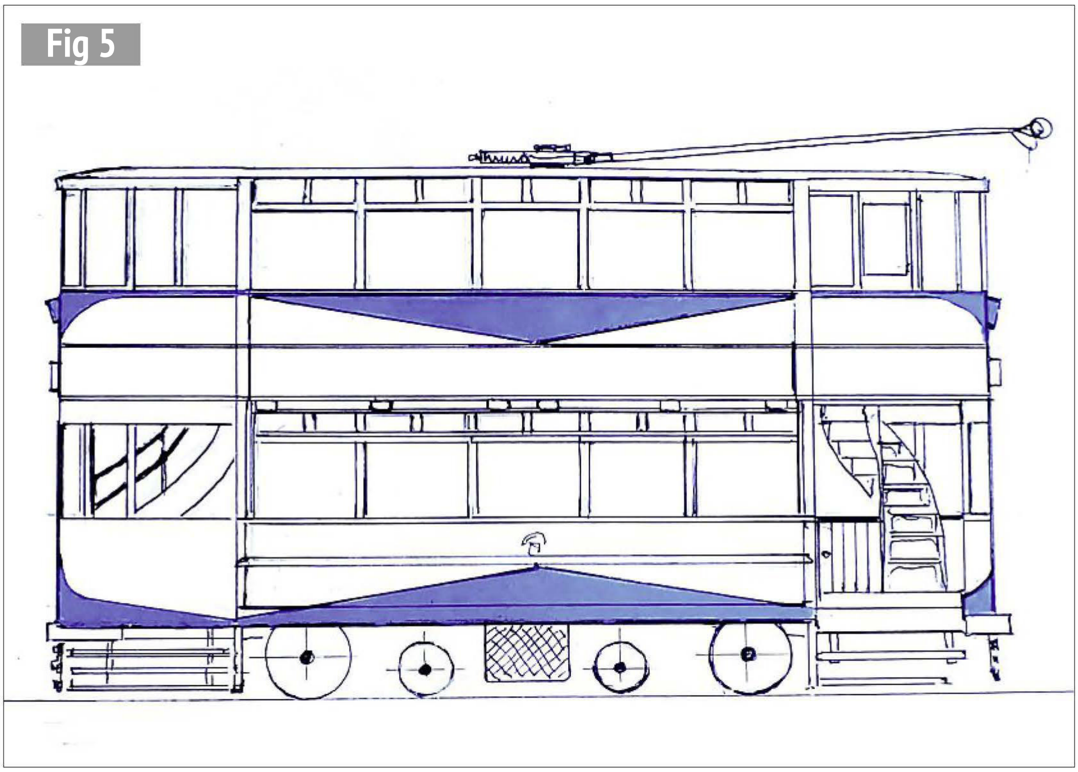
In researching for the content of this article leading to the building of No. 420 as a run-down, scruffy tram, it occurred to me that the history of British tramcar liveries was of considerable interest. Bolton itself demonstrated fairly typical use and development of the application of decorative lining to public transport vehicles (**photo 35**).

Even from before the Victorian era, lining was used extensively and probably reached the peak of its use in the 19th Century and into the first half of the 20th. It was particularly applied to railway locomotives and rolling stock as well as the emerging tram and bus fleets (**photo 36**). Widespread use declined slowly at first in the nineteen-

37

Aberdeen tramcar.

Fig 5



Egregious livery on Lytham St. Anne's tram.

thirties and then rapidly from the outbreak of war onwards. There was a short revival from 1945, especially on the railways where locomotives once again become fully lined out. This lasted to the end of steam in 1968. Somewhat before then, it vanished almost entirely from public transport road vehicles. Most surviving tramways didn't bother to restore lining for the few remaining years left for them.

The application of decorative lining on tramcars was an important feature and, for the most part, of considerable aesthetic benefit. This was largely because it conformed to a standard now no longer given any consideration by contemporary designers. My art school designers' training – albeit a long time ago – drummed into me that decoration of any sort, but particularly lining, should emphasise and enhance the structure of the vehicle and not be applied to conflict with it. This meant mouldings and panels should use lining to emphasise their outlines. Nowadays none of this applies and the absence of lining in my view is not in the slightest way compensated by garish colour stripes and blocks without connection to the basic structure, applied sweeping over the underlying shape even to go as far as to cover the windows, thus ruining the view from inside. The first stirrings of this decline appeared in the thirties at about the same time as the tramcar designs also developed and metal replaced wood. Streamlining, although actually ridiculous and expensive, was adopted and paint schemes followed.

The first attempts to modernise the existing trams was to remove lining and adopt modern sans serif fonts. Some streamlined trams were introduced with mouldings curved to follow the form of the streamlined profile. Done with care this could be attractive (**photo 37**). Traditional trams were given appropriate paintwork such as curved linings and triangles on dashes in a futile attempt to suggest a speed potential that did not exist. These were, on the whole, not seriously detrimental to the visual quality, even though, where lining was still applied, the first signs of a relaxed attitude to its use appeared.

There was one truly egregious example that stood out as almost a sign of things to come. Lytham St. Annes Corporation painted their tram, No. 55 with a large triangular shape on both decks. This had no aesthetic relationship with the car's structure (**fig 5**).

The traditional classic lining was actually of many styles; the simplest would be a single line with right angle corners. Generally the pale rocker panels employed a dark line, often using the main body colour, while the darker main body panels would have a pale, often gold line. The variations on this were many. Single or double lines were sometimes used, often

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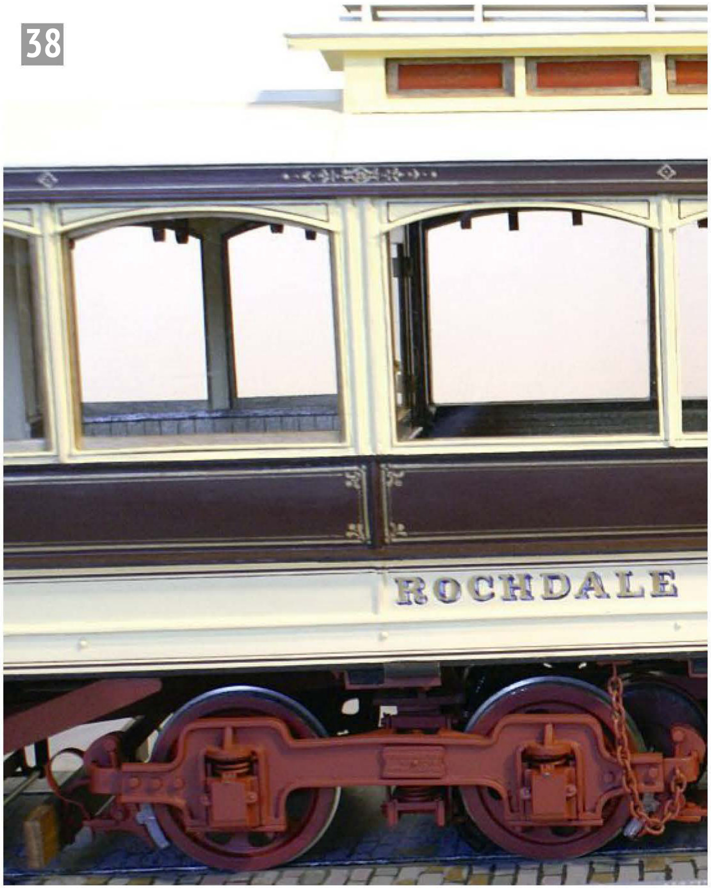
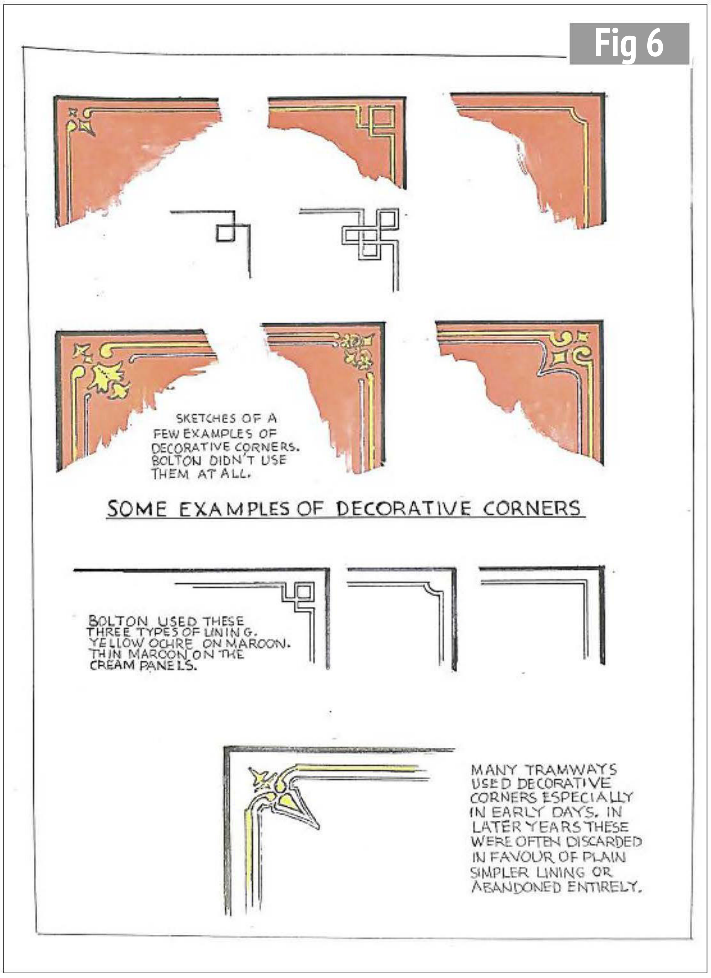


Rochdale's lining.



Some lining examples.

A use of double lines.

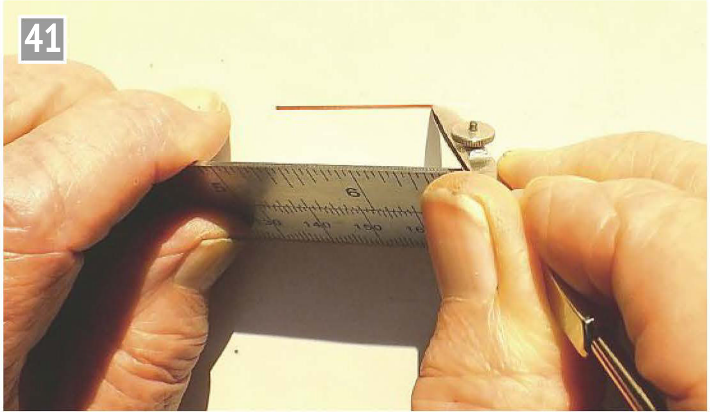
Manchester's 'fairground' livery.

with decorative corners and frequently of different colours and widths (**photo 38**). Just a few of the dozens of designs used decoratively by British tramway systems are shown in **fig 6**. Almost all tramways kept the application of decorative lining within the boundaries of tradition. There were a few systems that went to the limits, but even these kept to the unwritten rules (**photo 39**).

Manchester provides an outstanding example with its wonderful, over the top 'fairground' livery which, although in slightly simplified form, it managed to maintain throughout the war until its final demise in 1949 (**photo 40**). Accurate inclusion of such designs does much to enhance the realism of a model tramcar and is worth the effort involved in applying it.

Methods of lining

There are many ways to achieve a satisfactory result. My preferred method is by draughtsman's bow pen with the adjustable nib that can be loaded with paint and then used to produce a line of the appropriate thickness (**photo 41**). I find it essential to prepare a couple of surfaces of the same colours as on the model, each brought to the same rubbed down standard as the model. These are used for trial lining in order to get the paint to exactly the right consistency. This can take some time. It is a mistake to thin down the paint too much. If gold is to feature, it is wise to use an acrylic paint as oil-based gold will often 'bleed out' if varnish is applied later. If unwilling to risk this traditional method, various lining tapes and transfers are available and will give excellent results. It is a matter of choice. When using the bow pen, simple guides are essential. A ruler is ideal for straight lines but on curved panels such as canopy



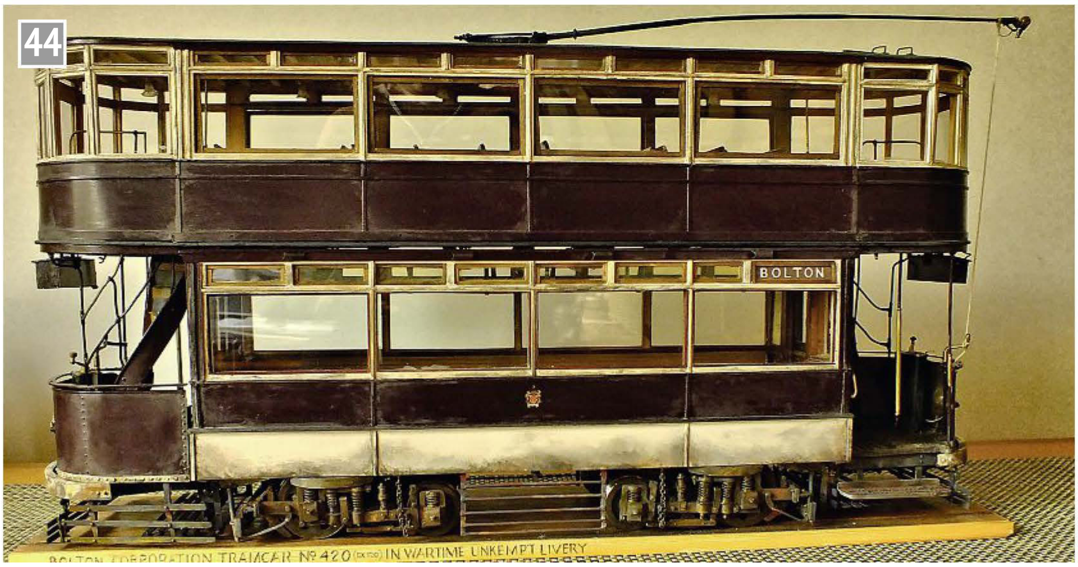
The bow pen in use.

Guide fixed ready for lining.

Civic pride and taste, 1930 livery.

bends, a stout card strip fixed in place with masking tape is suitable (**photo 42**). Mistakes and unwanted spots and runs can be removed quickly with a small brush or tissue soaked in thinners and then a second attempt can be made. Decorative corners and details are best attempted with a very fine, good quality brush down to about 5 zero size. I cannot pretend that doing lining by hand in this way is easy, but done with care the result can be rewarding, especially for anyone keen on using hand skills.

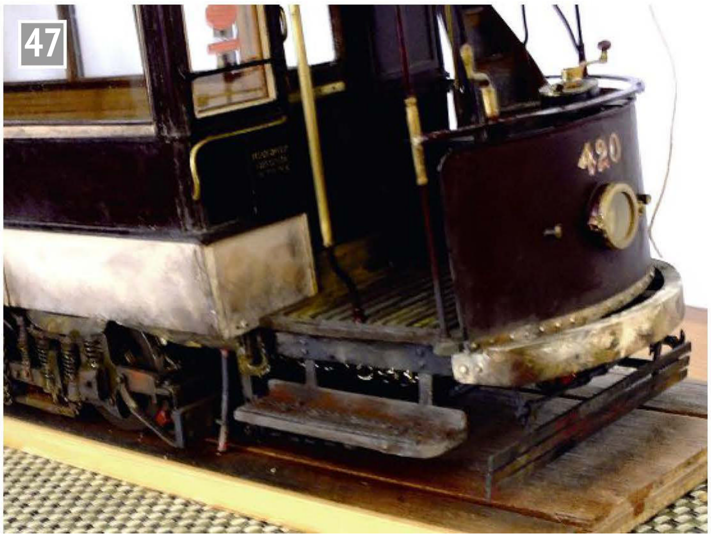
On the world stage, British Tramways, although not alone in the way that they rose and fell, did so in a uniquely precipitous manner. From a peak in 1927 there was a rapidly increasing decline and only the intervention of the Second World War prevented the near extinction that left only Blackpool Tramway with its links to the street tramways that once dominated the city streets. Many of us have been pleasantly surprised and grateful to observe the great revival of street tramways that has occurred in recent years. The decline can now, with hindsight, be regarded as unwise as is clearly shown by the way many tramways, particularly in Europe, chose to modernise and develop their systems rather than abandon them. It is now easy to assess the decline by looking back at what happened to the tramcars during the process. Although some systems did continue to care for their trams and some even introduced new trams, most managed the decline by simply allowing a lack of maintenance and care to dominate in the final years. Thus all unnecessary expenditure ceased and the trams became run down and clearly unloved. This fall from grace is perfectly demonstrated simply by looking at the tramcar in its prime, with obvious municipal pride to be seen in a clean, dignified vehicle, lined out in the most tasteful manner (**photo 43**) and then, within a few years, reduced to a drab, plainly painted and dirty, run down end-of-life tram (**photo 44**). This article has



Neglect and decline.

Standard Bolton 'tram livery'.

Bolton cars before the decline.



A bit of grime.

The end.

been an attempt to show how this happened and how so many trams ended up whilst still being able to provide a public service.

In writing this description, I have attempted to correct, in model form, the way history and reality are usually presented. My developing Bolton Tramway fleet now has examples of tramcars in all main manifestations, from care in their prime to the end of days when the lack of pride led to all too obvious neglect (**photos 45, 46, 47** and **48**).

ME

REFERENCES

Bolton 66 Group - Heaton Park Manchester Tramway Museum.

Tramways in Bolton by Tony Young and Derek Shepherd. ISBN 078-0-948106-58-3

Bolton Corporation Transport – Harry Postlethwaite ISBN 978-1905-304-165

Tramways of South East Lancashire (booklet, now out of print).

Thanks in particular to the late Derek Shepherd of the Bolton 66 Group.

We Visit the Cambridge and District Model Engineering Society

Martin Evans drops in on his local club.

The Cambridge club working party – (from left) Norman Wells, Bob Price, John Holmwood, Dave Harper, Steve Hallam, Ian Stenning, Roy Birch, Julian Garratt, David Wright, John Kegworth, Jeff Bolton.

Where your editor lives is a bit of a wasteland as far as model engineering societies are concerned. The area between Bury St. Edmunds and Haverhill appears to have acquired some kind of immunity as far as our clubs are concerned and the nearest clubs are all at least half an hour away. These include the clubs at Ipswich, Colchester, Brandon (the nearest) and Cambridge. I was kindly invited over to the Cambridge club on a couple of occasions recently and it was very pleasant to revisit a club I've got to know quite well over the years.

The Cambridge club is now 75 years old, having been founded in 1938, and acquired its first track in 1950. However, it soon moved, eight years later, to its larger and current site at the end of Fulbrooke Road, on the Grantchester side of the city. This allowed the construction of a continuous

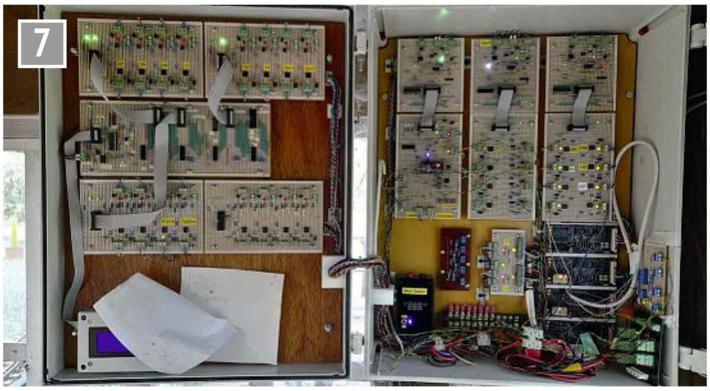
The spacious new carriage shed.

The new traverser and scissors lift in the down position.

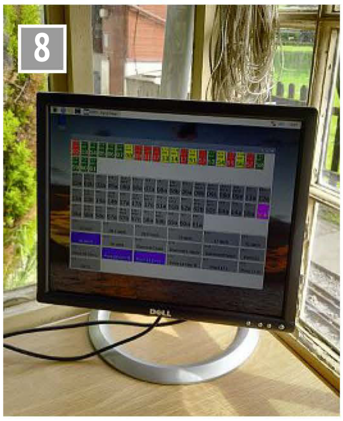
The lift raised to full height.

The new steaming bays awaiting installation.

One pad poured for the new steaming bays – two to go.

