

BUILD A TWIN COMPOUND WINDING ENGINE

Join our online community www.model-engineer.co.uk

Vol. 232 No. 4740 5 – 18 April 2024



Crossness

Adding
glamour to
the pumping
of sewage

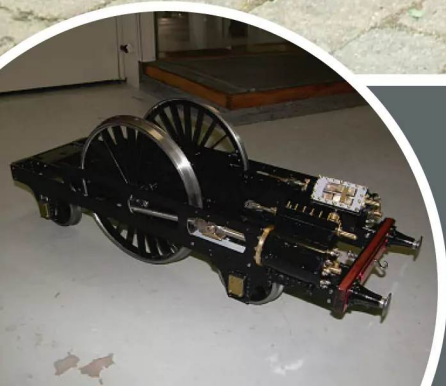
MODEL ENGINEER

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Ruby Swann takes to the road



MORTONS



Cornwall

LNWR single
wheeler is
ready to roll

Radio Control

Where steam
and electronics
meet

Rust

Where it comes
from – how to
stop it

Newton Tesla (Electric Drives) Ltd have been trading since 1987 supplying high power variable speed drives and electric motors to industry up to 500KW so you can be confident in buying from a well established and competent variable speed drive specialist.



New product promotion, AV550 550W motor / inverter for the Myford Super 7. Call for details!

Managing director George Newton, originally from the British Steel industry where he worked with 20,000 HP rolling mill drives is also a skilled machinist and uses his own lathes to design and refine speed controllers especially for the Myford ML7 & Super 7

For the Myford ML7, George and his team produce the AV400, a complete 'Plug & go' solution including a new variable speed motor that meets the original Myford motor specification, has the correct 5/8ths shaft diameter and is a direct fit

The 'AV' range is extended with the AV550 & AV750 for the Super 7 lathe giving a choice of 3/4HP & 1HP motor power

Full Torque is available from motor speed 90 - 1,750 RPM

Advanced Vector control for maximum machining performance

Prewired and programmed ready to go

The AV400/550/750 speed controllers have an impressive 10 year warranty for the inverter and 3 years for the motor (Terms and conditions apply)

Over 5,000 units supplied to Myford owners

Speed control solutions also available for other lathes including Bofford, Southbend, Colchester, Raglan etc call or email for details

Technical support available by telephone and email 7 days a week



Newton Tesla (Electric Drives) Ltd.
Warrington Business Park, Long Lane, Warrington
Cheshire WA2 8TX, Tel: 01925 444773

Email: info@newton-tesla.com

Visit <https://www.newton-tesla.com> for more information.

Follow us on Facebook: www.facebook.com/NewtonTeslaLtd



MODEL ENGINEER

Published by Mortons Media Group Ltd,
Media Centre, Morton Way, Horncastle, Lincs LN9 6JR
Tel: 01507 529589 Fax: 01507 371066
© 2023 Mortons Media ISSN 0026-7325
www.model-engineer.co.uk

EDITORIAL

Editor: Martin R. Evans
MEEditor@mortons.co.uk
Deputy editor: Diane Carney
Designer: Druck Media Pvt. Ltd.
Club News: Geoff Theasby
Illustrator: Grahame Chambers
Publisher: Steve O'Hara

CUSTOMER SERVICES

General Queries and Back Issues
01507 529529 Monday-Friday: 8.30am-5pm
Answerphone 24hr
help@classicmagazines.co.uk
www.classicmagazines.co.uk

ADVERTISING

GROUP HEAD OF INVESTMENT – Lifestyle & Tractor Publications | www.talk-media.uk

Mason Ponti
mason@talk-media.co.uk

Investment Manager: Chris Jeffery

By post: Model Engineer advertising, Mortons Media Group, Media Centre, Morton Way, Horncastle, Lincs LN9 6JR

PUBLISHING

Sales and distribution manager: Carl Smith
Marketing manager: Charlotte Park
Commercial director: Nigel Hole
Publishing director: Dan Savage

SUBSCRIPTION

Full subscription rates (but see page 486 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

EDITORIAL CONTRIBUTION

Accepted photographs and articles will be paid for upon publication. Items we cannot use will be returned if accompanied by a stamped addressed envelope and recorded delivery must clearly state so and enclose sufficient postage. In common with practice on other periodicals, all material is sent or returned at the contributor's own risk and neither Model Engineer, the editor, the staff nor Mortons Media Ltd can be held responsible for loss or damage, howsoever caused. The opinions expressed in Model Engineer are not necessarily those of the editor or staff. This periodical must not, without the written consent of the publishers first being given, be lent, sold, hired out or otherwise disposed of in a mutilated condition or in other unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial manner whatsoever.

MORTONS
MEDIA GROUP LTD



<http://www.facebook.com/modelengineersworkshop>

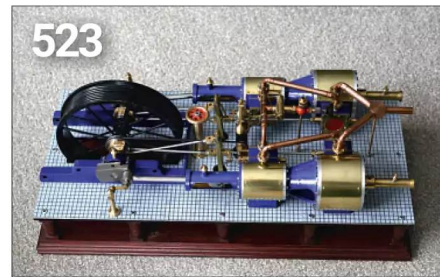


<http://twitter.com/modelengineers>



When you have finished with this magazine please recycle it.

Paper supplied from wood grown in forests managed in a sustainable way.



ISSUE IN THIS ISSUE IN THIS ISSUE IN THIS ISSUE

Vol.232 No.4740 5 – 18 April 2024

SUBSCRIBE & SAVE UP TO 49%
See page 486 for details.

488 SMOKE RINGS

News, views and comment on the world of model engineering.

489 BUTTERSIDE DOWN

Steve Goodbody returns with further tales of the trials and tribulations of a model engineer's life.

492 IMLEC 2024

Rod Ainsworth invites you to compete in this year's efficiency competition at Southport.

494 BUILDING 3020 CORNWALL IN 5 INCH GAUGE

Jim Clark builds a model of Francis Trevithick's LNWR 2-2-2 locomotive.

500 G1 OR 16MM LOCOMOTIVE RADIO CONTROL

Malcolm Batt uses BBC micro:bit computers to add radio control to a 32mm locomotive.

504 GRINDING THE TARCUTTA CAMSHAFT

Gerard Dean needs a pair of camshafts for a V12 motorcycle engine so decides to grind them himself.

506 THIXOTROPIC METALS – 'ALLOY 14'

Geoff Theasby strays into the cutting edge of metallurgical science.

507 SREE NEWS

Martin Kyte reports from the Society of Model and Experimental Engineers.

508 RUST FORMATION AND PREVENTION IN THE WORKSHOP

Neil Raine looks at the causes of rust and how it may be prevented.

512 POSTBAG

Readers' letters.

513 MERRYWEATHER SELF PROPELLED STEAM FIRE ENGINE

Werner Schleidt finds an old boiler and is inspired to construct a fire engine around it.

517 LNER B1 LOCOMOTIVE

Doug Hewson presents a true to scale five-inch gauge model of Thompson's B1.

523 A TWIN TANDEM COMPOUND STEAM ENGINE

Graeme Quayle presents an interesting design for a compound winding engine.

525 BOOK REVIEW

Henk-Jan de Ruiter reads about the restoration of antique toys.

526 THE AMERICAN LOCOMOTIVE

David Rollinson takes a look at the classic and ubiquitous 4-4-0 locomotive.

529 A VISIT TO THE CROSSNESS ENGINES

Robert Hobbs visits a rather grand and ornate pumping station in South East London.

532 CLUB NEWS

Geoff Theasby compiles the latest from model engineering clubs around the world.

535 CLUB DIARY

Future Events.



ON THE COVER...

Steve Goodbody's 3 inch scale Allchin 'Royal Chester' traction engine Ruby Swann (photo Steve Goodbody).



This issue was published on April 5, 2024.
The next will be on sale on April 19, 2024.

www.model-engineer.co.uk

HOME AND WORKSHOP MACHINERY



Check out our eBay store!

144 Maidstone Road, Fooks Cray, Sidcup, Kent, DA14 5HS
Tel: 020 8300 9070 - evenings 01959 532199
website: www.homeandworkshop.co.uk
email: sales@homeandworkshop.co.uk
visit our eBay store! Over 7500 items available; link on website;
homeandworkshopmachinery



eBay



Chester Cub630 6 complete with lots of tooling £2950



3 1/2" Britannia class 4-6-2 rolling chassis and castings + completed tender and part built cab, modelled on 70054 Dornoch Firth (LSBC) check out our website for more pictures
REDUCED £750



Colchester Bantam 2000 lathe (long bed) metric leadscrew, Dickson post £4950



Stanier precision vice 55mm jaw New / New Zealand £195



Myford Super Connoisseur centre lathe + Tesla inverter, DRO, stand, tooling £9750



Harrison L5, M250, M300 / Colchester Student 1200 / 1800 lathe change wheels + A&S 1ES milling machine table gears

Coming in; SIP mill drill, Kennedy hacksaw, Tom Senior dividing head, Axminster morticer, Bridgeport mill



Myford Super 7 lathe + Tesla inverter, stand in original condition £5750



Creuson Morrisflex 240V 8" polisher buffers £825 each



COLCHESTER Triumph 2000 lathe 7 1/2" x 50" bed held in stores section so very little work + taper turning attachment £9750



Elliot 8" pedestal grinder 3PH £245

Please phone 0208 300 9070 to check availability.
Distance no problem – Pallets leaving daily! – prices exclusive of VAT
Just a small selection of our current stock photographed!

Worldwide
Shipping

POWERED BY
barclaycard



FROM THE PUBLISHERS OF THE UK'S TOP NOSTALGIA MONTHLY



BEST OF BRITISH RAILWAYS



**YOUR
TICKET
TO RIDE**

Celebrating the best in Heritage
Railways, Classic Locomotives,
Models, Railway Art and more

MEET THE STAFF



THE UK'S FAVOURITES



MODEL RAILWAYS



BEST OF BRITISH RAILWAYS is a selection of railway related features from the pages of Best of British, the UK's favourite nostalgia magazine.

From Mallard's record-breaking run to a journey on the luxurious Belmond Northern Belle, join us as we celebrate almost a century of British railway history. Learn how the project to build Tornado got off the ground, meet those who keep our railways running, relive the joy of receiving a train set for Christmas and visit heritage railways and museums such as the Keighley & Worth Valley Railway – the location for the 1970 film The Railway Children.

Whether you have a life-long interest in the railways or just a passing fancy, let Best of British Railways be your ticket to ride!

ORDER YOURS TODAY

We are offering **FREE P&P**.

Order online at www.classicmagazines.co.uk

or call 01507 529529 to purchase a copy today.

UK £6.99/EUR £8.49/ROW £9.99 inc. P&P.

MARKET LEADER IN LARGE
SCALE, READY-TO-RUN,
LIVE STEAM

ANNOUNCING OUR FIRST FULLY MACHINED, BOLT-TOGETHER, KIT

GWR 15xx CLASS FOR 5" GAUGE

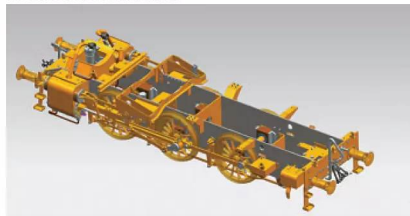
£6,495 + £195 p&p



Kit 1 Shown Assembled



Kit 1 & 2 Shown Assembled



Kit 1, 2 & 3 Shown Assembled



Kit 1, 2, 3 & 4 Shown Assembled



Kit 1, 2, 3, 4 & 5 Shown Assembled



Kit 1, 2, 3, 4, 5, & 6 Shown Assembled

Request your free brochure today

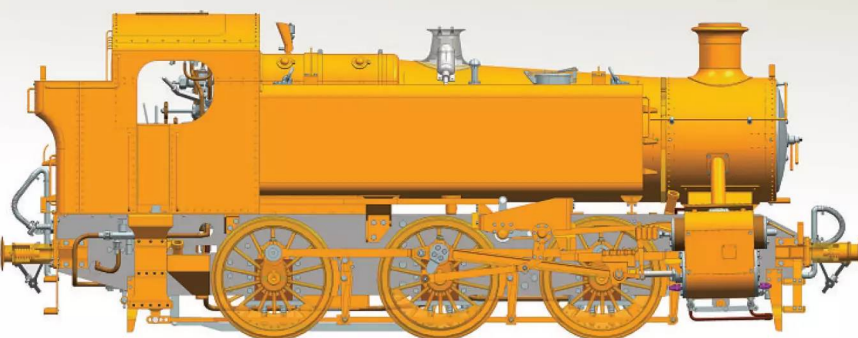
Request your free brochure today by e-mail, telephone, or by returning the coupon opposite.

Telephone: **01327 705 259**

E-mail: **info@silvercrestmodels.co.uk**

Find more information at

www.silvercrestmodels.co.uk



The GWR 15xx Class

All ten locomotives of the class were constructed in 1949 at Swindon and entered service on the Western Region of British Railways. They were employed on heavy shunting duties at London Paddington. Numbers 1501/2/9 were later sold to the National Coal Board for use in collieries. The 15xx was turned out in different liveries including lined black and NCB maroon.

The 15xx Model

We have chosen the 15xx Class as our first fully machined, bolt-together, kit model. It is a substantial tank engine with two outside cylinders and Walschaerts valve gear. You will receive the model in a single delivery with every component required to build a complete model. The kit is divided into 6 sub-kits. See illustrations here showing the build stages. It is suitable for the novice builder who will benefit from illustrated assembly instructions and an instructional video. The kit is delivered fully painted in the livery of your choice. The model is also available ready-to-run. Boilers are silver soldered and UKCA marked. All components benefit from a 5 year warranty.

Summary Specification

- 5" Gauge, coal-fired, live steam
- 2 outside cylinders
- Outside Walschaerts valve gear
- Stainless steel motion
- Silver soldered copper boiler
- Boiler feed by axle pump, injector and hand-pump
- Multi-element superheater
- Drain cocks
- Safety valve
- Etched brass body
- Choice of liveries
- Mechanical lubricator
- Reverser

Approximate Dimensions

- Length 35"
- Width 10"
- Height 14"
- Weight 51kg

**FREE
SAMPLE KIT
WORTH
£100!***

TRY BEFORE YOU BUY

Experience the 15xx build for yourself with this free kit comprising main frames, stretchers and buffer beams. It is completely free when you request the brochure. **It's yours to keep, with no obligation to buy the model.** This free kit reduces the cost of the model to £6,395 should you decide to purchase it.

Delivery and Payment

Save £195.00. Free p&p for any order received within 28 days.



The order book is now open and we are happy to accept your order reservation for a deposit of just £995.

We will request an interim payment of £2,450 in May as the manufacture progresses, a further stage payment of £2,450 in July and a final payment of £500 in October/November 2024 on batch completion.

Request your free brochure and free sample kit now by returning the coupon below, or by phoning 01327 705 259.



15xx model in BR Black livery

Please send, without obligation, my free brochure and free sample kit

Name: _____

Address: _____

Post Code: _____

Please send to: Silver Crest Models Limited
18 Cottesbrooke Park, Heartlands Business Park,
Daventry, Northamptonshire NN11 8YL

MEM

MODEL ENGINEER

SUBSCRIBE AND SAVE

Enjoy 12 months for just £68



PRINT ONLY

Quarterly direct debit for **£19**

1 year direct debit for **£68**

1 year credit/debit card for **£74**

PRINT + DIGITAL

Quarterly direct debit for **£22***

1 year direct debit for **£85***

1 year credit/debit card for **£88***

DIGITAL ONLY

1 year direct debit for **£50***

1 year credit/debit card for **£54***

**Any digital subscription package includes access to the online archive.*

Great reasons to subscribe

» Free UK delivery to your door or instant download to your digital device

» Save money on shop prices » Never miss an issue

» Receive your issue before it goes on sale in the shop



classicmagazines.co.uk/MEDPS



01507 529529 and quote **MEDPS**

Lines are open from 8.30am-5pm weekdays GMT

Offer ends December 31, 2024. Subscriptions will start with the next available issue. Direct Debit payments will continue on the agreed plan unless you tell us otherwise. To view the privacy policy for MMG Ltd (publisher of Model Engineer), please visit www.mortons.co.uk/privacy

Please visit www.classicmagazines.co.uk/terms for full terms & conditions.



MARTIN
EVANS
Editor



DIANE
CARNEY
Assistant
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.
07710-192953
MEeditor@mortons.co.uk



As I write this, the weather has turned positively spring-like and model engineers are beginning to come out of hibernation, blinking in the unaccustomed sunlight. Where I live, it is clear there has been a change in the weather as there has been no rain now for over 24 hours, for the first time, it seems, in several months. Temperatures have also managed to haul themselves into double figures so everything is looking very promising.

There are plenty of events to go to over the next few weeks, to make the most of the improving weather, and here I have listed a few of them.

Bassett-Lowke Rally

The second Bassett-Lowke Rally will be held at the Northampton Society of Model Engineers track on Saturday May 18th. Visiting locomotives are welcome in 7½, 5 and 3½ inch gauges to run on their raised and ground level tracks. There will also be Gauge 1 and Gauge 2 running in the marquee and the 45mm and 32mm garden railway will also be available.

To register please contact Kevin West on westkev58@gmail.com



Kevin West

Parklands Railway Week

The annual Parklands Railway Week at Hemsby, Norfolk is a very popular event amongst the 7¼ inch gauge fraternity but, sadly, this year's is to be the last. It is to be held during the week from May 25th to May 31st. If you wish to bring an engine you need to notify leighsteamer@btinternet.com and further details can be found at www.sevenandaquarter.org



Register Parklands



Details Parklands

3½ Inch Gauge Rally

If you are into 3½ inch gauge and are based not too far from the Midlands then you may be interested in the 3½ inch gauge rally at Rugeley Power Station. The rally is organised by the Rugeley Society of Model Engineers and takes place on the weekend of May 18th/19th. If you are interested you will need to book in advance (secretary@rugeley-sme.org.uk) and bring the usual paperwork (boiler test certificate and insurance documents). Food and refreshments will be available both days. For accommodation, both Travelodge and Premier Inn are situated nearby.



Details 3½ Inch Gauge

2½ Inch Gauge Rally

No need to feel left out! There is a 2½ inch gauge rally at the Cheltenham Society of Model Engineers on Sunday May 12th, from 10am to 4pm.

Engineering in Miniature

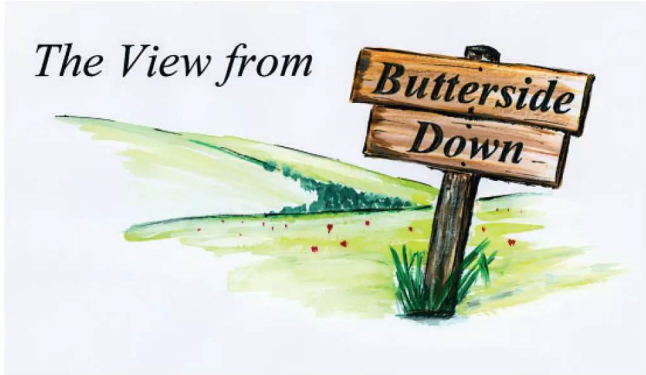
I was very sorry to hear the news that our rival publication, *Engineering in Miniature*, is to close after the May issue. Perhaps you think this odd, coming from the editor of this magazine. However, many of our readers may remember that I was for a while editor of *Engineering in Miniature* (EiM) so I am (if you like – or even if you don't like) 'family'. I followed Chris Rayward as editor (a hard act to follow) and was given a one-day crash course in putting together a magazine by him and proprietor Chris Deith. Chris then shepherded me carefully through the process over the subsequent year or so until he passed the magazine over to Warners. Chris was an excellent manager and I am very grateful to him for the guidance he gave me. I am glad though that he did not see the demise of his magazine, which he started back in 1979.

The two magazines provided two distinct styles in their presentation – a good thing for the readership. I hope that former readers of EiM may find the style of this magazine tolerable. I read in Facebook recently that our style is considered by some a little 'pompous' – so I shall endeavour to be a little more 'umble in future, Master Copperfield!

Another commentator on Facebook made the very apposite remark that life will become progressively more difficult for printed magazines, as the future is digital. That is quite right and so, as well as being a little more 'umble, we shall have to try to adapt to the changing *modus operandi* of the publishing industry. Our survival surely depends upon it.

The View from Butterside Down

Part 8: Third Hand Transportation, Part 4



Continued from p.451
M.E.4739 March 22

With all other possibilities exhausted, with a dead fire and a cobbled-together manometer as evidence, the author concluded that *Ruby Swann's Royal Chester*-based design was producing very little of that most desirable commodity for a lively firebox - draught.

And that raised two good questions: Why? and What could be done about it?

Disclaimers and denials
Over the years, with the rise of the Internet and an evolving plethora of model engineering forums and websites on both sides of the Atlantic, I have noticed there is one topic which, despite all reason and rationality, seems to provoke much angst, ire and gnashing-of-teeth amongst a portion of the message-typing populace and that subject is draughting, so, with a sense of trepidation, here is fair warning that I am about to touch on this dangerous subject and strongly advise sensitive readers to

cover their eyes and skip forward to the next article if they want to avoid the potential fallout.

However, in the fervent but probably naive hope that this will help sweeten the pill, let me admit right up front that I am most definitely not an expert on draughting. I know very little of the works of Greenly, Ell, Kylala, Chapelon, Giesl, Porta, LeMaitre and others and have undertaken no original research. I can honestly say that I have contributed absolutely nothing to the global body of knowledge on the subject and don't intend to start now. Should you feel strongly about anything that follows, therefore, I am sure you are in the right and you will receive no argument or complaint from me.

In short, everything which follows is simply a report of my first-hand experiences with a three inch scale single-cylindered Allchin traction engine named *Ruby Swann*, a doubled-up version of Bill Hughes's *Royal Chester* design and while I strongly suspect that some of these findings

may be broadly applicable to other engines, especially as the supply of decent coal becomes more and more scarce and may therefore be of interest to other engine owners (especially traction engine owners who are rarely considered when draughting is discussed, I have noticed) I am not claiming this for a fact. So there!

Honestly, you can't be too careful these days, can you?

Running the numbers
Now, with that behind us and for any brave souls who may still be following along, let me cautiously add that while not an expert on the subject, as an avid reader of this magazine for rather a long time I have noticed that the draughting arrangements of many of the popular locomotive designs published in these pages over the years seem to follow a broadly similar set of guidelines, possibly originating from Henry Greenly in the 1930s - but I really don't know - and which, if the reports are to be believed, seemingly result in steaming success. **Table 1** is included here as a reference for

	Approximate Guideline
Blast nozzle area	0.3% of the grate's surface area
Venturi choke area	6% of the grate's surface area
Venturi choke height above the blast nozzle	Based on a 1-in-3 cone of steam emerging from the blast nozzle
Minimum chimney height and maximum chimney diameter above the blast nozzle	Based on a 1-in-6 cone of steam emerging from the blast nozzle

Table 1: The approximate draughting guidelines, discerned from miniature railway locomotive designs.

what will follow; it summarises those approximate ratios, at least as I discern them, but I have no idea if these ratios and arrangements are anywhere near the best that can be achieved and make no claim, recommendation or comment regarding their accuracy, relevance, efficacy, degree of perfection, or ability to whistle the Marseilles in the key of G major. But I think you know this by now.

Stepping back and applying a bit of logic (a dangerous thing, I know), however, I certainly liked the fact that these ratios took the grate's size as their starting point because, to me, that made intuitive sense. As I reasoned it, rightly or wrongly, a well-designed boiler would sensibly be based upon the needs of the cylinders and, if so, then the size of the boiler's fire and therefore the size of the boiler's grate, must have been determined by the heat needed to produce sufficient steam from that boiler to feed those cylinders. And with the grate's size so determined, then the ashpan and flues should also have been designed, respectively, to allow sufficient air into the fire and to enable the resultant gases to efficiently escape, all to keep the flames merrily burning. To bring this train of thought to its conclusion, if the boiler was thus well designed and the grate, flues and ashpan were properly proportioned in turn, then the sole purpose of the draughting was to produce

sufficient vacuum inside the smokebox to draw enough air through the fire bed to make it all work. Since the appropriate amount of air is determined by the size of the fire and since the size of the fire is substantially determined by the size of the grate, then the grate's size seemed to be the appropriate starting point for the draughting design. QED.

As I say, this train of thought made sense to me.

Hearteningly, Bob Sanderson's article, *Front End Design*, appearing in the June 15, 1984 edition of *Model Engineer*, also used the grate's size as the basis for its front-end calculations and seemed to support my supposition. However, while the blast nozzle size calculated using Mr. Sanderson's formula agreed closely with the roughly 0.3% ratio to grate area which seemed typical, his approximately 2.5% ratio for the venturi choke was far smaller than the 6% which appeared more typical and I decided to stick with the latter.

To complete the picture, while I knew that cylinder back pressure was also an important factor, I decided not to worry about that too much unless the guidelines suggested I needed a considerably smaller blast nozzle than *Ruby Swann's* current fitting to get the fire burning.

Compare and contrast

At this point, convinced that inadequate draughting was

the root of my troubles, I now had the ability to generate a set of theoretical dimensions as a guideline against which to compare *Ruby Swann's* actual details. However, to add one further unknown into the mix - which is more of a caveat than a disclaimer, given that the guideline dimensions were presumably based upon the needs of a two-cylinder railway locomotive - I had no idea whether they were equally applicable to a single cylindered traction engine. With no other information or guidance available, however, I had to start somewhere and these ratios seemed to be as good a place as anywhere.

So, how did *Ruby Swann's* details compare with these figures? Well, after assembling the relevant formulae into a spreadsheet to perform the necessary calculations without repetitive effort, it certainly appeared that her front-end dimensions deviated significantly from the guideline ratios, especially when it came to her chimney. In fact, the chimney, with its lack of a venturi to help draw air from

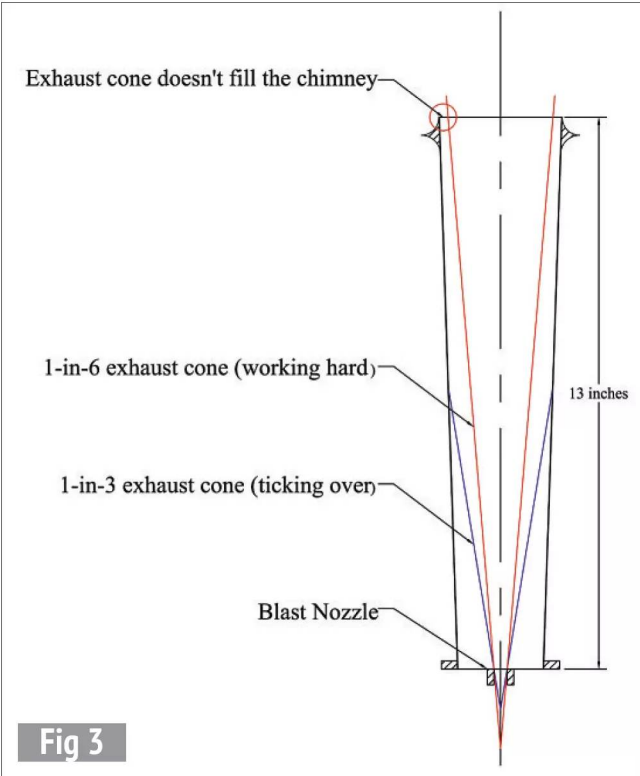
the smokebox and its large and increasingly larger diameter as it tapered upwards to the top, seemed to miss the mark by a significant margin in all respects and **Table 2** shows how the numbers stacked up.

Assuming the guidelines represented reasonable (if approximate) targets, then what did these figures suggest? Let's take each in turn, starting with the seemingly over large diameter at the top of *Ruby Swann's* chimney and see.

As I imagine it, as a steam engine works harder, the jet of steam exiting the blast nozzle speeds up and causes the cone of expanding steam which is shooting upwards to correspondingly narrow; the faster the jet, the narrower the cone and vice-versa. And this, it seems to me, is the likely reason behind the 1-in-3 and 1-in-6 cone ratios in the guidelines; the former representing the jet when the engine is working lightly and the latter when the engine is working hard. And from what I can recall from many hours spent unravelling the mysteries of fluid dynamics at

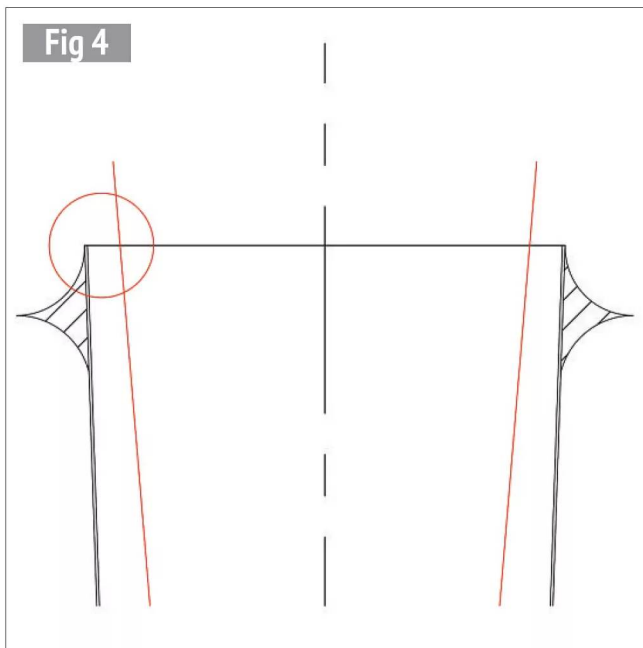
	Guideline Size	<i>Ruby Swann's</i> Actual Size
Blast nozzle diameter	0.35 inches	0.31 inches
Choke diameter for a 0.31-inch diameter blast nozzle	1.58 inches	Over 2 inches
Venturi choke height above a 0.31-inch diameter blast nozzle	3.81 inches	No venturi
Minimum chimney height above a 0.31-inch diameter blast nozzle	10.89 inches	13 inches
Maximum chimney exit diameter for a 0.31-inch diameter blast nozzle and a 13-inch-high chimney	2.47 inches	2.88 inches

Table 2: A comparison of *Allchin Ruby Swann's* actual details against the *Table 1* guidelines.



The 1-in-3 and 1-in-6 cones emerging from *Ruby Swann's* blastpipe, drawn to scale.

Fig 4



The top of the chimney depicted in fig 3. The chimney's diameter is too large to be filled by the 1-in-6 cone of steam, possibly allowing air to enter her smokebox through the annular gap.

university and beyond, I think that my imagination is on the right track, but I'm sure that someone will let me know if I'm wrong.

However, it also seemed to me important that when an engine is working its hardest, the chimney's diameter must be sufficiently small for the 1-in-6 cone to fully fill it before exiting out the top because, if it does not, air may creep down the annular gap between the steam jet and the chimney and deplete the smokebox vacuum. And in *Ruby Swann's* case, the calculated numbers in Table 2, which are also shown pictorially and to-scale in **figs 3 and 4**, suggested that, with its inner diameter of 2.88 inches, the top of *Ruby Swann's* chimney was roughly 3/8 of an inch too large, implying that the cone of exhausted steam may not be filling the chimney when the engine was working hard. In short, the guidelines suggested that improvement might be had if the chimney's overall diameter were reduced by at least 3/8 inch, but preferably more.

Next on the list, when working lightly, although the 1-in-3 cone of steam would certainly fill the chimney,

the guidelines. And, while I believe that a venturi is not a common front end design feature for a traction engine, it certainly seemed plausible that adding one would help mix the smokebox gases with the exhaust steam, draw those gases from the smokebox and reduce the smokebox pressure and create more draught in the process. In short, the guidelines suggested that adding a venturi with a 1.58 inch diameter choke at a height 3.81 inches above the blast nozzle, thereby reducing the chimney's diameter by roughly 5/8 inch at that point, would represent another possible area for improvement.

Finally, what about that blast nozzle diameter? With a guideline of 0.35 inches versus the actual diameter of 0.31 inches, it certainly appeared that *Ruby Swann's* blast nozzle was slightly undersized.

However, if increased, would that resolve the problem? While the spreadsheet suggested no - her chimney would still be too big even with a larger blast nozzle - this was an easy experiment to perform and so,

after half an hour of lathe work, I repeated the manometer tests with a selection of larger nozzles and confirmed that, as far as I could detect, they made not a whit of difference to the smokebox vacuum which, in all cases, remained undetectable.

In conclusion, were I to believe the guidelines, then they were telling me that a narrower chimney, together with a proper venturi to help draw the gases out of the smokebox, would be avenues worth exploring.

But how to achieve these two goals without ruining *Ruby Swann's* otherwise attractive and true-to-scale appearance (**photo 16**)? Well, that's a very good question but I see that our editor is pointedly tapping his watch and so the answer will have to wait until next time I'm afraid.

●To be continued.



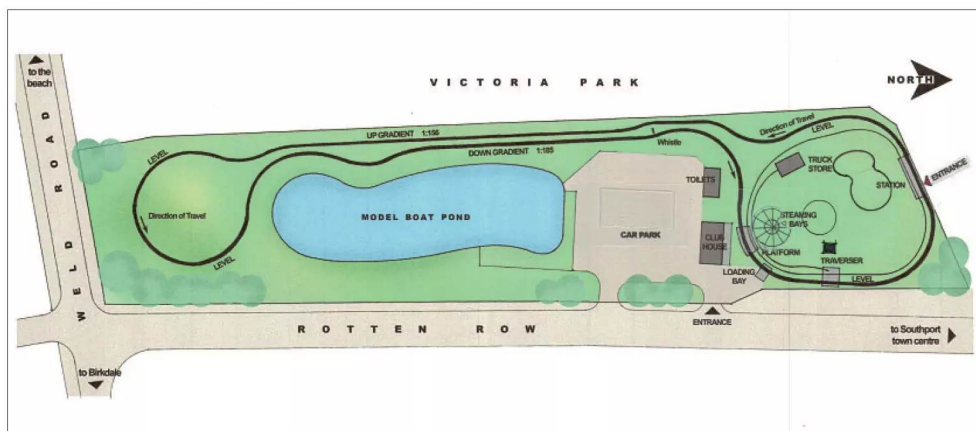
A narrower chimney would certainly spoil the elegant appearance of an Allchin traction engine, in the author's view!

IMLEC 2024

Rod Ainsworth, chairman of Southport Model Engineering Club, invites entries for this year's IMLEC.



Southport Model Engineering - IMLEC



The 54th International Model Locomotive Efficiency Competition is to be held at Victoria Park, Southport on 19th-21st July 2024.

The members of Southport Model Engineering Club, assisted by members of the Leyland Club, are proud to be the hosts of the 54th anniversary event of IMLEC. Our club was formed in 1978 and has currently over 120 members who range from raw novices to professional engineers. The club has extensive and attractive grounds and a clubhouse situated at the southern end of Victoria Park, Southport with access off Rotten Row. We have two raised tracks each catering for 3½ and 5 inch gauge locomotives. The first of these tracks also has a 2½ inch gauge track and is 640 feet long and the second track is 1733 feet long. We also have a gauge 1 and 32mm track of 300 and 165 feet respectively. The grounds have been judged to be 'Outstanding' by the Royal Horticultural Society's 'It's Your Neighbourhood' scheme.

Southport is a delightful Victorian seaside resort, known as 'The Classic Resort'. Southport is renowned for its gardens, sandy beaches and

many golf courses, including Royal Birkdale where the Open Golf Championship has been held on numerous occasions. Its elegant town centre provides a vast array of shops and a wide selection of restaurants. Lord Street is the main street with many pavement cafés situated under a glass and cast iron Victorian canopy.

Visitors to the event will be required to purchase a ticket which will provide entry to the club grounds and the event itself. The cost will be £5 per day or £12 for the three days of the event. There is ample on and off-street parking available for both entrants and visitors. There will be spaces available close to our grounds from Thursday till Monday 18th-22nd July for tents, camper vans and caravans. These

will be under our control for which there will be a nominal charge. Mr Ben Pavier is in charge of our caravanning and camping arrangements and visitors wishing to make use of these facilities on the weekend should contact him.

There is also a Caravan Club site, for members of the caravan club, within a few minutes' walk, but pitches here have to be booked well in advance as it very popular location! Visitors will be responsible for making their own arrangements with the Caravan Club. Southport is a popular seaside resort and has ample hotel, guest house and bed and breakfast accommodation and again visitors will be responsible for making their own arrangements in this respect.





Within easy travelling distance of Southport is the fine market town of Ormskirk and if the event at the club and the attractions in Southport are not enough to retain your interest then a visit on Saturday to the open market is well worthwhile.

There will be a dedicated area for trade stands and if any traders are interested in having a spot over the weekend please contact Ben as soon as possible.

The Southport Club has a website: southportmodelengineering.club This website will be kept up-to-date with information about the competition and the main point of contact will be Ben Pavier by e-mail (Publicity@southportmodelengineering.club) or mobile (07882 259845).

The members of Southport Model Engineering Club would like to extend a warm

welcome to new and past entrants of IMLEC as well as all spectators. We look forward to meeting you over the weekend and to having a really great, mutually enjoyable weekend. Our main aim is to provide all entrants and spectators with a thoroughly enjoyable competition. Refreshments, including alcohol, will be available throughout the weekend with an evening of live music on the Saturday night. There will also be an opportunity for visitors to run their locomotives on our tracks on Friday and Saturday evenings, subject to the usual paperwork but excluding any entrant who has not completed their run!

For any competition to run successfully and be fair to all entrants there have to be rules. This event is no exception and the following paragraphs outline the basic rules which apply over the weekend. The

competition will take place over three days with the first run starting around mid-day on Friday, depending on the number of entrants.

The competition will be run on our 5 and 3½ inch gauge dual gauge raised track and will be open to applicants on a first-come first-served basis by application form only. The forms should be completed in full in order to be considered and accepted. A strict time line will be observed on all entries. The competition will be restricted to a total of 28 measured runs using the usual practice of the driver sitting on a dynamometer car, loaned to us by Leyland Club, coupled to the engine. No initial circuits will be allowed prior to the run and a full fire at the start of the run will be observed. A set of the rules will be sent to the successful entrants.

The coal supplied for the event will be anthracite in a

choice of two sizes, grains and beans.

If more applications are received than can be run as planned then a list of reserve engines will be considered from the applications in order of receipt. The applicants will be informed if they are to be placed on the reserved list and they can decide whether to partake or not. If not the next one on the list will be offered a similar option. The number of reserve entrants will be limited to six and there will be a tick box on the application form where applicants can indicate their interest in a reserve place. Every effort will be made to find a slot for the reservists to run over the weekend, but we cannot give any guarantees.

Prizes will be awarded to the competitors finishing in first, second and third places in the competition for the Martin Evans Challenge Trophy plus a prize for the best performing 3½ inch gauge locomotive.

If you wish to enter the competition you should apply for an entry form via the website or from Ben Pavier. All application forms will be sent out by email to the prospective entrants at the same time, as soon as possible, and the closing date for the return will be 10th May.

The request for an application form will not guarantee entrance into the competition. A form will be sent to all potential applicants at the same time, and acceptance into the competition will only be considered after a completed form is submitted. A brief description of the entrant's locomotive and a short history of the driver will be required and a photograph would be appreciated. Any previous IMLEC winners should declare the year and details of their winning entry. All successful applicants will be notified by post and they will be sent copies of maps, rules and local information. Reservists and unsuccessful applicants will also be notified.

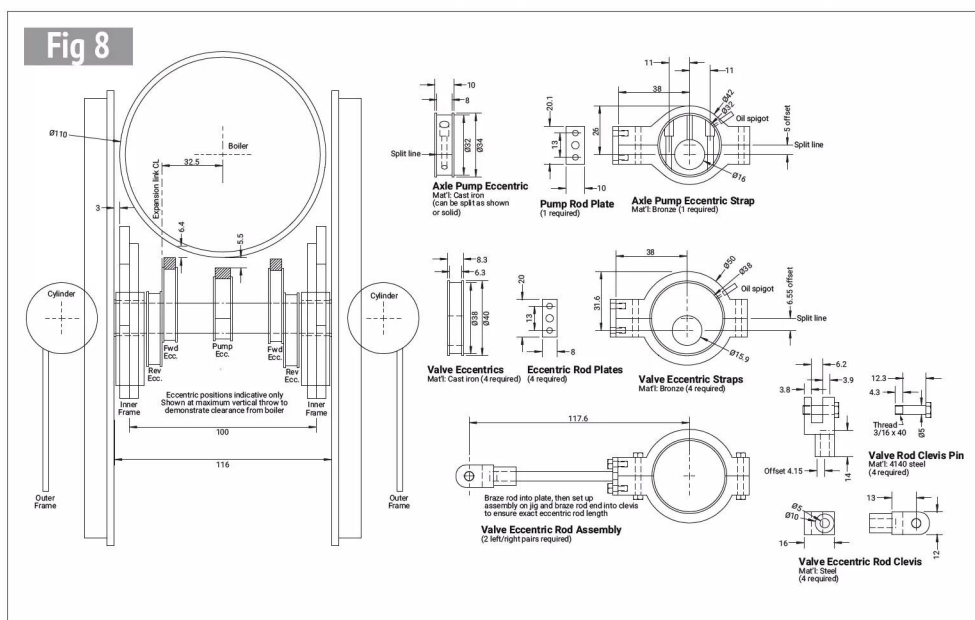
BUILDING 3020 CORNWALL in 5 Inch Gauge

PART 3

Jim Clark
builds the
famous
LNWR 2-2-2 – the first
locomotive earmarked
for preservation.



Continued from p.459
M.E.4739 March 22



Eccentric design details.

Eccentrics

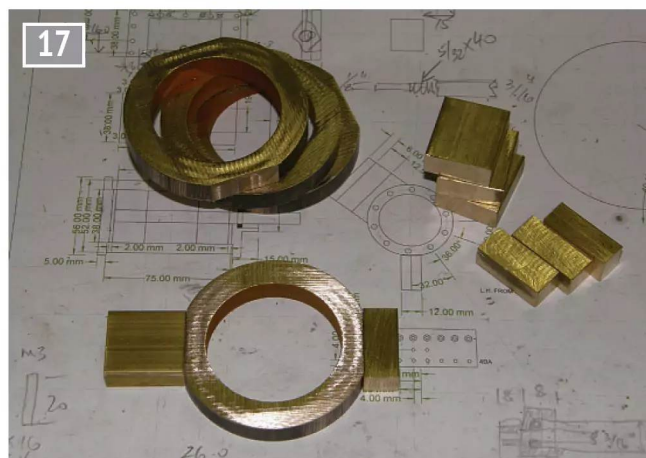
The eccentric straps for the valves were another significant design challenge. These have to be mounted on the centre axle and, as the boiler sits right above this axle, there is very little room. **Figure 8** shows the eccentrics and a cross-section

through the main axle, which demonstrates the problem and details my solution.

I resolved this problem by splitting the eccentric straps horizontally instead of vertically, as is usual practice (**photos 17** and **18**). The centre eccentric is the smallest, with

only a 5mm offset giving a 10mm stroke and this is used for a water pump. When the various eccentric straps are fitted to the eccentrics, they just clear the bottom of the boiler at their highest point of rotation.

The eccentric strap bodies were fabricated from slices

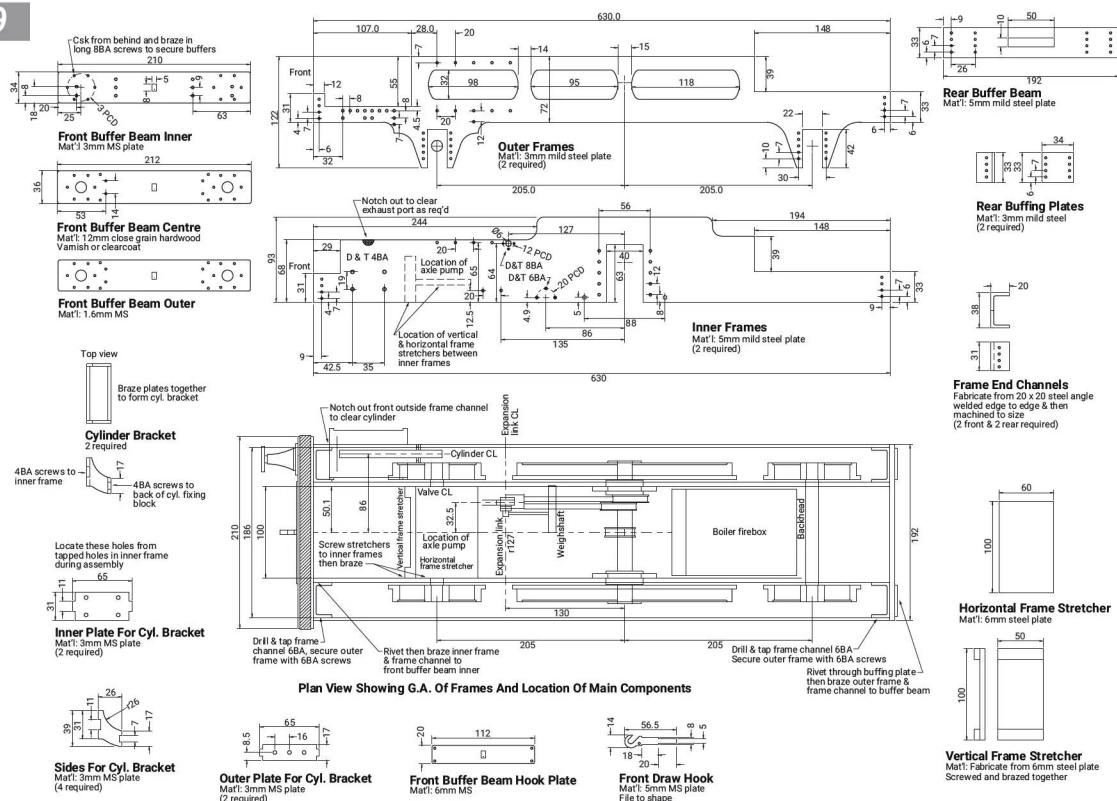


This shows most of the component parts for the eccentric straps.



Here is one complete eccentric strap, valve rod and clevis, finish machined and sitting on the jig that was used to ensure the correct valve rod length.

Fig 9



Design details for the chassis components.

of the same phosphor bronze hollow bar that I had used for the cylinders, with 'ears' of brass silver soldered to either side. These were split through the middle with a fine slitting saw and machined up to fit the eccentrics.

Photograph 19, taken much later in the build, shows the finished eccentric straps in place and connected up to

the valve gear. The boiler will sit between the wheels immediately above them. The space limitations are obvious. The small brass spigots sticking out the right-hand side of each eccentric strap are for flexible silicone lubricator pipes that will bring oil down to the eccentrics from reservoirs on the running boards. The eccentrics are otherwise quite

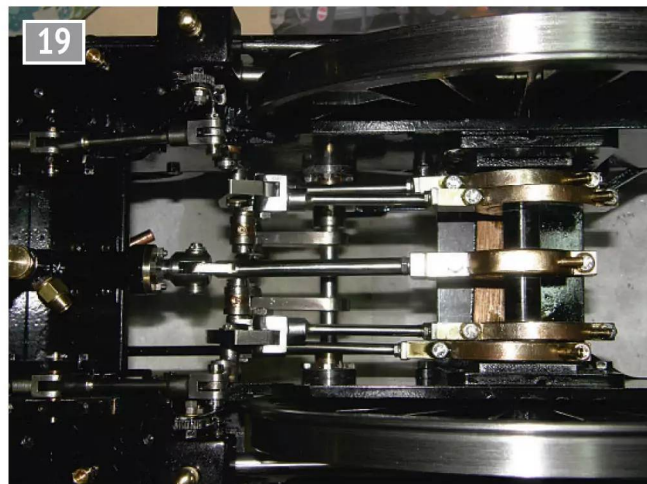
inaccessible once the boiler is in place.

The chassis

In the meantime, I had detailed out the frames and plates (**fig 9**) that make up the chassis to a point where these could go

out for laser cutting (**photo 20**). A bit of filing, some riveting and a little more silver brazing and the kit of parts turned into the basic framework (**photo 21**).

The two inner frames and the front and rear buffer beams are riveted and brazed together



Looking straight down on to the main axle between the driving wheels.

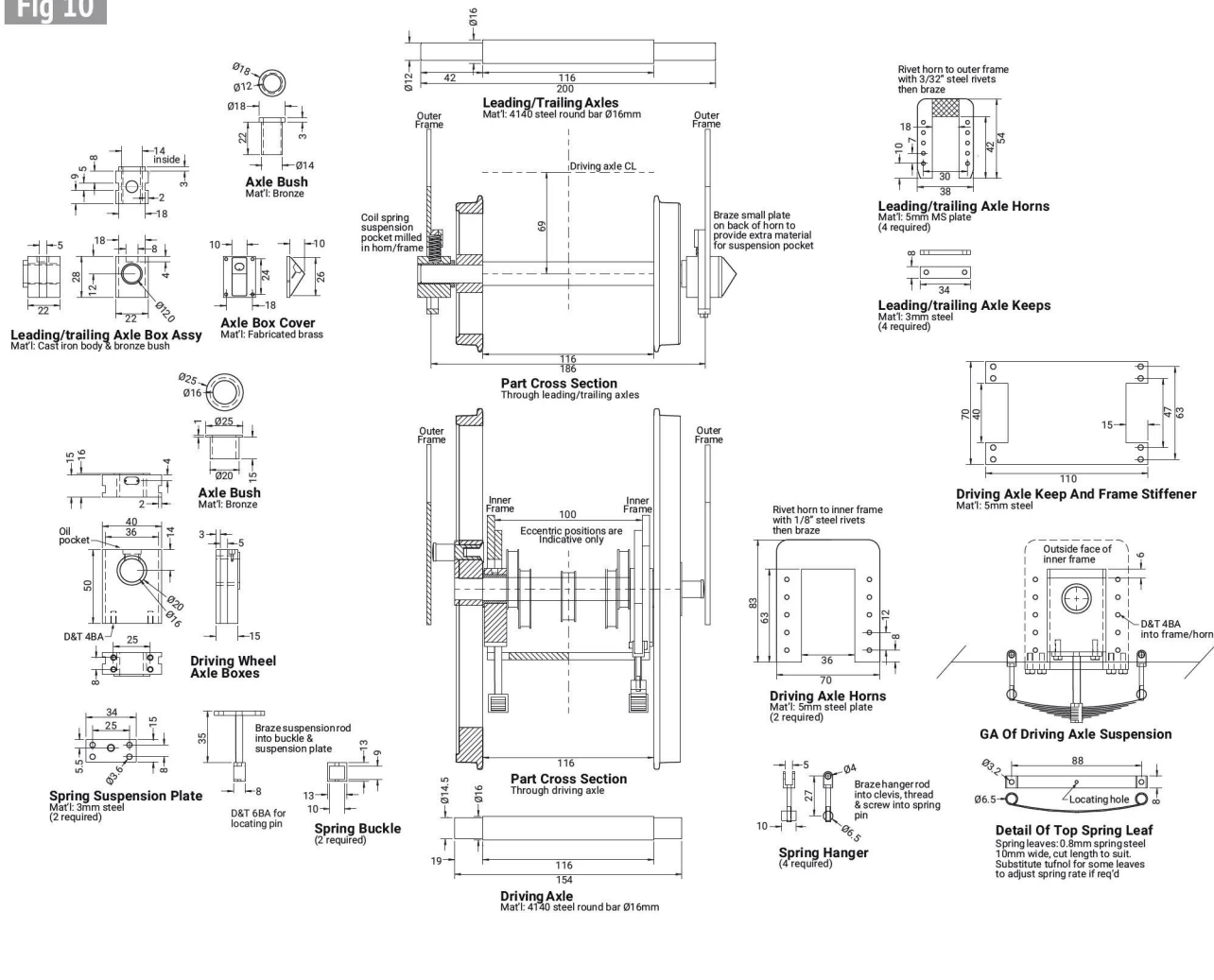


A kit of mild steel plates ready to be put together.