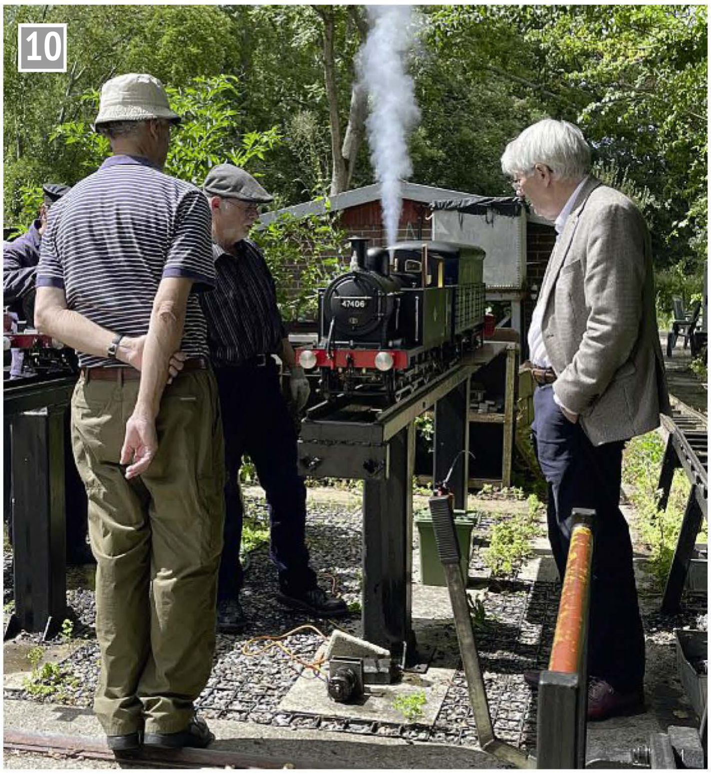


The rather neat microprocessor controlled signalling system.



A monitor in the signal box displays the status of all the signals and track sections.

The new raised 3½ and 5 inch track is staked out in the northern extension.



Tim Coles (centre) steams up his new 7¼ inch gauge LMS Jinty observed by club chairman, Julian Garratt (left) and your editor (right).

Tim Coles looks a little smug after having achieved a first lap of the track.

Your editor in charge of the Jinty while Tim tries to look unconcerned.

Norman Atkin takes the club locomotive for a spin around the extended track.

A board commemorating events and models from Ted's life, including a couple of caption competitions!

track, which winds through the woods and is very popular with young families on summer Sunday afternoons. About ten years ago the society was offered further land to the north of the site which allowed the construction of an extension to the track, which now acquired a figure-of-eight shape and a length of around a third of a mile, of 3½, 5 and 7¼ inch gauge track. The extra land also provided space for a new carriage shed.

The entire railway was also resignalled at that time and is now fully interlocked with microprocessor controlled signals. This of course is no less than you might expect in the UK's hi-tech capital.

Kathy Goode discusses some of the pictures with Brian Apthorpe.

Ted's Isle of Wight railway 02 locomotive decorated for the occasion.

17

Ted's LNER J15 locomotive is watered at the station.

Soon afterwards, further land became available allowing a southern relief loop to be added. This loop cut through the original 3½ and 5 inch gauge raised track which thus became redundant. The acquisition of the extra land to the north had also provided room for a new continuous raised track and I was able to see the proposed route of the new track staked out. Most of this route will be constructed using rails retrieved from the old raised track.

The purpose of my first visit was to admire the latest developments at the club. On a previous visit I had been able to see the concrete pad newly laid for the carriage shed but I was now able to take a look at the completed construction, which is indeed very impressive. It's odd how these constructions always seem larger when finished than the size of the bare concrete pad might suggest! Six tracks allow the storage of a large number of passenger vehicles. I was also able to take a ride, for the first time, on the recently extended track. The 'folded figure-of-eight' route allows for a two lap ride which does not repeat itself.

The highlight for me was to see the site of the new steaming bays and, in particular, the very smart new traverser and scissor lift. It occurred to your editor that combining these two functions,

18

Ted's 7¼ inch gauge GWR pannier tank awaits the 'off'.

19

A line-up of Ted's engines – the pannier, the J15 and the O2.

20

Teatime at the well-attended memorial event for long-standing club member and prolific model engineer Ted Goode.

as they have, could allow for steaming bays of varying heights, which might be handy for the shorter members of the club. The new lift was outside awaiting installation, along with several new steaming bays. The lift is electrically operated and can lift up to a ton, which should easily cover even the largest 7¼ inch gauge locomotives.

The occasion of my second recent visit to the Cambridge track was a celebration of the life of Ted Goode, a long-standing member of the club over more than 60 years and a highly skilled and prolific model engineer. As well as seven completed locomotives he built a number of orrery's (three, I was told) and several clocks, including two Congreve clocks. Three of Ted's locomotives were in steam on the day, offering rides to the many visitors. These included a 7¼ inch gauge GWR pannier tank, an LNER J15 and an Isle of Wight railway O2. A 5 inch gauge GWR pannier tank and riding trolley were on display in the clubhouse. Several other locomotives were also in steam including a recently completed 7¼ inch gauge LMS Jinty, one of a pair constructed by club newsletter editor, Tim Coles. It was good to see one of these locomotives now fully painted and in steam. It was accompanied by a riding trolley previously described in *Model Engineer* (M.E.4685 *et seq.*).

The weather was kind and the event was very well attended - and rounded off with an excellent tea, which (for me) included a very nice piece of lemon drizzle cake.

Kathy Goode is looking for new owners for a few of Ted's engines, including the 5 inch GWR pannier tank and driving truck. Any enquiries should be made to the editor in the first instance.

ME

RECYCLING PART 5

A SOUTHERN SCHOOLS 3½ INCH LOCOMOTIVE

Robert Hobbs takes a box of bits and turns out a Schools Class 4-4-0

Continued from p.392
M.E.4725 September 8

The completed items of the Schools Class locomotive and tender are shown in **photos 91** and **92** awaiting final assembly. The cylinder blocks were the first items to be fitted to the main frames and these set the whole alignment of the locomotive up because the fixings pass from the inner cylinder through the frame and then into the outer cylinder.

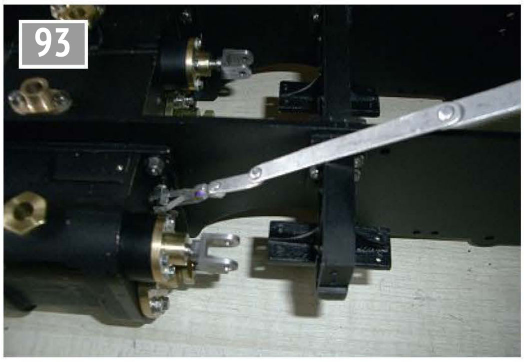
In the past there have been problems getting the fixings into place around the cylinder bogie area on the locomotives that I had built and this one turned out to be no different. **Photograph 93** shows the cylinders in place with the retaining nut being positioned with a holding tool that was made when I was an apprentice some 64 years ago. **Photograph 94** shows a close up of two of these flexible armed holding devices. When an apprentice in the aircraft industry one of the duties in the fitting shop was to construct sub-assemblies using metal thread nuts and bolts to hold them together before the assembly was passed to the riveting department. These were complicated assemblies and young hands were ideal for these tasks but sometimes our nimble fingers were not good enough to access some areas; we made these tools to help.

Speedy assembly was also important because the jobs were all on piece rate and affected your pay at the end of the week. Even a few pence

91

92

Schools Class locomotive parts awaiting assembly.



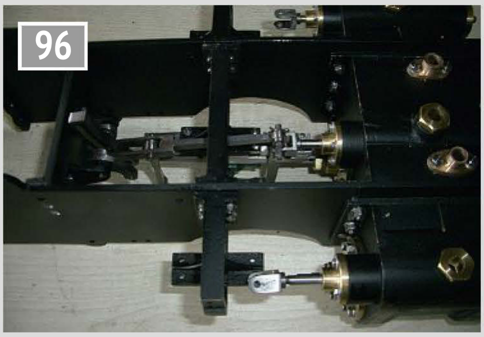
93

Using a special nut holding tool to secure a cylinder.

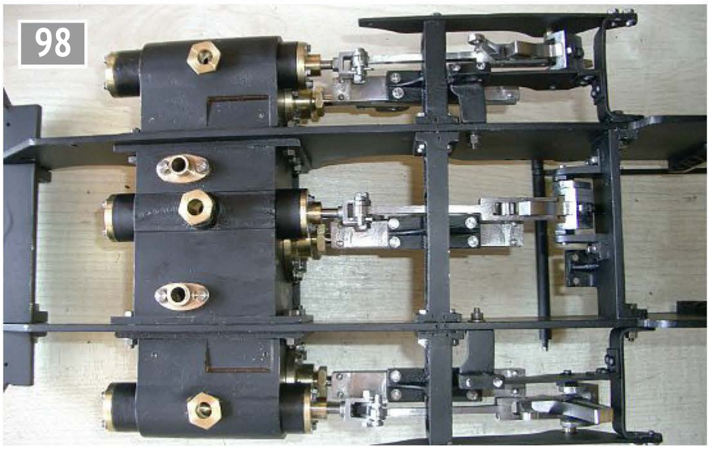
94

Close ups of the screw and nut holding tool.

Irrelevant picture of yachts for light relief.



A couple of views of the inside slide bars.



Most of the valve gear is now in place.

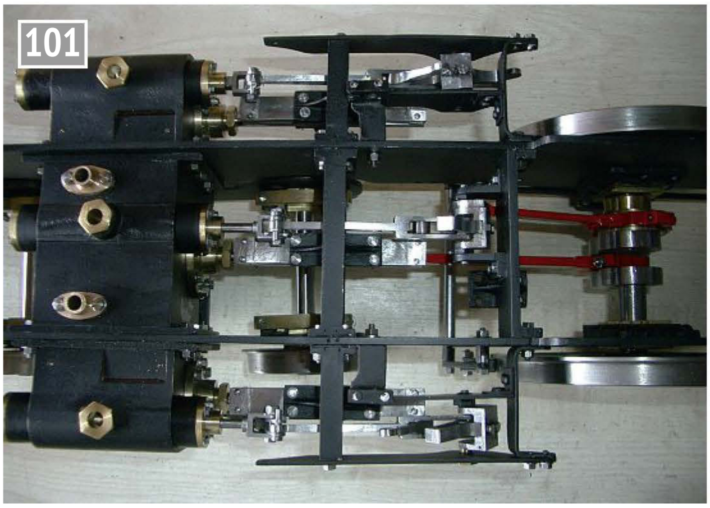
Steam brake cylinder.

Brake gear is added.

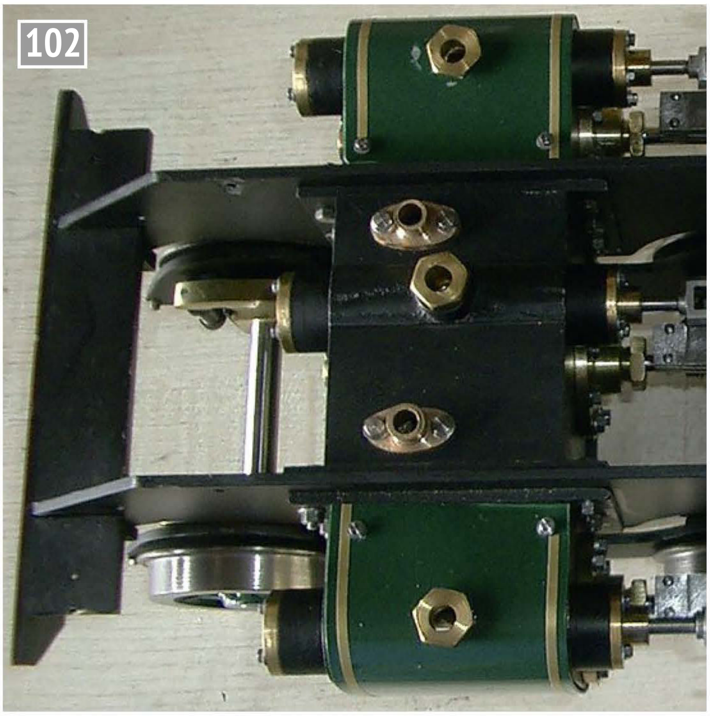
made a difference when two pound seven shillings and four pence was the rate for a forty-four and a half-hour week. I still have the damaged knuckles on my index fingers from reaching inside box sections and nacelles to hold the bumper bar for the riveters, another job for young long skinny arms. Whilst reminiscing, I always have a warm glow when going to my tool box to use some of my father's or father-in-law's tools. Many of these tools are older than me and whilst holding my father's screwdriver recently I realised it was marked with the broad arrow and a date of nineteen hundred and forty-three, the year I was born - not only that but as I write this Schools article today is my eightieth birthday. Modern tools are readily available for quite modest expenditure and I certainly wear out files and the edges of modern screwdrivers, so one wonders how long some of these will remain usable in years to come.

Some readers will remember that my other hobby is radio control yacht racing, especially the International A Class. These 3 metre high 2.5 metre long yachts are celebrating their centenary this year. Fiona our daughter arrived on my birthday with a traditional quilt that she had been making during the last year to celebrate the A Classes' centenary. **Photograph 95** shows the traditional quilt, 1.4 x 1.8 m, made using a Canadian pattern. Fiona must have inherited some of her skills from yours truly because traditional quilt making is a precision and mammoth engineering task.

Returning to the build, the inside valve gear and slide bars were fitted to the support castings and are shown in **photo 96** and **photo 97** shows the setup from below. The outside valve gear frames were bolted in position on the frames together with the slide bars and the valve gear, which is shown in **photo 98**. Moving to the rear of the main frames the brake activating cylinder and the brake pull rod were installed on their bracket and are shown in **photo 99** - it was

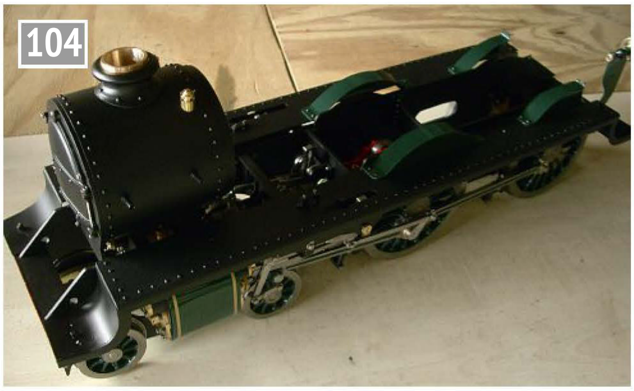


The inside valve gear is now complete.



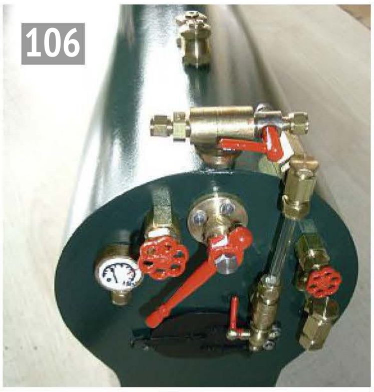
The cylinder covers are fitted.

Smokebox with door, chimney and snifting valves.



The splashers add a dash of colour to the platforms.

The front apron is in place.



Some of the backhead fittings are dummies.

necessary to fit these prior to the wheels in order to access the fixing bolts. The leading pair of wheels were fitted in their horn blocks and the brake hangers, brake blocks and the pull rods were installed as shown in **photo 100**.

Fitting the front pair of wheels involved careful manipulation of the central connecting rod and the eccentric rod to position them on the cross head and the lever on the central trunnion block. **Photograph 101** shows the restricted and complicated set up in between the frames. If this was not complicated enough, later on we have the job of installing the upper and lower reversing shafts and the lifting links.

The painted covers to the outside cylinders were fitted next, because once the running boards were in position there would be no access to this area. **Photograph 102** shows the covers in position. The smoke box was fitted with the front door and its associated peripheral clamps and hinge system. The dummy snifting valves were bolted in place and the chimney positioned and the flange drilled and riveted in place. Four mounting extensions were fitted, two on each side of the smoke box, to retain the top edge of the smoke deflectors. **Photograph 103** shows the smoke box assembly.

With the smoke box fitted to the frames the reversing stand was then fitted to the rear of the frames which now allowed the running boards to be fitted. The four wheel splashers had been previously riveted in position on the boards - **photo 104** shows the boards in place and **photo 105** provides a close-up view of the front apron. The boiler regulator, blow down valve, steam turret, pressure gauge, clacks, fire door and water gauge, some of which are dummies, were made from brass stock and are shown in **photo 106**.

The boiler was then offered up to the frames as shown in **photo 107**. With the reach rod

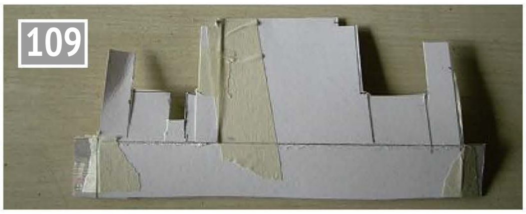
The boiler is fitted to the frames.

Reverser and reach rod.

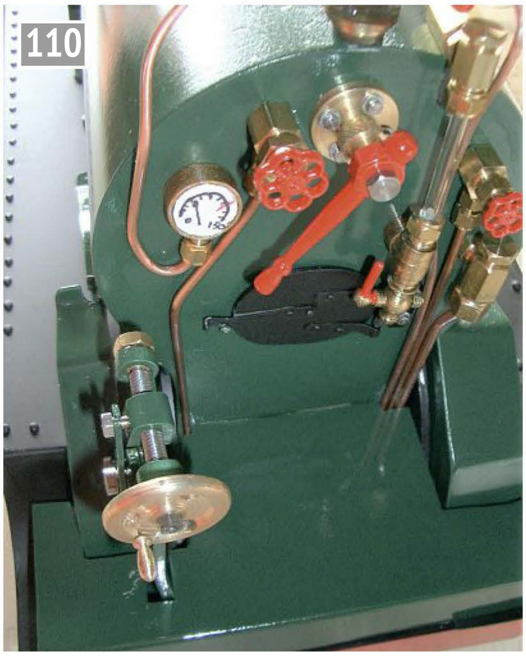
now in position, the operating quadrant was shaped to give the necessary movement and this is shown together with the screw reverser in **photo 108**.

It was now time to make the cab floor, which was raised to align with the tender apron, and initially a cardboard template was cut and patched to suit the odd shaped area. **Photograph 109** shows the template used for the floor and **photo 110** shows the fabricated cab floor in position. The previously painted cab sides were fitted, carefully installing the hand rails which had been bent to shape and fitted with collars where they passed through the window edging strips. **Photograph 111** shows the cab sides bolted to the running boards and a link plate joining the two halves of the spectacle plate over the top of the boiler in place. The copper piping to finish off the back plate has also now been installed.

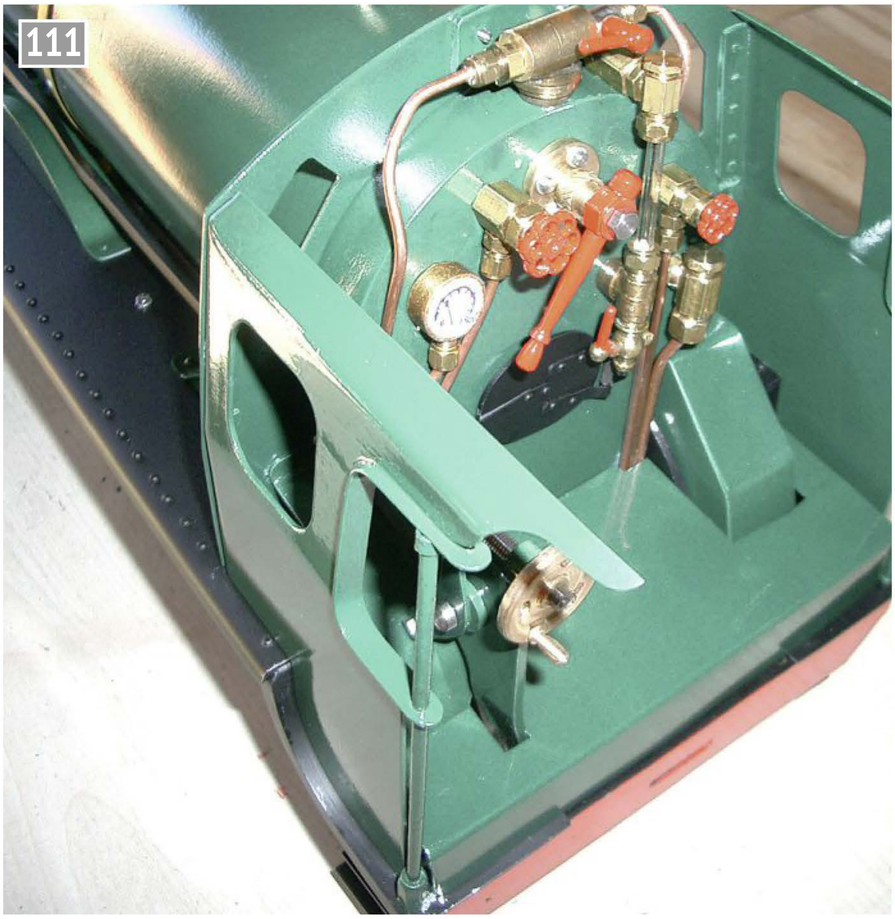
●To be continued.



Template for the cab floor.



Cab floor is made and fitted.



The cab sides are added.

POSTBAG

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Responses to published letters are forwarded as appropriate.

Gauge 2

Dear Martin,

Many years ago, in the mid 1970's, I was asked to restore to static display a small live steam locomotive that had been very badly damaged in a fire. It had been in a building fire and the remains had lain in a box for many years before it had come to me. It was in a very sad state but after many hours of work, which included trying to work out the jigsaw puzzle of loose pieces in the box, I managed to restore it to its owner who then displayed it in his office in Sydney.