Frames partly assembled.

Fig 10



Axle and suspension details.

to form a rigid central core for the chassis. In addition, there is a vertical and a horizontal frame stretcher that is screwed then brazed across the inside of the inner frames just behind the cylinders, to add even more rigidity. The horizontal stretcher also provides a convenient place to mount the axle water pump. This core part of the chassis is never disassembled again; however, the outer frames and other components are screwed on to it and they are all removable.

The wheel sets had already been completed, so now I just needed to machine up the axle boxes, fabricate two large springs and hangers for the main axle boxes and sort out a few other minor fixtures and fittings (fig 10).

This was quite an exciting part of the build, because it seemed to go from a lengthy period of head-scratching, problem solving and fiddling with drawings on the computer to something that began to look like a real locomotive surprisingly quickly (photo 22).

I did have some difficulties fitting up the cylinder assemblies which had also been made earlier. As these are turned inwards so the valve chests sit at an angle facing in towards the smokebox, it was a little difficult getting the cylinder mounting blocks silver soldered at exactly the correct angle during initial fabrication.

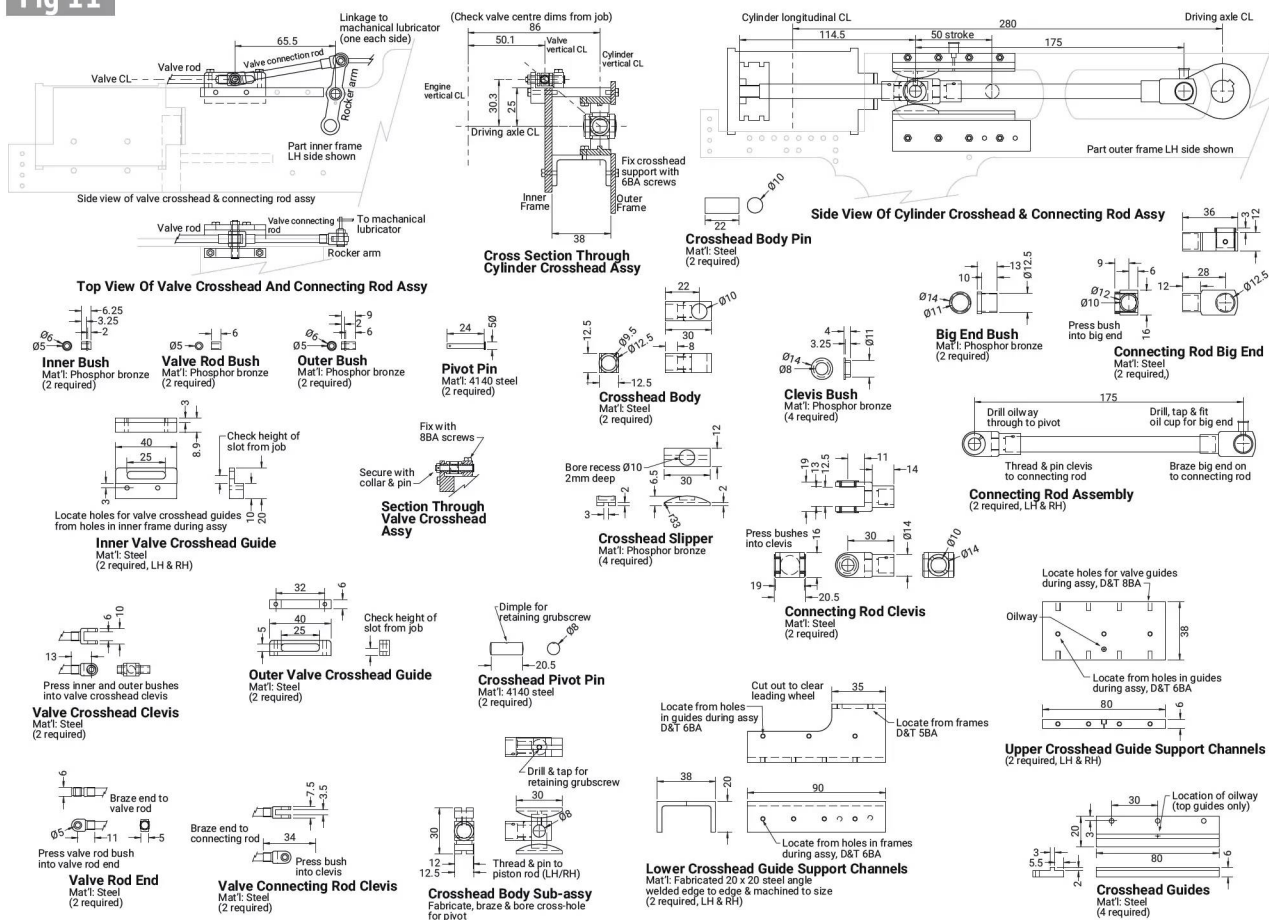
The error I made during fabrication came back to bite me during assembly of the chassis, as the two sides ended

up being slightly asymmetrical and things like the valve centres and the connecting rods did not quite line up as they were supposed to.

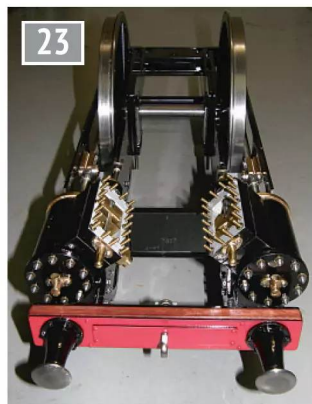
However, some judicious fiddling and application of shims in appropriate places eventually sorted the problems out, and the front view of the



A rolling chassis!

Fig 11

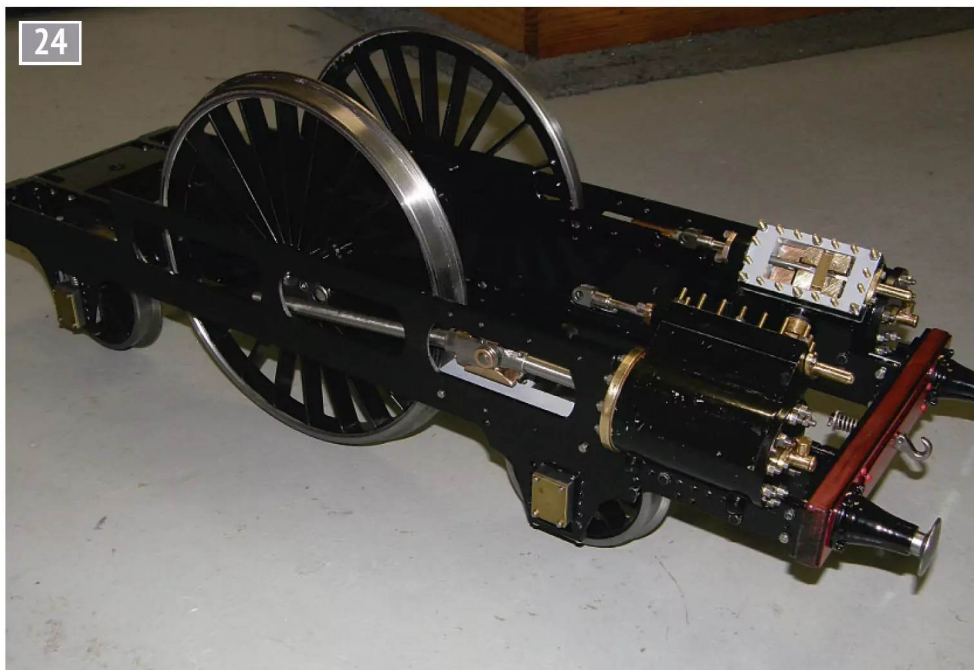
Crossheads and connecting rods.



Front view with cylinders fitted.

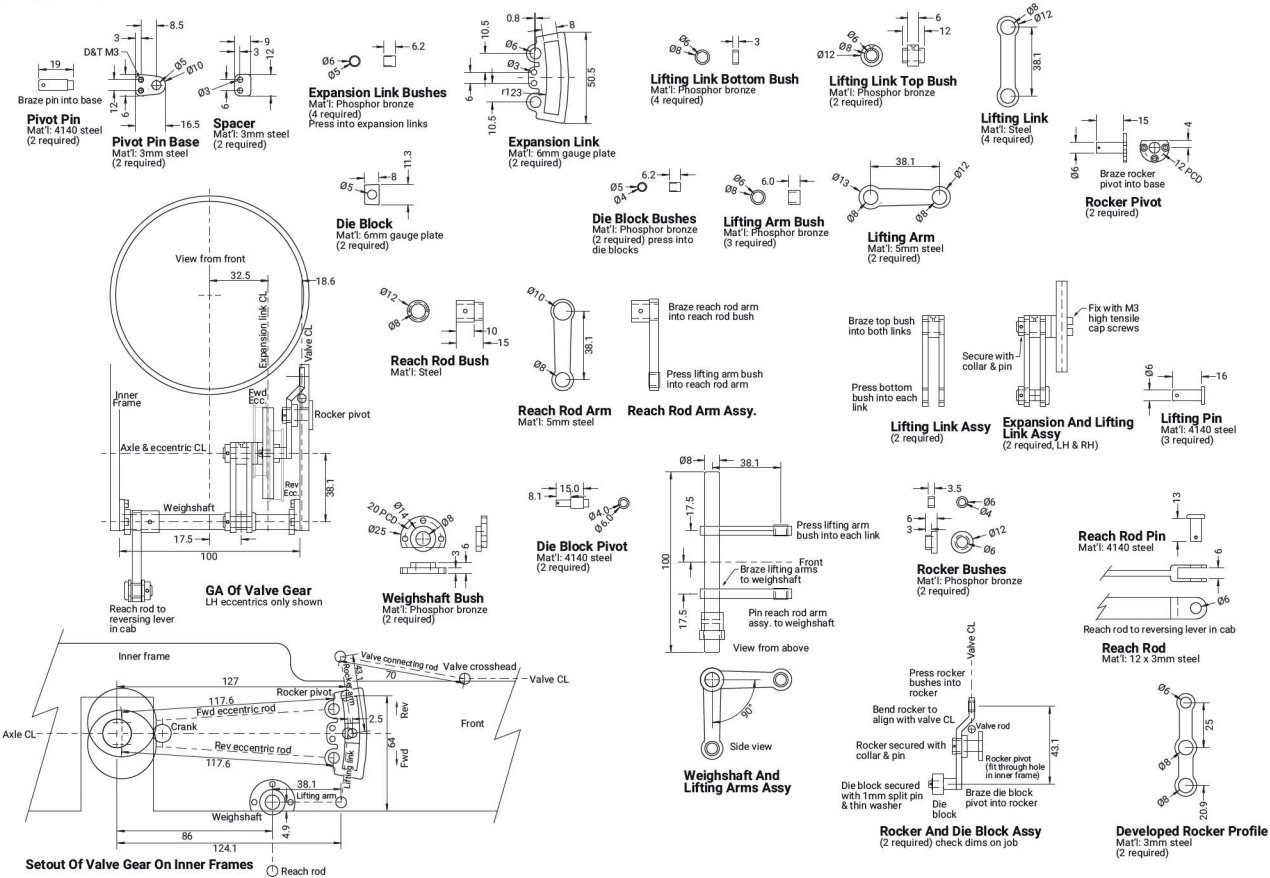
locomotive now looked as shown in **photo 23**.

I finished the crossheads and connecting rods (**fig 11**), which I made as close as I could to the details I could see in the photos, as these are very prominent and visible features of Cornwall (**photo 24**).



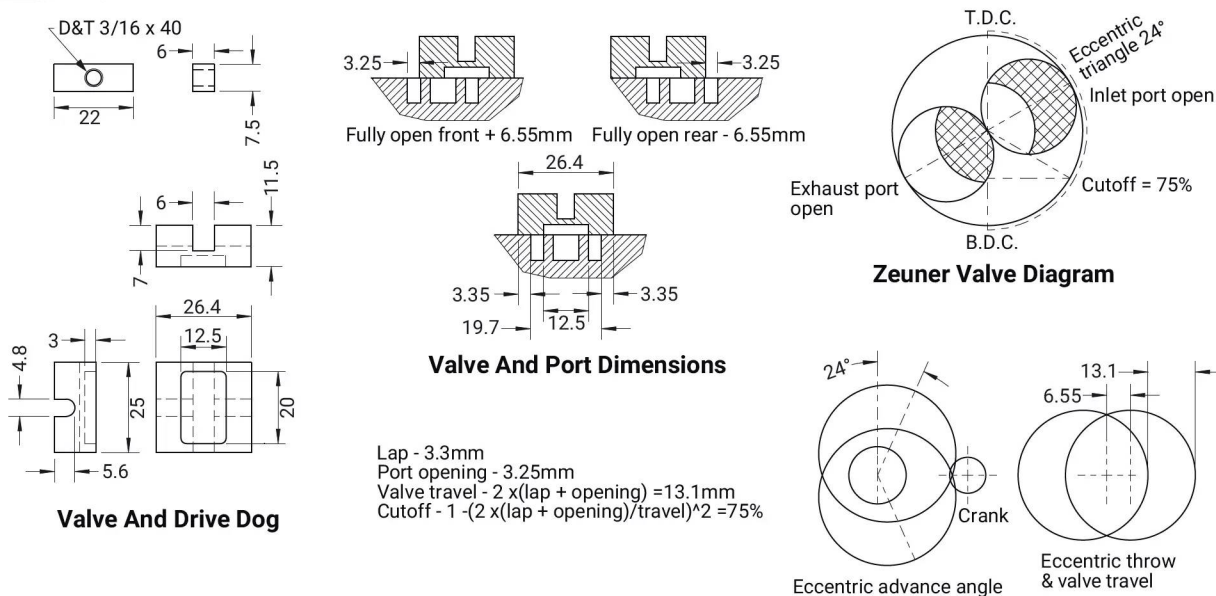
We now have a rolling chassis with cylinders fitted and pistons that go back and forth as the wheels go round. Progress indeed!

Fig 12



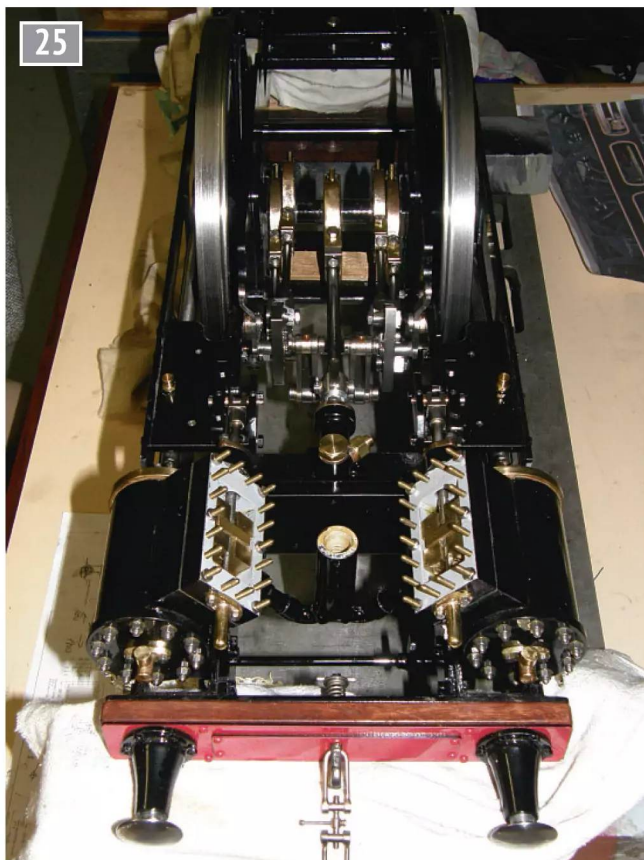
Details of the valve gear.

Fig 13



Valve timing.

25



Here is the almost completed valve gear seen from the front of the locomotive.

In late 2019 there was a disruption to progress caused by the arrival in my workshop of a certain *Flying Scotsman* locomotive, which diverted my attentions for some time. But that is another story!

The valve gear

When I finally got back to *Cornwall* after completing the *Flying Scotsman* project, there were some fairly tricky details to be sorted out with the valve gear. This all needed to fit in between the frames, and as previously mentioned regarding the valve eccentrics, the valve gear must not foul the bottom of the boiler, sitting between and just above the main axle.

I drew up the valve operating mechanism in considerable detail and checked the design parameters against the formula and procedures given in Don Ashton's book *Design Procedures for Walschaert's and Stephenson's Valve Gear* (fig 12).

I also ran the design parameters through two versions of valve gear

simulation software, which are available free on-line from Charles Dockstader and Dr. Allan Wallace. I used the information obtained by fine-tuning the simulations to determine the exact lengths of the pivot arms and the correct placement of the pivot points, and to determine the optimum advance angle for the eccentrics.

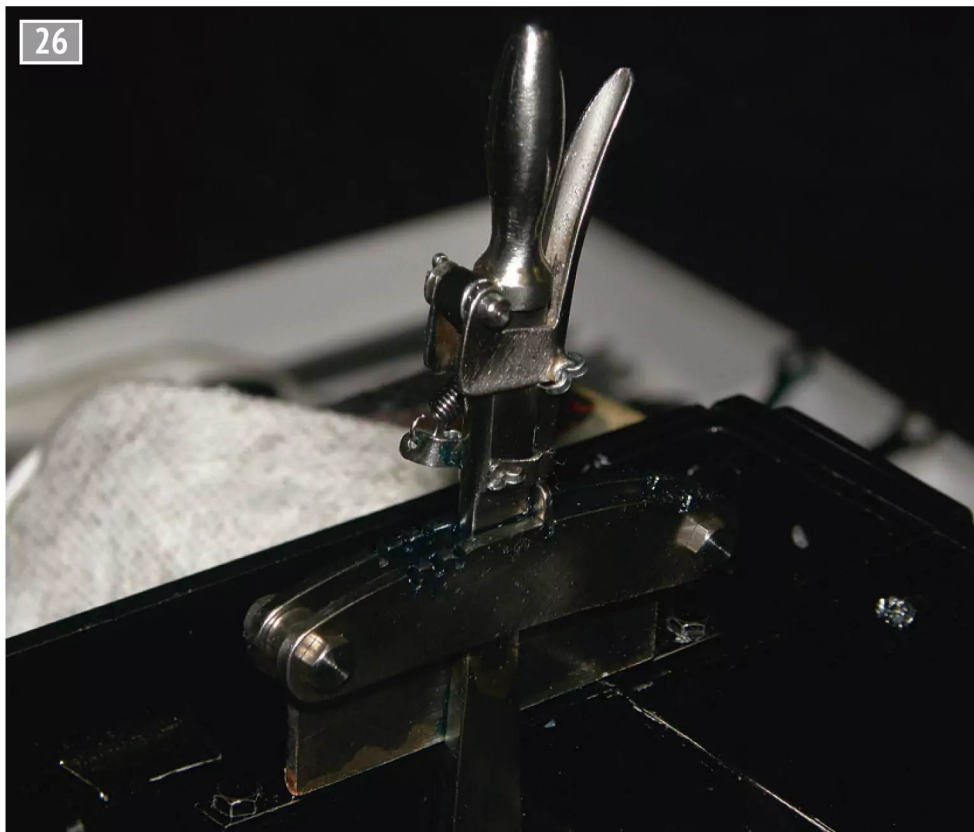
I even went so far as to draw a Zeuner Diagram showing geometrically the timing and cut-off I should expect, as shown in fig 13. The Zeuner diagram shows the relative opening of the ports (the hatched areas) as the crankshaft rotates through a complete cycle from top dead centre (TDC) to bottom dead centre (BDC) and back. This was a method of analysing steam valve gears developed by German engineer Gustav Zeuner in the 19th century, nowhere near as sophisticated as more modern valve gear analysis and certainly not as useful or accurate as the software simulations, but an interesting exercise nonetheless.

In the centre of photo 25 is the small axle-driven water feed pump, with the left and right-hand side valve gear sandwiched in beside it. The motion for each valve rod is brought up from the die block down below via a cranked pivot arm.

Missing in photo 25 is the remaining connecting linkage between the rocker arm and the valve rod crosshead – this is still a work in progress. The reversing lever, however (photo 26), was added at this stage.

The valve gear was probably the most difficult although not the most fiddly part of the locomotive. That was because I was trying to get a somewhat overscale design to fit into a very limited space between the frames and under the boiler. In the end, I think it has turned out to be quite robust and should provide smooth and reliable running (I hope!)

26



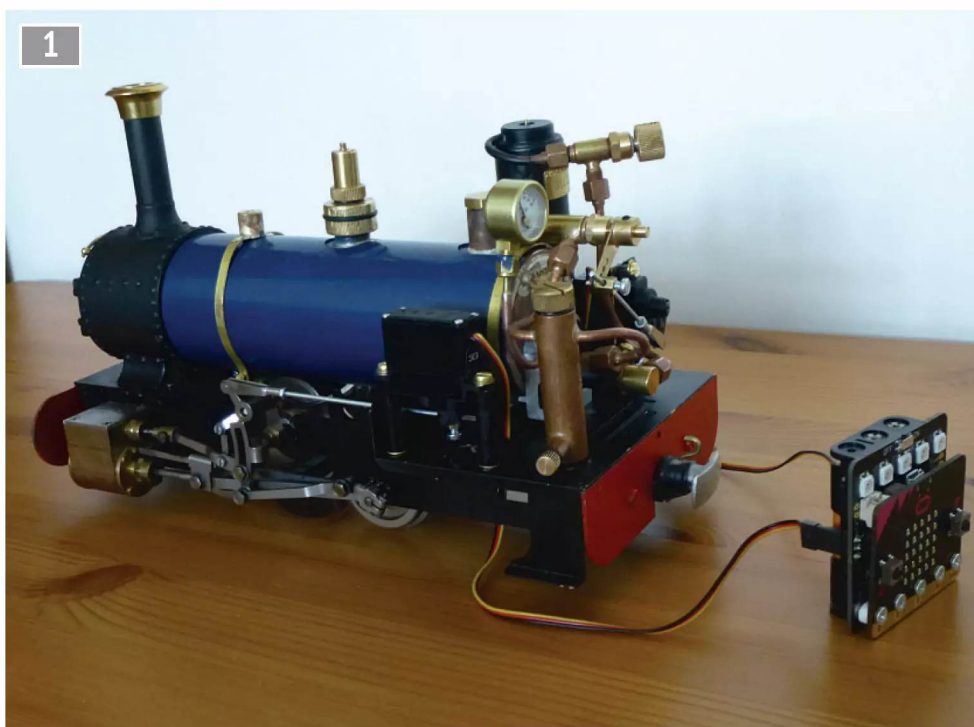
A close-up of the reversing lever, fitted to the frame at the rear where it will be accessible inside the cab.

● To be continued.

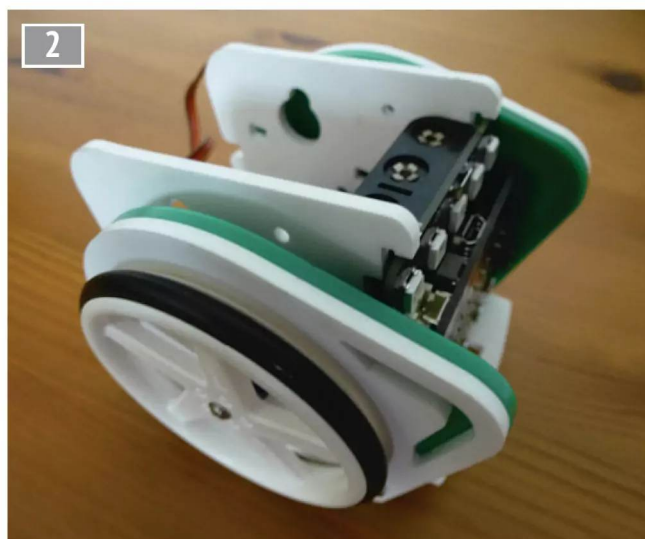
G1 or 16mm Locomotive Radio Control using BBC micro:bit Computers

Malcolm Batt

shows that building your own radio control system need not be complicated.



Roundhouse Kate before fitting cab showing control servos fitted.



Kitronik Move 2 robot.

Introduction

This article describes a method of using a pair of BBC micro:bit computers to provide an economical radio control system for Gauge 1 or 16mm model steam locomotives.

The project started during lock down when I decided to build a 32mm locomotive to run on the track at the Wimborne Model Engineering Club. I started to develop a loco of my own design but being new to this gauge (my previous build was a 5 inch Sweet Pea) I soon realised the difficulties and complexities of providing the mechanics at this smaller size, so I purchased a set of kits from Roundhouse

Engineering (**photo 1**). This picture was taken during the development phase before the cab was fitted. Although a lot of our members like to buy ready to run locomotives for each of the club's gauges, I like the challenges and satisfaction of running something that I have built. So, when it came to providing a radio control system, the same challenge was there.

As well as being an active member of our model engineering club, I also help run an engineering club at a local school. Our projects, which we roll out to the students, include robotics which are based on the BBC micro:bit computer.

The micro:bit is a credit card sized microcomputer and includes a microphone, an accelerometer, a matrix display, a compass and - very useful for this project - a Bluetooth radio interface, which enables a pair of micro:bits to talk to each other. All this of course uses mobile phone technology at a very affordable price. Although I have provided some notes on the construction of the Roundhouse locomotive, the article is mainly based on the development and construction of the radio control system.

Radio control System using BBC micro:bit computers.

This project evolved from the requirement to remotely control a 16mm steam locomotive following my experience with the school robotic products. The first check was to ensure that the Bluetooth radio had sufficient range to cover the whole of our track, a maximum distance of 24m. To do this I took one of our school robots, a Kitronix Move mini Mk2 (photo 2) and placed it on the far end of the track. Using a second micro:bit, I was able to control the functions of the Move mini giving me confidence to proceed with the development. For those interested in availability of these microcomputers and associated products, Kitronik provide a vast wealth of items on their website, see kitronik.co.uk.



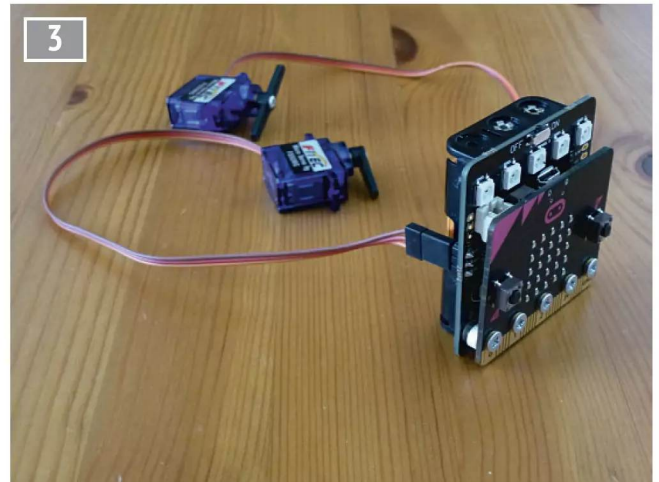
Kitronik



micro:bit

Before I describe the radio control system in detail, let's look at how the micro:bit is used. This credit card sized microcomputer does not have an embedded operating system. Programming is performed on a PC or laptop connected to the online development system. Go to micro:bit.org and click on the MakeCode tab. I used the Block program option which has been developed for schools so should be found easy to use for anyone with some computer literacy. The programming language uses a system of blocks which are dragged from a menu and will where appropriate link to each other. For instance, if you drag a 'For Loop' into the program, a conditional statement can be dragged into the loop and will attach automatically. Log in to the URL and try it out for yourself. You don't even have to have a micro:bit to start with as a visual simulator shows what is happening on the left side of your screen. The micro:bit comes with two buttons, A and B, which provide three input options, i.e. pressing A, B or A+B, and three major input and output pins. However, in developing my radio control I used an edge connector breakout board from Kitronik, stock code 5601B. As well providing a convenient method of mounting the micro:bit it gives access to all the smaller connecting pins providing additional functionality, including operation of the buttons A and B via additional push button switches and an analogue input which I will be using on the handset.

Having developed a program, one clicks on the Download tab which puts the assembled program into the Download directory of your PC. Once downloaded, the micro:bit computer can be connected to a USB port on your PC using the lead provided and the assembled code will automatically load by dragging and dropping the file to the micro:bit logo shown on the relevant USB drive.



Kitronik servo driver board with servos attached. Note the position of the brown wire.

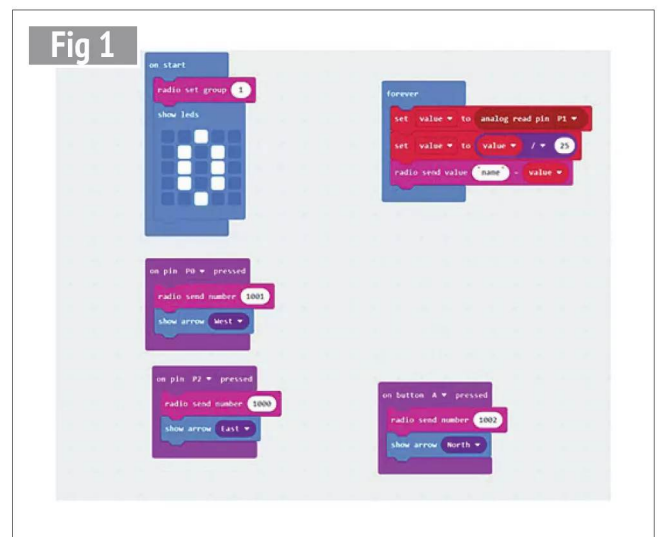
Note: The MakeCode facility is an online compiler which converts the graphical program into machine code, a series of numbers which control the functions on the microprocessor.

The final link in the development was the availability of the Move mini servo driver board. This is available separately from Kitronix, stock code 5623. This board includes a three-cell battery holder, a mounting for a micro:bit computer and the necessary connectivity to directly plug in a pair of standard model aircraft servo motors (photo 3). We will see later how I adapted the micro:bit and server driver board to fit into the Roundhouse model while the

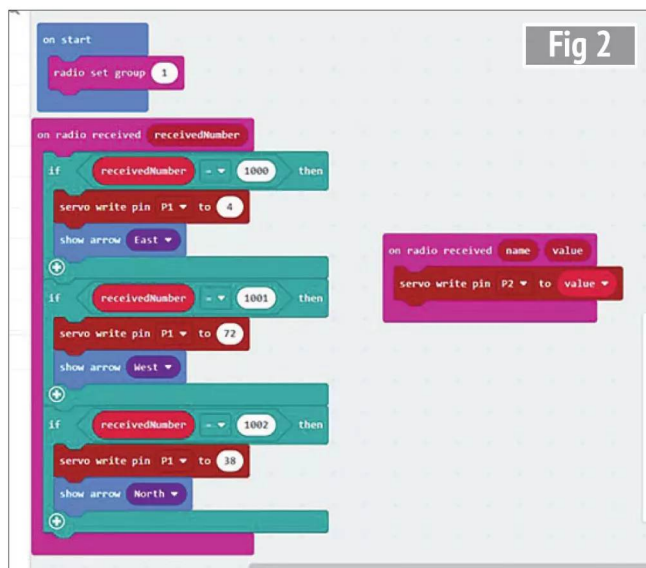
final associated handset had three push buttons giving Forward, Midgear and Reverse settings to the valve gear and an infinitely variable control for the regulator.

Programming the micro:bit computer

The following describes the programs used. There are two programs described, firstly the handset, i.e. the transmitter and secondly the receiver and servo controller. Figure 1 shows the program for the handset. There are five individual program blocks which means there are five separate processes running at once. The first block sets the channel number of the Bluetooth transmitter which I have set to channel 1. There are up to 255 possible channels



Micro:bit program for handset.



Receiver program.

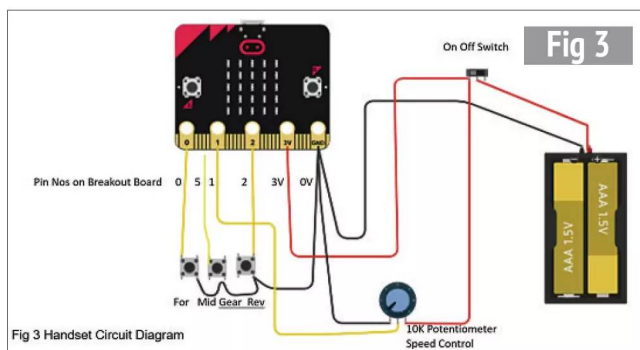
available so you can choose an alternative number if more than one locomotive is being controlled at the same location.

The next three blocks set inputs to pin 0, pin 2 and to the Button A input. These three pins on the micro:bit will be connected to 0 volts via push buttons. These buttons set the reversing lever on the locomotive to Forward, Mid Gear or Reverse. To send an instruction to the locomotive, code 1000 sets forward, 1001 reverse and 1002 mid-gear respectively. I have added an instruction in each block to display an arrow in the matrix display on the micro:bit, i.e. forward (west) mid-gear (north) and reverse (east). Although

not seen inside the completed assembly, they provide a useful diagnostic aid.

The final block shown to the right of fig 1 transmits code to the regulator servo to set the speed of the locomotive. A 10kohm potentiometer in the handset applies a variable voltage between 0 and 2 volts to the analogue input on pin 1. An additional line of code within the block divides the input by 25. This is because on the Roundhouse model the regulator only needs to move by a relatively small amount. This number will need to be established by trial and error to suit a particular model.

The program for the receiver and servo driver is shown in



Handset circuit diagram.

fig 2. Here there are three blocks of program which run concurrent processes. The first block merely sets the radio channel of the receiving micro:bit, to channel 1 to match the setting of the transmitter.

The second block controls the reversing lever servo. There are three numbers transmitted: 1000 for forward, 1001 for reverse and 1002 for mid gear. These are tested by the 'if' statements and the number of degrees in each case deflects the reversing servo is written to output Pin1. In my example I have used 4 for reverse, 72 for forward and 38 for mid-gear. Again, the actual deflections need to be determined by trial and error to suit the model.

The third block of instructions controls the regulator servo and writes the required deflection angle transmitted from the handset to the regulator servo.

Construction details

For the handset a suitable sized plastic case was sourced. In this design the case used was an ABS Enclosure - 142x80x30mm, ordered from CPC (cpc.farnell.com) under part no: RTM2030/30-GY.

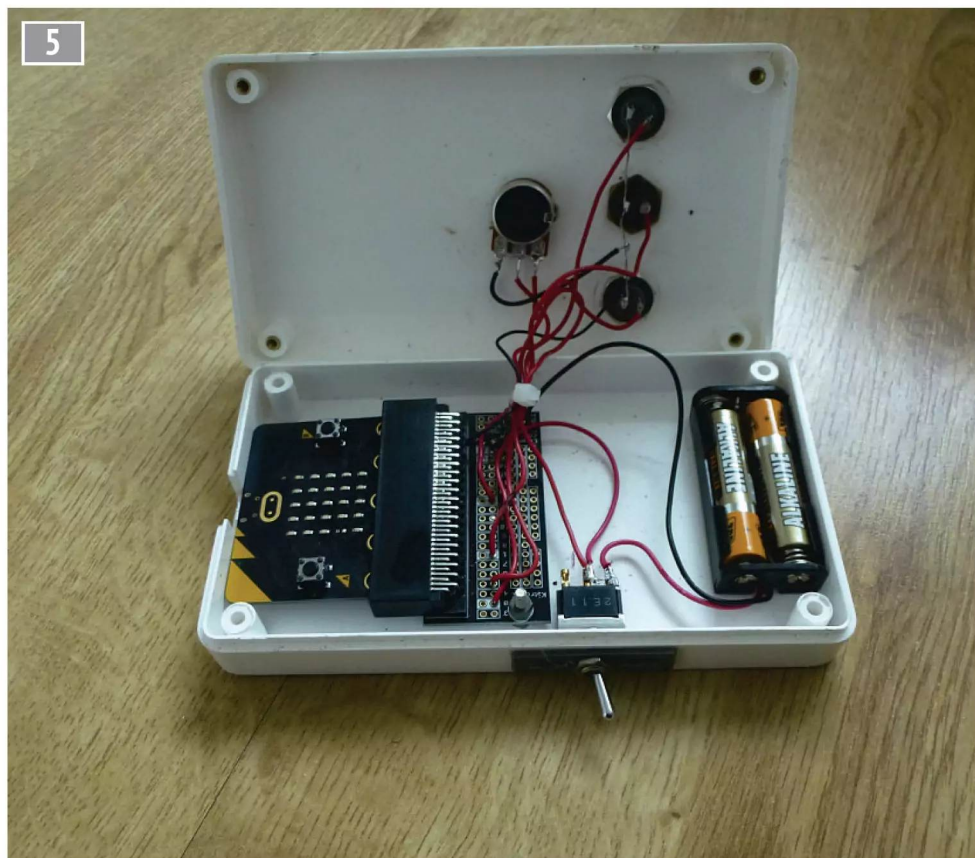


Completed handset.

There are of course many similar enclosures to be found online. The completed handset is shown in **photo 4**. The micro:bit edge connector complete with the micro:bit computer was fitted into the case near the top and the other components fitted as shown in **photo 5**. The actual circuit is wired as shown in **fig 3**. It will be necessary to solder connecting wires to the breakout board before fixing it into the case. The two cell AAA battery holder was glued to the case and a slot cut in the case adjacent to the USB socket on the micro:bit to allow connection of the USB cable in the event of needing to make a software update. This slot can be seen in photo 5.

The receiver this is simply the Ktronik servo driver board with a micro:bit fitted. The fixing is by five M3 screws which pass through the five large holes in the micro:bit into connected thread inserts on the servo board. The servo board also includes a three cell AAA battery pack and two sets of pins which allow connection of standard radio control servos (see photo 3). With the receiver program loaded, this receiver module should function and in this form can be used to check full operation. When connecting the servos however it is necessary to ensure their connectors are fitted the correct way round. Of the three wires connecting each servo to its connector, one is the common rail and is colour coded either brown or black. The connector should be orientated so the common wire is nearest to the end of

5



Handset interior.

the micro:bit with the USB connector as shown in photo 3.

If the model is large enough or the receiver can be fitted into a trailing truck, nothing else needs to be done, however, to fit the receiver into a Roundhouse locomotive such as their Katie model, some modifications are described. In addition, when ordering a model (or a kit) from Roundhouse, it is necessary to include their R/C extras. Included are two brackets which bolt to the cab floor to which aircraft type servos can be fitted and a modified regulator valve with a coarse operating thread which ensures complete operation from off to full stream within the limits of the throw of the servo actuator. As model aircraft servos can vary in size it is recommended to use those specified by Roundhouse.

The Roundhouse model has two compartments to house the actual control receiver equipment, a compartment

under the cab floor to house the actual receiver and a second compartment under the cab roof housing the batteries. These compartments are designed to house a conventional aircraft style receiver, but the micro:bit computer and servo driver will fit into the compartment under the cab floor providing the battery holder is removed from the servo driver board. It was found that the full range of operation continues to be satisfactory with the micro:bit in this position. The battery holder is held onto the servo driver board by two screws but to remove it it is also necessary to unsolder the two interconnecting pins from the board. With the battery holder removed two lengths of wire should be soldered into the pads on the PCB, one red and one black corresponding to the positive and negative connections. With the servo connections in place, the assembly can be fitted into the lower

compartment. Roundhouse suggest fitting a slider switch in the compartment adjacent to a slot in the frames to provide an on/off switch. Unfortunately the micro:bit assembly is slightly larger than a standard radio control receiver so arrangements have been made to isolate the batteries at the battery box.

Finally, the battery box is fitted to the compartment in the cab roof. This compartment is designed to hold 4 AA batteries but only three are required for our receiver. In my model I used AA batteries fitted to a three cell battery holder purchased online. These holders come fitted with male and female studs to accept a standard battery connector. It is possible to obtain a battery holder complete with switch or the batteries can be isolated after use by simply unplugging the connector. A standard connector comes with a short length of red and black connecting wires. These are

not long enough to connect directly to the servo driver board so inline joints to the wires previously connected to the PCB are required. Heat shrink sleeving is included in the Roundhouse kit to insulate the joints.

There should not be a lot of trouble getting the control system to work as the parts from KitroniK have done the difficult tasks. However, you will need to adjust the positioning of the reversing rod and the regulator operating rod in the model. Final sorting of the regulator settings will need to be completed with the loco in steam. It may also be necessary to modify the adjusting numbers in the software, e.g. the divisor in the analogue input command in the handset and the output servo movement commands in the receiver software.

Conclusions

Having used the BBC micro:bit computer for various school projects, it led to the development of the radio control system described here. The actual project was made very easy due to the use of the KitroniK servo driver board and the relatively simple software and associated commands to provide the relevant controls. Further projects could evolve from the application of these micro:bits, for instance KitroniK also provide a motor drive board to provide control for small DC motors. This would lend itself to control battery locomotives of similar gauges. These motor drive boards provide a number of other output terminals which could be deployed for lighting or sound effects. It may be possible to amplify the motor drive outputs from this board using MOSFET transistors to control much larger motors to control a 5 or 7¼ inch locomotive using a remote handheld controller without the usual umbilical cord and there could be numerous applications to be found for this basic microprocessor in the future.

ME

Grinding the Tarcutta Camshaft

PART 2

Gerard Dean

makes a pair of camshafts for his V12 motorcycle engine.



Continued from p.437
M.E.4739 March 22

There's an old Aussie tradition – never let the facts get in the way of a good yarn!

Recapping on the first epic chapter, it was plain even to me, as the master of rough enough is good enough, that I had to make the Tarcutta camshafts 'correctly' and not simply Loctite a few cam lobes on a shaft. Still, the prospect of making so called real camshafts didn't worry me too much – after all, if Mercedes Benz and Kawasaki can make camshafts, anyone can. So, what to do?

When doubt fills the air, fate often plays its hand and thus it came to pass that Chloe, our International Sales Manager, asked if we could buy a machine tool to make precision setting masters. The setting master (**photo 7**) is used to set MP44 Can Gauges in manufacturing plants worldwide. The setting master is made from 440C magnetic stainless steel which machines and grinds well, hardens up to 58HRC, resists corrosion from



A precision setting master.



Demonstrating the new grinder.

operators with acidic hands and is stable over time.

I was about to roll my eyes and put the kibosh on Chloe's idea when an evil thought popped into my head – maybe this machine could make my Tarcutta camshafts. So it came to pass a Universal Cylindrical Grinder was ordered complete with every attachment for around Aussie \$125,000.00 (about the equivalent of four Big Macs from a London MacDonald's store). Several months later the grinder arrived. Neb, the boss of the machine shop was smiling until he saw me and quietly shook

his head. I knew why – he didn't want a Wimmera wheat farm boy in size 13 steel cap boots destroying his new toy.

Here we see Neb demonstrating our new grinder to Brittany (**photo 8**).

A word on the side about them is in order. Not long after Neb started at the company a rumour got around that he was in the top three machinists on the planet. As for Brittany, she not only machines and builds precision measurement systems, she installs them in Europe and the USA. If you do ever run into Brittany, remember she finished on the podium at the World Shotgun Championships on the EJ Churchill Range in England in 2019 so it pays to be polite to her – especially if she hints her 12 gauge is in the car. As for the rumour about our mate Neb, it turns that in good Aussie fashion, he started the rumour himself!

Still, Neb did step in to save me when he announced the new grinder had averted a major stuff up because he was able to grind a part for an urgent shipment to the USA. This impressed those who



Home-made camshaft grinder.

must be obeyed in the front office, my wife Annie and the formidable Raelene, so honour was preserved on all sides. Except, I still had to grind my camshafts. What to do now?

Well, the trusty internet came to my rescue and showed the path to glory – build a rocking camshaft grinder using a six inch bench grinder. A rocking cam grinder utilises a master cam that is locked to the camshaft being ground. The 1:1 scale master cam lobe rotates against a rolling master wheel that is approximately the same diameter as the grinding wheel, thereby ensuring a reasonably accurate copying process.

I cut the left shaft off a A\$99 Ryobi six inch grinder and made a guard for the 180 mm diameter grinding wheel. The grinder is mounted on two linear bearings so it can be moved from cam to cam and back to the diamond dresser when required (**photo 9**). An M8 bolt locks the grinder in place during grinding.

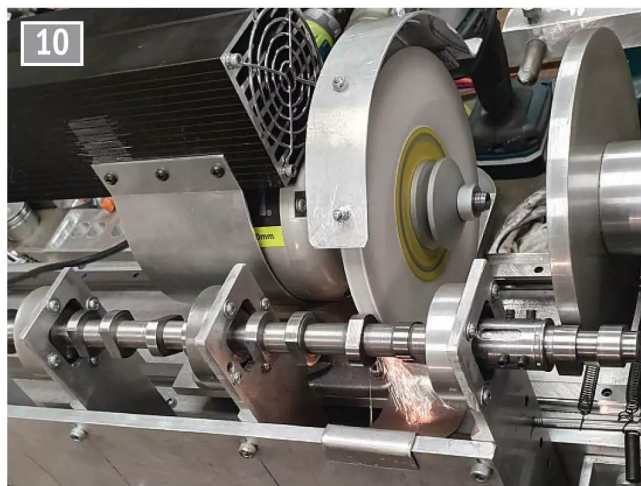
The cam blank is turned from 25mm precision ground 4140 steel shafting. This steel is easy to machine, grinds well and doesn't distort when put through a low temperature nitride hardening process. The shaft runs in 25mm inside diameter ball bearings which are bolted to the rocker assembly. On the left end of the camshaft a 24V DC motor running off a motorcycle battery rotates the camshaft and master cam. Around

20 RPM was scientifically calculated as the optimum rotational speed ... either that, or it just so happened that the motor I scrounged (stole) from work was 20 RPM.

An XY table holds the master wheel and the diamond dresser. The front hand wheel direction dictates the final depth of cut on the cam lobe and the depth of cut on the diamond dresser across the grinding wheel.

Now comes the time to fess up to outsourcing to a superior knower of things camshaft. I needed a master cam for my grinder. Asking around it turned out that Clive Stenlake from Clive Cams in Melbourne has made camshafts for some of Australia's most powerful cars – the mighty Holden and Ford V8 muscle cars. His camshafts powered many supercars down the mountain in the Bathurst 1000 km touring car race at Eastertime. When I went to visit Clive he mentioned he'd glanced over my book *Der Tiger*. My delight was short lived when he said he had grave doubts about my model camshaft manufacturing methods.

He asked me to describe the Tarcutta motor – 1450cc, inline vertical valves, small inlet and exhaust ports, supercharged ... then went into a trance and started muttering numbers – 108, 109, no too small, 112, no 111 degrees lobe separation angle ... and so on and so on.



The grinder in action.



Milling a cam lobe.



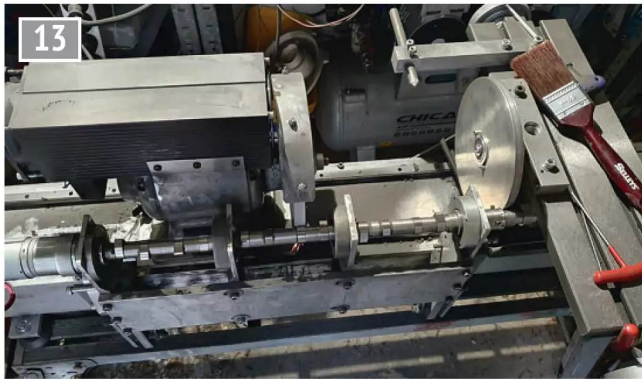
Grinding a lobe.

Several weeks later my master cam arrived complete with digital printout of the cam specifications. On receipt of the master cam, I mounted it on a rotary table and milled six reference dimples to allow indexing of the camshaft to suit the six cylinders on each bank.

In **photo 10** the rocker holding the rotating camshaft

and master cam is pulled against the master wheel via spring force. Once a cam lobe is completed, the locking grub screws are loosened to rotate the master cam ready for the next lobe.

Note the diamond dresser in the rear of the grinding wheel. The wheel is dressed between each cam grind.



The grinder in residence in the garden shed.

Initially I left the camshaft lobe fully round, but it took hours for the grinder to remove the extra metal which grooved the grinding wheel and overheated the Ryobi. Two things were done to fix the problem. Firstly, I roughly, and I mean roughly, milled the cam lobes around the base circle (**photo 11**). Secondly, a cooling fan was fitted to the Ryobi. Both measures reduced grinding time on the remaining

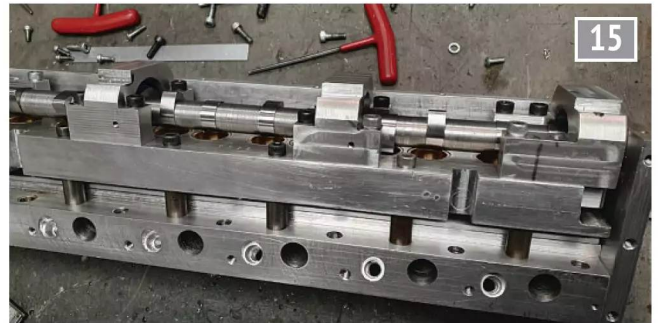
23 lobes and kept the Ryobi cool (**photo 12**).

The prospect of the grinding dust from 23 cams covering my workshop prompted moving the grinder into the garden shed so that the ring-tailed possums and spiders could help out (**photo 13**).

The result – a pretty cool camshaft (**photo 14**)! I must fess up that I ended up making three camshafts because someone who shall remain



The finished camshaft.



The camshaft installed in a cylinder head.

nameless made a mistake indexing the master cam and ended up with one cylinder where the exhaust valve opened before the inlet valve.

With the cams ground and nitrided, it was time to start installing them in the heads

(**photo 15**). The cams push on hardened buckets with shims on top of the valves for clearance adjustment.

More to come – one day!

ME

Thixotropic Metals – ‘Alloy 14’

Geoff Theasby brings us bang up to date with the latest from the labs.



A bit of news not found in the metallurgy mainstream - hurrah! for the independent journals that grace our bookshelves. Unfunded by modern risk-free culture, this is a discovery which may be as ground-breaking as the qualities of graphene.

In a ground-breaking discovery that has left the scientific community both baffled and amused, researchers have unveiled a new class of materials that defies the laws of physics and challenges our understanding of metallurgy. Say hello to thixotropic metals – the liquid-solid hybrid that's set to reshape the way we perceive the rigidity of traditional metallic structures – provisionally named 'Alloy 14'.

Thixotropic metals, a term coined by imaginative scientists with a flair for the dramatic, are claiming to be the next big thing in materials science. According to the researchers,

these metals have the unique ability to transform from a solid to a liquid state and back again, seemingly at will. Forget what you know about the classic properties of metals; thixotropic metals are rewriting the script. Consider a material that is soft when machined therefore easy to turn in a lathe or mill and hard when it has to be supportive; or road surfaces that are hard wearing in use but offer grip to the tyres of a 4x4 traversing a difficult landscape. Michelin X tyres of decades ago exhibited a similar behaviour, known as 'cling rubber'.