The engine was obviously a commercial product and I had no idea of its origin. It was a strange gauge, somewhere between gauge 1 and 2½ inch. The riddle was finally solved when I opened M.E.4717 (May 19) page 669 and there it was. It was a Gauge 2 Carson Precursor. Thanks to your excellent magazine, a 45-year old mystery has finally been solved.

Barry Potter
(Orange, New South Wales)

Ivan Law

Dear Martin,

It's with great sadness to find out that Ivan Law has passed away. He was a truly exceptional engineer and his obituary says it all. His book *Gears and Gear Cutting* is a brilliant piece of work. Without it I doubt I would have been able to produce really good quality spur gears for my engines.

I must try to adopt his saying "I'll go and get a cut on" and then disappear into the workshop for several hours!

Andrew Whale

IMLEC

Dear Martin,

I write to congratulate the Bristol society for hosting such a friendly IMLEC (International Model Locomotive Efficiency Competition). It is an interesting track in a great parkland setting.

The weather was challenging for all but the gazebo kept most of us dry when the heavens opened. The refreshments were most welcome and it was good to note that the Scouts were being supported by the sales.

Sadly, technology let them down this weekend. Who hasn't been on the wrong side of this behemoth? As a spectator I would have appreciated more information on their PA system. Also 'the ladies in the gazebo' discussed how we missed the IMLEC 'board' - clear information for all to see throughout the weekend, to photograph and enjoy the anticipation of where the most recent competitor would 'hang'. Where is the board now and can it be used again next time please?

It is an immense amount of work for a club of volunteers to host IMLEC and it is appreciated. Shame on Bristol council for charging for parking in a field and wanting a share of the gate money. I'm sure the original councillors, who gave so much support initially, would be horrified. I do hope Bristol are not put off from hosting again.

Regards,
Doreen Flippance

In Bristol it seems to be all about the money. I returned home from Bristol to a £60 fine for driving in their 'low emission zone' - I didn't even know they had one. That's a nice little scam, isn't it? - Ed.

4QD

Dear Martin,

At the last running session the electric locomotive *Zahia* was not behaving properly. After various ministrations, I suspected the controller. I spoke to a very helpful gentleman called Steve on the support desk of 4QD (manufacturer of the board - www.4qd.co.uk) and he said that most boards returned to them actually had no fault. He also said that there is a test board for the controllers with leads for the Porter, DNO (aka NCC), Pro, VTX series controllers as well as the 4QD-200 and 300 series. He then said that he would send me a test board because one has been sent to all the model engineering societies that 4QD knew of!

I have now received it, used it and made an adjustment to the preset that controls acceleration, setting it to the slowest acceleration possible.

I have been most impressed with this level of service - the cost of the board was nothing! Customer service that is several levels ahead of most companies and this controller is at least 20 to 25 years old. It arrived in three working days. Absolutely outstanding. And as a comparison, a friend of mine working in electronics said that he does not get that level of support from organisations that his company spend £MILLIONS with!

It is, of course, available to anyone else within the St Albans and District MES that needs to test a 4QD controller board.

Regards,
Mike Joseph (Chipperfield)

Why I Write

Dear Martin,

By means of this letter I would like to comment on the article of Geoff Theasby - *Why I Write* in M.E.4719 (June 16). It was very interesting to get a look behind the scenes of THQ. His Club News articles not only keep us, as readers, up to date with what's cooking in the model building fraternity from around the globe but they also show technical knowledge, a broad scope of interest, humour, use of Latin (*sic*!) and a keen eye for the oddball things.

Therefore one of the pillars of *Model Engineer* magazine!

Henk-Jan de Ruiter
(The Netherlands)

Joint Failure in Silver Soldered Stainless Steel

PART 2

Graham Astbury researches an unexpected metallurgical problem.

Introduction

Almost fifty years ago, I made a weather vane from 300 series (austenitic) stainless steel sheet depicting a galleon in full sail. The galleon was silver soldered to the stainless steel pivoted arm with an arrow head on the other end. It was silver soldered using Easy-flo No.2 and Easy-flo stainless steel flux. It was free to rotate on a supporting rod which held the four compass direction arms and was mounted on the shed in my parents' garden. When my wife and I bought our own house the weather vane was, of course, removed from my parents' shed and installed on the shed in my own garden. This lasted over thirty years until one dark and stormy night the galleon disappeared from the vane. I found it in the garden where it had landed after falling off the vane. When I took down the supporting rod and four compass point arms, all the letters were loose and came away as well. As a house move was pending, I put the various bits away safely to attend to it when the move was complete. As always, another few years (fifteen actually) went by until I had the time to repair it (**photo 1**).

The problem

Looking at the point at which the galleon had been silver soldered to its rod, it appeared that the silver solder had not 'taken' onto the stainless steel, as it appeared to not have any silver solder remaining on the surface in the joint area at all. The same thing had happened to all the joints for the direction letters. I thought that this was strange as I had never seen this type of failure before. At the time of making the weather vane in 1975, I had taken the advice of a friend of mine who regularly silver soldered stainless steels as he was a maker of specialised surgical instruments. He advised the use of the Easy-flo No.2 silver solder and Easy-flo stainless steel flux for the job. Easy-flo No.2 conformed to the Specification AG 303 of EN 1044:1999, *Brazing Filler Metals* and its composition, along with other silver solders, will be given later in a table in Part 2.

When it was made, the initial results were good as the galleon was attached firmly to the pivoted rod. Since I had subsequently lost contact with my friend over the passage of time, I was unable to pick his brains as to the reason for the failure over thirty years later. Hence the need to research the cause of the problem. Note that the following research and discussion is focussed solely on austenitic (300-series) stainless steels which contain both chromium and nickel. The metallurgy of the ferritic (400-series) stainless steels, which do not contain nickel, is different from the 300-series and is beyond the scope of this article, because the silver solders and fluxes required are different. Whilst every care has been taken in its preparation, it is up to readers to confirm that the information contained within this article is suitable for their own applications.

The repaired weather vane.

Initial research

Clearly this had been some specific failure which was not mentioned on the packs of silver solder or flux that I had bought. Consequently, I considered that it might have been some form of corrosion, so I searched the literature for corrosion of silver soldered stainless steel joints. A paper by Singh (**ref 1**) describes eleven types of corrosion, of which there were three that seemed most likely to be the cause of the problem that I had encountered. The three types were crevice corrosion; inter-facial (or inter-granular) corrosion and galvanic (or bimetallic) corrosion. These will be discussed in turn.

Crevice corrosion

This occurs typically on a metal which relies on the surface becoming passivated by a hard, insoluble corrosion-resistant layer. For stainless steels, the chromium on the surface of the steel is oxidised to chromium oxide which is a passive material and resists further oxidation. It is self-healing in that if the chromium oxide is removed, for example by scratching or abrasion, the exposed chromium promptly combines with the atmospheric oxygen to re-form the hard, passive chromium oxide, thereby protecting the underlying metal. Where there is a crevice, there is usually inadequate oxygen at the bottom of the crevice to re-passivate the chromium to form the chromium oxide layer and the result is corrosion. This is particularly common where crevices are built into the construction of items used in aqueous environments. As an example, where a stainless steel marine propeller is mounted on a stainless steel shaft, water can penetrate the gap between the hub of the propeller and the shaft. As the water corrodes any un-passivated surface, there is insufficient oxygen present to re-form the passive layer and the corrosion continues. The result may well be a series of crevices or cracks which are only visible when the parts are taken apart for inspection or when total failure occurs. It appears that the presence of silver solder is not necessary for this type of corrosion. In the case of my weather vane, there appeared to be no cracks present, so I concluded that crevice corrosion was unlikely in this case.

Inter-facial corrosion - background information

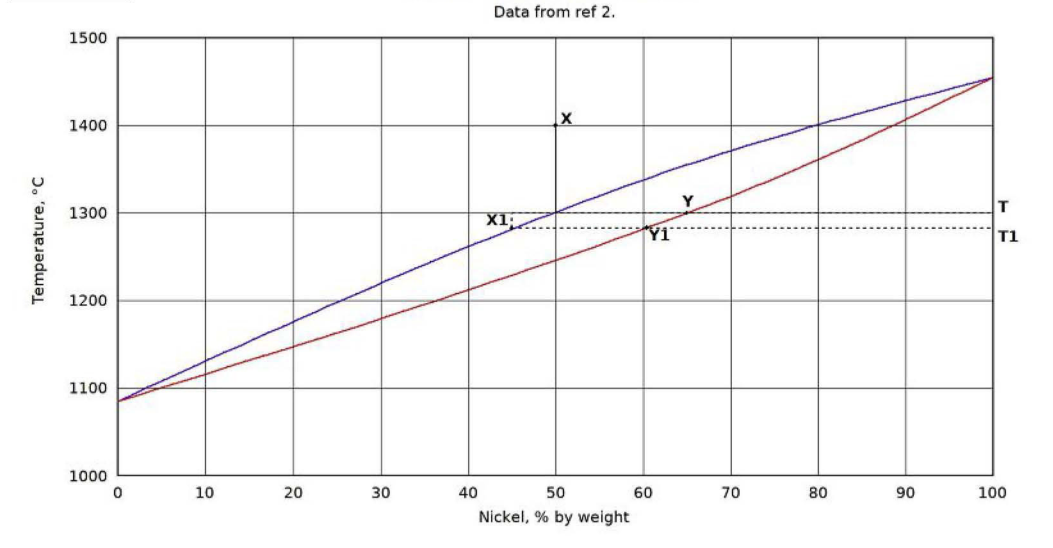
In order to understand this topic we need to have a diversion into the structure of alloys and what happens as molten solder cools down to form a joint.

When molten metal alloys solidify, grains are formed. To understand why this occurs, first look at **fig 1** which is a *phase diagram* depicting mixtures of nickel and copper which has been redrawn from data available in **ref 2**. Copper and nickel are completely soluble in each other both in the liquid state and the solid state. The upper, blue line is the *liquidus* above which all mixtures of the copper and nickel are liquid. The lower, red line is the *solidus* below which the mixture is solid. On the left of the diagram where the solidus and liquidus lines meet, is pure copper with a melting point of 1085 degrees C and on the right is pure nickel with a melting point of 1455 degrees C.

Assuming that an alloy with the composition 'X' at 50% nickel is cooled, it remains liquid until it meets the liquidus when freezing starts. The solid that freezes out is not of the same composition as the liquid but is a composition of that of the solidus at 'Y', that is 65% nickel, and the temperature 'T' is that at which a 65% nickel alloy would commence melting. The first particles to form in the solution will be richer in nickel (as that has the higher melting point) and the liquid will have, say, the composition of 'X1'. At the corresponding temperature T1 the composition of the solid in equilibrium is now 'Y1', and a further deposit of solid will occur and grow on the solid already present to change their composition from 'Y' to 'Y1'. This process continues until the entire liquid freezes. If an infinitely slow cooling process occurred, the copper would diffuse into the nickel and the composition and structure of the solid would be uniform. In practice, the metal deposits in microscopic grains layer by layer and the quicker the cooling, the larger the grains. A comprehensive description of this is given by Rollason (**ref 3**).

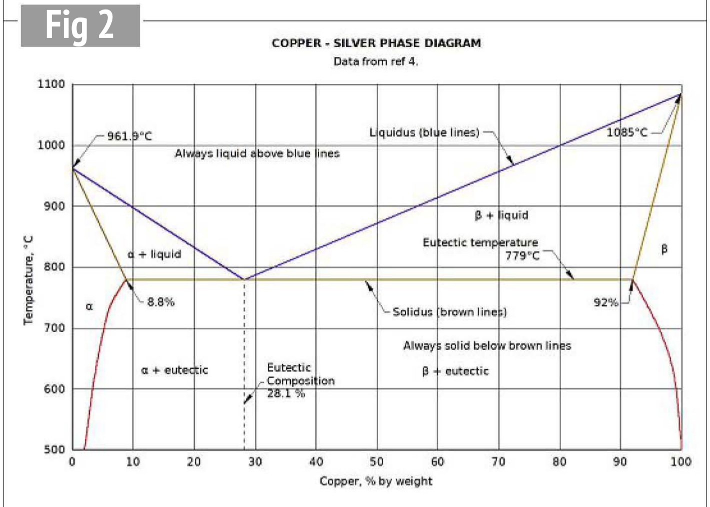
The above case was where both metals were fully mutually soluble in each other. In many cases, the two metals are not completely soluble in each other. As an example, take the combination of silver and copper. Both these metals appear in many types of silver solders, so it is appropriate to examine their behaviour. The simplified equilibrium diagram for these metals is shown in **fig 2** using data available from **ref 4**. It can be seen that this is a far more complex diagram than fig 1, due to the limited range over which silver and copper are soluble in the liquid and solid phases. Where there are two metals which are not completely soluble in each other, they will form a *eutectic mixture* (*eutectic* is from the Greek meaning 'easily melting')

Fig 1



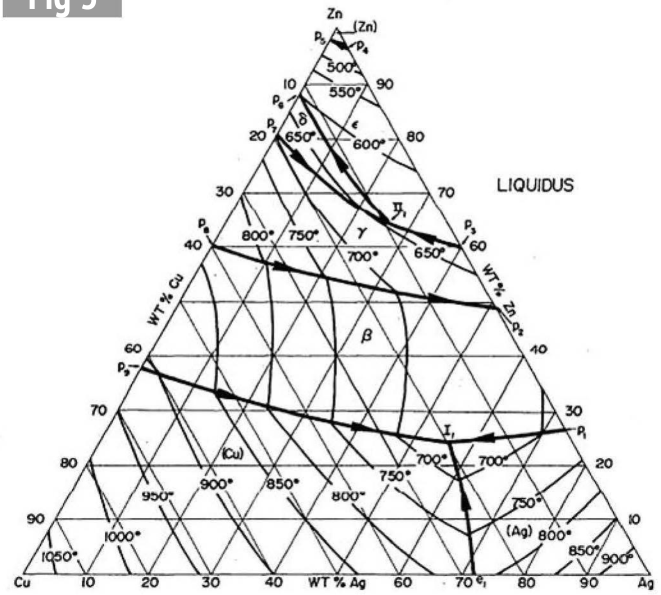
The Copper-Nickel system phase diagram (redrawn using data from ref 2).

Fig 2



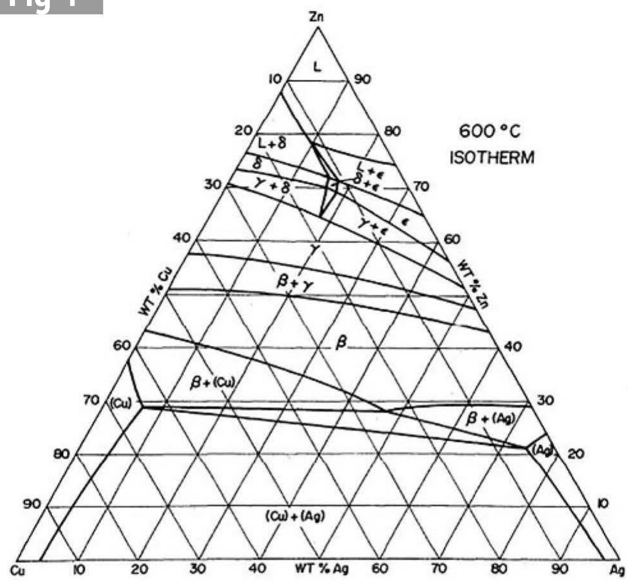
The Copper-Silver System phase diagram (redrawn using data from ref 3).

Fig 3



Liquidus of the Copper-Silver-Zinc system (© American Institute of Physics - reproduced with permission).

Fig 4



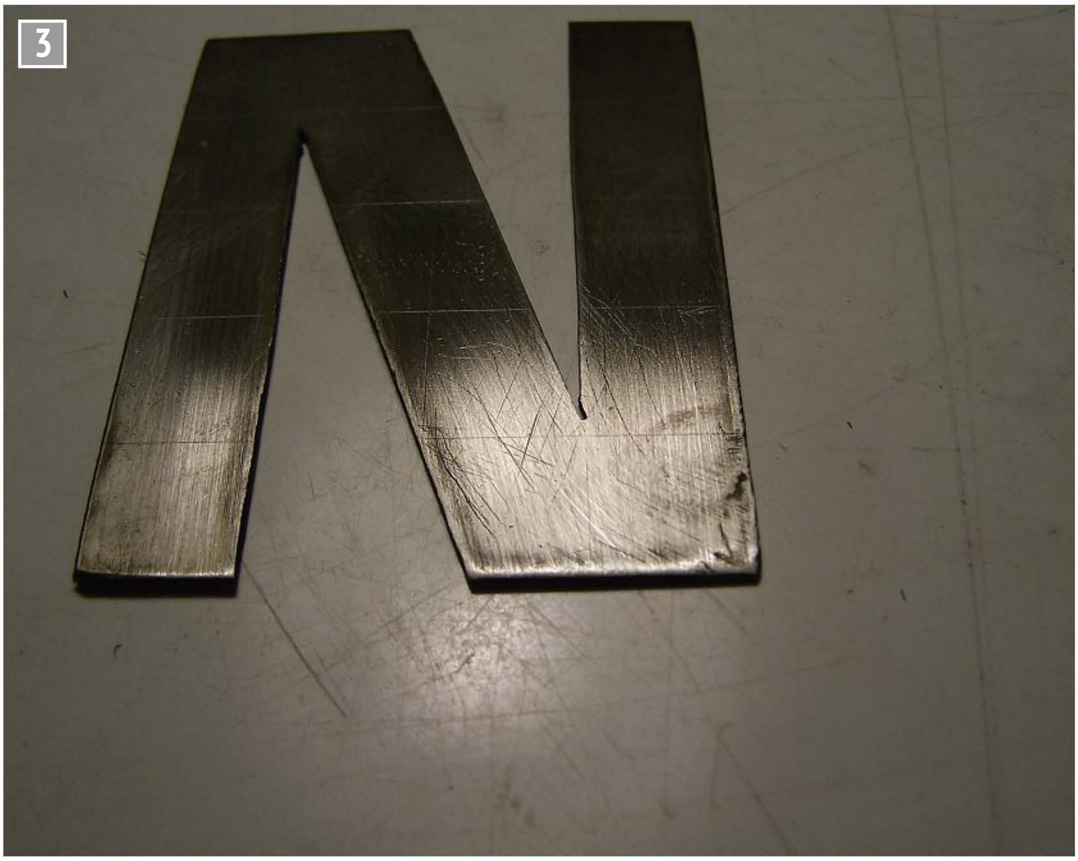
Isotherm at 600 degrees C of the Copper-Silver-Zinc system (© American Institute of Physics - reproduced with permission).

which is the composition of the alloy with the lowest melting point and is below the melting points of both of the pure metals making up the mixture. This can be seen in fig 2 as the mixture which is at the junction of the two blue liquidus lines, corresponding to 28.1% copper. Taking a mixture of 50% copper as an example which is cooled from say 1000 degrees C, it will remain liquid until it reaches the liquidus (blue) line. At this point copper-rich grains start to precipitate out as the 'β' phase, and the composition of the liquid moves towards the eutectic composition. From the diagram, it can be seen at the right-hand side that the solubility limit of silver in copper is 8% (the balance is 92% copper) and this mixture is classed as the β phase. Note that at the left of the diagram, the solubility limit of copper in silver is 8.8% and is termed the α phase. The phases are named in the order in which they occur as the concentration rises. It is usual to draw phase diagrams with the higher melting point component starting at 0% at the left, rising to 100% at the right but some authors do not follow this convention. Eventually, the whole mass solidifies and the resultant composition is in the area shown as 'β + Eutectic' on fig 2. It can be seen that on melting an alloy of 50% copper-50% silver would cover a range of temperatures from the moment it starts to melt at the eutectic temperature of 779 degrees C until it is fully molten at about 875 degrees C.

The above description shows how microscopic grains form in alloys consisting of two metals as they cool. Whilst this is reasonably simple, in practice silver solders usually have more than two metals in them. Instead of a binary mixture with a simple eutectic, there can be three components so the phase diagram has to be drawn on triangular coordinates. An example of this is shown in **fig 3** for the liquidus of the silver-copper-zinc system (**ref 5**). This shows that the liquidus forms a *surface*, rather than lines as in fig 2, with temperature being on a vertical axis coming out of the paper. It can be seen that there is a binary eutectic at 71.9% silver and 28.1% copper about three quarters of the way along the bottom (silver) axis. As the composition changes with an increase in zinc content, the liquidus forms a valley which can be seen from the isotherms (lines of constant temperature), rather like the contours of a map. This valley continues towards the copper axis.

At a temperature of 600 degrees C (**fig 4**) there are multiple phases in both the liquid and the solid, some of which differ from those of the liquid mixture. These different phases are noted by Greek letters but it appears that on three-component (ternary) diagrams, there is little consensus as to the order in which phases are named. Consequently, it can be seen that having three components in a silver solder makes it such that the solder has phases in the molten liquid as well as phases in the solid, which may be different from those in the liquid. Interested readers may like to view how the phases change with temperature by looking at the original reference (ref 5) which has isotherms at 700 degrees C, 600 degrees C, 500 degrees C and 350 degrees C. From all this, the main point is that silver solders are not simple one-phase mixtures - they are mixtures of many phases when solidified

The silver solder still intact after the joint failed.