Picture this: you're constructing a building with thixotropic steel beams. During normal conditions, they stand tall and rigid, supporting the structure with the strength of conventional metals. However, when faced with an earthquake, the thixotropic magic kicks in. The steel beams start flowing like a river, allowing the building to sway gracefully with the

seismic waves. Once the threat is over, the beams seamlessly solidify once again, leaving onlookers scratching their heads.

In an exclusive interview with the lead scientist behind this revolutionary discovery, she exclaimed, "Thixotropic metals are the future! We stumbled upon this incredible property while mixing coffee in the lab one day. The spoon just seemed to dance through the metal alloy and that's when we knew we were onto something big."

The applications of thixotropic metals are purportedly endless. Imagine a car with tires made of thixotropic alloys that can adapt to road conditions on the fly, transitioning from a solid state for maximum traction to a liquid state for a smoother ride. The possibilities are as wild as they are scientifically curious.

www.sciencedirect.com/topics/engineering/thixotropic-material

www.avontyres.com/en-gb/classic-tyres/textile-radial/

ME



Thixotropic materials



Cling rubber tyres

SMEE News

Nuts and Bolts (How hard can it be?)

Martin Kyte has the latest from the Society of Model and Experimental Engineers.



SMEE

We use them all the time and probably don't give them a second thought except maybe when tackling a cylinder head. SMEE's Engine Builders Group was treated to a fascinating lecture recently that gave us pause for thought. David Harvey was persuaded to come and talk to us about his 40 year career in automotive fasteners and we soon realised there was more to the subject than we may have assumed.

After apprenticeship David completed a degree at Birmingham University and joined the Toolroom at GKN as production controller and ended his career as vice president of manufacturing and automotive supplies via a few other companies. This makes him officially a 'telezygologist', a word that you will no doubt instantly forget but describes himself as "knowing a bit about nuts and bolts".

A quick run through of manufacturing technologies with videos of multistage cold heading and thread rolling machines using parallel grooved and hardened dies throwing out 250 parts per minute set the scene. David then moved on to design considerations pointing out the desirability of being able to use the same tool to tighten multiple fasteners and ideally to the same torque, speeding up assembly and saving cost. Anyone who has used a Bridgeport will realise what a blessing it is to use the same spanner to make all adjustments. Rationalising the number of different fasteners saves cost in storage and is more competitive when buying stock. The XJS originally had 1650 different fasteners excluding the engine but in its later derivation, the F Type, that

number was down to 350. So you can see that thoughtful design of fixings is well worth the effort.

After a run through of coatings for corrosion resistance thread locking and pre-lubrication we settled down to review a test case of seat belt bolts at a major car manufacturer. The originals were 7/16 inch with a nylon 66 patch for vibration resistance. The installation was into a semi trimmed vehicle so no oil or dirt could be allowed to come off the coating and soil the assembly team's hands as the interior and the bolt had to be able to be removed and replaced up to five times in the event of seat belt repair. This design had its issues. The bolts were not being finger started and were often driven in cross threaded, easy with such a fine thread, which sometimes broke the welds holding the nut onto the body. Occasionally the bolt would seize before being driven fully home either due to the cross threading or from paint or weld splatter in the thread or if the weld nut was welded at an angle to the axis of the bolt.

The official rework process was twofold. If the nut was still attached then the bolt was removed and the thread helicoiled. If it was detached then the area around the nut was cut out and a repair plate with new nut was welded in. The unofficial rework was to get a bigger power tool and force the bolt home and if that didn't work run a tap into the damaged thread and fit the bolt. In the first case it would have been likely impossible to remove the bolt if needed during the life of the car and the second would have weakened the safety critical fixing. Clearly a broken weld nut

was preferable as that would entail a proper repair.

A number of partial fixes were tried such as better jigs, using a teflon coating to reduce friction, plugging the holes before painting and using anti splatter coating on the nut threads, all of which were expensive and didn't really solve the cross-threading problem. Finally, a frontal attack on the cross-threading issue came up with the solution. A trilobular bolt was to be used in an unthreaded nut. Thilobular bolts have the first few threads hardened and can form their own threads into nuts with plain holes. Cross threading was solved at a stroke. Try outs in the factory showed it was possible to drive the bolts in up to 10 degrees out of true but tests showed that that just resulted in a stronger fixing. Anti-friction coatings (Molykote 7405) reduced the driving force and a reduction to M10 saved weight and cost as well as further reducing driving force. Limiting the Molykote to the first few threads also saved money and allowed the heads to be colour coated which saved fitting caps for decorative trim.

The need for rework disappeared overnight pleasing everyone except the rework team who lost their weekend overtime. With the savings in weight and no rework costs the company saved £1,500,000 in the first year and the system was eventually rolled out to all models and has ultimately become industry standard.

So, simple nuts and bolts? Not so much.

ME

Rust Formation and Prevention in the Workshop

PART 2



Neil Raine explains the formation of rust and how it may be prevented.



The condensation conundrum in the workshop

The conditions necessary for the formation of rust are the presence of iron, water and oxygen. In an engineering workshop, as oxygen and iron are difficult to remove from the equation, the control of corrosion comes down to the regulation of air temperature and humidity. The ideal conditions required inside any building in the winter months are warmth and dryness. When a home is structurally sound, ventilated, insulated, and heated daily it is possible to maintain a fairly constant environment with favourable temperature and humidity. Rarely do workshops achieve this level of environmental consistency. The problem is that in the winter months the environment of many workshops is in a continual state of flux. Attempts to increase air temperature and lower air humidity in the daytime will often completely reverse overnight.

To create a more favorable environment for tools, machinery and oneself in the winter months, the humidity of the air inside the workshop needs to be lowered. One option to lower air humidity is to improve ventilation, just as opening a window or turning on an extractor fan helps to remove water vapour from a steamed-up bathroom or kitchen. The problem is, in the winter months the humidity of the air outside the workshop will likely be similar to that inside. Generally, though, a good through flow of air will be of some benefit. A deeper problem is that increasing ventilation slows the rise in air temperature when the heat source is turned on. In other words, the solution to one problem (ventilation) adds to another problem (lowering of room temperature).

Similarly, attempts to increase the workshop air temperature can have an undesirable effect on water vapour condensing onto the cold metal surfaces. On cold winter days soon after the fire is lit and burning, but before the room temperature has risen, condensation can form in abundance onto cold metal. The explanation for this is connected to the difference in specific heat capacity of the air and the metal. As it takes more energy to heat metal compared to air, the room air temperature rises relatively quickly and the metal temperature lags behind. As the air is warmed, it circulates, contacts the cold metal and the water vapour condenses. It is a conundrum to know what is best to do.

The environment and the situation will not stabilise until air humidity is lowered and both the air temperature and the surface temperature of the iron machinery rise. Eventually, condensation will evaporate off the machinery but this can take many hours. Assuming the building is not heated overnight, and depending upon how well insulated the building is, the conditions the following day will likely have reversed again.

Damp air is quite capable of causing the corrosion of iron and steel even though condensation may not visibly form on the surface. When water vapour condenses into droplets that stay on the surface of metal the conditions for rust formation are more favourable. Even when exposed metal is oiled it is soon capable of showing the beginnings of rust formation with a familiar but undesirable terracotta hue. The surface of iron and steel has many invisible crevices and depressions that are opportunities for water to penetrate beneath the surface of the metal.

As in a home, the best way to manage the internal environment of a workshop is to achieve a balance between damp-proofing, heating, ventilation and insulation. There are cost implications for this, of course, and improvement may not be permissible. Ultimately, the aim is to stabilise the environment and provide some control. Fortunately, controlling the workshop environment and improving the buildings' capability to withstand cold and

Continued from p.441
M.E.4739 March 22

damp conditions is not the only way to protect valuable tools and machinery. The next line of defense is directed to the tools and machines themselves.

Corrosion prevention

Forsaking the use of an alternative material, iron and steel must be protected from the environment otherwise it will corrode, it wants to corrode. Protective barriers can be divided into those that are temporary or permanent. Articulating machine parts, magnetised parts and parts that pose a risk of toxicity (e.g. in food processing) are not suited to receive a permanent coating such as paint. In some instances only, particular temporary coatings will be permissible. Some examples of temporary coatings include oil, grease, paste-wax, Waxoyl®, WD40® and physical covers. Temporary coatings tend to be translucent and this allows the metal to be inspected regularly. There are also many options for permanently coating iron and steel. Some examples of permanent coatings include paint, metal electroplating (tin, nickel, zinc, chromium, copper, silver), galvanizing (dipping in molten zinc) (**photo 9**), enameling, plastic coating, and powder coating. One complication of a permanent opaque coating, e.g. paint, is that corrosion can spread beneath it undetected until the damage becomes obvious. The protection of workshop tools and machinery from corrosion is discussed separately below.

Corrosion inhibitors

Corrosion inhibitors are chemicals that offer a different category of protection compared to coatings. The term inhibitor refers to the interference of a chemical reaction(s) that is responsible for the corrosion of a particular material. Corrosion inhibitors target a key corrosive agent(s), e.g. oxygen, neutralising it to reduce its availability. Typically, corrosion inhibitors are solutions that are added to e.g. circulating fluid systems



A zinc-galvanised steel lamppost – a common sight on many streets. The crystalline structure of the zinc plating can clearly be seen.

such as central heating systems. Industrial boilers are often protected by a corrosion inhibitor of the type known as volatile amines. There does seem to be some ambiguity attached to the term corrosion inhibitor. Some products that are described as corrosion inhibitors may actually be better described as coatings or protectants. Perhaps true corrosion inhibitors would be more accurately described as corrosion reaction inhibitors.

Tool and machine care Protecting hand-tools

In the main, engineering hand tools are bare steel. Some new tools may receive a clear lacquer, light oiling or even a temporary wax coating at the factory, but many are left exposed to the air. Stainless steel tools, such as rulers and calipers, definitely survive better in humid conditions as do chromium-plated tools, such as socket-sets and spanners. To prevent rust forming on steel hand tools some type of barrier between the metal and the air, that will not affect the performance of the tool, needs to be applied. The options for this are relatively limited.

Generally, paint is only suitable for tool handles as it will interfere with the normal operation. Grease is a good temporary protectant, perhaps over winter, but it is not practical for hand tools in daily use. Applying a light

coat of mineral oil to hand tools works well but it needs reapplying regularly as the oil transfers readily from the tool to the hands. Another very successful method is to coat the tool with WD40®. Application can be by aerosol spray is but better value from the product is gained by decanting it into a glass-jar and then painting it onto the tool; a used toothbrush serves very well. When the tool is left to dry for a week or two, if possible, WD40® forms a dry invisible coating that can prove to be a more durable rust preventer than using mineral oil. When dry there is no transference of product onto the hands either.

Storing hand tools

There is no doubt it is convenient to leave tools that are in regular use out in the workshop so they are close to hand the next time they are needed. But, any iron and steel object that is left in the open air of a damp workshop will soon start to rust. This includes hand tools and other small items such as pliers, tin snips, spanners, Allen keys, micrometers, calipers, tap wrenches, taps and dies, drill bits, Jacobs chucks, lathe tool cutters and milling cutters.

In many professional engineering workshops, large metal cabinets are favoured for storing tools as they are relatively fireproof and provide excellent security when padlocked shut. The security of expensive tools and consumables in an unoccupied workshop overnight is, understandably, a priority. Unfortunately, when humidity is high, condensation will form on the cold interior surface of metal cabinets and their contents. When security is not so much of a concern, tools will often survive better in a wooden tool-box. Wood absorbs and releases water to equilibrate with the environmental conditions. Wooden furniture exhibits seasonal movement and this is the reason why drawers and doors will start to stick in the damp winter months.

Therefore, wood is a natural dehumidifier although its capacity is not exhaustive. A wooden toolbox will provide better protection if it has a close-fitting lid. Indeed, engineers' traditional portable toolboxes were made from wood and had many drawers and compartments. These were often finely made from good quality hardwood. An economical way to improve tool storage is to salvage a solid wood desk complete with a tower of drawers. When the desktop is removed, or not, the remaining drawers provide a solid readymade partitioned wooden toolbox. When a metal box is used as a toolbox, this can quite easily be lined with thin plywood to help reduce the local humidity without reducing the volume of the space by much. Another strategy to lower local humidity inside a small toolbox is to place a number of the small desiccant sachets of silica-gel that are included with many new electrical items and some other products too.

The environment in which a tool is homed greatly influences its susceptibility to corrosion. Keeping the volume of air low that circulates around tools is an important feature of effective tool preservation. It is better to fill any container to minimise the volume of air that remains inside it. Small tins and jars with good seals are excellent containers for homing small items such as nuts and bolts (**photo 10**). Old tobacco tins were made with a seal to keep moisture inside and preserve the product, but they are also good at keeping moisture out. Larger items such as drill bits, taps and dies etc. tend to survive well in plastic containers with a close-fitting lid (**photo 11**). Tools will always fare better if they are lightly oiled before storage. An occasional light spray of WD40® inside the container and the addition of some silica-gel sachets will help to keep the moisture at bay. For larger items that cannot be homed in a wooden toolbox, e.g. lathe chucks, machine attachments



Small well sealed tins and jars are excellent containers to keep nuts and bolts rust free. Sprayed with WD40® and stored with a packet of silica-gel.



Plastic containers work well for storing larger items such as drill bits. Items were oiled and stored with a packet of silica-gel.



A lathe chuck that was over-wintered, between October to April, in a damp workshop that was heated occasionally. The chuck was old and previously very rusty before being renovated a few years ago – here it is oiled and wrapped in cling-film.

(steady rest, vertical slide, drill chuck, faceplate) and metal stock, one option is to oil the part and then wrap it tightly in plastic film/cling film or place it inside a zip-lock plastic bag removing as much air as possible (**photo 12**). In effect, this is a type of shrink wrapping. The advantages of this method are that the air space between the barrier and the metal is kept very small, the oil film will not quickly evaporate and the clear film allows the condition of the tool to be checked easily without disturbing it. As an example, a lathe chuck that is prone to rusting spent last winter in the workshop wrapped in cling film and survived better than ever before with only minimal surface rust forming (**photo 13**). When tools and the workshop are used infrequently over the winter months, it is useful to periodically check how the tools are doing. This will avoid the disappointment of being faced with a box full of rusty tools come springtime. For a small collection of hand tools or tools of particular

value, it might be worth considering relocating, or sneaking, these into the main dwelling for the winter months.

Machine care – regular use

Engineering machinery is greatly susceptible to the formation of rust as there is a high proportion of exposed iron and steel that is necessary for usual operation. Mostly, these are articulating parts, parts that are manufactured to be completely flat and parts that are used for fixing or holding the work. The manufacturers of machinery attempt to lessen the likelihood of rust forming by coating suitable parts with paint when this does not interfere with normal operation. This extends to coating the centre of gear wheels and the reverse side of lathe face plates. A fascinating film produced by Colchester Lathes Ltd. shows the detailed manufacture of lathes including the protection that is given to the main iron castings (**ref 5**). This included an outer coat of zinc chromate primer, a sealing coat with the appearance of red lead applied to the inner casting, the application of an outer filler coat to achieve a smooth finish on the casting, and finally a painted top coat (not shown in the film). The seemingly outstanding quality of manufacture of Colchester lathes is matched by the survival and use of many older examples today. Painted parts on machines do inevitably get battle scarred over a lifetime by dropped spanners, chuck keys and components.

Although options are limited for protecting the exposed metal of engineering machinery, the formation of rust can be prevented. A film of mineral oil acts as a protective barrier between iron machinery and the water vapour present in air although this protection is not durable enough unless oiling is repeated regularly. Steam locomotives and traction engines were/are inspected and lubricated daily and the bare metal components wiped over with an oily rag when necessary. In every respect, to guarantee the preservation of valuable iron workshop equipment, a similar degree of fastidiousness is required. The wise old mantra of little and often does work very well.

Way oil, slideway oil, or slide oil is a type of hydraulic machine oil that is designed for machines such as lathes, milling machines or any other machine that has a slideway mechanism. Way oil contains an additive called a tackifier that is designed to improve adhesion of the oil onto vertical machine parts and slideways. Because of its adhesion qualities, way oil should offer good corrosion protection. Obviously, way oil is not to be confused with the oil recommended by the manufacturer for lubricating other machine parts such as the headstock bearings and gears of the lathe. When oiling machinery in the winter months, timing is important to ensure there is no condensation on the surface of the exposed metal. Otherwise,

the end result will be a milky looking emulsion.

The internal parts of machines are also at risk of corrosion and are easily overlooked. For example, the gearing on a lathe is usually sealed behind a cover plate and although this will tend to survive quite well, a periodic inspection and oiling will do no harm. Any other components that are contained in a cabinet such as the electric motor, motor mountings, adjustment levers, belt tensioners and pulley wheels will also be regularly exposed to moisture in the air throughout wintertime.

Machine care - long-term storage

For machinery that is not to be used for a number of days, weeks or even months over winter, covering the machine is an option. In theory this seems a logical solution to exclude dampness but there are potential complications. As an example, over this past winter the writer used a type of opaque cover that is designed to protect outdoor furniture from the rain, to cover a quite newly acquired, yet older, lathe. Leaving the close-fitting cover in place for several weeks without checking the lathe, the gasps must have been audible when the cover was finally removed. There was visible surface rust on all of the hand wheels, parts of the compound slide and the chuck left on the machine. It soon dawned the most likely



The chuck on unwrapping after winter and showing the worst area of corrosion.

culprit was the permeability, or lack thereof, of the fabric. Damp air had found its way underneath the edges of the cover, condensed onto the machine and had then become trapped. The failing was in the assumption the machine was well protected, from dust perhaps, and was not checked for a number of weeks. It was noticed most of the parts that had rusted were those regularly touched when operating the lathe meaning much of the protective oil had been transferred from the machine onto the hands. Also, it was the uppermost areas, e.g. hand wheels that showed the most corrosion where it was easier for the condensation to settle and not run off.

Among the many other strategies that might be used to protect machinery from dampness, the possibility is that it may be better to leave a machine exposed to the air. The advantages of this strategy are that air will circulate around the machine much better and on warmer days any surface condensation will evaporate. If feasible, some direct daylight through a workshop window will be beneficial. But, perhaps the greatest benefit of not using a cover is that the condition of the machine can be reviewed daily, if possible. It is surprising how much of an obstacle it becomes to take off a cover and then reapply it only for the sake of checking for rust. For smaller exposed areas of iron such as the table of a pillar or pedestal-drill, in addition to oiling, covering the surface with an oily-rag can work very well. Collecting rags that are used for wiping oily hands and machinery throughout the year has its benefits. Any cover needs to be as close-fitting as possible to limit the amount of air circulating between the layers.

Other longer term rust prevention strategies include applying a temporary layer of paste wax to exposed metal. Owners of classic cars often apply wax to chrome-plated parts when storing cars over the winter. Using Waxoyl® is

also an option and this can easily be removed with spirit come springtime. Although Waxoyl® has not been tested here on workshop machinery the protection that it offers to the underside of cars and other areas at risk of corroding is quite exceptional. Before applying any long-term protection, the metal must first be completely clean and dry. One thing is certain - when it is time for regular machine use again it will be much easier to wipe off a temporary protective coating than to remove surface rust from all of the affected parts. This will likely require the partial dismantling of the machine.

Steam, iron and rust

Apart from threatening the condition of tools and machinery, rust can also affect models and particularly those powered by steam. The corrosion of iron must be classed as one of the limitations of using steam power. A steam engine is a particularly harsh environment for parts containing iron. Although brass is used to manufacture many steam engine components, cast iron and steel are also relied upon for making parts such as flywheels, connecting rods, valve gear, cylinder blocks, nuts and bolts. Unprotected cast iron willingly corrodes. The part shown in photo 8 (part 1, M.E.4739) spent the winter months in a wooden drawer in the workshop and was not oiled or wrapped up. For this reason, cast iron parts tend to be painted on completed models. Model engineers do, however, escape some of the risk of corrosion by using copper for making boilers and pipework. Iron and steel articulating parts cannot be permanently coated to protect them and so regular oiling is a good line of defense. In addition to how unsightly rust is, model steam engines are at risk of components becoming stuck in place.

Potential workshop improvements

In a small workshop a suspended (3 to 6 inches)

wooden floor is an excellent investment. A vapour barrier placed beneath the wood flooring may or may not be necessary depending upon whether the building has a damp-proof course and evidence of rising damp. A wooden floor can be constructed from sheet material or floorboards that are laid over 3 x 2 inch timbers at 16 inch centers. Perhaps even a number of wooden pallets of matching depth can be used. Some consideration or calculation of weight bearing may be necessary for the placement of very heavy machinery. By acting as a natural dehumidifier, increasing the amount of wood in the workshop will help to lower the air humidity. A wooden floor, compared to a concrete floor, is also much better for keeping the feet and the body warmer in winter. Insulating the roof space and the walls of the workshop will help to reduce the amount of flux in both air humidity and temperature.

There are a number of things to consider when choosing a heat source for a workshop, including local regulations, cost of the heater and its installation, fuel and maintenance. Portable cylinder type gas heaters are a quick and simple way to get some heat into the workshop but they are unlikely to offer a long-term solution. The cost of gas cylinder replacement will only escalate and if using the workshop regularly on cold days these will run down quickly. Butane and propane gas heaters also exhaust a lot of water that will add to any humidity issue. More importantly, burning gas produces carbon dioxide, and under some conditions carbon monoxide and so good ventilation of the workshop is essential because of the risk of poisonous gases accumulating.

Depending on the workshop's location and the capability for accumulating, chopping, seasoning and storing wood, a wood-burning or multi-fuel

stove is an excellent choice. A wood-burner can be self-installed and the most difficult hurdle is routing the flue out of the building, extending it above the roof height or in accordance with regulations and then securing it to the wall. A wood-burning stove can emit a tremendous amount of heat and soon makes a small workshop quite comfortably warm. It is wiser to invest in a quality solid cast iron unit that will last a long time. Thin steel plate walled or double-walled units have been seen to burn through completely, quite quickly. The purchase and installation cost of a wood-burner will quickly pay for itself, perhaps in the first winter compared to using gas or electricity for heating.

Conclusion

Corrosion is the greatest limitation to using iron in manufacturing and especially so when the environment offers the perfect ingredients to accelerate the key chemical reactions. Understanding and preventing the corrosion of iron and steel has endless applications. To see valued models, tools and machines deteriorate as a consequence of rust is demoralising and creates unnecessary work to restore items back to peak condition. The environmental conditions in the workshop, especially over the winter months, are a significant predictor of the rate of iron corrosion. There are many effective defense strategies that can be directed to iron tools and machinery kept in the workshop. One thing is for certain - iron will do its utmost best to rust and so it pays to be aware and be prepared for the battle.

ME

REFERENCE

- Ref 5** The Colchester Lathe Company Ltd. (1961), *The World Turns: Some facts about Colchester Lathes*, A Random Production.



Views and opinions expressed in letters published in *Postbag* should not be assumed to be in accordance with those of the Editor, other contributors, or Mortons Media Group Ltd. Correspondence for *Postbag* should be sent to:

Martin R. Evans,
The Editor, Model Engineer,
Mortons Media Group Ltd, Media
Centre, Morton Way, Horncastle,
Lincs LN9 6JR

F. 01507 371066

E. MEeditor@mortons.co.uk

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

In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.

Metal Finishing

Dear Martin,

While I've been doing model engineering for 50 years (since I was a teenager) I am always looking out for ways of doing things better.

In M.E.4734 (January 12) Peter Seymour-Howell, in the caption to photo 10, writes 'then over to the trusty files for a little hand work, the final job involving a Dremel sanding drum to polish'.

It may be interesting for readers to figure out how to polish metal to make the job look finished. For instance, while I own one, I have never used the Dremel for polishing metal!

Things like

- lapping cast iron/ gunmetal cylinders (for 'O'-rings, etc.),
- smoothing a port face for a slide valve,
- easy removal of machining marks (as in PS-H's comment mentioned above),
- removal of scale on hot-rolled steel,
- differences between brass/bronze/steel/aluminium - what to use for each?

I tend to use a bit of sandpaper wrapped around a dowel in the drill press (as they are called over here) and some files but, as most of what I do is learnt via reading, not from work, nor school and (to a lesser amount) nor other model-engineers, it may make for an interesting article.

Regards,

John A. Stewart
(Ottawa, Canada)

Propane

Dear Martin,

I read Charles Reiter's article *Propane, an Ideal Model Locomotive Fuel* in M.E.4738 (March 8) with some alarm. My own interests are in miniature steam (boiler under 3 bar-litre), mainly a Roundhouse collection. The working pressure (WP) for the so-called gas tank (really a store of liquid fuel in equilibrium with the saturated vapour above, but I'll conventionally stick

to gas tank) is stated in the locomotive test certificate(s) as 17 bar (247 psig) with a hydraulic test pressure of 34 bar (493 psig), giving a safety factor of 2:1. Pipework, gas flow control valve and burner nozzle are all sized to work in this WP range.

In the literature the maximum operating gas tank temperature is stated as 60 degrees Centigrade (140 Fahrenheit) or 65 degrees C (149 F) though I'll confess that I have not been able to find direct evidence for this but we'll accept the figures for now.

At 60 degrees centigrade butane has a vapour pressure (VP) of about 5.3 bar. The common (!) 70/30 butane/propane mix, as sold mainly for camping purposes in the UK, has a 60 degree Centigrade VP of 9.7 bar, while pure propane has a VP of about 19.3 bar. This last figure is bit higher than the WP stated in the Roundhouse literature. Though the safety factor is reduced the gas tank should not fail but the burner will be very difficult to control. Practiced operators will be aware that in locos where the tank heats up during a run through proximity to the boiler (by design to provide the heat to turn the liquid into vapour) it's good practice to turn back the flow control valve to counter the increased burner flow from the rising pressure in the tank, hence seeking to maintain the steam pressure at or preferably a little below PRV (pressure reducing valve) pressure (thereby maximising the run time).

Filling gas tanks in these locos with propane under regular conditions is likely to make them uncontrollable – I certainly would not recommend it.

I do agree with Mr Reiter's point of not using butane under very cold conditions. Anywhere below around 10 degrees centigrade (50 F, all too common in UK outdoor running) the VP of butane becomes too low to effectively drive the burner. In these cases I use the 70/30 mix which does the job nicely, with no need

to go for the extreme of pure propane.

Some of the above also has a bearing on the steaming problem mentioned in Dave Robinson's letter in the same issue. He attributes this steaming (gas burner) deterioration to selective evaporation from a propane/butane mix but the clue may be in the improvement witnessed by placing warm water in the tender. It's not clear if the gas tank is in the tender - some designs place it here with the requirement to fill the tank 'bund' with warm water. To keep turning liquid into vapour requires heat (if you want to keep a kettle boiling you need to keep it switched on). If you don't provide external heat the liquid fuel will continue to boil but it will extract heat from itself and the metal of the gas tank. With a butane/propane mix the tank will get very cold and frost readily forms. I have never experienced any deterioration in loco steaming during a run with 70/30 mix where the gas tank was heated through proximity to the boiler, even under near freezing ambient conditions (good steam effects though).

Regards,

Mike Gray
(Louth, Lincolnshire)

Club News

Dear Martin,

It would appear that the picture (Club News, photo 5, M.E.4738. March 8) was taken in the military section.

I would suggest that the man is improperly dressed. He has only one shoe on.

Any other thoughts are rather rude.

Regards,

Dick Pool

Merryweather Self Propelled Steam Fire Engine

PART 2

**Werner
Schleidt**

builds a one
third scale Merryweather
fire engine.



Continued from p.432,
M.E.4739, March 22

Now I could start with the construction of the steam engine. The design was based on a two-cylinder ship's steam engine with chain drive in the middle. The construction was labour intensive but not difficult (**photo 9**). After three months of intensive work the machine made its first movements under its own power with compressed air at Easter 2016. After a short running-in period, the steam engine ran quite passably. With the steam engine, the feed pumps were also built as crosshead pumps. One pump would have been enough but a second is always good. And when the water level is low, replenishment obviously happens more quickly.

Parallel to the steam engine, the steam boiler was worked on. The brass boiler top was difficult to find but I found an old flower bowl by chance on eBay. The handles were cut off and dents were dinged out with a plastic hammer. The edge facing the boiler was reshaped with three conical rollers (**photo 10**).

The cowl and the boiler top are fixed with M2 model screws. It was a work of patience to cut the threads into the aluminium support discs. As always happens, despite caution and cutting oil, the tap broke off at the first hole. I decided to consider it lucky, because I was able to change the hole arrangement and the new tap held.

After the flue gas cowl was fixed, the brass cladding sheets could be fitted. Cork and wooden strips were used for insulation. Cardboard was used



The steam engine.



Bending the boiler top cover to fit it to the boiler.



Boiler ready to install.

to make templates. The brass half-shells were bent into shape over a duct pipe with bare hands. This was quite painful but successful. It is interesting to see what simple means can be used to achieve good results (photo 11).

After the steam engine was finished, it was installed in the frame (photo 12). To do this, the chains had to be aligned to the gearbox and the differential. Furthermore, the layout of the chain drive needed to accommodate the fire pump, yet to be built. All this was not so easy because it was difficult to find reference surfaces. A lot of measurements were taken but also some things had to be aligned by eye. But this was also done. Now came the time when I wanted to test whether the drive was correctly designed. A compressed

air connection to the steam engine was improvised and with a flexible pipe it was possible to drive a distance of two metres.

Now I remembered that some time ago I had already carried out a test with grandma's walking frame with a spring balance to verify the design assumptions. So the walking frame was taken to the workshop and attached to the fire engine with a belt. The pressure was set to three bar and in first gear the wheels spun. I then put the boiler in the chassis and it was possible to drive 2 metres. In second gear, though, nothing happened at first and then suddenly the workshop was very quickly too small. By luck the hose slipped off, otherwise I would have thundered into the cupboard. Now that it was clear that the considerations



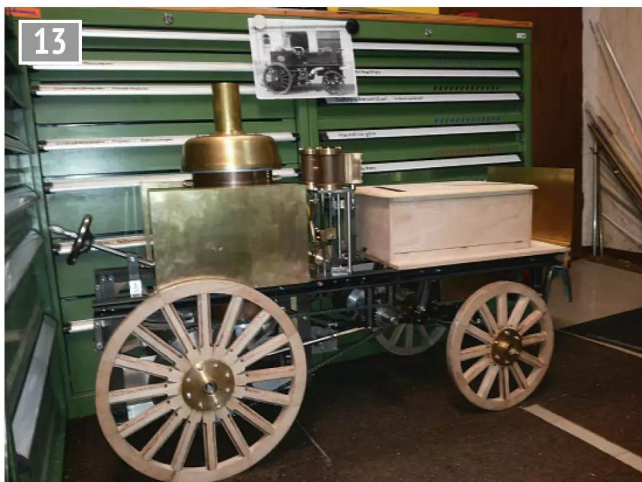
The chassis.

for the drive layout were basically correct, I could continue working.

The models of the water tanks, which were already mocked up in cardboard, were measured and compared with the original pictures. Only minor corrections were necessary. The materials were procured and processed. The wooden front structure was the simplest to build. The small hinges for the side flaps came from China for a ridiculous price. The latch locks were made to scale from a sample drawing of a furniture lock. A total of three tanks are responsible for the water supply of the steam engine. The side tanks are connected to a tank under the chassis. In this way, a total of 14 litres of water are available. The basis of the most important parts was completed in mid-2016 (photo 13).

In September, the painting began. This had its pitfalls. The black premium synthetic resin paint was supposed to be completely dry after one day. In fact, it took almost 2 weeks. The red two in one acrylic paint showed an unknown new feature - after applying it over a wide area, it pulled together into a blob before it was dry. The result was very suboptimal. The only thing that helped was to roll the thinned paint until it was almost dry. It took a few tries to figure this out. But in the end the result was quite appealing. The paint had at least one important advantage - colour improvements after small accidents were hardly visible. This is important in practice, because you always get stuck somewhere and damage something.

The paint work was very time-consuming. Between the



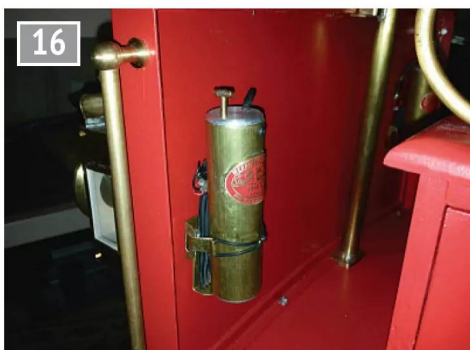
Initial build.



The plates.



The front view.



Fire extinguisher.



Fire fighter tools.



Tool box.

drying phases, the designs for the signs were made. Based on old pictures, the etching templates were created with the software Inkscape. The brass sheet was prepared, cleaned and coated with photoresist. Then the printed artwork was laid on the brass and exposed to light. Developing was done with a weak etching soda solution. The etching was then done in an ammonium persulphate solution by heating and blowing in air.

For 0.15 mm etching depth it took about one hour. The results were very good (photo 14).

Lamps and battery holders disguised as fire extinguishers were made (photos 15 and 16).

The only question that remained was what was in the transport box on which the driver and crew were sitting. After an internet search I found that the company Merryweather and Sons still existed. I then wrote an email with pictures of the construction and got back a lot

of copies from old catalogues - many thanks for that support. It became clear that the transport box was used to store hoses and fire fighting tools. I then divided the available space into two halves. On the left, hose, spade, jump cloth, hydrant key, patent cord and axe (photo 17). On the right, drawers with tools for the steam engine and oil (photo 18).

The suction hose for the fire hose should look as original as possible. A suction hose from the DIY store was trimmed to

look old by wrapping a gauze bandage around it and fixing it with black acrylic paint. The original was available in hemp or black. The look corresponded well to the old pictures.

The fire pump was retrofitted and driven with a chain. With a switching claw the pump can be switched on when the gearbox is in neutral. The fire king was now ready (photo 19).

The trailer was built next, with turntable steering with the wheels moved inwards so that there is still enough space for the feet. The wagon was designed for functionality and spiced up with suction hoses and fire brigade ladders (photo 20).

A total of 20 litres of water can be transported in the seat boxes. A coal reserve tank can hold another 2 kg. These supplies should be enough for a long driving distance.

Before the driver's test could begin, it had to be clarified whether the vehicle could be driven on public roads. The road traffic regulations in Germany only gave the hint that vehicles up to 6 km/h are not treated. Through an Internet search, I found a competent paper on self-propelled machines. The search for the author led to the University of Public Law. I then wrote to the author and he clearly explained that a motor vehicle with a maximum design speed of 6 km/h is exempt from registration, operating licence, licence



First roll out.



Trailer.



First rides.



Return journey in the forest.

plate, tax and insurance but a driving licence is required. This reassured me greatly, as my interpretation of the regulation and the Fire King gear ratio were correct. The driving testing could begin.

Technical data

Fire engine

Scale 1:4.3
Length 126 cm
Width 55 cm
Track width 47 cm
Axle base 67 cm
Empty weight 62 kg
Service weight 82 kg
Driving speed in first gear 0-3 km/h, in second gear 0-6 km/h
Boiler with 3 litre water capacity, pressure 7 bar

Trailer

Drawbar 20 cm
Length 110 cm
Axle 80 cm
Load capacity 2 persons
Drawbar length 246 cm
Additional 20 litre water and 2 kg coal

After Easter 2017, the first fire was lit. Starting the cold steam engine was a bit difficult, but again patience helps. After the steam engine was running, the pumps were tested.

Now it was decided to drive. Everything was recorded by the camera. The driving performance was not bad but subjectively slower than calculated. In total, about 800 metres were driven that afternoon. After the first round, I noticed that I had lost nuts on the stud bolts of the front wheels. After retightening them, I was able to continue. The first ride was successful (photo 21)!

The driver's test brought ups and downs. The steam development and driving performance were good, so this was successful. Unfortunately, the oil pump was unreliable. I then temporarily used the oil pump from my locomotive. The problem of the oil pump could be fixed with a rubber plate valve. The driving performance improved with every ride.

After two days of driving, I ventured on a longer journey.



Drive to the 'Mainspitze', the junction of river Rhine and Main, with Mainz in the background.



Steam line-up.

I drove to the Mainspitze and the Kostheim water lock on different days (photos 22 and 23). That was 2.3 and 2.6 km there and back. There was something to do after each trip - tighten the screws and check the pumps. Cleaning was not to be forgotten either. The steam development and driving performance were good. After a few laps, the rubber tyre on one rear wheel came off. The special rubber-metal glue had failed miserably. It was almost impossible to remove it from the steel tyre, but there was no bond on the rubber. I was then advised to glue with epoxy resin. This was successful. Unfortunately, the oil pump was still unreliable.

The fire pump had to be reworked because the flow cross-sections in the valve box were too small. Afterwards, a spraying range of approximately 12 metres

could be achieved, which was completely sufficient and visually similar to the original on old pictures. With luck, two firemen from the Steiff company were found and purchased at an auction. There is a clear division of labour - one drives and the other sprays.

The project had challenged my skills a lot. Sometimes I didn't know how to solve problems. But with some much appreciated help, I was able to overcome all hurdles or find better solutions.

Now in 2023, after 5 years, I have covered a total of about 170 km at various events (photo 24).

The incredulous amazement of the children is a source of satisfaction and an incentive for me to bring the history of technology to life.

ME

LNER B1 Locomotive

PART 42 – THE CAB

Doug Hewson

presents an authentic 5 inch gauge version of Thompson's B1 locomotive.



Continued from p.435,
M.E.4739, March 22

We now come on to something that I would think you would find a little more interesting for the general reader and that is the cab and platforms. I am going into some detail about the cab for a start, as I think that you will hopefully enjoy building that. I do hope that you will build it with the opening windows too. I am hoping that there will be some lost wax castings for the frames as they will just make the job. There will be a laser cut set of parts for the cab and platforms as that will make the job somewhat easier. This should by now be available from G & S Supplies.

I have laid all the sheets out in the flat but there is a small piece to add to the two cab side sheets. There is a little 'T' shaped step which fits up the slope at the front of the cab on either side of the cab. This needs silver soldering to the cab side and you make the step first; you can make a spacer to hold it parallel to the cab side and then silver solder it on. The spectacle plate has a shroud around the projecting front of the manifold and this needs attaching to the front with a dash of silver solder too. I would suggest that you warm the whole lot up before you attempt to silver solder it on. Otherwise, I can see it distorting, perhaps irreparably. Also, I have shown the brass window frames which are hinged diagonally so you will need a couple of those. If they arrive as lost wax castings they need the insides of the frames cleaning out with a minute grinding wheel in your mini drill otherwise you will hear a faint 'tick' and that will be the end of your pane of glass! The glass I used on my 4MT was 1.2mm glass from 'Chance Glass' at Malvern



Driver McCulloch stands proudly by B1 61261 (photo by TTT).

Link. We used to keep a stock of it when I ran my business but I am not sure that anyone does now. There is nothing looks more like glass than glass!

For the windscreens, once again I made up some patterns and had them all lost wax cast. If you wanted to you could make the screens in one long length and fold the top and bottom over at right angles. However, note that the lower gimble had a square hole through it and the upper one has a round hole in it with enough movement in it to allow

it to be pushed up to release it from the square so that it can be turned through 90 degrees. I noticed that 61264 has one at either end of the cab sides as it spends a lot of its time going up and down the line. This is not an original fitting.

Photograph 289 is driver McCulloch beside his steed showing off the left-hand side of his cab. There are one or two things worth noting on this photograph including the step just above his right shoulder and the leather upholstered arm rest poking out of the window.



The right-hand side of a B1 cab.

Photograph 290 is the other side of the cab and note there is only one side windscreen. Also note that there are few visible rivets on this cab side.

Photograph 291 shows 61264 with its double side windscreens and the window

wide open so you can see how it is constructed. Again, note the rivets on the front of the cab which are barely visible and the proliferation of rivets on this side of the cab.

Photograph 292 - again, this photograph shows the near



B1 61002 while masquerading as Impala.

side of the cab and that the step had dimples on the top, and the lack of rivets on this side. This was taken when it was masquerading as *Impala*.

Photograph 293 shows the cab roof. This has several

types of fixings showing. The rain strips, which in this case can be $\frac{1}{8} \times \frac{1}{32}$ inch brass angle are held on place by $\frac{1}{32}$ inch rivets and you may have to warm them up and anneal them. Note the little



Close up showing the construction of the windscreens.



A view of the cab roof.

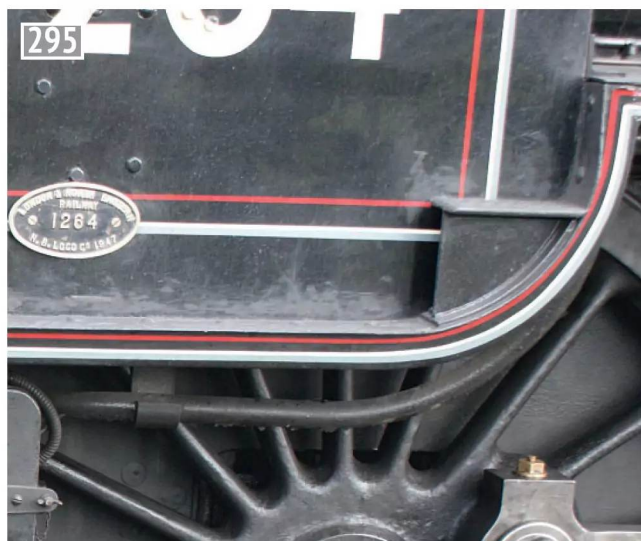


The inside of the cab (photo by John Thompson).

rounded end on the upright leg. The plate on the top of the roof is not original but if you want to fit one like that, feel free! I have fitted the slinging hatches on my cab roof as there are two lifting holes in the frames which just line up very nicely with them. These are for re-railing an engine and are nothing to do with the driver and fireman sunning

themselves. They are purely there for practical reasons! There are three 8BA nuts which hold the bar across the cab roof which holds the bell crank for the whistle pull rod. There are a couple of lifting eyes which will hopefully be at the centre of gravity for lifting the roof off though they are not original.

I thought I would include this



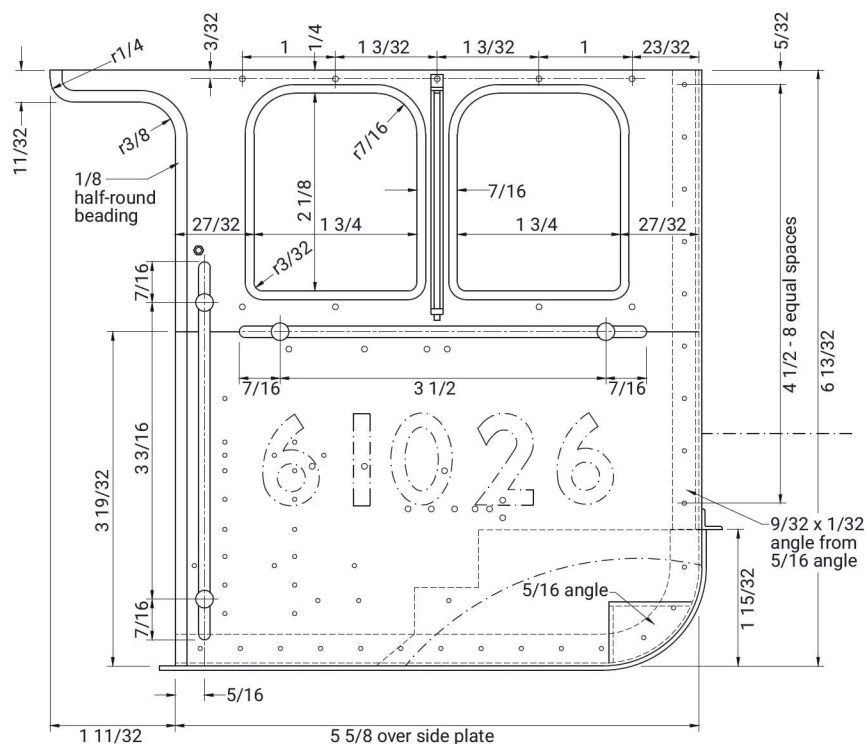
Small step on the outside of the cab.

picture (photo 294) as it is a very good photo taken by John Thompson of the inside of the cab as it shows the 'T' stiffener which runs over the inside of the roof and also the bolts which hold the top window slide in place. It also shows a lot of the conduit in the cab for all the wiring which went on when the Stones dynamos were fitted. If you want to fit

all that lot, then I am sure The Steam Workshop can oblige as Mike Jack has made lost wax castings for all the conduit fittings for all the wiring on the BR Class 3MT which he is presently building! Have a count up to see how many fittings there are!

Photograph 295 shows the dimpled step on the right hand outside of the cab.

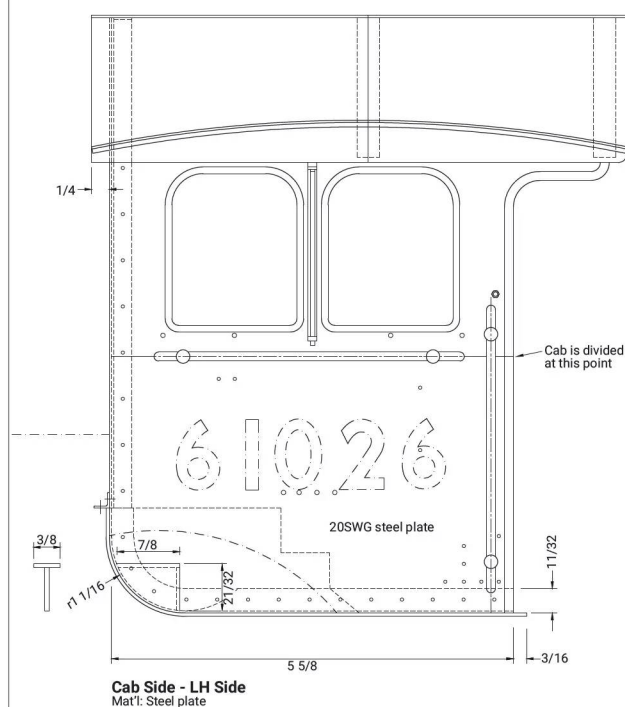
Fig 165



Cab Side - LH Side
Mat'l: Steel plate

Cab - right-hand side.

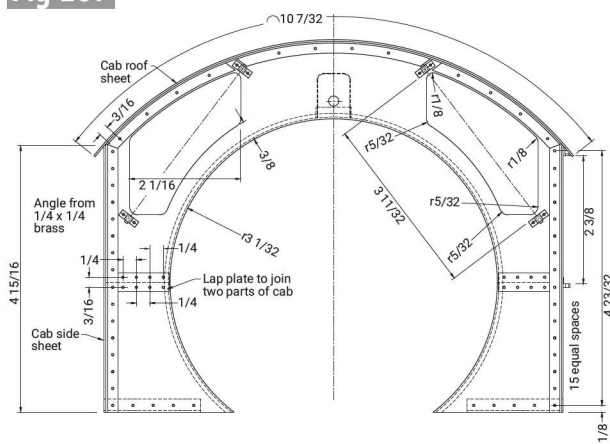
Fig 166



Cab Side - LH Side
Mat'l: Steel plate

Cab - left-hand side.

Fig 167



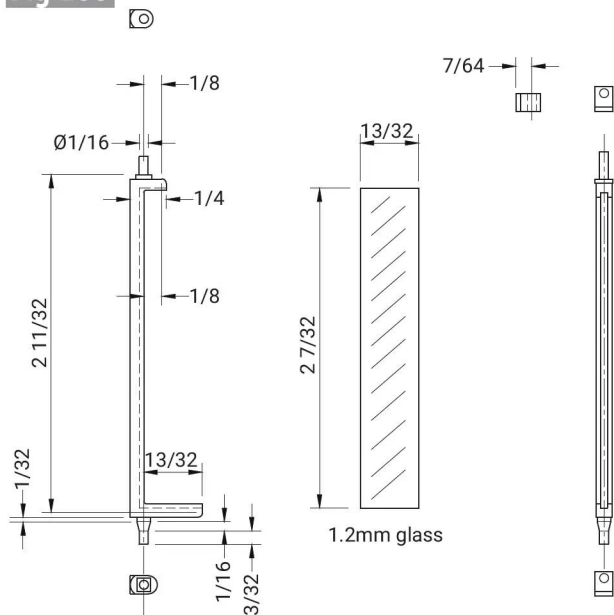
Cab - spectacle plate.

Photograph 296 shows the cab windows which we made for one of the Britannias we built.

Mike Jack in New Zealand machined my window slides for me using a gang miller, and this is me bending the upright over for attaching the cab roof to for my 4MT (**photo 297**). The runners are exactly the

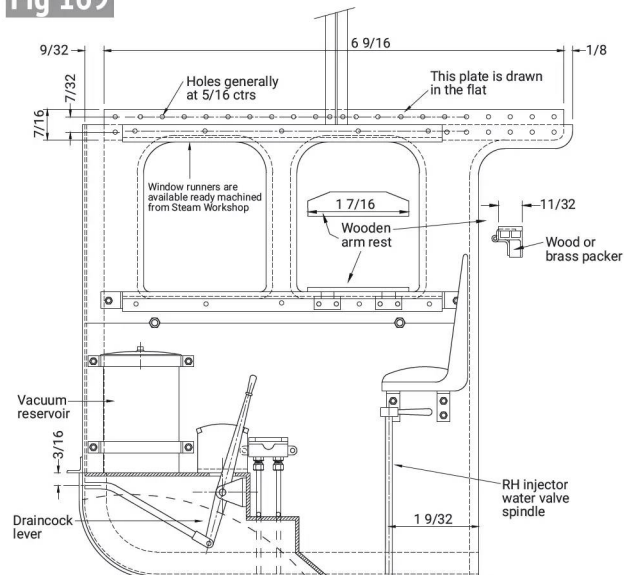
same on the B1. I then had to put some saw cuts in, and silver soldered some triangular stiffeners in there for the bottom runners (**photo 298**).

The cab windows as seen in photo 296 were laid out on a sheet of 1.5mm glass and then we used iron on mahogany grained tape ('Contistrip' from a DIY shop) which were all

Fig 168

Side Windscreen
Mat'l: Brass casting set

Side windscreen.

Fig 169

Cab Side - RH Side
Mat'l: Steel plate

Cab - right-hand side interior.

jointed properly at the corners with a scalpel. There are a couple of jobs which you also need to do if you want to make a proper job of your engine and that is to fit the proper hinged arm rests to go either side of

the cab. See driver McCulloch's engine in photo 289. I made mine from a piece of 20swg steel plate and silver soldered a piece of $\frac{1}{16}$ inch copper tube along one edge. I then cut out a piece from the middle (divided

296

Britannia cab windows.

297

Bending over the upright on a window slide.

298

Triangular stiffeners soldered in.



Left-hand water valve – below seat (photo by John Thompson).



Right-hand water valve – lever below seat (photo by John Thompson).

by 3) with the ends bent up to suit and fitted pins from $\frac{1}{16}$ inch welding rod. They were fixed in by a dab of soft solder on each end. I think my arm

rests on the 4MT were on little wooden spacers with a couple of 12BA bolts in each one.

There is one more thing we need to do and that is to soft

solder 16swg pads on the insides of the cab sides so that they can be tapped 10BA to support the two swab boxes and the driver and fireman's

seats. You will also need to fix the water valves for the two injectors. On the left-hand side of the B1 the water valve is bolted to the back of an electrical box of some kind as seen in **photo 299**. On the right-hand side there is a rather more complicated structure with two parallel plates at either side of the right-hand water valve and a universal joint at a very steep angle which is also at a very inconvenient place for the fireman to use (**photo 300**). Note also that the left-hand water valve is operated by a handwheel and the right hand one is lever operated.