The apparent lack of any silver solder bond on the stainless steel.

and this is where the potential problems of corrosion arise. The foregoing provides the background to the formation of interfaces between the grains that form in the solidified solder and hence why inter-facial or inter-granular corrosion can occur. It is important to note that grain boundaries occur in the parent metals as well as the silver solder, as the parent metals are also alloys with many components.

Inter-facial corrosion

Having looked at cooling and structure of alloys, we can now return to discussing inter-facial corrosion. This occurs at the junction of two surfaces between the grains of the solder and the parent metal, where one metal preferentially leaches out of the junction of the two surfaces, resulting in depletion of the joint strength. Where a silver solder is used on austenitic (300series) stainless steel, the silver in the solder forms intermetallic compounds with the parent metal. This is similar to the mechanism of soft-soldering as described previously (**ref 6**) only it is the silver rather than the tin which forms the intermetallic compounds in this case. The metal most likely to leach out of the silver solder is the zinc. Dissolution of the zinc will result in failure of the joint. This is somewhat similar to de-zincification of brasses in the presence of water. According to Takemoto and Okamoto (**ref 7**), '...*corrosion at the braze interface may have significance and control joint life because it proceeds faster than the corrosion of the filler metal*...'. From the joint failure that had occurred on the weather vane, this would seem to have been the case as the silver solder filler metal appeared to be unaffected by corrosion yet the joint had failed at the filler metal - parent metal interface (**photo 2**). This observation is supported by Sloboda (**ref 8**) who states '...*the usual reaction of an observer faced with a failure of this kind is to conclude that the joint fell apart because no bond formation had actually taken place*...' (**photo 3**). On a joint that had not failed completely it was apparent that the silver solder had started to become detached from the parent metal due to inter-facial corrosion and ultimately, total failure would result (**photo 4**).

The silver solder detaching from the parent metal due to inter-facial corrosion.

●To be continued.

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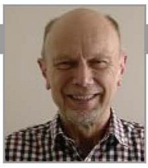
A Model Engineer's Clock

PART 1



Jim Clark makes a skeleton clock making good use of modern manufacturing methods.

There is a wide variety of interests amongst the members of our club, the Northern Districts Model Engineering Society (NDMES) in Perth, Western Australia, including road and rail steam, electric and internal combustion, stationary engines and other more esoteric devices. Personally, I have always been interested in clocks, along with most other old mechanical devices. Clocks always appealed to me because of their seeming complexity and the symmetry of the many gears and wheels, together with the hypnotic reliability of a smoothly ticking mechanism.

Why a Model Engineer's Clock?

While I like clocks, I also like the robustness of bigger machines such as beam engines and steam locomotives. Many people, including numerous model engineers, have made clocks although the discipline doesn't appear to be as popular within model engineering circles as it once was. Most clocks are made to published designs which provide most, if not all, details of the clock mechanism; the wheels and pinions (not called 'gears' in the clock world!) and the shapes of each part. Most designs follow long traditions of horological practice.

I wanted to do something a little different – a clock more in the style of model engineering, hence the 'Model Engineer's Clock' (**photo 1**). My main objectives were:

- A large 'statement' clock with all moving parts large enough to be easily seen
- Simple enough to be easily understood and stylish enough to be attractive
- Robust enough to run out in the open, without needing to be kept in a glass case

1

The finished Model Engineer's Clock.

2

A typical skeleton clock by the well-known clock designer, John Wilding, with the glass dome removed for the photo (photo: John Wilding).

- The wheels to be fairly chunky with corner radii, in the style of larger machines, rather than the usual fine proportions and square corners of horological tradition.

The obvious choice was a skeleton clock, where the frame of the clock is minimised to show off the inner workings. There are quite a few published designs available, including clocks by John Wilding (**photo 2**) and an excellent YouTube series on constructing a skeleton clock using traditional methods by 'Clickspring'. These designs fit the first two criteria but they are not particularly large and are intended to be permanently housed inside a glass dome to keep the dust off.

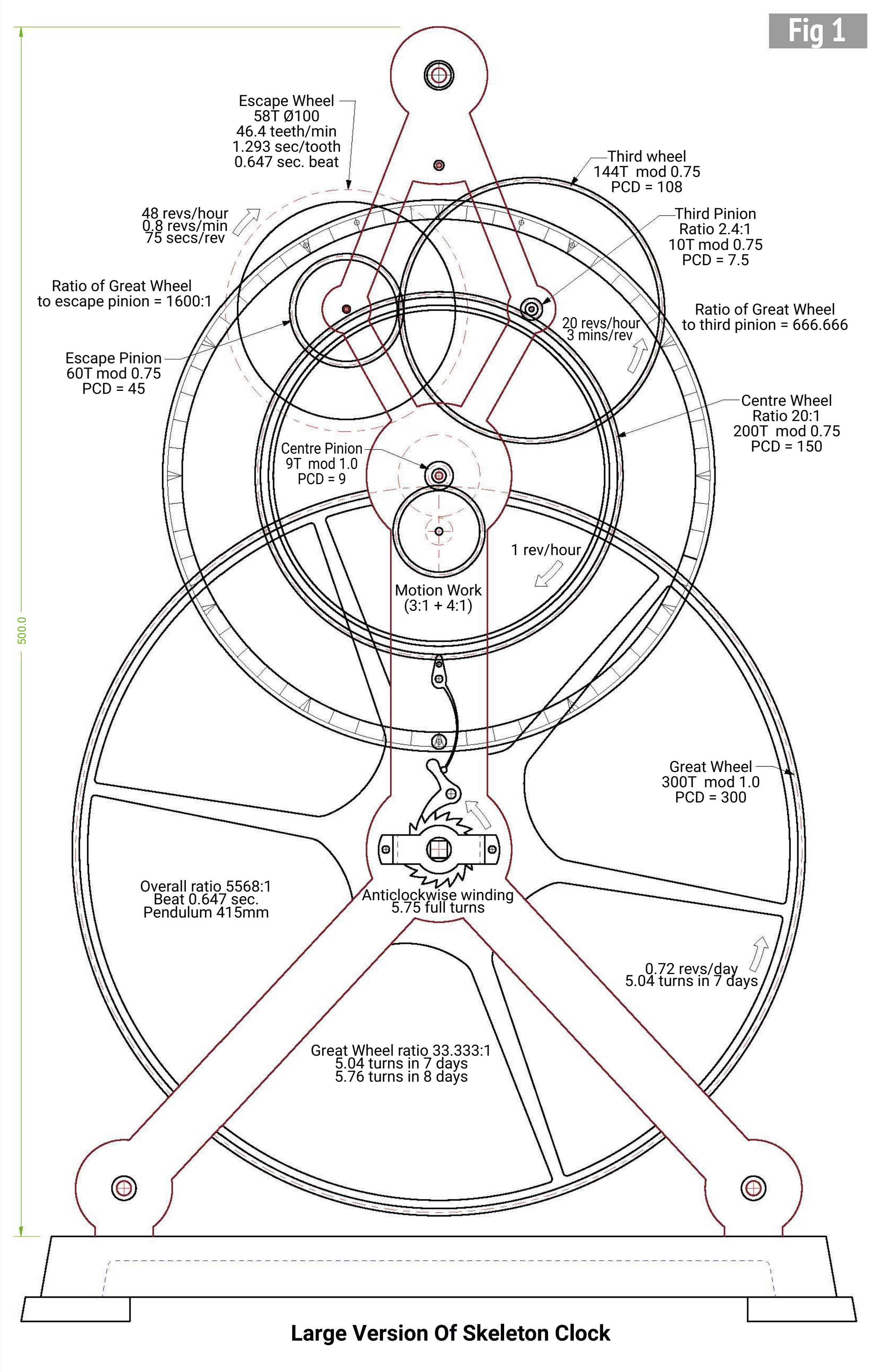
Designing the clock

I started with the Large Wheel Skeleton Clock described in a construction booklet by John Wilding, as this was closest to the sort of thing I had in mind. I intended, however, to bring to bear some modern technology on the established design:

- The use of CAD to allow for accurate design and drawing of the critical parts
- The use of EDM (wire cutting) to cut the wheel and pinion profiles.

To design the clock, I used a free CAD program called DoubleCAD (as I could not afford AutoCAD), which has its drawbacks but is sufficient to do the job. Being able to accurately draw up the working parts of the clock allows things like the accurate placement of the centres for the wheel arbors and the precise (theoretical) depthing of the wheel/ pinion engagement. It also allows an escapement to be designed and drawn up from first principles rather than simply copying an established design.

Having access to EDM facilities through my friend Ron Collins allows the precisely drawn clock parts to be translated directly into metal cut-outs with very high accuracy. When assembled, the parts should then fit together and run without needing further adjustments, avoiding manual



Front elevation of the proposed 'Model Engineer's Clock'.

layout processes such as the depthing process, typically used to set out the wheels and pinions in a traditional clock. EDM is also capable of producing gear teeth of an exact profile, removing the tricky and error-prone job of machine-cutting each tooth on a circular blank.

On, then, with the design! I took John Wilding's Large Wheel Skeleton Clock as the basis for the new clock and scaled it up to a couple of different sizes. I printed the outlines on paper at 1:1 size and cut them out to see how it would look in reality.

I decided that if we were going big, then it would be as

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big as practicable so I chose a scale that gave a clock frame 500mm tall, with the 'great wheel' being 300mm diameter. That size of frame would allow me to have a pendulum with an effective length of just over 400mm, which then sets the 'beat' or pendulum rate of the clock itself, which of course is determined by the acceleration force of gravity. Using the following formula with a pendulum length of 415mm gives:

$S = \sqrt{L/C}$ (where S is beat in seconds, L is length in mm and C a constant 994), so
$S = \sqrt{415/994}$
(formula taken from clockmaker's book).

The 'beat' is the time of the swing on one side from centre back to centre, so the overall period of one complete pendulum double swing is 1.292 seconds.

This basic decision is important, because the beat determines what the overall ratio of the escapement and gear train must provide in order that the minute hand, which is attached to the centre wheel, rotates exactly once per hour.

Figure 1 shows the general arrangement of the new clock.

Now to calculate the required overall timekeeping ratio from the pendulum escapement down to the centre wheel, which needs to rotate once per hour:

$$Ratio = \frac{secondsperhour}{pendulumbeat}$$

$$\frac{3600}{0.646} = 5573$$

Therefore, the overall ratio for the timekeeping part or 'going train' is 5573:1

The pendulum only passes half a tooth each beat (it releases one complete tooth for every double beat, or complete swing of the pendulum), so the number of teeth on the escape wheel must be doubled when calculating the wheel train.

We are working with three wheel and pinion combinations in the timing train: the escape wheel, escape pinion, third wheel, third pinion and centre wheel. Various combinations of teeth numbers on these five items can be chosen, which will all satisfy the overall ratio, so it is a matter of trying a few different combinations that will provide reasonable looking wheels and also practical sized pinions.

This is particularly important in a clock like this, where the escape wheel and third wheel need to look visually balanced and the whole arrangement be symmetrical.

The combination I have chosen for this clock is:

Escape wheel:	58 teeth
Escape pinion:	60 teeth
Third wheel:	144 teeth
Third pinion:	10 teeth
Centre wheel:	200 teeth

The resulting ratio is:

$$\frac{200x144x(58x2)}{60x10} = 5568:1$$

This is close enough to the ratio previously derived from the beat, which was 5573:1 and the slight difference will be taken care of by adjusting the final pendulum length using the rating adjustment nut.

The ratio of the centre wheel to great wheel I chose to be 33.333:1 (great wheel of 300 teeth on a 9 tooth centre pinion), so that the great wheel will make 0.72 revolutions every 24 hours, or 5.76 revolutions in 8 days. This gives a main spring winding requirement of about 6 full turns for 8 day operation. A 9 tooth pinion is the smallest practicable size I thought we could use.

Choosing a suitable size of main spring appears to be something of a black art. Even John Wilding vacillates between spring sizes in his designs and notes in his construction series that his Large Wheel Skeleton Clock turned out to be over-powered, causing the pallets to bottom out on the escapement wheel, so he subsequently fitted a lighter duty spring.

I left the decisions about springs for later on, for the moment just allowing for a large spring barrel that could accommodate a variety of possible spring sizes.

The escapement

Most clock designs for amateur builders use a 'recoil' type of escapement design, as this is generally thought to be fairly easy to set out and machine in the home workshop, and is reliable in operation. However, as this is a Model Engineer's Clock, I decided I needed more of a challenge.

The 'dead beat' escapement (invented in 1715 by George Graham) is a later development of the recoil design, but the escape wheel does not recoil on each beat, hence its name. It is a more complicated design and relies on some very precise layout and machining, but when well made it apparently provides superior timekeeping to the recoil escapement. So, this is the type I chose.

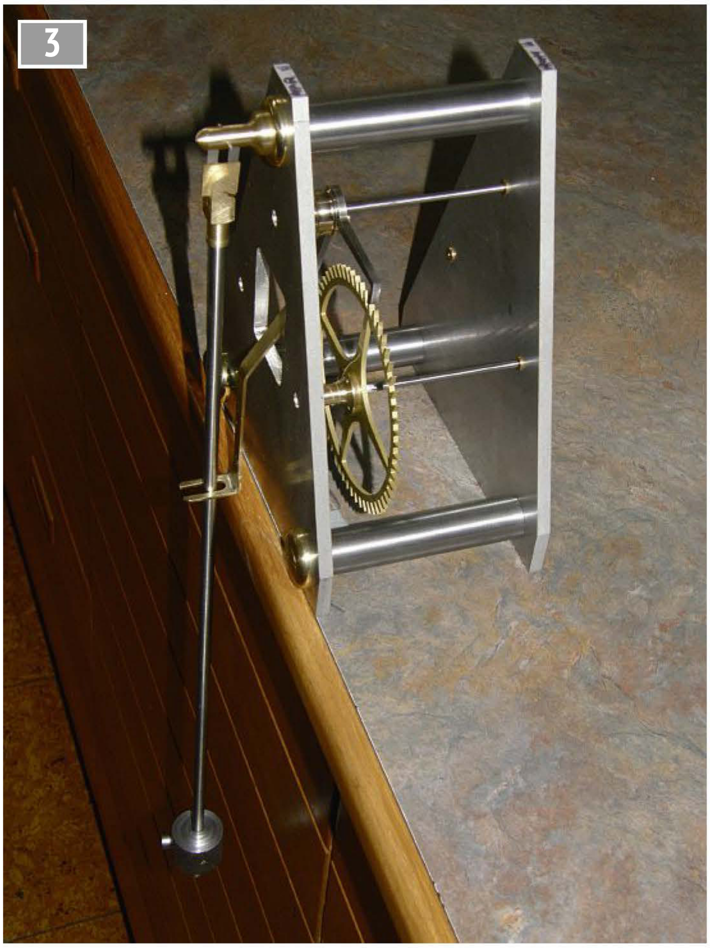
I started from first principles, using a series of articles entitled *Escapements: Theory and Practice* published in *The Clockmaker* magazine by someone calling themselves 'Graver'. I read the section on dead beat escapements numerous times until I thought I had a reasonable understanding of the requirements, then I laid out my own design in CAD using the various criteria for 'impulse', 'lock' and 'drop'.

The description in the article was good but, like so many technical descriptions, it assumed a few things and was lacking a couple of crucial steps that are required in order to complete the layout.

Nonetheless, I persevered and after several attempts, I had a design that looked like it should work - on paper, at least (**fig 2**).

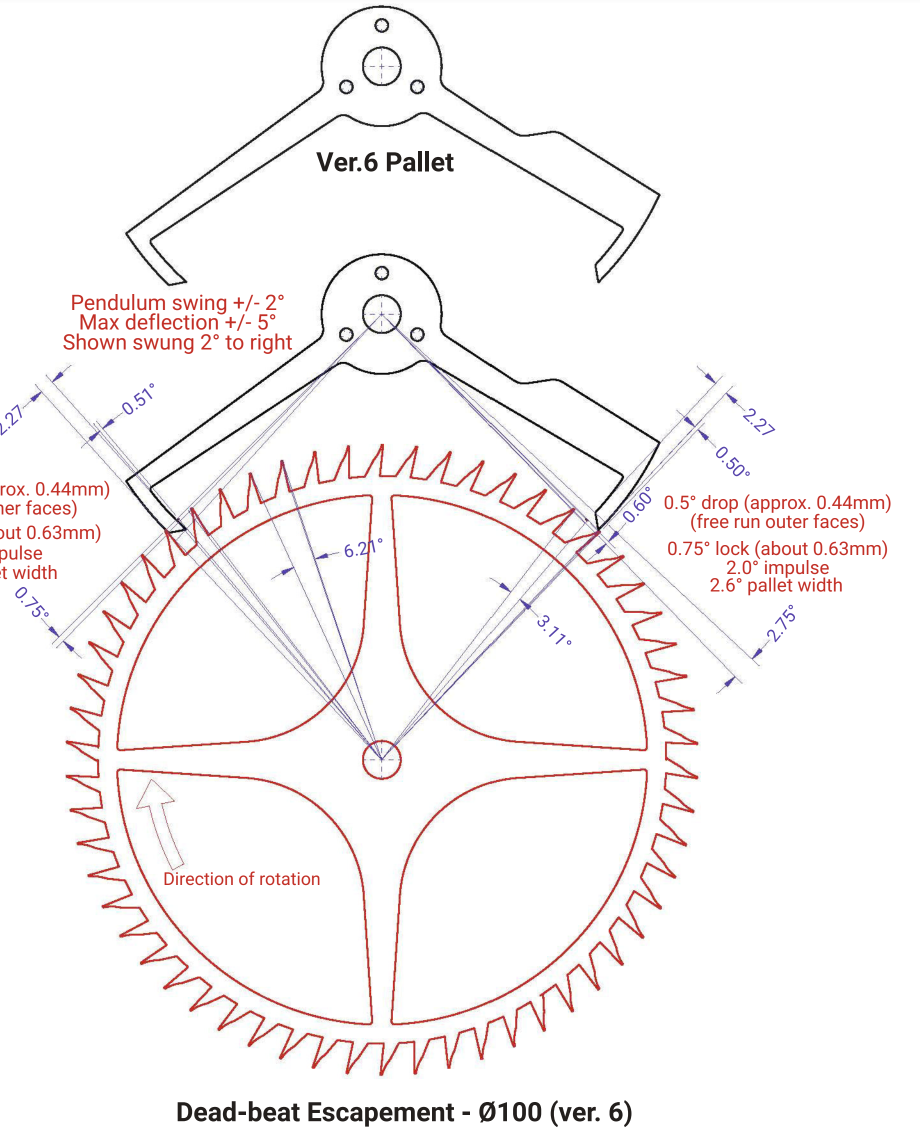
Still being sceptical, I decided it would be worth the effort to build a test rig that would allow me to test and prove the escapement in practice so I asked Ron to wire cut the various components for the escape wheel, escape pallet, escape pinion and the third wheel (**photo 3**).

The first attempt was not



I made up the arbors and bushes and assembled the test rig, with a trial pendulum hanging off one side.

Fig 2



This drawing shows the final escapement version, which was arrived at after several further trials.

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Technical discussion, fuelled by cake.

successful as the escapement would either refuse to run, ran erratically or stopped after a short time. After much discussion over coffee and cake (**photo 4**), several changes to the design were made, including adding some back face clearance to the escape wheel teeth and tinkering with the amount of drop and lock. Yet, still, it did not run smoothly or reliably. We sought the expert opinion of our resident horologist, Garth Caesar (**photo 5**).

Ron Collins recalls: 'Garth wandered over to look at the test escapement and looked at it very closely for a few moments before, in all seriousness, announcing that he thought the escapement design was "out by about 4 thou." Subsequently Jim discovered that there was a design error of 91 microns (0.0036" or 3.6 thou) in the width of the pallet teeth. I thought that was brilliant - and have related the story many times!

Therefore, in the final version of the design, we slightly reduced the width of the pallet teeth by 0.09mm. Now it would run quite happily for a couple of minutes, until the small metal weight suspended on a string around the third wheel arbor dropped to the desktop and its power supply ran out.

Success at last!

Making a test rig to sort this issue out certainly paid off – it would have been a nightmare trying to pull the finished clock apart over and over again to change out escape wheels and pallets …

●To be continued.

5

Checking the working of the escapement.

The Twist Drill Bit

PART 1

Neil Raine remembers the 160th anniversary of the invention by Stephen A. Morse.

The twist drill bit is a sophisticated and cleverly designed tool. Readily available in numerous sizes and materials to meet every demand in engineering, the twist drill bit seems more popular nowadays than ever before. It is widely accepted that Stephen Morse invented the twist drill bit in 1863. At this time, other drill bits were already in use but Morse significantly improved on these by including innovative elements of design. The modern twist drill bit is remarkably similar to the one described by Morse in the U.S. Patent of 1863. This alone is evidence of the significance of Morse's achievement. However, perhaps because of its enduring popularity and familiarity, there is a risk the simple twist drill bit is not widely appreciated and understood. This year marks the 160th anniversary of the invention of the twist drill bit and the patent awarded to Morse by the U.S. Patent Office (**refs 1** and **2**). Therefore, the intention of this article is to recognise the inventor of the twist drill bit and discuss some of the brilliant elements of the original design.

Cutting metal into shape continues to be an essential requirement of many manufacturing industries. The ability to cast molten metal into precise and intricate shapes has greatly assisted manufacturing and eased the reliance upon metal cutting operations. To accurately dimension components and achieve a precise interaction between moving parts, though, the various metal cutting operations of turning, milling and drilling have not yet been surpassed. There is no substitute to drilling for producing a smooth-walled hole at the required angle and depth, to accurate dimensions, quickly. Making holes or bores into the components of machines is required to meet many operational needs including fixing, lubrication, cooling, articulation, the generation of energy (e.g. internal combustion chamber), force transmission (e.g. hydraulics, steam engine cylinder), housing (e.g. locks, electronics) and weight saving (e.g. racing cars, aircraft and spacecraft).

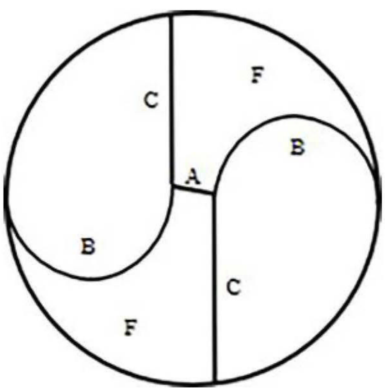
The process of drilling into metal is believed to be the most challenging of all the metal cutting operations (**refs 3** and **4**). Despite this, and although other hole making technologies have emerged e.g. laser and water-jet, mechanical drilling, using a twist drill bit remains the most popular method in most manufacturing industries. For example, in the aviation industry where the fixing of components is predominantly accomplished using rivets and bolts, it is estimated there are three million drilled holes in a passenger aircraft. The production cost of this equates to roughly 3% of the total build cost of the aircraft (**ref 5**).

Compared to other metal cutting operations, the process of drilling into metal is somewhat different. Unlike other metal cutting processes that dimension the work from the outside, the drill bit has the added complexity of cutting inside the workpiece. As shall be seen, the design of the drill bit is closely allied to this unique requirement. Drill bits are required to cut clean, straight and true holes in a variety of materials, transport swarf away from the cutting-edge and out of the hole, and withstand heat buildup and thrust and torque forces. However, the seemingly simple operation of drilling a hole can easily go awry resulting in drill bit wander, an over-size bore, overheating, burr formation and a broken drill bit (**ref 6**). These complications are frustrating and costly in terms of both time and materials that often need to be scrapped. When a component has undergone many stages of production before drilling begins, the consequence of any complication with drilling is multiplied.

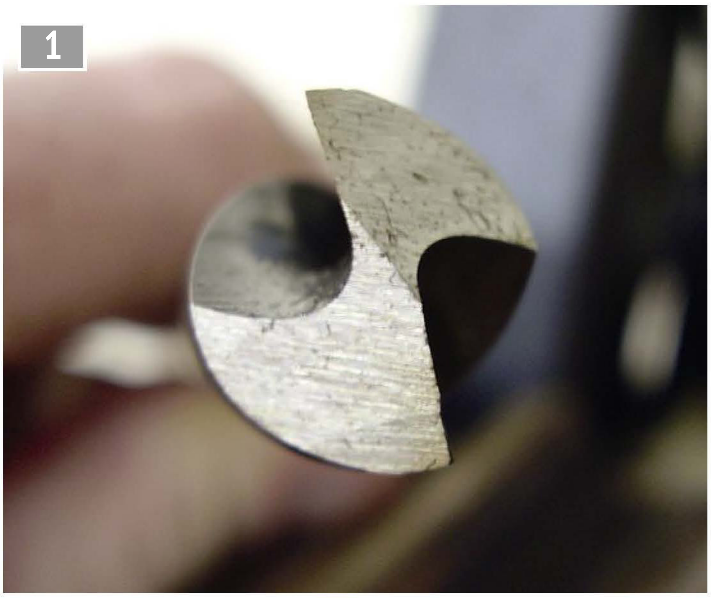
A description of the shape and design of the twist drill bit

The twist drill bit has a number of unique elements of design to overcome the specific demands of cutting a hole into metal. The drill bit begins as a cylinder or rod of metal, usually steel, that is ground, cut or hot-forged into the shape of a double-helix. The shape of a twist drill bit is similar to that of a notable biological molecule. It could in fact be said the structure of DNA resembles the shape of a twist drill bit as its invention pre-dates the discovery of the structure of

Fig 1



Plan view of the point of a twist drill bit. A – arris, B – flute, C – cutting-edge and F – flank.



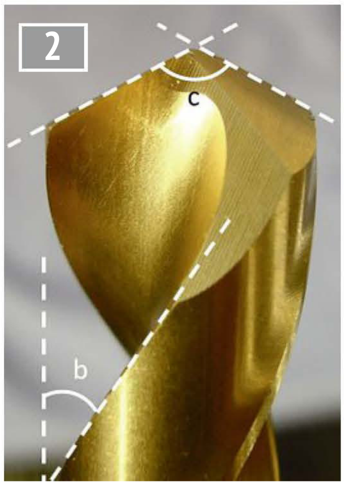
End view of a twist drill showing the helical structure - both flanks ground flat.

DNA by Watson and Crick (**ref 7**) by exactly ninety years. Regardless, the shape of the twist drill bit is instantly recognisable.

When a drill bit is formed by grinding or by cutting with rotating burrs, as Morse did, a considerable amount of material is removed from the drill rod, perhaps up to one third of the original mass. Larger drill bits can also be made by hot forging the shape onto a red-hot steel rod. The two helices that emerge from the solid drill rod directly oppose each other and are joined in the middle by a thin band of metal called the web (**fig 1** and **photo 1**). The helices of a drill bit are rarely referred to as this and a more common description of them is the wings or the flanks. When a drill bit is viewed in cross-section the helixes appear as two sector-like shapes each with two radii and an arc. The arc of each sector-shaped helix is formed by what remains of the circumference of the original drill rod. Unlike a sector that has two straight radii, the two sides of each helix of a drill bit are neither straight nor identical. This shape was best described by Morse: '*the right side of the groove being a short, quick curve, and nearly in the direction of the radius, while the left or opposite side of the groove is a longer or more shallow curve*' (ref 1). The groove Morse refers to is now commonly known as the flute. Obviously, the cross-sectional shape of each helix is no accident and was designed by Morse to serve a vital functional purpose as we shall discuss later.

In a drill bit, the tightness of the twist of the helix(s) is determined by the helix angle that is measured between the vertical Y-axis and the edge of the helix (**photo 2** – angle 'b'). The tightness of the twist to the helix(s) is otherwise known as the pitch and is expressed as the distance required for one complete revolution of the helix(s). The thread of a common screw or bolt is also a helix shape but because the pitch is much less than that of a drill bit it is expressed as turns per inch (tpi). The helix angle also has another important role. At the tip of the drill bit, the helix angle is equivalent to the rake angle that is found on a planer tool and most lathe cutting tools too. Therefore, the helix angle of a drill bit simultaneously determines the pitch of the helix and the angle of the inner face of the cutting edge. When a drill bit is held horizontally at an angle of approximately 60 degrees to mimic the orientation of a lathe cutting tool, the similarity in shape of the two tools is easier to visualise.

The helix angle, or the rake angle, is not standardised for all drill bits and is chosen to suit the material the drill bit is designed to cut. Some drill bits, as used in clock-making, are manufactured without any twist to them at all. A conventional drill bit rotates in the clockwise direction. Drill bits that cut in the anti-clockwise direction are also available but these are much less common. With a conventional drill bit, the lesser curved inner face of the helix leads into the cut and the more curved face follows behind. Separating the two helices of the drill bit are the flutes - longitudinal spaces that remain after the drill rod is ground along its length. The cross-sectional shape of the flutes is determined by the shape of the two opposing helices that border them - one acutely curved face and one lesser curved face (see fig 1).



The helix angle of a twist drill (angle 'b') and the point angle ('c').

When viewed in cross-section, the shape of the flute has the appearance of the lower-case letter j spiraling down the length of the drill bit (as shown in photo 1). The flutes are essential to the performance of a twist drill bit but the necessity for them introduces a structural weakness that is found in the narrow web in the centre.

Beginning on the outer corner of each cutting edge and spiraling along the length of the drill bit there is a narrow band of metal known as the land. This narrow raised ridge is left behind when the outer arc of each helix is ground along its entire length in production. The width of the land varies in relation to the size of the drill bit but is estimated between 1 to 2mm wide. The land can clearly be seen spiraling down the helix of the drill bit (**photo 3**).

A view of the lands spiraling down the drill to minimise friction while drilling and the flutes to clear swarf.

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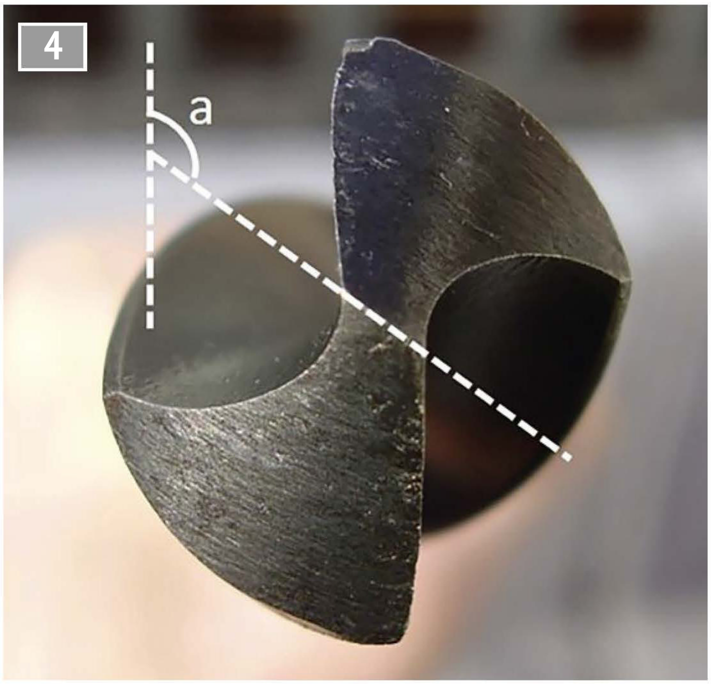


A view of the arriss at the end of the drill showing the clearance angle ('a').

Viewed end on, the tip of most twist drill bits has a small ridge of metal in the centre called the chisel edge or the arris (**photo 4**). The arris is not a functional cutting edge. When a pilot hole is first made in the workpiece (**photos 5** and **6**), the arris centres on this and provides stability to the drill bit until it penetrates the work completely. Metal cutting drill bits that have a single chisel point or arris do not have a designed in self-centering property (**ref 8**). Mostly in engineering workshops drill bits are not required to be self-centering as both the machine and the workpiece are fixed steady. Pre-drilling a pilot hole ensures the cutting edges of the drill bit become engaged with the work immediately.

Metal cutting drill bits with a designed-in self-centering property are available but are generally more expensive than typical jobber drill bits. These drill bits are designed with either four facets at the point, sometimes known as split point (**photo 7**), or are point thinned and start cutting the work immediately upon contact. While drill bits with a self-centering property are not necessary for machine use, they are more practicable for use in hand drills for non-workshop applications; e.g. in automotive engineering, steel frame construction and the agricultural industry. Rarely, if at all, is the need for a centre punched point eliminated when drilling into metal using a hand-held tool. Other examples of drill bits with a designed-in centering ability include most wood drill bits such as the spur point, brad point, and forstner bit.

The arris may be functionally limited but it is the best visual marker of the thickness of the web at the centre of the drill bit. It is also a very good visual reference of the clearance angle. When looking down on the point of the drill bit with the cutting edges orientated vertically, the angle formed between the arris and the cutting edges represents the clearance angle (angle 'a' in photo 4). This can be measured easily using a protractor. When there is no clearance angle ground onto the drill bit, the arris will sit virtually at a right-angle to the cutting edges. As the clearance angle increases, the angle formed between the arris and the cutting edges shall also increase. Many manufactures of drill bits have tended to adopt a standard clearance angle of 130 degrees. Such a drill bit will cut metal quite aggressively and the efficiency with which material is removed is better suited for industrial work. However, for use in the home workshop, Bradley (**ref 9**) recommends the clearance angle is better reduced to 120-125 degrees. This angle makes the cutting edges less aggressive, reduces the likelihood of chatter and the bit biting into the work. The clearance angle can also be assessed by looking directly at the flank when the drill bit is held vertically and typically measures 9 to 12 degrees in this orientation.

If unsure about the geometry of the cutting edges on a drill bit, one option is to find an untouched factory ground example in the tool box and compare the two. Factory ground examples are easy to identify as the flanks have a rounded profile, all aspects of the point have perfect symmetry and the arris is orientated to approximately 4 o'clock when the cutting edges are held vertically. Examples of untouched factory ground drill bits are shown in photo 3.

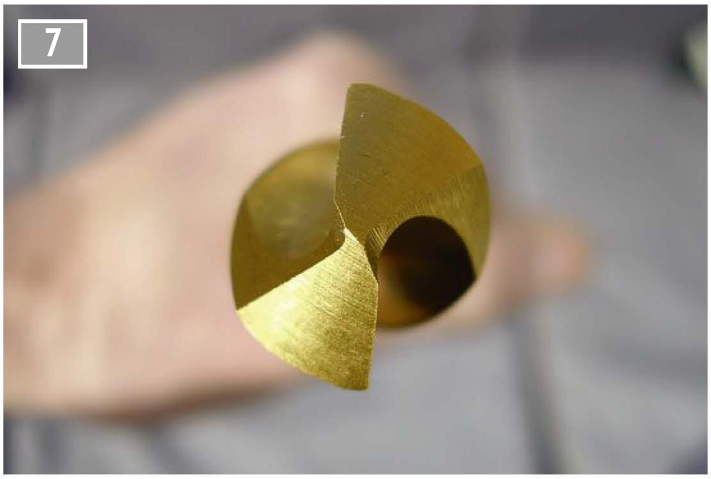
The tip of a drill bit is ground circumferentially into a point or spear-head shape. Flat bottom drill bits that resemble end mill cutters are also available for drilling into curved surfaces and for when a true flat bottom hole is required. Quite a lot of material must be removed from the end of the drill rod to convert it into a point. Were there no clearance angle included on the helixes to form the cutting edge, the shape of the point of a drill bit would be purely conical. The final shape of the point of a drill bit is discussed in more detail later as it is relevant to understanding correct sharpening. For most twist drill bits each flank is ground to an

Starting a bore with a centre drill.

6

The arriss engaging with the pilot hole.

7



A modern tin-coated factory-ground drill-bit drill ground with four facets.

angle of 59 degrees and the two flanks combine to form a point angle of 118 degrees. To meet the demand of a particular job, any chosen point angle can of course be ground onto the drill bit. For optimal cutting performance there must be perfect symmetry to the point angle and the clearance angle of each flank.

Drill bits are different to most other metal cutting tools in that they have two cutting edges, or lips, that are formed at the end of each helix. The drill bit is intentionally designed so that it can be repeatedly sharpened. This was eloquently described by Morse: '*The peculiar shape of the groove is retained throughout its whole length, and as the drill is gradually shortened by grinding the shape of the cutting-edge remains unchanged.*' (ref 1). As the helices of the drill bit directly oppose, so do the cutting edges formed at the tip. This arrangement equally divides the work each cutting edge must perform.

The shape of the point of a drill bit

To begin a description of the shape of the point of a twist drill bit, it is easier to envisage the end of a rod or cylinder. When the rod is angled in the X-axis only and is ground circumferentially at the end, it forms the shape of a cone. When the rod is angled in two dimensions simultaneously the X-axis and the Y-axis form a compound angle, and if ground circumferentially, it will form the shape of an oblique cone leaning to one side. But, a drill bit is not ground truly circumferentially - it is ground as two separate halves or semi-circles as it has two cutting edges. Because of this, and ignoring all other features, the final geometric shape of the point of a drill bit is described as two halves of an oblique cone offset by 180 degrees and joined down the centre line. Therefore, the point of a drill bit does not have conventional symmetry, it has rotational symmetry (see fig 1 and photo 1). To add to the complexity, this shape is superimposed onto, not a cylinder, but a bi-sector shaped arrangement joined at the centre. Viewed from above, the cross-sectional shape of a drill bit looks somewhat bat-like. Because it is difficult to conceptualise the shape of the point of a drill bit, it is not surprising that problems are frequently encountered when it comes to sharpening them. The requirement to use a drill bit sharpening jig is, therefore, greatly beneficial.

●To be continued.

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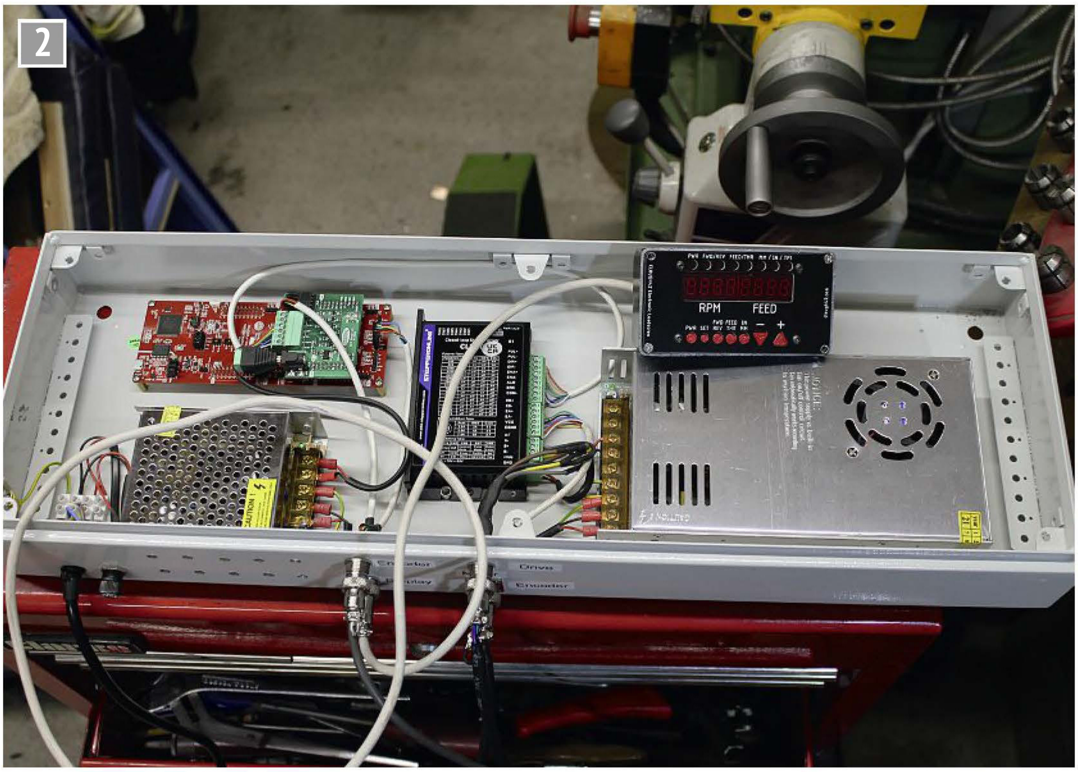
The Lathe Electronic Leadscrew

PART 2 - FITTING THE LEADSCREW TO A WARCO WM250V LATHE

Peter Russell explains how screwcutting can be done electronically.

Continued from p.407
M.E.4725 September 8



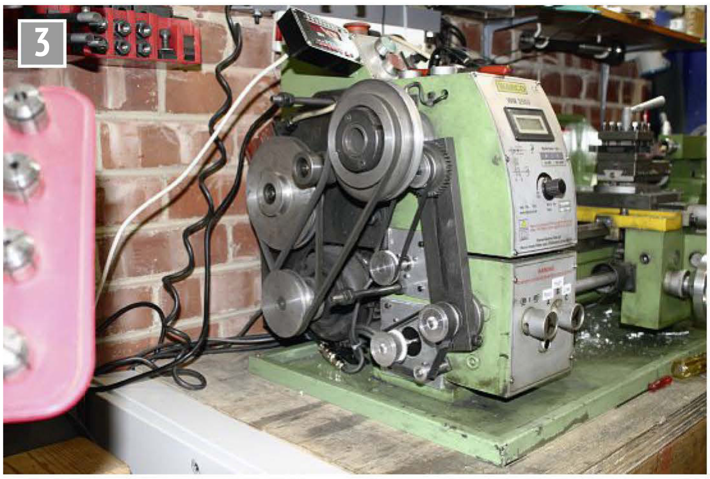
The enclosure with all the bits that fit inside - and those that don't.

First of all, we need to think about the choice of motor to drive the leadscrew. There are basically three types to think about – stepper motor, servo motor and hybrid stepper.

A stepper motor, on receiving a pulse from its controller, will rotate by a fixed amount. On receiving a train of pulses at a fixed rate, it will rotate at a constant speed. If it is under load, there is the possibility that it will 'lose' steps and not achieve the desired speed. You will only know about this when it ruins the thread you are cutting.