The seats are just about the same other than that they are handed. They are built on a more or less circular base out of tinplate and flanged downwards and then the seat back is mostly cylindrical shaped and can be soft soldered on to the base. The back leans back at about 8 deg. and overall, it is about 1 15/16 inches top to bottom. They are about 1 1/2 inches wide. As you will see, they have nicely upholstered cushions on the seats. They also have two angle bracket supports for the two seats and are bolted through the cab sides with what I would say are 10BA bolts.

● To be continued.

NEXT TIME

The cab roof and whistle.

A Twin Tandem Compound Steam Engine

PART 1

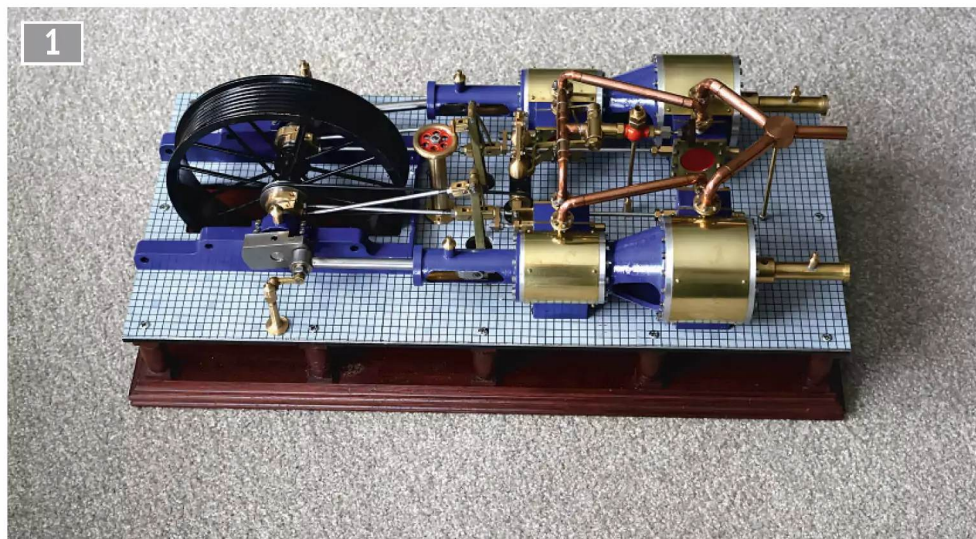
Graeme Quayle presents his own design for a compound winding engine.



MBM Model Engineering



Knupfer



Finished twin tandem compound winding engine.

Some background information on this engine and its maker gives an insight into the model (photo 1).

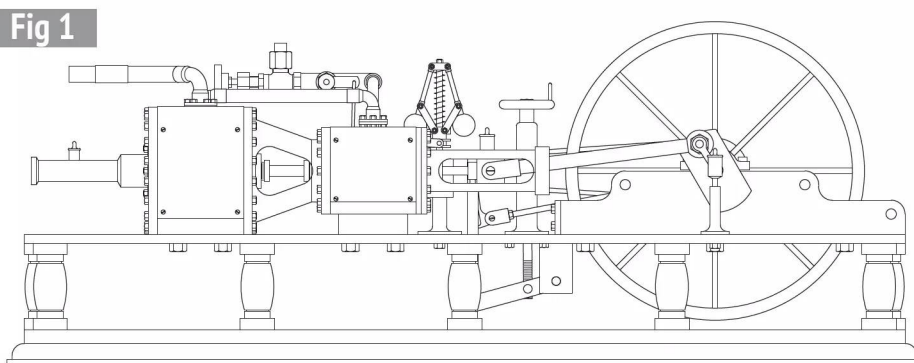
I have been a model engineer for many years now, building mostly industrial and marine model steam engines both from casting kits and from standard bar and sheet metal,

a good proportion of which have been to my own designs and at one stage I was selling kits of raw materials and instructions for some seven different model steam engines. These are still available from another company, www.mbmmodelengineering.com in New Zealand.

This model Twin Tandem

Compound Steam Engine (figs 1 and 2) came about because two members of a club to which I belong had built the Brunel 'Tandem Compound' horizontal mill engine and suggested that my next model should be the twin.

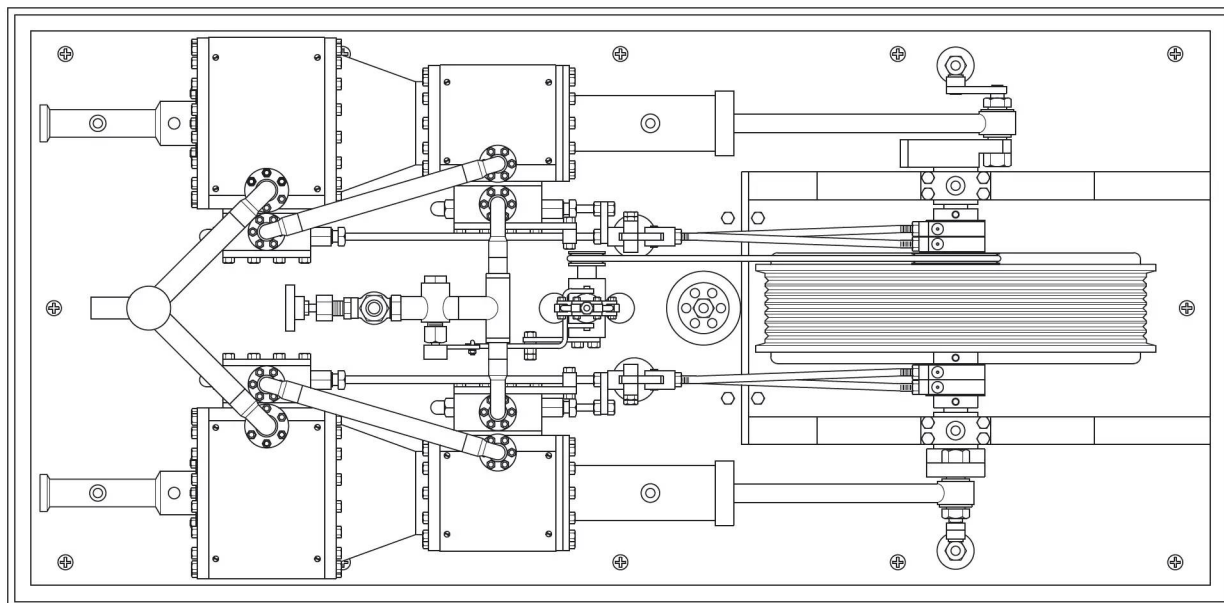
Well, over the years I have had to be very frugal when it came to my hobby of model



Twin Tandem Compound Steam Engine
Side Elevation

General arrangement – side elevation.

Fig 2



**Twin Tandem Compound Steam Engine
Plan View**

General arrangement – plan view.



Band sawing the aluminium block to size.

engineering and when it came time to buy any tools or the like I have had to limit what I spent and, in the case of the Brunel Twin Tandem Compound, I felt with my modelling and draughting background I could make a similar model out of bar and sheet metal, obviating the need for castings.

Generally, commercially made steel, brass, aluminium etc. can be relied upon to be good to work with. After drawing up a model and over time refining the drawings, the model illustrated came to be made.

If, at this point, you are thinking of making this engine then take note it is quite an involved project - not a starter model by any means - which will tax your abilities and your need to source, purchase, borrow beg or steal the materials required. There is no bill of materials to refer to so you can judge what you may have in stock or need to source.

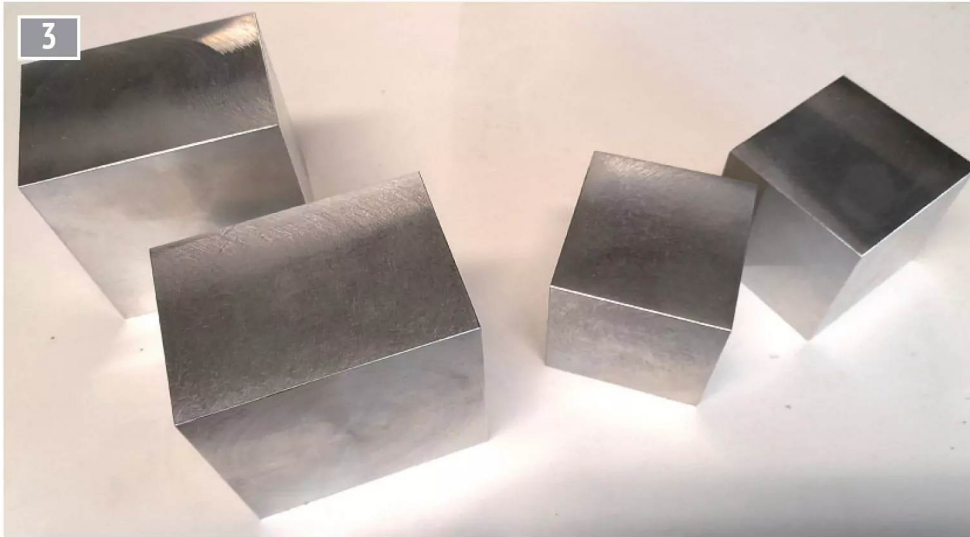
A word on machinery is relevant at this point. Your lathe needs to be accurate and capable of turning 150mm

plus in diameter. My lathe is a Boxford. The mill I have is a Chinese one with digital readouts - and oh! do I find the digital readouts such a boon. I simply do not know how I got by before I had it. I also have a 150mm rotary table which makes pitching radial holes so easy.

As the model developed, it acquired some additional accoutrements: reversing gear, governor, tail rod guides, modified grooved flywheel, big end oilers ... and so it became a winding engine, not a mill engine.

So, now it is a Twin Tandem Compound Winding Engine, that's a mouthful isn't it.

I like working with aluminium and brass/bronze so that is the basis of this engine. It also materially helped to reduce the weight of the finished engine. However, if you wish you could make the cylinder assemblies out of cast iron and do away with the bronze bushes. Sure, using aluminium is not prototypical but when the engine is finished and painted



Machined blocks for high pressure and low pressure cylinders.

it will not be too obvious. Also, because the model is carved out of bar stock there will be heaps of swarf which is not a problem. The workshop vacuum cleaner copes with piles of swarf. However, the main parts - the cylinders - are designed around 2 and 3 inch square bar with standard

bronze bushes pressed in for the 25mm and 40mm cylinder bores. The stroke is 36mm.

The trunk guides are standard bronze bushes of 20mm bore. As the layout evolved it seemed to flow quite well and with minor tweaks has grown into the model as shown.

I did not have the 75mm (3

inch) square aluminium for the LP cylinders but I knew that one of my mates had a big block of aluminium and two smaller blocks. I acquired one of the smaller blocks and band-sawed out a piece that was 75mm (3 inches) square x 50mm (2 inch)+ plus another 50mm (2 inch) square

x 50mm (2 inch)+ for a HP cylinder (**photo 2**). Then these were fly cut on the mill down to 74mm square x 50mm+ and 50mm square x 50mm+ (**photo 3**). They were then ready for further machining operations. I had a round piece of aluminium from which I was able to machine one of the tapered joiner pieces as well as an LP cylinder end cover. The other piece of round aluminium that the other tapered piece was made from was acquired from another mate. See how this project came about? It was all about using contacts.

There was a toss-up as to what screws to use for most of the hardware. The preference was 2.5mm but I did not have any but it so happens that I had quite good stocks of 7BA so that is what I used.

The drawings show metric hardware and hex-head metric screws are available from knupfer.info/shop in Germany.

● To be continued.

Book Review

Ritter Restaurierungen

G. Ritter



The restoration and conservation of vintage and antique toys is not an easy subject.

Sooner or later every collector of diecast and tinplate toys, whether they collect model cars, model ships, steam machines or model trains, will

face the question to restore or not to restore.

Then the next question is raised, how far should you go in restoration? That could be the replacement of some technical parts by new (repro) parts, a (re)paint job or a complete overhaul.

One kind of collectors like the play-worn patina of old toys and just leave them the way they are, no matter what condition, but others prefer them in as new as possible condition.

It can be a delicate balancing act and sometimes needs to be left only in the hands of specialists in order to maintain their historical value and to keep their historical

importance. This is especially the case with antique toys.

A company with a long-established expertise in this field and the restoration of vintage toys is RITTER RESTAURATIONEN in Germany. They not only do restorations for private collectors but also for famous toy companies such as Märklin.

A very interesting book about them in the German language has been published, written by the founder of the company Mr. Gernot Ritter and his son Elmar Ritter. The book, consisting of 208 pages, is lavishly illustrated with many colour photographs showing their high skill and craftsmanship.

Henk-Jan de Ruiter

Published by HEEL Verlag
ISBN 978-3-96664-020-6
208pp, 240 x 270 mm,
hardback

The American Locomotive

PART 3

David Rollinson

explores the development of the classic American 4-4-0 locomotive.



Continued from p.445
M.E.4739 March 22

By 1850 the Bury-type locomotive boiler, with its high round-topped firebox, was being replaced by the 'wagon' top style. Difficult to make and repair, and also a poor steam generator, the Bury firebox could not become the boiler of choice for the developing American-type engines. The wagon top boiler, with its large steam space over the firebox and distinctive sloping front where it connected to the barrel, was not only easier to build and repair than the Bury-type, but it offered additional steam and water space above the firebox crown. Unlike the Bury-type it was also able to cope with the alkali feed water generally available to the railroads out west. There were, however, two issues related to the use of the wagon top boiler: one was the difficulty found in staying the high outer wrapper and sloping front sheet; the other concerned the use of a single steam dome placed over the firebox. The wagon top boiler continued in use on the 4-4-0s until they became redundant (fig 8).

The parallel type boiler, incorporating a round top firebox, was introduced after

1855 but was never as popular as the wagon top. While it was a stronger boiler and was certainly cheaper and easier to build than the wagon top, it lacked its steam storage. To compensate, two steam domes were used to match the steam storage capacity of the wagon top, but concerns about having two holes in the boiler barrel saw the number reduced to one placed over the fire box.

Even though the use of wrought iron for boilers and boiler components was accepted practice by 1844 the locomotive *Richmond* was fitted with cast iron crown sheet girders when constructed in the same year. When its boiler exploded, after only nineteen days in service, part of the blame for the explosion was attributed to the use of this material. Needless to say, it was the only known occasion cast iron was used for this purpose. As a further development in boiler construction, wrought iron had replaced copper for firebox construction by 1860.

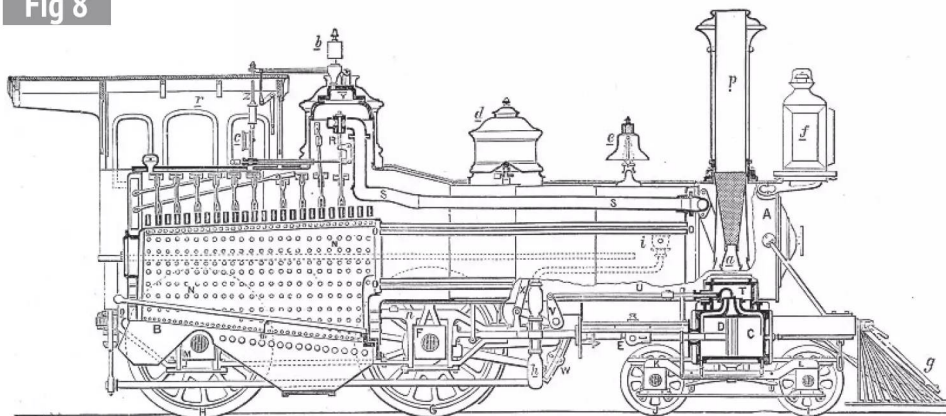
The large diameter driving wheels of the American-type 4-4-0 forced designers to adopt a narrow firebox that would fit between the frames

and accommodate an ash pan between the two driving axles. The result was a wood-burning boiler with poor fuel economy, high maintenance requirements and a short operating life when compared with contemporary British and European examples. In a *Miners Journal* of 1859 a correspondent wrote, 'Sufficient experiments have been made in the last year, to demonstrate the great superiority of coal as a fuel for Locomotives...' After the general introduction of coal firing, fireboxes remained narrow but became longer with the crown bars now placed across, rather than lengthwise, on the firebox top.

With coal gaining momentum in all regions by 1860, an increase in firebox size was the most fundamental change made to boilers fitted to the eight-wheelers. The search for a grate that could survive the use of either soft or hard coal produced a number of designs until a style was found that would work efficiently in the deep firebox of the engines. While preferring soft coal, which was the common fuel, the grates could burn good quality anthracite when available.

One issue with the long and narrow fireboxes on the American-type locomotives was that the fire grate was, as can be seen in the boiler cross sections, quite deep below the boiler barrel. While this construction provided room for a grate and a deep fire, it was inefficient in steam production. Much of the combustible gas that was produced by the fire did not get burned within the firebox to produce heat before it was pulled into the boiler tubes. This rapid removal of hot gasses also left the top and upper sides of the firebox cool, reducing further the steam raising capacity and causing

Fig 8



The 'wagon top' boiler.

problems with the boiler itself. To help slow down the movement of the gasses a rudimentary brick arch was fitted to a locomotive firebox in America in 1854. While its operating life was short, it was effective in increasing the steaming capacity of the host boiler. In 1857 brick arches were being used on the Boston & Providence Railroad, but the type of bricks used, and their setting, made them impractical. Eventually a practical brick arch was introduced, although not to universal approval. However, as coal firing became common the public began to complain about the amount of smoke being produced, especially from engines burning soft coal. It was found that the use of brick arches, when coupled with improvements in firing techniques, provided sufficient steam with the minimum smoke.

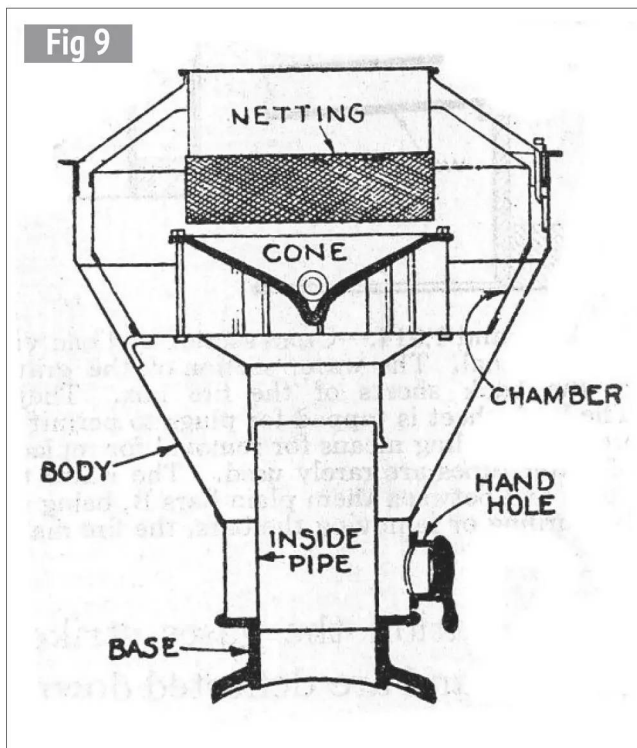
Winters along the north eastern shores of America can be cold, but are positively mild compared with those found in the great Central Plains, where prolonged winter temperatures can fall to -51 degrees C. As the railroad made its way west it entered a new environment that made the use of boiler insulation essential.

The loss of heat from the boiler was recognised early in the evolution of the steam locomotive. An insulating cover of wood strips, secured by iron or brass bands, was the first type of boiler insulation. Early images of the eight-wheeler show the boiler barrel covered with hardwood strips, usually 2 – 3 inches thick, secured by brass bands. The firebox sides and backheads were never insulated. Even when varnished, the wooden strips deteriorated quickly, leading to the use of imported 'Russian iron' as a cladding over the wood. This thin metal cover protected the wood, its blue/black finish adding to the visual appeal of the locomotive. It was usually secured to the boiler using iron bands. As rolling mill technology developed in America, a similar material became available,

replacing the imported material. Eventually felt began to replace the traditional wood on better quality locomotives. Applied in layers, the felt was treated with a mixture of alum, soda and lime to prevent it burning. By the 1880s the 4-4-0s would have been lagged with either asbestos or magnesium.

Both round and 'D' shaped smokeboxes were used on early American-type locomotives. Later designs used the round type, with the bottom of the box being supported on a saddle cast *en bloc* with the two outside cylinders. The need to include spark arresters in the exhaust system became evident in the earliest days of American railroads, when wood-burning engines began setting fire to the landscapes they passed through. On his 1842 tour of America Charles Dickens noted that the locomotive hauling his night-time train produced 'a whirlwind of bright sparks, which showered about us like a storm of fiery snow.' As compensation costs for burned fields and buildings mounted, dozens of spark arrester designs were patented and trialled by engine builders. Eventually, a more complicated internal arrangement (**fig 9**) replaced the simple wire mesh covers first fitted to the top of the stack (chimney), proving reasonably effective for both coal and wood burners. More complex systems were incorporated inside the smokebox, but none were completely effective as all of them contributed to a reduction in smokebox draught. Eventually the straight stack was introduced when coal became the usual fuel. Blast pipes of the usual type were fitted, although attempts to perfect a variable exhaust, as they were called in America, persisted for many years. They did not find universal acceptance and had been discounted as being ineffective by 1870. Superheating was never used on the eight-wheelers

Most steam locomotives operating in America used



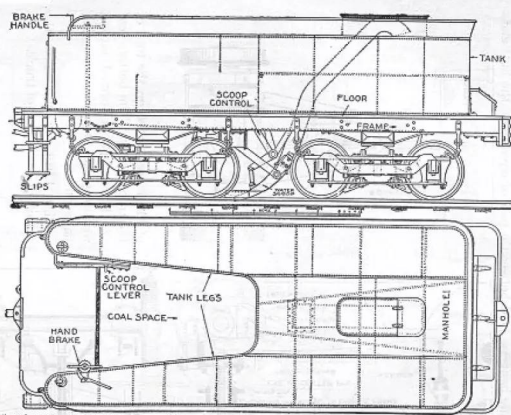
A late design of spark arrester.

a single action force feed water pump well into the late 1800s. Called 'the most cantankerous mechanism on the locomotive,' the pumps were usually driven from the crosshead or, less common, an eccentric on a driving axle. This type of horizontal pump worked reasonably well until train speeds increased, at which point they became less effective at putting water into the boiler. These pumps also had a habit of freezing in the winter, despite being fitted with heating coils, and found it difficult to cope with the hard, sediment-contaminated feed water they were usually offered. But their biggest disadvantage was that they only worked when the locomotive was moving. It was not uncommon for engines to be uncoupled from their trains and run light up and down the track to replenish the boiler.

Even though injectors were available from about 1860, they were not well received by enginemen and usually a mechanical pump continued to be fitted. It was only in the 1890s that locomotives were being built with injectors only.

While steam pumps of the 'Worthington' pattern found universal use in American steam plants and ships, they were never accepted for locomotive work.

It is interesting that the builders, mechanics and engineers connected with the American locomotive could be so innovative when it came to design and construction, yet at the same time equally conservative when it came to aspects of operation that were related to safety. In addition to the issue with brakes mentioned earlier, another prime example of this attitude related to the use of gauge glasses for showing boiler water levels. Early locomotive boilers were fitted with three try cocks somewhere on the backhead, as seen on the *William Crooks* cab photograph. These try cocks only showed the level of water at the time when they were opened; if there was no water showing when the lowest one was operated it was likely too late to add water, as by that time the crown sheet was uncovered. Boiler explosions were both numerous and

Fig 10

FIGS. 1,955 and 1,956.—Plan and elevation of locomotive tender showing construction details and names of parts. Among the details shown is the water scoop (seen in elevation in fig. 1,955), for replenishing the supply without stopping.

The bogie tender.

deadly in America throughout the mid and late 1800s; locomotive boilers were not excluded from contributing to this carnage and in many instances a shortage of boiler water was the culprit. Even though a glass water gauge had been demonstrated as being practical by 1831, the great antipathy shown to them by all levels of railroad men kept them out of locomotive cabs until the late 1800s when their use was legislated. The objection raised against their use was in part due to their expense, combined with the fear of unreliable reading due to water foaming.

Contrary to the use of gauge glasses, steam pressure gauges found early favour with footplate crews. Steam pressure began at 50psi on the early pre-4-4-0 engines, but quickly rose to 90 or 100psi by the 1830s. Increases came incrementally, partly as a result of the improvements in boiler materials and construction, so that by the 1870s the eight-wheelers were operating at 120psi, and pressure gauges were, according to the *Master Mechanics Report* of the time, universally used. When NYC RR No. 999 entered service in 1893 she had a boiler pressed to 180psi, although generally regular 4-4-0s were operating at 150 pounds per square inch. At these pressures footplate crews understood the contribution the pressure

gauge made towards efficient running.

The tender for Stephenson's *John Bull*, built for the Camden and Amboy Railroad in 1830, was a four wheel flat car fitted with a wooden barrel for water and a wooden platform for fuel. This rudimentary layout, typical of those used in England at the time, was soon replaced by one resembling a garden shed on wheels, the shed being used to protect the brakeman. As *John Bull* was not expected to travel any distance, water and fuel did not require a large tender, a situation that was going to change quickly as the rail network expanded westwards.

The use of wood fuel required trains to make frequent stops to 'wood up' at one of the many wood sheds located along the line. Both hard and soft woods were used as boiler fuel on the eight wheelers, depending on the territory they were passing through. The rule of thumb used in the mid-1800s was that 2,000 lbs of soft (bituminous) coal was of equal calorific value to 5,200 lbs of wood. The 2,000 lbs of coal took up 40 cubic feet of tender space, while the 1¾ cords of wood needed 224 cubic feet. On its first passenger run of ten miles in 1862 the *William Crooks* had consumed the two cords of wood in its tender before reaching the first wood shed located along its route. Reportedly, the train

crew had to rip up wooden fencing to make enough steam to proceed. Such was the demand for wood for locomotive fuel that by the 1850s Pennsylvania's railroads had consumed a staggering 40 million cords of original forest, in the process pretty well denuding the state of trees.