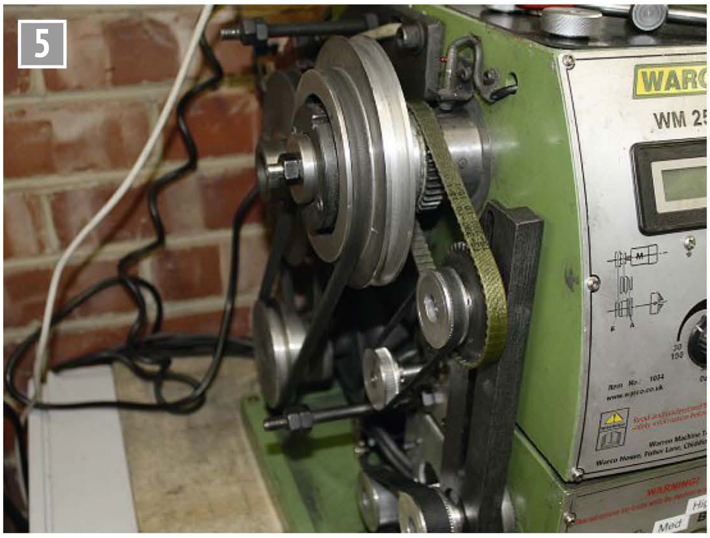
A servo motor will rotate at a speed determined by its control signal, using internal feedback to ensure its accuracy. A servo motor is significantly more accurate and more expensive than a stepper.

A hybrid (or closed loop) stepper uses feedback to give it almost the same accuracy as a servo, at a price lower than a servo but more than a stepper. If it does lose steps, it sends an error signal back to the controller which could,



The encoder and stepper mounted with their belt drives.

The display panel mounted next to the lathe control unit.



1:1 gearing using the banjo and a 40 tooth gear.

for example, be used to stop the motor.

I chose to use a hybrid stepper.

We also have to consider how powerful the motor is (actually its stall torque) and here Clough has done us a big favour by actually testing the stall torque of various motors. It turns out that for my size of lathe a 3 Nm motor will work fine – as long as you don't cut your threads in one pass!

Now, all of the electronic bits (other than the encoder, the motor and the display panel) will have to be fitted into some kind of enclosure. I found an electrical enclosure which was just the right size to fit on the end of my lathe bench - a useful place to put it – out of the way but accessible if needed. The computer board with its 'piggy-back' interface board, the stepper driver and the two power supplies are all mounted inside the enclosure. I also mounted a mains fuse and four multiway plugs to connect to the display, the encoder and the stepper motor (**photo 2**).

A word of warning here. The F2800 board has two sets of interface connectors. One of these is used for the interface board and the other is free. Make sure you get the right one and that it's the right way round.

Don't ask!

Thankfully, the system survived.

Now for the difficult bit. Where are we going to put the display, the rotary encoder and the stepper motor?

As I said earlier, my lathe is a Warco WM250V and, having seen many similar ones, I'm sure they all use the same head end castings.

There are two usefully sized 'holes' through the head casting, one just the right size for the encoder and the other (which seems to have been provided primarily to hide the lathe mounting bolts) is just the right size for a stepper motor. Mounting the encoder and stepper motor into these holes, we can then use toothed belts and pulleys for the drives.

I had also hoped to get rid of all the gears, but I couldn't find a way of attaching a toothed pulley to the spindle, so I settled for using a 1:1 gearing instead, mounting the pulley on the same stub as the gear at the end of the banjo (**photo 3**).

I made up a couple of plates from 4mm aluminium to mount the encoder and the stepper and bolted them to the casting and I mounted the display on the side of the lathe control box (**photo 4**). The stepper comes with very short leads and a pair of extension cables. You can see the connectors under the lathe motor in photo 6.

Now for the fun. Powering up and allowing the display to settle then turning the chuck to see speed indicated on the display. So far, so good. Turn on the lathe at a low speed. What a racket! I had hoped that getting rid of (most of) the gears would result in a quiet machine. With only one pair of gears in use it was just as noisy as a full train.

I tried to adjust the spacing of the gears, but it didn't really help. Okay, the system works just fine – but you need ear defenders. Time to find a Plan B. Was there another way to get rid of these gears?

Looking at the 40 tooth gear, it looked to me like it could be 5mm pitch. Now, somewhere, I've got a 5mm pitch belt. Yes, it is 5mm pitch – and of course, so is its mate. Now, if I separate those two gears and use them as toothed pulleys would it work? Yes, it does. Now, I know I'll have all the purists up in arms at my heresy, but that's how we make progress! So, I ended up with a double belt drive to my encoder – still 1:1 ratio - and it works perfectly (**photo 5**). And the silence! Well, not perfect silence but more than acceptable. Of course, there is the possibility that the belt might run off the gears as there are no cheeks. It might also be the case that I'll need a new belt in a couple of years. Let's just wait and see.

Okay, time for a real trial. Chuck a bit of mild steel, about ½ inch, and turn it down a bit using fine feed - 0.5mm / rev and cutting nicely with a 0.4mm cut. Try 0.25mm / rev. Quite a nice finish. Try 0.1mm / rev. Superb finish. I'm getting to like this already. And so quiet! Screw cutting? No problem. Imperial or metric, TPI or mm pitch, all at the press of a couple of little buttons. Magic.

As you might guess, I'm hooked, and I'm looking forward to much better finished turned parts in my projects. And I'll probably do a lot more screw cutting.

The one thing I haven't touched on yet is cost. The expensive bits are the hybrid stepper and controller (£86), the encoder (£25), the Launchpad computer (£46) and the bits from Clough (£73 inc. shipping and VAT – but that might have gone up a bit with the recent financial hiatus). Then there are all the sundries which will bring the total cost up to about £400.

If you are considering embarking on a project like this, you need to consider the work involved. If you aren't happy building up the electronics enclosure, then either get someone else who is competent to do it for you, or forget the whole thing. I'm assuming that as you are reading ME, then you are probably able to do the mechanical bits.

I found this a very rewarding project and once I'd got all the bits, it took around four weeks to complete. I am happy to answer questions by email, just don't all shout at once!

peter@steamrail.co.uk

ME

A Five-Inch Gauge
0-4-0 Padarn Railway Tender Locomotive PART 12

Luker builds a five inch gauge model of a Welsh slate quarry locomotive.

Continued from p.377
M.E.4725 September 8

It's always an interesting debate: when should a model be painted? As the builder gains experience and confidence in his builds, I find the painting moves earlier and earlier in the project. I personally like to paint in batches. When all the components are completed for testing on air, I make sure everything moves like it should, then I strip and paint. Only after painting do I reassemble, oil all the moving parts, and only then do the final testing on air. The next painting stage is the completed boiler with the cladding, etc. For my *Fire Queen*, because everything is mounted to the boiler, painting was left rather late in the build. But before I can tell you about painting the model, the lagging needs to be completed and a few minor clashes dealt with.

The wooden lagging

For the lagging on all my locomotives I've used genuine sleeper wood. I take a drive out to the second hand sleeper yard, servicing the gardening sector, and personally pick the best looking piece I can find. The proprietor has, on more than one occasion, gotten a little annoyed because I wanted to check every side of the sleeper in great detail, regardless of how deep in the pile it was. On one occasion the proprietor has said 'you're welcome to dig it out', which to his dismay, I promptly did! Generally, I walk away with a fantastic piece of wood at a much discounted price; I'm sure this has nothing to do with them trying to get rid of me!

Once the skin has been removed the wood is generally of outstanding quality, so much so, that it's actually a shame to paint over it. The older the wood, the better it is; especially when the wood comes from a bygone steam era that used oak or teak for the sleepers. If these sleepers were left standing for long enough they would have settled to a point where cutting them into thin strips won't cause undue warping. I bought a very cheap DIY table saw that required a few modifications to cut the denser wood but it has done the job rather well. Batches of thin pieces are cut in a morning with 4 x 10mm for the boiler lagging (**photo 119**) and 3 x 8mm for the cylinders (**photo 120**). These strips were glued to the boiler using RTV silicone and held in place overnight with cable ties. The cylinders, rockers, smokebox etc. all needed to be fitted, with the wooden slats assembled, piece by piece, around all the fittings until the boiler was completely lagged. No functional parts were bolted to the wood (or through the wood to the boiler), with the cylinders etc. all bolted directly to the boiler.

The area under the front frame was not lagged to give a little extra space for the eccentric straps and mechanical lubricator. The copper exhaust flanges also needed to be filed slightly to clear the lagging. These are all slight deviations from the large scale but are hardly noticeable on the final model.

When the silicone has cured the lagging can be sanded to

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The wooden lagging glued to the boiler and sanded for painting. The maintenance frame helped to orientate the boiler into convenient positions as needed.

The cylinder lagging fitted and sanded, ready for a little paint.

a smooth finish and painted using normal 2K automotive spray paint. I did not use any primer because I wanted the grain of the wood to show through the paint like the large scale locomotive. The thinner paint also penetrated into the wood, so I expect the paint to last reasonably well (**photo 121**).

The brass edging

The brass edging that hides the irregular wooden ends neatens the boiler assembly considerably, but they are a tricky thing to make. In the past I've rolled similar steel angles in my little ring roller with no difficulty, but brass is another animal entirely. The easiest way to make these angles is using a forging-annealing process. The edging was hammered with a soft (home-made lead) mallet around a suitably sized piece of pipe to get the general shape, then heated to red hot and dunked in water (annealed). As we all know, the circumference of a circle decreases as you move to the centre, but the plate just folded had a uniform length. Nature very quickly solved that indiscretion by making folds (**photo 122**). These folds were forged flat, against an unused wheel, until the shape fitted the boiler properly. I lost count of how many times I fitted, annealed and hammered the piece into submission but eventually persistence won and I think it turned out rather nicely.

To get the brass to bling I let it sit in my pickling solution for a couple of minutes to get rid of the worst oxide, then cleaned it with a pot scourer and finally polished it with brass metal polish. I didn't need to do any sanding; the mallet was very kind to the outside surface.

The boiler and wooden lagging painted. The brass edging hides the uneven wood ends rather nicely.

When forcing a strip round a former it buckles under the load, making folds. Further forging and annealing were required to fit the brass edging for the boiler.

The front splashers

The very early locomotives without splashers were probably meant for one of the back lines away from the public eye. Not *Fire Queen*; she had beautifully painted front and

View of the large-scale Fire Queen front splashers (photo courtesy E. Lander).

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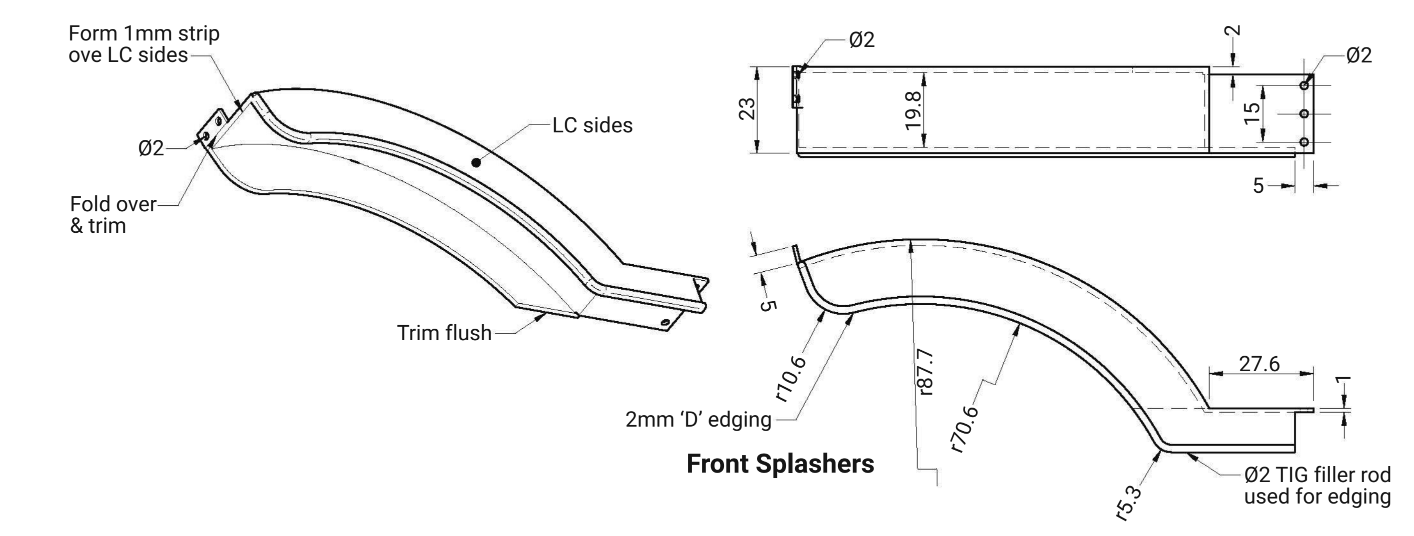
Fig 24



Front splashers.

rear splashers that are one of the first things you notice (that, and the exhausts). Both the rear and front splashers had half round edging at the bottom edge to further improve the look. The large scale was riveted with mostly countersunk rivets to give a nice clean finish (**photo 123**).

To match the large scale's sleek look, the front splashers were kept very simple and were made from laser cut plate with a 1mm mild steel strip formed over the sides and welded on the top. TIG filler rod was formed around the bottom edge and tacked on the inside using a thin TIG rod to finish the fabricated assembly (**photo 124**).

The back footplate and splasher assembly

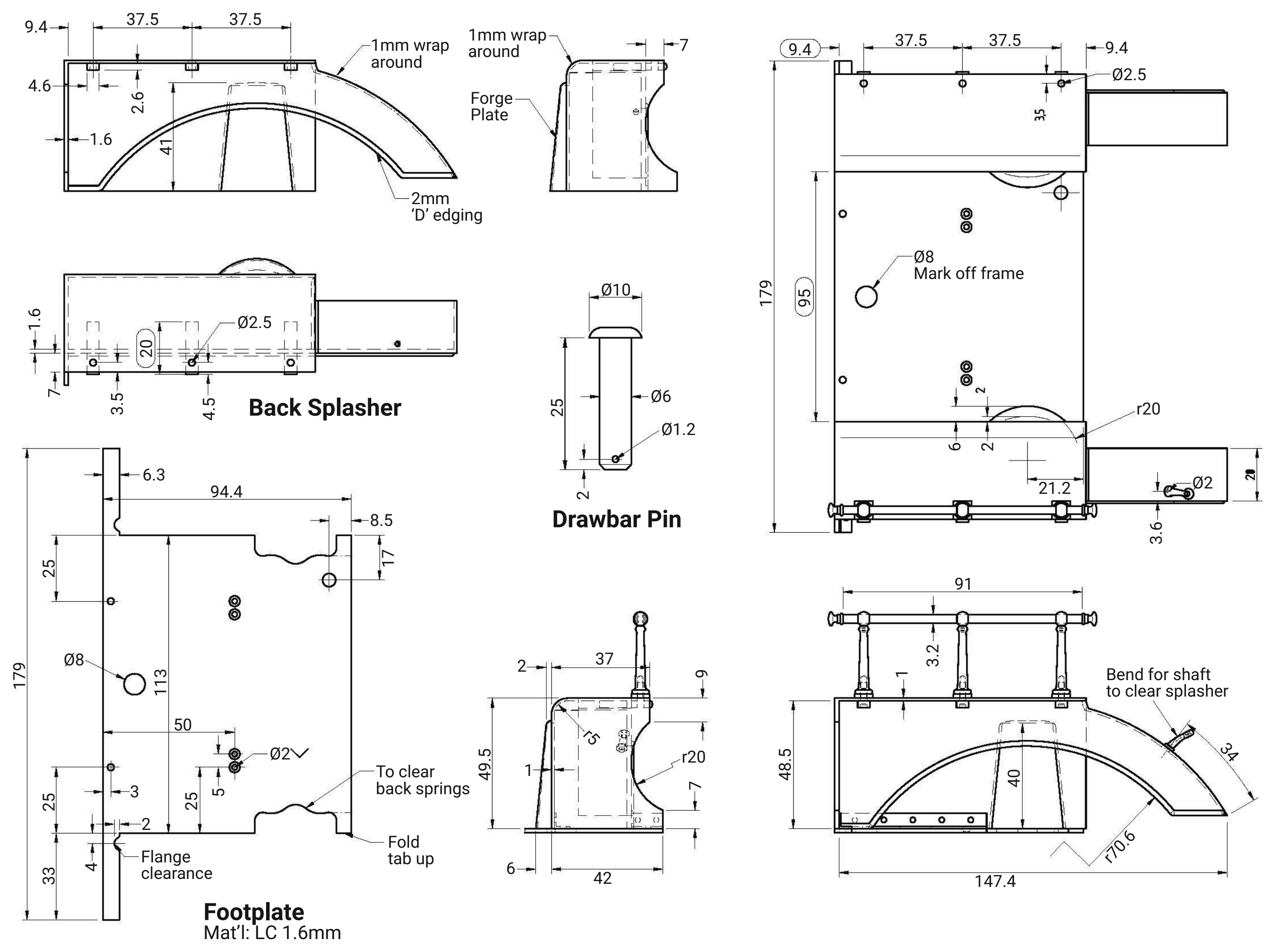
Most of the footplate platework for the model is laser cut with the splashers fabricated in a similar fashion to the front splashers (**photo 125**). One of the trickier things to do is the forged section that misses the back springs. This was done by grinding a recess into a scrap piece of steel and hammering a piece of plate, larger than required, into submission (**photo 126**). The bottom straight edge will, in all likelihood, pull in substantially

Front splashers fabricated assembly. Note how the plates extend past the edges to prevent the welds getting too hot at the end of the join.

The fabricated footplate and back splashers before beautification and painting.

Cold forging the back splasher on a metal former; the bottom edge has already been filed straight.

Fig 25



Back splashers and footplate.

so this needed to be trimmed straight, once the correct form has been forged. Using the die as a filing guide made this job much easier; so it's worthwhile to keep the forming cavity as close as possible to perpendicular to the bottom edge. When looking at some of the large scale pictures Mr. Lander sent me, it was clear as day these footplate inside splashers were forged, with the light in the photos catching the hammering marks almost uniformly in this region. Unfortunately, my forging looked pretty good and the paint filled all the minor hammer marks, once again deviating from the large scale inadvertently.

The whole assembly is held together with small angles

127

The splashers etc. all nicely painted with some of the detail fittings assembled.

>>

and screws with the heads rounded to look like rivets. Detail like the hand railing (polished brass), stanchions (polished steel) and the stiffeners (oil blackened) under the stanchions finish the assembly off beautifully.

Because I am somewhat limited by my budget, most of these welded assemblies come out a little rougher than they would if brass and soft solder were used. This is a compromise between cost, strength and available materials. On the other hand, a fabricated steel construction is much stronger than the normal brass construction methods typically used in model engineering. With a little automotive filler and automotive paint, the assembly can be cleaned up and made beautiful in no time (**photo 127**). The strength of the automotive range of finishing products is good enough for even the roughest handling and cleaning (and I would know!).

The front splashers completed, ready to be assembled.

Painting in general

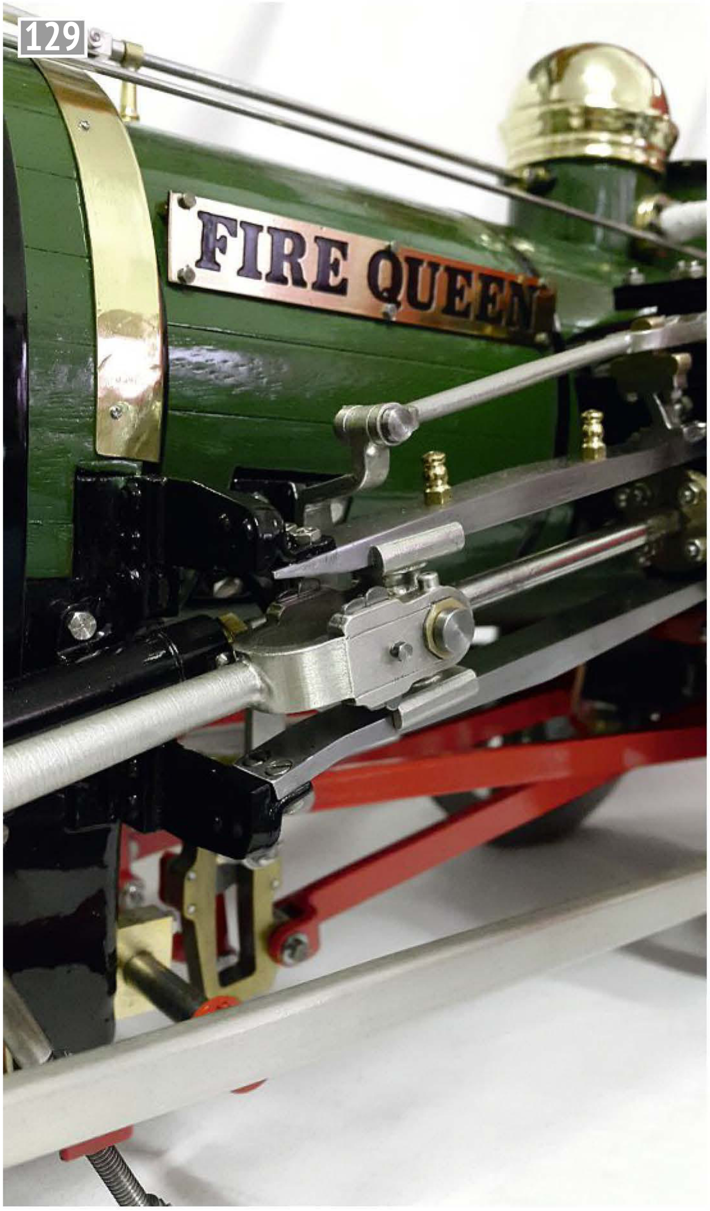
Back to the painting! This seems like an odd time to discuss painting the model, which is normally done at the close of a construction series. Most of the painting on my model was completed before finishing off the steam valves and the other bits and pieces at the top of the boiler, roughly at the current stage of the series.

The original *Fire Queen* was beautifully painted; the colours used matched the bold name. The large scale is currently painted as it would have been in 1905. Before restoration commenced, samples of the paint from under the boiler and other areas where light would not have caused colour degradation were analysed by the University of Wales (**ref 2**). The wooden lagging was given as green, the beams and splashers painted in Indian red (this was actually according to the hand sketches not the notes, but it matched the pictures better) with black trimming. The inside of the frames are all currently painted black, but there is evidence from the notes that this could have been dark brown. The colour of the lining and layout were not given but I followed the general lining as the large locomotive is currently displayed which I thought looked rather nice. There are much older pictures of *Fire Queen*, before restoration, that showed the lining as it was when she started her long slumber, but alas, I don't have copyright permission to add them to the series.

To get that nice crisp line between the black trimming and Indian red for the splashers, automotive lining tape was used with normal 2K paint to finish off the beautification (**photo 128**). The black and red contrasted the green-painted lagged boiler beautifully!

One aspect of this build that goes unchallenged, in my humble view, is the beauty of the contrasting paint colours to the polished brass and unpainted valve gear (**photo 129**).

●To be continued.



The beautiful contrast between the painted items and the steel and brass polished components.

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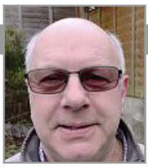
IMLEC 2023 PART 3



Rob Speare reports on this year's IMLEC held at Bristol on 7th – 9th July.

Continued from p.381
M.E.4725 September 8

Competition Day 3 – Sunday

After the disruption of Saturday, many what-if scenarios were played out preparing for Sunday's packed agenda. By 7:45 there was a long queue forming outside Ashton Court Gate, as we waited for the park gates to be unlocked. We decided to stick closely to the original sequence as that made sense although, with extra runs to fit in, it was going to be a longer day for all.

With a slight improvement in the forecast, there was some optimism this might be a drier day and our volunteers were ready to put in their best for the hours ahead of them. Although the dynamometer car now had a new load cell unit fitted, the opportunity was taken to check the calibration before using it in earnest.

Run 22 (photo 21)

The first runner was Marcus Peel from Southport MEC, whose run had been postponed on the previous afternoon. Quite a few members from his home club were on hand as he prepared his 5-inch gauge LMS Mogul, a purchase from a few years back. This appears to be a scaled up 'Princess Marina' design and certainly has quite nice detailing, this being its first appearance at an IMLEC. Given the fine start to the day, Marcus opted to take ten passengers - perhaps ambitious but he enjoyed a good clean start. He put in steady, undramatic circuits for the most part but on lap 9 the locomotive suffered slippage on the incline entering the tunnel, so Marcus set back to take a run. And again, he made it into the tunnel but stopped before the summit. Now past 30 minutes into his run, in discussion with his observer it was felt his best option was to drop all his passengers. They were asked to disembark and exit to the rear of the train and, when clear, he was able to restart, making a mad dash to the finish, with a total run time of 32:32 minutes. Not a blistering run but Marcus must have controlled his run well, as he had a recorded use of 1.065 lb of coal for the nine laps achieved and a stoppage time of 4:05. Apart from the unfortunate distraction at the end, this had been a confident run, which showed he was comfortable with the locomotive.

Marcus Peel and 5 inch LMS Stanier Mogul 2-8-0 13245.

John Williams and 5 inch LNER 01 2-8-0 3473.

Run 23 (photo 22)

Originally due to be the first Sunday runner, another member of Southport MEC was John Williams, entering his 5-inch gauge LNER/ GNR O1 2-8-0 *Nigel Gresley*. Although cloudy, the track was dry and John chose to take eight passengers plus himself and observer, setting off for a good steady run. While the approach to the tunnel proved quite a challenge for many competitors, John tackled the gradient in a very consistent manner as he battled with the balance of speed and coal consumption, using the potential of the O1's large boiler to get his train over the summit then to speed up after exiting the tunnel. With no recorded stop time, many of his passengers were impressed with the consistency of the run, completing nine circuits in a time of 29:26 with all passengers, consuming a reasonable 1.695 lb of coal. It was obvious that John had carefully planned his method of working - he was calm in his approach and deserves to be pleased with his performance.

Josh Homes and 5 inch S&D 7F 2-8-0 53809.

David Mayall and 5 inch GWR 1500 Class 0-6-0PT 1506.

Simon Hudson and 5 inch Midland Compound 4-4-0 1004.

Run 21 (photo 23)

Josh Holmes from Swansea SME was our next competitor, delayed from Saturday. This was Josh's first time entering IMLEC and the weather was looking stable as he prepared his very smart SDJR 7F. The locomotive was completed to the Ivo Peters design by builder Paul Tomkins and Josh has owned the locomotive since last year. Steam was raised without problems and Josh started his run with twelve passengers, setting off well but on his second lap he came to a halt on the climb to the tunnel. After setting back and attempting to regain pressure, after some four minutes of trying he decided to retire as the fire was black.

Josh was understandably disappointed with the outcome, believing it was due to poor firing. He had followed advice to stay on charcoal until the last minute and thought maybe he should have switched to coal much earlier. However, Josh has since discovered the silver solder on the superheater had given up and an open seam was passing steam into the firebox, killing the fire; so not bad firing after all.

Run 20 reviewed

With the previous afternoon unravelling so quickly, we had to tell David Kerry that we had no results for his run - easier said than done as he was spotted riding as a passenger as we were trying to find him. Tracking him down and explaining our dilemma, David was offered the chance of a re-run later in the day, which he accepted. However, a few hours later he approached one of our observers with a change of mind. David said that despite the circumstances, he had enjoyed his run, and was pleased with it, and it had been a good family day. He was concerned that if he went again, he might mess up the run and regret it so was happy to forego the opportunity of a re-run which, considering the context, we thought was very gracious of David.

Run 24 (photo 24)

Next, the 1501 class or 'Speedy' as built and entered by David Mayall of Bracknell RS, this pairing having competed in IMLEC on many occasions, getting as high as second place at Southport in 2017, and again at Maidstone in 2021 - so would 2023 be a year to win? Well, in cloudy conditions, David set off with a load of eight passengers, using an iron ore tippler wagon to carry his coal and injector water supply. A good start and he bowled along the back straight at about 9.5 mph and up through the tunnel, with a similar turn of speed as he came past the steaming bays. But passing the traverser, as David attempted to open the regulator wide for the climb, the locomotive suddenly locked up and pushed by the momentum of the train, slid to a halt some 75 feet later. No. 1506 had to be manhandled back to the steaming bays where David could isolate the problem. He found the left side crosshead had picked up on the slide bar and a small roll of metal was jamming any movement, which sadly terminated David's run. By partial dismantling he was able to wheel the locomotive back into his car and, after cleaning up at home, the locomotive is now running without issue. Although the coal consumed is recorded as 0.520 lb, that value is a bit meaningless in the context of less than a lap completed.

Run 25 (photo 25)

Another newcomer to IMLEC was Simon Hudson, representing Brighouse & Halifax MES, running a close scale model of c.1907 Midland Railway No. 4004, a true 4-4-0 compound in 5-inch gauge, currently owned by Nigel Dickinson. Simon elected to take just four passengers, as he set out in dry but cloudy conditions. The first few laps seemed a struggle and he failed to make the climb to the station and set back a fair way. After a call-out for pliers, which allowed Simon to open his stuck blower valve, the pressure picked up as the stop time wound up to 6:06 minutes. However, from then on, the compound roared away to give a lively performance, the large seven-inch driving wheels giving this locomotive the opportunity to stretch its legs, picking up a speeding mark for 11 mph on lap three. Now sorted, Simon seemed to relish his run, putting in six fast unimpeded laps before finishing at 30:20 duration, completing eight laps with all passengers, using 1.81 lb of coal. If he hadn't suffered

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John Cottam and 5 inch Merchant Navy21C6 4-6-2.

Jo Flippance and 5 inch BR proposed freight 2-8-2 George Eveniss*.*

Paul Hutfield and 5 inch S&DJR 7F 0-8-0 53807.

Glyn Winsall and 5 inch BR ex SR U Class Mogul 2-6-0 31635.

problems early on, perhaps Simon's run may have had podium potential.

Run 26 (photo 26)

Another IMLEC regular and previous winner was John Cottam from Chesterfield DMES. This year he brought his rare 5-inch gauge model of an original Merchant Navy class locomotive 21C6, in experimental blue livery. This locomotive is to John's own design, nearly 20 years old, and it also competed in the 2009 event at Bristol. This locomotive has a fairly large boiler and wide firebox, and was one of the few locomotives present to use a rosebud grate, a modification John has made and been pleased with. The run from the steaming bay showed no slipping, displaying good driving skills and commenced in dry conditions, with twelve passengers. The first lap went well, the locomotive looking very smart on the front of the train. On the second lap the locomotive slowed to a halt on the climb to the station, with a loss of pressure. He coaxed it forward to the station and stopped to raise steam but, after nearly full stoppage time, John retired the run a few feet short of a full second lap. The problem was a modified and lengthened bypass handle John had made just prior to the event, to make it easier to operate. Unfortunately, its length meant the handle hit the cab side so John was unable to open it fully, resulting in the boiler over-filling with cold water. A huge disappointment for John although, as he told the observer, there was no-one to blame but himself.

Run 27 (photo 27)

Although the sky was still relatively blue, there were strong gusts of wind swaying the trees at the start of Jo Flippance's run, representing Worthing DSME. Jo last entered IMLEC in 2019 at Leyland, finishing in 2nd place with a blistering run on her Dad's 'BR Proposed' 2-8-2 *George Eveniss*. She was back with the same locomotive, although she had little opportunity to get much practice with this substantially built machine. However, with a steaming bay pep talk from Dad, Jo was not afraid to work the locomotive hard. With the highest starting load of the event, twenty passengers across five trolleys, Jo made a decent start and it was good to see a long train powering around the circuit, although suffering slipping on the rise to the station. However, a few laps in, she struggled to get up the bank to the tunnel and reversed back, dropped three passengers, then had a run at it, five minutes later dropping a few more, which made running easier. Nevertheless, with a heavy load in tow, Jo found she still needed to get a good run at the ascent to the tunnel and on laps five and six she picked up a couple of speeding marks at the approach to the climb. Despite the stops, Jo completed her run in 30:45 minutes, covering seven complete laps, with under a minute of stop time. But pulling such a load at a lick, with added slipping, consumed 2.290 lb of coal which, while probably placing her in the top third, did not match her 2019 outing.

Run 28 (photo 28)

Now in sunshine, but with wind still gusting strongly, Paul Hutfield, a member of the Scale Steam Society, entered another S&DJR 7F. This one was built in the early 1990s by David Sutcliffe who won IMLEC 1992 with it, although now owned by Nigel Dickenson. Drawing a fair amount of attention while raising steam, and departing some 95 minutes later than the original schedule, this was a nice steady run, a sensible

Steve Eaton and 5 inch LNER A3 4-6-2 2500 Windsor Lad.

Ben Pavier and 5 inch LNER Q5 0-8-0 1032.

Lionel Flippance and 5 inch BR proposed heavy freight 2-8-2.

Billy Stock and 5 inch freelance narrow gauge tank engine 0-4-2T.

workout for this fine locomotive without racing. However, Paul did drop off three passengers over several laps and stopped briefly to regain pressure but only racked up 3:06 minutes of stop time. With a duration of 32:46, the locomotive completed eight laps using a fair amount of coal at 1.985 lb, but it can still be regarded as a good solid run.

Our final five drivers were all competent former winners, so what sort of runs would they put in?

Run 29 (photo 29)

With his beautiful SR 'U' class mogul, Glyn Winsall from Rugby MES, in tandem with his son George, was keeping the family tradition of having a 'Winsall' in every IMLEC since it started, Glyn's Dad Fred also winning at Bristol in 1974.

The start of Glyn's run was nearly two hours behind schedule and the sunny/cloudy weather seeming to be holding but, noting the disruption of the weather on previous runs, he set off with a modest four passengers. With no particular drama the locomotive took the journey in its stride, just touching the 10 mph limit at the end of the long straight, with no slipping or stop time across 30:09 minutes. The observer noted this was a brilliantly consistent run of fourteen laps completed, with a tidy use of 1.385 lb of coal.

Run 30 (photo 30)

Among those bagging a sunny run on this afternoon was Steve Eaton from Chesterfield DMES. His locomotive, an LNER A3, was built by his father who previously entered it in IMLEC at Bristol in 1984. However, due to ill health, it was sold around 1987 and spent 35 years unused in a private collection. It was only fairly recently that Steve had the opportunity to be reunited with his Dad's magnificent locomotive, so was pleased to bring it back to Bristol. Steve set off with an ambitious load of sixteen passengers for an 'eventful' first lap - the climb to the station defeated the locomotive, which slipped to a halt within yards of the summit. In total he set back four times, once as far back as the workshop! After the 1st attempt four passengers off, after a 3rd go a further two got off. Finally, after four attempts, the summit was beaten to the cheers of all. With the load now more suited to the prevailing conditions, Steve then put in a further six blistering laps, not even stopping when told the leading bogie had the two rear wheels off! Despite his considerable experience, perhaps Steve set out with too much load but, to quote him - "Never give up" - and certainly he did complete, with an overall time of 31:25 minutes. Sadly, all that early slipping and re-running at gradients pushed his coal consumption up to a high 2.465 lb usage.

Run 31 (photo 31)

Our last competitor from Southport MES was Ben Pavier with his 5-inch gauge LNER Worsdsell designed Q5 No. 1032, making its fifth appearance at an IMLEC. The impeccably turned out 0-8-0 constructed by Ben is based on LBSC's 'Netta' but with many enhancements. The observer noted that on leaving the preparation area, the Q5 had a thick fire of charcoal with a sprinkling of coal on top and, in dry conditions with broken sunshine, Ben chose to take eight passengers spread across three passenger cars, well within the capability of this powerful locomotive. Showing experience in the competition and understanding the characteristics of his iron-steed, Ben's run was controlled and fast-paced, knowing when to put the power on, the Q5 handling the demands. This was a flawless run of eleven laps, returning with a full contingent

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Run	Driver	Home Club	Gauge	Locomotive	Load at Start	Load at Finish	Run Time (m:s)	Laps	Coal Used (lb)	Notes
1	Entry Withdrawn	Cheltenham SME	5 in	LBSC 'Maid of Kent'						Entry Withdrawn
2	Roger Hopkins	Nottingham SMEE	3.5 in	Derby 4F - No. 44019	4	4	31:30	11	0.815	Good run
3	Nick Feast	Bournemouth & Dist SME	3.5 in	Ex Southern Q1 No. 33006	4	0	35+	8	1.19	Failed - out of steam
4	David Shepheard	Bracknell Railway Soc	5 in	Polly 3	2	0	30+	4	1.32	Failed - injector issue
5	Paul Davies	Stroud MES	5 in	Ajax - 'Batty Thomas'			0	0	n/a	Failed - blocked blower
6	Peter Wardropper	SMEE	3.5 in	LBSC Betty 'River Darenth'	4	4	27:48	12	1.405	A spirited run
7	Andy Healey	Gravesend MM&ES	5 in	BR Britannia class - 'Apollo'	6	6	31:55	14	2.45	Good run
8	Alan Heywood	Urmston & District MES	5 in	Hunslet NG large quarry class 'Tilly'	12	0	34:50	10	3.455	Good run
9	Andy Pope	Southport MEC	3.5 in	Southern S15 No. 835	0	0	6:30	0	0.57	Failed - Pressure Loss
10	Danny Hayward	Southport MEC	5 in	LBSC 'Maid of Kent', SR No. 1753	4	3	35+	10	2.315	Failed - seized boxes
11	Roger Holland	Chesterfield & DMES	5 in	Union Pacific Switcher	9	6	34:06	3	3.13	Failed - ran out of steam
12	George Winsall	Rugby MES	3.5 in	W.H.R. NG 'Russell'	12	12	32:32	11	2.35	Good run
13	Alex Linkins	Romney Marsh MES	5 in	LMS Black 5 No. 45440	9	9	30:53	14	2.275	Good fast run
14	Tom Parham	Maidstone MES	5 in	LNER A1 'Tornado'	16	16	32:00	13	2	Very good run
15	Luke Bridges	Maidstone MES	5 in	Polly Trojan P.L.A. No. 53	2	2	11:00	2	1.98	Retired
16	Chris Dore	Fareham & Dist SME	5 in	LNER B1 'Nyala'	8	8	31:28	12	2.17	Went well
17	Linda Gearing	Andover District MES	5 in	Freelance Metre-Maid - 'Eric'	3	0	28:00	5	1.125	Retired, despite a spirited attempt
18	Graham Hickie	Newton Abbot & DMES	5 in	Super Simplex	6	0	30:00	7	1.685	Lots of slipping, but a valliant first IMLEC.
19	Alan Crossfield	Leyland SME	5 in	Ex. LMS Patriot 'Royal Army Ordnance Corps'	6	0	32:20	8	1.495	A very wet run beset with slipping
20	David Kerry	Chesterfield & DMES	5 in	BR 9F No. 92220 'Evening Star'	12	12	30:32	6	2.94	Overall a good run by David.
21	Josh Holmes	Swansea SME	5 in	Ex S&D 7F No. 53809	12	0	10:05	1.5	0.995	Retired - lost the fire
22	Marcus Peel	Southport MEC	5 in	LMS Stanier Mogul No. 13245	10	0	32:32	9	1.065	Sunday starter
23	John Williams	Southport MEC	5 in	Nigel Gresley, LNER 01 No. 3473	8	8	29:26	9	1.695	A steady run
24	David Mayall	Bracknell Railway Soc	5 in	GWR 1500 class No. 1506	8	8	03:00	0.8	0.52	Retired - piston rod seized
25	Simon Hudson	Brighouse & Halifax MES	5 in	Midland Compound No. 1004	4	4	30:20	8	1.81	Completed ok
26	John Cottam	Chesterfield & DMES	5 in	S.R. Merchant Navy 21C6 'P.&O.S.N.Co.'	12	12	25:04	1	1.035	Retired - overfilled boiler
27	Jo Flippance	Worthing & District SME	5 in	BR Proposed Freight 'George Eveniss'	20	14	30:45	7	2.29	Good run
28	Paul Hutfield	Scale Steam Society	5 in	Ex S&DJR 7F No. 53807	7	4	32:45	8	1.985	Fair run
29	Glyn Winsall	Rugby MES	5 in	BR Ex SR U class mogul No. 31635	4	4	30:09	14	1.385	Consistent run
30	Steve Eaton	Chesterfield & DMES	5 in	LNER A3 No. 2500 'Windsor Lad'	16	9	31:25	5	2.465	Lots of slipping, big load
31	Ben Pavier	Southport MEC	5 in	LNER Q5 No. 1032	8	8	28:30	11	1.4	Good run
32	Lionel Flippance	Worthing & District SME	5 in	BR Proposed Heavy Freight No. 91001	11	11	31:08	12	1.485	Well managed run
33	Billy Stock	Urmston & District MES	5 in	Freelance NG Tank Engine 'Lampwick'	6	0	25:00	9	1.97	Very wet

Colour coding :	Green =	A new entrant to the IMLEC competition
	Pink =	Driver is a previous IMLEC winner
	Yellow =	Highlight = 'Entry Withdrawn', or 'Did not start'
	Blue =	Highlight = 'Retired', 'Failed', or 'Disqualified'
	In Gauge column	Speed warnings issued : 1 = Pink box 2 = Brown box

of passengers, the Q5 making economic use of 1.400 lb of his coal supply, when finishing with 28:30 on the clock. The observer commented it was a remarkable achievement.

By now the clock had gone way past our expected finishing time but we still had runs to complete.

Run 32 (photo 32)

The penultimate run was by Lionel Flippance from Worthing DSME. Driving the most recently completed of his two 'B.R. proposed 2-8-2' locomotives, No. 91001, with which he won the 2018 IMLEC at Birmingham, he was also competing against his daughter

Jo, driving his other 2-8-2. It was overcast as Lionel was raising steam but we had been watching some heavy storm clouds pass nearby, when there was a distant rumble of thunder. Setting off with eleven passengers including Jo, most seemed to be prepared for some rain - and it started! There was a really heavy rain shower, the type that drenches, and our poor observer copped it too while stoically doing his job; it was so unfortunate that late running took us into this wet period.

Nevertheless, this did not phase Lionel and, while the locomotive was definitely slipping as he really worked it hard on the ascents, it performed brilliantly throughout. The rain stopped, and although eligible to complete at 25 minutes, he elected to put in another lap, then another, bringing his full complement of passengers back after 31:08 minutes, achieving a very respectable twelve laps, nibbling at 1.485 lb of coal, showing his considerable ability at the controls.

Run 33 (photo 33)

Last was Billy Stock from Urmston DMES; as last year's defending champion, he took the final run slot but, having won twice in succession with his Britannia, had to enter an alternate locomotive. So, he brought along something quite different, a freelance narrow gauge 0-4-2 tank engine *Lampwick* of the former Donegal & Killybegs Railway. Fitted with Hackworth valve gear, Billy bought this locomotive in 2018 and it has since been fully rebuilt.

The rain was coming down heavily as Billy was raising steam and the run started just as wet, and it would be fair to say that his six passengers got a thorough soaking as they lapped the track. The sun re-appeared and, nearing the end of his run, Billy pulled into the station and stopped and indicated to drop his passengers. As he had not crossed the finish line, we thought the run might be over but no - this was the strategy of a champion deciding not to use a second bag of coal. So, after waiting a couple of minutes, and checking the time on the run clock, he steamed forward the few paces to cross the finish line using the remainder of his fire. And so, completing nine laps in just over 25 minutes using 1.97 lb of coal, Billy finished to applause at the station and the day's runs were complete.

Ending the day, the sun greeted those that had stayed through the rather eventful weekend. With 32 locomotives attending, we can surely say there were some thrilling runs but where one third of our competitors had sadly retired through one reason or another.

The event was well supported by spectators, although some had to make a quick dash to the marquee during the numerous summer showers (**photo 34**). They certainly had a longer day than anticipated with extra runs to include and we finished well past the published finish time.

Our food tent had been well received by both visitors and our own volunteers, and several members dedicated themselves to the preparation and selling of hot food, cake, flapjacks and ice-cream. They had sold out by mid-afternoon and all the proceeds - which even on very small margins amounted to a worthy sum of over £600 - went to a local Scouts group.

We were happy to be joined for the competition by Martin Evans representing *Model Engineer* who was also there for the awards presentation. On the facing page is a table showing the competitors across the weekend.

I can hear the obvious question – where are the efficiency values? Well, there was a prize giving ceremony and the recipients received the awards, as befits such an occasion.

However, with time to reflect on things, there was concern over the robustness of some of the calculated figures. Certainly, the total loss of David Kerry's

34

Heavy sky and a rainbow during the last run.

results on Saturday highlighted a major issue and we had to accept there may be problems with other results of the listed Saturday competitors. In addition, we had glitches with our tablets not fully recording every data stream. So, in fairness to all, and in wishing to maintain the integrity of IMLEC, the BSMEE IMLEC team took the difficult decision to void all the results. This is not a reflection of the capable drives of the winners declared on the day but an acceptance that, without the technical issues, the podium may have looked a little different. Yes, it's a shame, and embarrassing, but we hope it may be seen in the wider context.

Indeed, whilst we have chosen not to publish any results, that does not take away from the fact this was a great event. For possibly 80% of those that came along, the results were not the most important thing anyway. It was a chance to meet people with a similar passion, a chance to visit a different Society, and watch some magnificent locomotives and drivers in action. As a Society it also brought together many members, volunteers who don't normally get to do that sort of thing, and they really enjoyed it, while meeting and greeting our many visitors.

Since taking the decision to void the results, we have had contact from quite a number of competitors, all saying that they agree it was a difficult decision but that it did not spoil their enjoyment of the weekend, while hoping we are not put off holding it again.

It is difficult when organising an event for the first time in 14 years to get it spot on, when perhaps barely three people were in roles they had previously undertaken.

Will we do it again? I hope so. Despite the stresses of the weekend, it was great fun, enjoyed by most, and IMLEC remains a wonderful and unique social occasion, as well a chance to see many fine locomotives working hard. But clearly, we would look to iron out all the problems encountered.

For those that couldn't go, or who may wish to see the runs again, and probably from more angles, a video of the event is being produced by Chris Eden-Green on either DVD or a Digital Download, available at https://www.e-gmedia.co.uk/shop

Praise goes to our own volunteers, who dedicated themselves in little and big ways to make this event a success. We also thank the support from a great group of sponsors that helped us to stage the event.

And our thanks go to Martin Evans and *Model Engineer* magazine, for attending and sponsoring the prizes, although BSMEE was happy to return them as befitting the outcome.

Photographs courtesy of Rob Speare, Bernard North and Richard Pearson.

ME

CLUB NEWS

Geoff Theasby reports on the latest news from the clubs.

Another nugget of dross amongst the gold; here I am again, with more tales of my travels in the Far North, unusual vehicles and interesting engineering.

In this issue: hello, sailors!, the possible end of a club, a cuckoo clock - or should I say a Phoenix clock, a screw loose, a river clean, no trains, a centenary bucket list, knobbly knees, skip diving, slot cars under a bushel and a frightening ignorance of tool knowledge.

The Daily Telegraph Magazine of 29 July carries a great item about those who build model boats. As we in the model making fraternity/sorority understand and practise, the essence is in the detail. One of them is quoted as not owning a television; 'sitting in an armchair looking at a box bores me to tears.' Another says, 'there's always someone who knows something about everything that you don't know. A fellow member began with model aeroplanes which became too expensive to crash.' The subject is reported seriously, not making fun of the enthusiasts. How pleasant it is to see this subject discussed in the mainstream press.

Lionsheart, summer, from the **Old Locomotive Committee** begins with a message from the editor, Adrian Banks. With the death of chairman, John Brandrick, who was the driving force behind the society, allied to the secretary and treasurer both resigning, having done their jobs for a very long time and Adrian himself being an octogenarian, it is time for new blood to step up. Without them the end may come by the end of this year, or certainly by the AGM in May. Adrian writes John's comprehensive obituary. Treasurer, Jan Forde has written a brief history of the society and appended a constitution. As a photograph in the piece includes sight of the New Brighton tower, a short item on this edifice is included. Finally, as well as the Hornby model of Lion, Rapido is to release one as well.

W. www.lionlocomotive.org.uk

I begin with the three-wheel electric trike spotted in Honningswagen, a *Monster* electric trike with full bodywork (**photo 1**) and the Norwegian Navy, KNN W310 *Jan Mayen* (**photo 2**). Also spotted in Sheffield, a Ford GT40 Mustang Cobra.

The **Model and Experimental Engineers Auckland,** Newsletter, reveals that Ray Brown is building a model steam ploughing engine. The very same model as that featured on a cover of *Model Engineer*, but he does not state the issue number. The boiler is 1/4 inch steel and pressed to 250psi, passing the steam test with flying colours. Chris Ratcliffe showed a microscope condenser lens from the late 19th Century. Made from brass, it shows the fine engineering of the time. Some time after a broken cuckoo clock case was given to Michael Cryns he acquired an unhoused movement. He managed to marry the two and, using a cuckoo from a box of scrap, incorporated it. When the clock strikes, the cuckoo emerges, opens its beak and spreads its wings. The movement probably dates from the 1880s. A rather complex tale of obtaining and selecting the correct screws to assemble parts for a winding engine hinged upon (I think) 8BA with a 9BA head, but the supplied spanners were 1/8 inch AF. To keep things ticking over until the correct tools arrive, a borrowed 3.2mm driver is being used. Just in case beginners read this piece, a 9BA screw head is 3.33mm across, a 1/8 inch AF (across flats) spanner is 3.175mm and a 3.2mm nut driver is available.

1

Econero, Honningswag.

2

RNN W310, Jan Mayen.

So, 1/8 inch AF compared to 9BA is 0.158mm different. When you are trying to make a fine model, this is a huge (5%) difference.

On Track, August, from **Richmond Hill Live Steamers**, does not have much to say, however the Newsletter is dated 1/8/2023, which was **Yorkshire Day -** bring out the Henderson's Relish!

Shoulder to Shoulder, June, from **UKMSA**, reports a great ShedFest at which the Forest of Dean Community Shed won the best turned item, a snooker cue and darts. Sherwood (Tunbridge Wells) MES had some finely carved deer heads made with, wait for it, a bandsaw! Wow! MSC (Mens Sheds Cymru) have formally joined the UKMSA; the previous arrangement was loosely supported officially, but now their position is regularised. UKMSA is offering 12 months free membership to anyone who has not been a member for three years or more. Rostrevor MS (Near Warrenpoint, NI) annually organises a 'River Clean' to clear up a half mile stretch of the village's river, removing an amount of junk discarded at dark of night, one presumes. However, every year the amount collected reduces and it is not wrong to assume that the clean river is being noticed by would be felons who seemingly dispose of their ill-gotten gains elsewhere.
W. www.ukmensheds.co.uk

Ryedale Society of Model Engineers July, points out that to a recent public running event only five members turned up, which is not enough for safety, meaning no trains would run. Some visitors complained, having intended to ride. But, we are all volunteers! The railway needs the income from public running, without which membership fees would have to rise substantially. On the positive side, letters of thanks were received from Keighley Model Engineering Society and Bradford Model Engineering Society for the friendly welcome on the (separate) occasions of their visits.
W. www.rsme.org.uk


3

'I see a lighthouse and I want to paint it black' (with apologies to Mick Jagger).

Southampton Society of Model Engineers, sends two *Newsletters*. The May-June and the July-August. The first covers Joyce Ward's year of achievements, for her 100th birthday! These included a ride in a fast car, a chocolate factory visit, a visit to a castle, a steam train ride and a forest visit. The second newsletter brings us up to date. Ryan Norton has built a Tich and documented it for the benefit of other new modellers. Living in South Africa he found materials procurement rather harder than we in UK normally do. LSWR T3 563 has been restored at Swanage and runs again after 75 years.
W. www.southamptonsme.org

Our cruise took us past many small islands, especially around Lofoten - far more than I was expecting. Many had a small lighthouse on them … and leading me into a Rolling Stones song, *I see a lighthouse and I want to paint it black…* (**photo 3**).

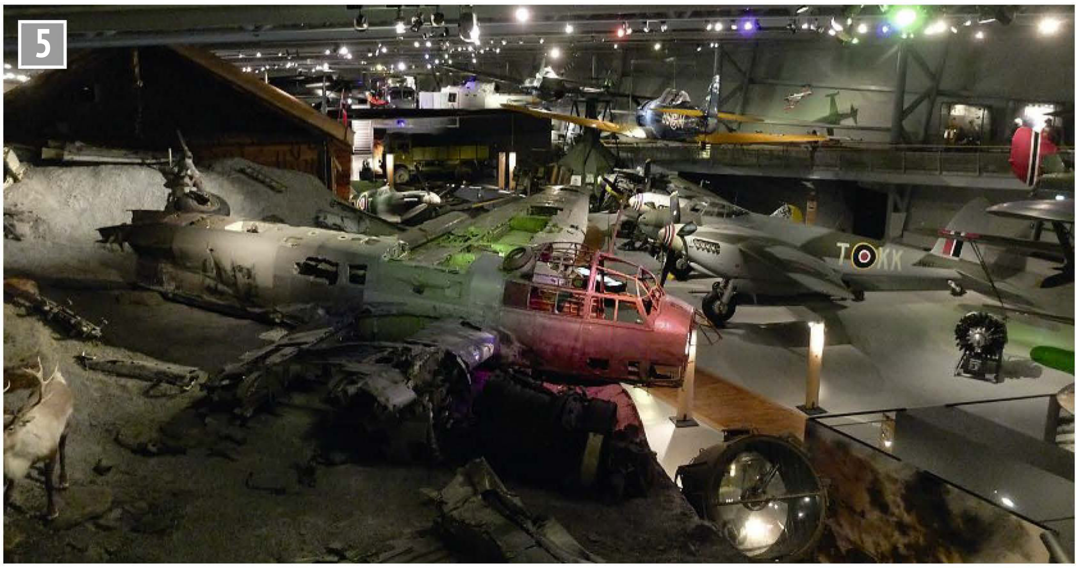
Visiting the glacier, this Turkish-built Guleryuz coach - of whom I had not heard, but investigation reveals that the company began in 1967 - has a capacity of 600 vehicles per year (**photo 4**).

The Frimley Flier, July, from **Frimley & Ascot Locomotive Club** begins with John Comrey, who concludes his explanation of *All you need to know about electric locomotives and their controls*. Peter Gardner offers a picture of three pairs of knobbly knees and invites readers to guess their identity. Richard Clark has built the railways of Holmfirth in N-Gauge. The real village near Halifax is where *Last of The Summer Wine* was filmed and on the moors is Holme Moss radio transmitter.
W. www.flmr.org

Raising Steam from the **Steam Apprentice Club** of the **National Traction Engine Trust** begins with a full frontal of Burrell 2072, *The Masterpiece*, of 1898. Eliot Jones wrote on the Horsham driving day and thought it 'brilliant!' The SAC at Bath & West Show was reported and the queue for a chance to drive even including those who had never seen a traction engine before. This event was notable as it featured the parade commentator riding on an engine which was taking part in that very parade. A boiler carriage was restored by a group who sawed oak beams 9 inches square, by steam power, using a Marshall portable engine which was burning the waste from the saw. Very Green! 'Victoria's Torton Tales' covers the work done over the winter and notes that Wendy has a new toy, a 6 inch scale

4

Turkish built coach in Norway.



Crashed Ju88 at Bodo Luftfartsmuseum.

Foden C type wagon. A birthday present! The mystery picture is of something completely *Diff-erent*, which rarely sees the light of day.

The Prospectus, August, from **Reading Society of Model Engineers** opens with chairman, John Billard confirming a successful series of public runnings, boosting the finances, and a new subscription system has resulted in a number of new members. Alec Bray writes three pages on a potted history of *Lion*. Terry Wood describes a 7¼ inch gauge loading trolley, using an old wheelchair found when 'skip diving'. The engine is laid in front of the vehicle in question, which rolls on and is then lifted to the right height. Being wheelchair based, it is already fitted with brakes. Mike Manners comments on the lepidoptera around the site. Some species have declined but this one has increased. Mike took some good photographs of a few of them. Much interest in the wildlife, wouldn't you say, Imelda? (Thereby neatly bridging the gap 'twixt the fluttering beasties and the heavy metals we use for our hobby - Geoff.)

A feature of the Norwegian State Air Museum at Bodo is this imaginative tableau/diorama of a crashed Ju88. In the UK, this aircrash would have been noticed and transported back to a similar place, or stripped of souvenirs. In sparsely populated Norway, it wasn't found until 1996 (?) (**photo 5**).

Photograph 6 shows Deb's grand-family taking the high road (the raised track) at Abbeydale Miniature Railway on 6th August. The day was very busy, in support of Sheffield Childrens' Hosital and raised £3,300 for the charity.

The News from **North London Society of Model Engineers** contains thanks for my 'eerier' (sic) comment on this missive. I hadn't thought of the matter in such terms. Hmmm, Elvira, steampunk, goths and when is the next steampunk event at the South Yorkshire Transport museum? Chairman Les has an interesting point about public running and the publicity generated by comments on Facebook. He rather thinks that it may eventually be looked on as a business venture, not a club of hobbyists and asks, could it become a rod for their own backs? A local event was held in support of Keech Hospice referencing children and parents who have undisturbed access to the track, free from the pressures of an open event. This year the heavy rain arrived and departed almost exactly coinciding with the opening hours. A train was out in the downpour and took to the tunnel as a respite. Eventually, their desire for more tea and cakes beat their cosy shelter and they returned to the clubhouse very wet, but still enjoying the ride. 'Bookworm', recommends *Thunderbolt's Last Run* by Thomas M. Young. He says, all lovers of the *Titfield Thunderbolt* film should read this. A somewhat quiet section of the society is the slot car racers, despite meeting regularly. Geoff and Dudley comment on a 00-gauge layout which is quite substantial. The electrical wiring beneath the baseboard is very comprehensive and was installed by Dudley, working on his back, fitting lots of 'chocolate block' connectors. Peter on GLR news (ground level) ran *Maid Marion*, which performed quite well, despite his forgetting to fit the firebars (and setting the fire in the ashpan). Hmmm! Dennis Holmes writes on learning by modules. Several examples are quoted, from students who thought a saw was for chopping, never having used so much as a Junior hacksaw, to a student friend who despite graduating in Philosophy, had never heard of Wittgenstein. ('We didn't do him'.) Also, his horror of school leavers being made to wear safety glasses when using scissors or wood chisels having the edge ground off 'because they are sharp'.
W. www.nlsme.co.uk

And finally, Peruvian owls always hunt in pairs; this is because they are Inca hoots,

ME

Debs' grand-family on the move. No strikes here!

Club Diary 20 September– 2 November 2023

September

20 Bristol SMEE
Auction, Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

21 Warrington & District MES
Talk: Paul Caldwell on 'Big Game Hunting', St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

23 Brandon & District SME
Running/family day, Weeting track. See www.brandonanddistrictsme.com

24 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

24 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

24 Sutton MEC
Diamond Driving Centre fete. Contact: Paul Harding, 0208 254 9749

24 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

28 Newton Abbot & District MES
Club night at Rydon Community Hall, Kingsteignton. See nadmes.org.uk

28 Sutton MEC
Afternoon run from 12 noon. Contact: Paul Harding, 0208 254 9749

October

1 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

1 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

1 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

1 Small Model Steam Engine Group
Open meeting. 14:00-17:00. See www.gmes.org.uk

1 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk

1 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

4 Bradford MES
Talk – Graham Astbury, 'Twist Drills', Saltaire Methodist Church, 19:30. Contact: Russ Coppin, 07815 048999

4 Bristol SMEE
'On the Table' evening, Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

5 Sutton MEC
Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

5 Warrington & District MES
Projects/natter night, St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

6 Rochdale SMEE
Models competition night, Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

6 Warrington & District MES
Night running at the club track. See www.wdmes.org.uk/events

7 Tiverton & District MES
Running day at Rackenford track. Contact: Chris Catley, 01884 798370

8 Bradford MES
Public running day, Northcliffe, 13:30. Contact: Russ Coppin, 07815 048999

8 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

8 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

8 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

8 Sutton MEC
Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

8 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

15 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

15 Guildford MES
Open day, 14:00-17:00. See www.gmes.org.uk

15 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

15 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk

15 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

17 Taunton Model Engineers
Meeting, West Buckland, auction, 19:30-21:30. See www.tauntonme.org.uk

18 Bristol SMEE
Talk: 'Steam Launches and Engines', Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

19 Warrington & District MES
Talk: Jeremy Nichols on 'British Railways in WW1', St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

20 Rochdale SMEE
AGM, Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

22 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

22 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

22 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

22 Tiverton & District MES
Running day at Rackenford track. Contact: Chris Catley, 01884 798370

22 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

26 Guildford MES
Open day, 10:00-13:00. See www.gmes.org.uk

26 Newton Abbot & District MES
Club night at Rydon Community Hall, Kingsteignton. See nadmes.org.uk

26 Sutton MEC
Afternoon run from 12 noon. Contact: Paul Harding, 0208 254 9749

28 Brandon & District SME
Hallowe'en run, Weeting track, 14:30 until dark. See www.brandonanddistrictsme.com

28 North Wilts MES
Hallowe'en run at the Coate Water Railway, 15:30-20:30 (booked slots). See www.nwmes.info

29 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

29 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

29 North Wilts MES
Public running at the Coate Water Railway, 11:00-dusk. See www.nwmes.info

29 Warrington & District MES
Running day at the club track. See www.wdmes.org.uk/events

November

1 Bradford MES
Autumn auction, Saltaire Methodist Church, 19:30. Contact: Russ Coppin, 07815 048999

1 Bristol SMEE
Talk: 'Use of Machatronics at the Crofton Pumping Engines', Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

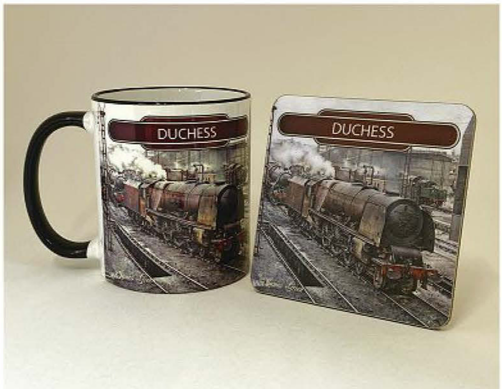
2 Sutton MEC
Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

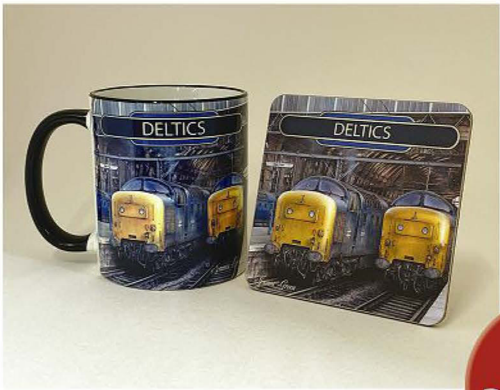
2 Warrington & District MES
Projects/natter night, St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

Model Engineer *Classified*

MODEL ENGINEER

Artist James Green





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