Evolution from the early flat carts to a more substantial four wheeled metal tender with a built-in water tank and designated wood storage space was evident with the 4-2-0 locomotive *Lafayette*, built by Norris in 1837. A decade later *Tioga*, also from Norris, had a six wheel tender. As locomotive size increased, so did the need for more water and fuel, resulting in the typical 1850s rectangular tender mounted on two four-wheel bogies. The water tank at the rear of the tender began to feature the typical 'U' shape and the fuel storage space became more formalised. This type of tender (**fig 10**) shows the general construction of the under frame, bogies and water scoop. Water availability remained a challenge throughout much of the American railroad system into the late 1800s. Either tender capacity had to be increased or, on longer runs between major rail centres, water pickup troughs installed. The New York Central, which ran express passenger services out of New York on multi-track roadbeds, began using tender water scoops in 1870. Needless to say No. 999 was fitted with a scoop when first built to replenish its 3,500 gallon tender tank.

To non-American eyes, the brightly painted and decorated American-type locomotives of the latter half of the 19th Century are a distinct contrast to the restrained finish that was used on their local railway. Seemingly extravagant, the bright paintwork, ornamentation and excess of polished brass had a practical purpose. For the early locomotive builders the appearance of their locomotives offered an

example of the work they could produce. For the locomotive's owners it helped promote the new form of transportation and showed pride of ownership. As many parts of the eight-wheelers were of cast iron, paint provided a more attractive finish while helping to protect the metal. Such was customer demand for a special finish that Baldwin Locomotive Works developed a 'style book', which specified not only the level of finish to be provided (there were four classes) but listed the available style of lettering, decoration on such fittings as sand domes and wheel centres, or paint colours for each class. In effect, each locomotive was 'customised' for the owner. Apparently the increasing cost of individualising the locomotives became so expensive that by the 1890s a plain black finish was adopted by most railroads.

The American-type 4-4-0 steam locomotive owed its popularity and longevity to its high route availability, reasonable haulage capacity, simple and inexpensive construction and the ease of maintenance and repair. It was claimed that in 1870 eighty five percent of the locomotives in service in America were eight-wheelers, and even a decade later sixty per cent of Baldwin's output was of this type.

The early 1880s saw the beginning of the end for the 4-4-0; as freight movements increased on American railroads, the need for more powerful engines saw them replaced by 2-6-0s or 2-8-0s. Although by this time relegated to light passenger work, even this was eventually lost when new, and heavy, passenger coaches on faster schedules became the norm.

Used for half a century, and with over 25,000 reportedly built, the American-type 4-4-0 was pivotal in establishing the American West and helping the country to become a 20th Century industrial powerhouse.

ME

A Visit to the Crossness Engines

PART 1



Souvenir jigsaw.

Robert Hobbs visits a preserved pumping station in South East London.



Continued from p.437
M.E.4739 March 22



Crossness

During the Covid shut down we found completing jigsaw puzzles a very rewarding way to pass the time, away from the locomotives in the workshop, especially as there was no radio-control sailing at my Gosport club. One day a parcel arrived from our daughter containing a puzzle of the Crossness Engines (**photo 1**). What a surprise! Little did I realise that this year our planned holiday to visit the Beth Chatto Gardens in Essex and Ickworth House in Suffolk would include a visit to Crossness. Just before the Dartford Tunnel, when coming from the south, the Erith turn-off leads you to Abbey Wood on the A206; after then it was difficult to negotiate the maze of junctions that give access to the Old Works of the Thames Water S.W.T. at Bazalgette Way,

SE2 9AQ. The sat-nav in the car was of no use, but Google maps live on the phone did the job brilliantly.

The Crossness Engines Trust (**ref 1**), a registered charity, looks after the buildings and the engines in the Old Works of

the current Thames Water site. The importance of the buildings and the engines was recognised in 1972 by The Bexley Civic Society and the management of Thames Mead Town and in 1980 the engine and boiler house were listed as Grade I with the fitting shop and valve house classed as Grade 2 by English Heritage. The working group started restoration in 1985 and the first open day was in 1986. The president of the Trust is Sir Peter Bazalgette, the great-great-grandson of Sir Joseph. Sir Peter's involvement in the negotiations in 1989 with Thames Water Utilities in the campaign to 'Save Crossness Engines' culminated in the re-opening of Crossness in 1991 and the restoration of the engines and buildings is an ongoing project.

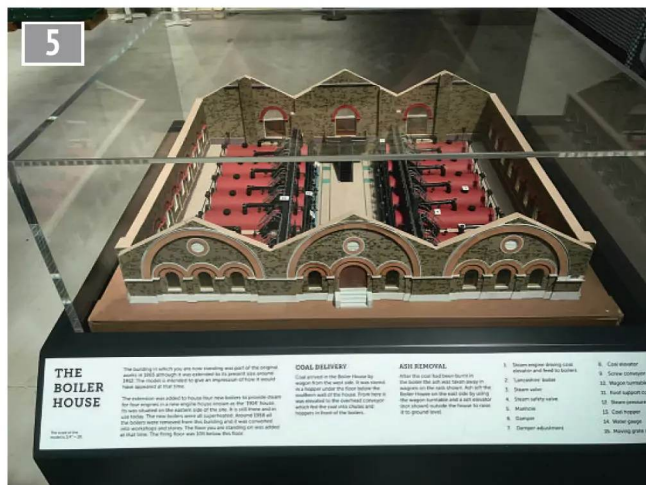
The elegant and ornate boiler house chimney, which was 208 feet high, dominates the buildings as can be seen in **photo 2** which is an illustration of the site in 1865 when the works buildings and engines were officially opened. The



Contemporary view of the pumping station.



Picture caption celebrating the opening.



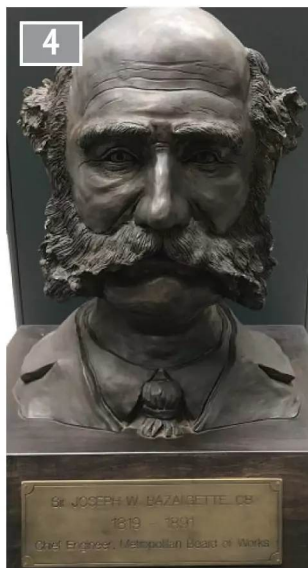
Model of the boiler house.



Double arch feature.



The octagonal feature in the centre of the engine house.



Bust of Sir Joseph Bazalgette.



Window frame.

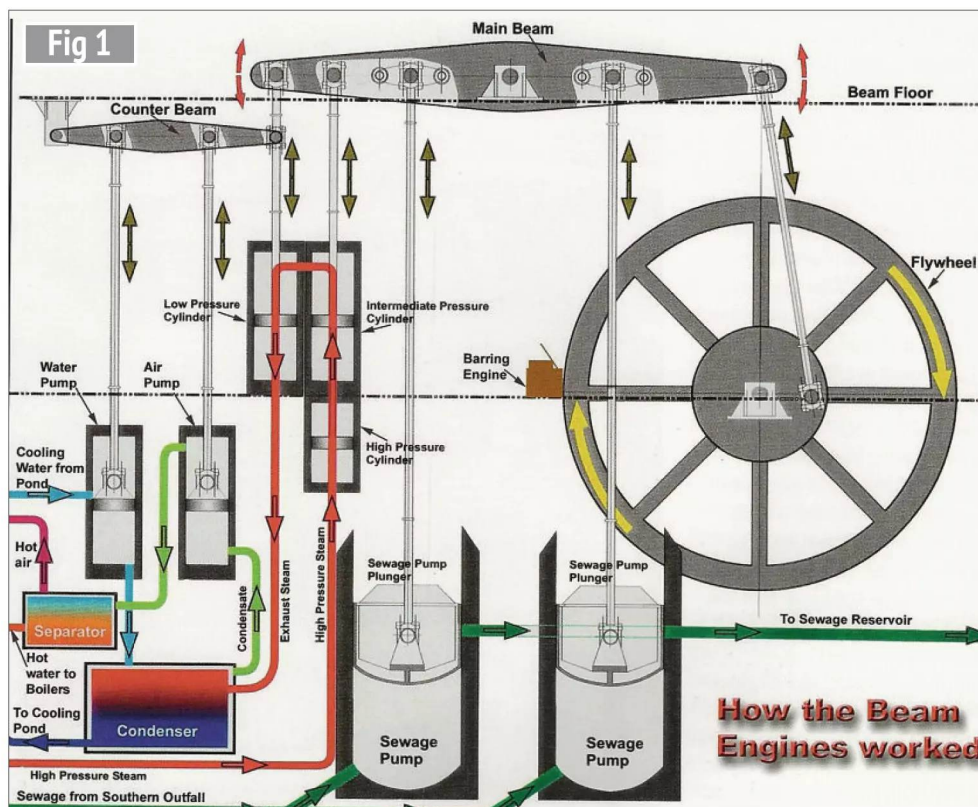
main object of the site was to help relieve the 'Stink of London' by pumping 17 million tons of sewage per day either into

a holding reservoir, if the tide was out, or being discharged direct into the Thames, using the tide to carry the effluent out to sea. **Photograph 3** shows the caption on the frame commemorating the opening. Working with Sir Joseph Bazalgette, the principal architect was Charles Henry Driver and the main contractor was William Webster (Snr).

In the reception area, and before entering the Engine House, there are numerous exhibits relating to the site and water treatment, both ancient and modern. **Photograph 4** shows a bust of Sir Joseph Bazalgette and **photo 5** shows the layout of the twelve Cornish boilers. This building has many architectural features with the brickwork being the most prominent; the window arches are picked out in a red brick which contrasts starkly with the yellow of the walls. **Photograph 6** shows a double arch with doorway and window whilst **photo 7** shows a close-up of the window frame with a very neat, hinged pane in the centre. The attention to detail throughout the building/site is exceptional.

Before entering the Engine House, we were equipped with hard hats and safety glasses because some work was going on at the time. Although it was not scheduled to run that weekend, on the day of our visit we were lucky enough to see the engine *Prince Consort* in steam.

Even after completing the jigsaw mentioned above, the first sight of the highly decorated steel work was simply a joy; firstly the colours and then the massive size of the building and the engines. **Photograph 8** shows the octagon at the centre of the building with Fiona and Eva in the foreground. (Safety glasses had been removed for the photo.) Arriving just before lunch we were fortunate enough to be able to talk with the morning's Engine Operative, Bob Langridge (**photo 9**) who explained some of the humour that was incorporated into the structure and



A schematic of the pumping engines.

especially the octagon seen in the background. The ornate columns have a garlands of fig leaves just before the plinth for the arches and below these leaves there are senna pod seed cases (**photo 10**). The gratings between the columns are decorated with blackberry and dogwood emblems, thus covering both relief from constipation and the means to stop diarrhoea! **Photograph 11** shows one of the grating walls forming the octagon, with the crest of the Metropolitan Board of Works in the centre. This highlights the quality of the new paintwork and, once again, the attention to detail afforded by the constructors of the original building and also of the volunteer restorers working on this project today.

● To be continued.

REFERENCES

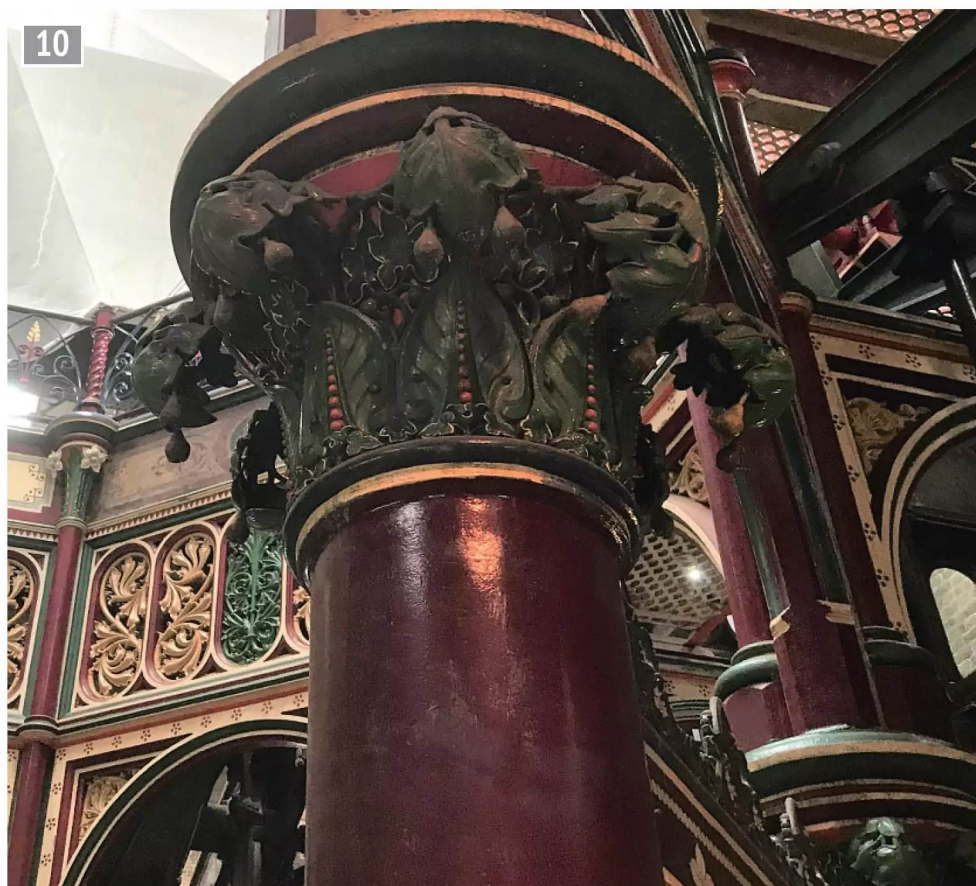
- 1 www.crossness.org.uk



Bob Langridge, who runs the engines.



The engine house is well ornamented with appropriate motifs.



'And upon the top of the pillars was lily work' (1 Kings 7:22)

Geoff Theasby
reports on
the latest news from the
clubs.



I was musing on the monologue 'Albert and the Lion', as one does in idle moments (what are they? - Ed), and added a verse: 'Young Albert did not like his breakfast, he hated dry toast and jam, he consented to days by the seaside, but wanted to ride on a tram.' So there.

Right, a competition, worthy of the highest accolade, so that's the level I'm aiming at,

Finish this - 'There's a town in the north that's called Oslo, that's noted for Nynorsk and schnapps, and Herr und Frau Humdinger, with one of their jungfrau's nice chaps...' (Erik Bloodaxe, if you must know).

In this issue, an apology, the wrong type of electricity, a monorail, Pullmans (...men?), Ezekiel's inattention, postnuptial transport, décolletés?, if I fell... (John Lennon), OLCO and servo tape.

Firstly, a correction. In issue 4737 I referred to George Ray's *Galloping Goose* so worded as to suggest that George built it. It was in fact a Maxittrak product, designed by Andy Probyn. My apologies to all parties involved.

Mark and Carol Brazier, from **Chula Vista Live steamers**, in San Diego, California, write to say their site was devastated in the January storms. Over 3000 feet of the 7¼ inch GL line was washed out, see www.youtube.com/watch?v=IRRD-GFbbKg As they were not insured for flood damage, local clubs weighed in to help, and a Gofundme campaign has raised \$3000 so far.

Reading Society of Model Engineers newsletters for December, January and February arrived all at once, so last to read them all is a cissy! Starting with the December issue, chairman John Billard says membership has now reached 100! Alec Bray writes on power in disguise, or locomotives in sheep's clothing. Conventional-looking steam engines but with pantographs appeared in Austria. The power supply at the time was 16 2/3 Hertz,

which was unsuitable for electric motors. It was used to boil water and the steam used as usual. Some similar locomotives were used in Switzerland in 1943. Treasurer Jim Bowen resigned after 50 years in the post. Well done thou good and faithful servant! A trip to the private Fawley miniature railway is being prepared for June.

W. www.rsme.uk

Steam Whistle February, from **Sheffield Society of Model and Experimental Engineers**, is collecting names for an August trip on the Cromford canal and members will be descending on Cromford canal and museum with a trip on their electric canal boat, plus, a visit to the nearby Lea Wood pumping station. Neil Ritchie's new project is a gyro-stabilised monorail, originally devised by Louis Brennan, in 1910. No-one appears to have made a model of one, which means

a) no competition and b) the design is not proven, so Neil had very little to go on, and had to make his own mistakes. Was the device successful? It doesn't say. Mr Brennan was awarded a Grand Prize at an exhibition in 1910, but it failed commercially, as there were doubts regarding gyro failure and any extra coaches/goods vehicles would also need to be stabilised. Two gyroscopes, spinning in opposite directions, increased the stability and avoided derailing but the cost offset the savings made by only having one rail. In the full-

size version the gyros had to be massive to deal with controlling a 22 ton vehicle. www.youtube.com/watch?v=kUYzuAJeg3M and www.youtube.com/watch?v=od4ZQFPCx5I

W. www.sheffieldmodelengineers.com

Southampton Society of Model Engineers January-February *Newsletter*, from Southampton, begins with a photograph of a blue 2-6-2 which is almost, but not quite the same shade as, the spot colour elsewhere in the newsletter. Maybe it's the light, as the side tanks appear to be a much darker shade. Catherine is giving up the editorship and Katie and Colin will assume the position. The Frostbite Day saw an excellent turnout of members. The Society has a comprehensive range of personalised clothing so there is no hiding place for the unwilling...

W. www.southampton sme.co.uk

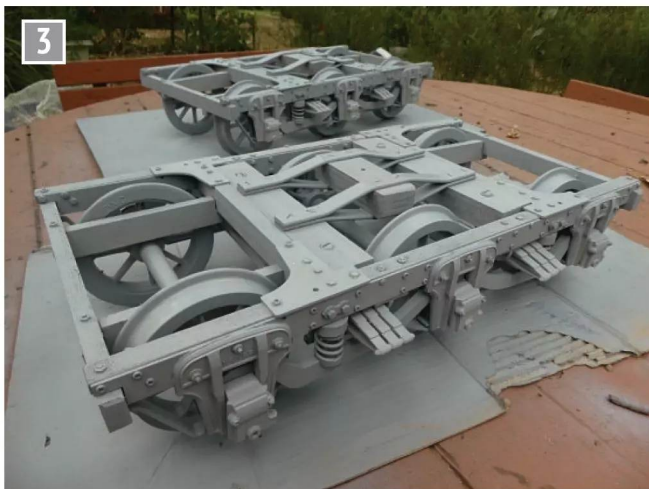
Sydney Live Steam Locomotive Society, in their February *Newsletter*, start us off with a picture of James Saunders and his newly finished 2705 (**photo 1**). The January newsletter reports that the January running day saw 636 visitors who took 1606 rides. Very good for a January meeting. Andrew Allison describes 'Set 88' (**photo 2**), being seven Pullman cars, the costs and work being shared with the owner of a laser cutting machine, and designed for ease of assembly.



James Saunders' new locomotive (photo taken by James Saunders, scanned from SLSLS Newsletter).



The 88 set (photo scanned from Newsletter).



The printed bogies (photo scanned from Newsletter).



Steve Weaver's AEC Matador at NSMEE.

Laser-etched translucent panels have the appearance of the decorated originals. Despite the production of literally thousands of parts in the laser cutter, many more were required and one coach was assembled first, which threw up some problems,

were in turn fed back down the line to make the rest of the carriages less problematic. Each bogie required 64 laser cut components, making 768 in all (photo 3). Ross Bishop describes the Fowler water cart of 1910 in 1/4 scale. The English version had lots of forgings

and hundreds of fasteners. The Australian, 'Furphy', used two shafts, cast ends and a few dozen bolts. As in many cases, New Zealanders reduce everything to its fundamentals, and are not over-engineered.

W. www.sls.asn.au

In Nottingham Society of Model Engineers' Kingpin, Steve Weaver's 'other' transport is shown, an AEC Matador (photo 4). His other transport is undergoing maintenance (my other car is a Porsche...).

I acquired a couple of boxes of radio control equipment at a recent auction and, knowing nothing of the subject, invested some time in reading it up. I think everything is there - two transmitters, 50 MHz and 2.4 GHz, several servos and one receiver. Plus two sets of batteries, a Nicad charger and some R/C test equipment. So, it will go onto the shelves of equipment waiting for attention.

Another one bites the dust! Heathkit IM-17 electronic test meter arrived with no reading on any scale. Flashing across the meter terminals with an ohmmeter proved the meter was OK. In doing this I noted the nuts were loose on the meter terminals. I tightened these up, end of problem! Now then, what do I charge the customer?

Whistlestop, January, from Hereford SME, had to cancel the Hallowe'en event, after buying £700 of fireworks. The extension roadworkers were very busy preparing the ground, using diggers, dump trucks and wheelbarrows. In the carriage shed, Warren trusses were being painted and erected. Warren trusses were invented in 1846, based on a series

of equilateral triangles. (Other forms of triangle are available.) The carriage wheel sets are very worn, so blanks have been bought, needing only boring for the axles. It is interesting to note that a four-jaw chuck should be used, 'cos the three-jaw isn't accurate enough. The Christmas social was enlivened by Liz Donaldson with her carillon, from which only an odd discordant clang emerged. John Townsend writes on the ease, or not, of driving a locomotive, of whatever style. He used his *Aquarius* as an example, because it is a mature locomotive in that its little peccadillos are known and understood and that this means lots of practice, even in the Age of *Aquarius* (Ho Ho). It has about 50 lubrication points to be checked before a run. So it isn't 'just' driving. In contrast, Chris Rayward describes his first steaming experience. Bill Hall describes the build up to his wedding, in which the bride was the last to know the nature of her transport, a steam roller. I leave my reader(s) to imagine her response...

W. www.hsme.co.uk

Gauge 1 North, Yorkshire group, in their February Newsletter, refer to decals. Or as we Old People say, 'transfers'. I have read at length on the subject and I still see no reason to change the usage. So, transfers it is. One is one and all alone ... and never the twain shall meet. I've never met a twain before but being a railway enthusiast I should have... Secretary, Malcolm High relates his experience in using MS Word to design his own (own what?) using 'Text Box'. The running days at Drax went well, despite being held in February when there were only four people present when beginning to set up, eventually becoming eight. A bigger problem is breaking the layout down and loading the trailer. There were often only three people remaining to do that, when eight would be best. Thanks to those stout fellows who did. Malcolm adds that NandJ editor Rod Clarke is intending to appear



Deadman's Lane diesel depot at Wakefield model railway exhibition.

at Gauge 1 North, Bakewell. He will be coming from Canada, so a good turnout will be welcome. There may be a GTG at Chesterfield later this year. That would be a good meeting for me, as it is quite near and I could meet some of those who are only names at the moment.

W. www.gauge1north.org.uk

A conference is to be held in Coalbrookdale on the life of L.T.C. Rolt, a one-man powerhouse who had a hand in many industrial restoration projects, like the Tal-y-llyn railway, the canals, old cars and his classic narrow boat. He founded the Vintage Sports Car Club in 1934, and was V-P of the Newcomen Society. He also wrote *The Tools for the Job*, the very first book on machine tools. The conference is organised by the Ironbridge Gorge Museum and Keele University on 9/10/11 May. It sounds very tempting. <https://www.ironbridge.org.uk/learn/ltr-rolt-conference/>

The Fell locomotive featured in a documentary on YouTube. I always wondered what was revolutionary about this machine. Four engines, two gear boxes and lots of

ingenuity. Despite it being an absorbing programme, I am still no wiser. I was falling asleep on the sofa, so maybe it is my fault. Mea culpa, mea maxima culpa.

In February Debs and I went to a Newcomen Society talk on Steam Locomotive Developments 1825-1830. The plight of the **Old Locomotive Committee**, who support the 1838 *Lion*, was brought to the attention of the meeting,

which took place at Kelham Island Museum (I am a Friend of Sheffield Museums). As previously reported in these columns, the OLCO currently has no chair, secretary or treasurer.

Welcome to *Turnout*, the magazine of the **Ground Level 5 inch Gauge Main Line Railway Association**. I don't think I have been sent any previous issues and I hope this will be the first of many. As is

appropriate, the first item is about the laying of sidings, by Doug Hewson. I never knew so much detail was involved. Every layout should have a number of sidings, for oil and coal deliveries, for shunting, etc. - after all, you can't shunt if there isn't a sort of 'limbo' into which trucks can be placed whilst the rest of the train is assembled. Martyn Wyatt discusses wagon loads and tarpaulins, involving coffee stirrers and model aircraft servo tape ("vot is zis?"). Not having heard of such, I did some research and found it was double sided sticky tape. I already have something of the sort but the aircraft type may be better, or not. We should take note of other disciplines in the model world, it isn't all locomotives. Cross fertilisation, you see.

The Railway by Andrew Dow, is recommended reading, in this instance. A unique book, it deals solely with railway track since 1804. The front page of *Turnout* bears a great picture of a signal box interior, with all the miniature levers at rest except for a couple of dissenters in the foreground. Geoff Moore makes LNER headlamps, and this is followed by a couple of drawings for a 12 ton mineral wagon. The back cover is of a quite startlingly red breakdown crane.

W. www.gl5.org

ME



A modern day Santa delivering his presents.

Club Diary

21 April 2024 – 19 May 2024

April

21 Bradford MES

Public Running Day. Members from 11:30, public from 13:30 to 16:00, whatever the weather, Northcliff. Contact: Russ Coppin, 07815 048999.

21 Guildford MES

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

21 Plymouth Miniature Steam

Public running, 14:00-16:30, Pendeen Crescent, Plymouth, PL6 6RE, Contact: Rob Hitchcock, 01822 852479

21 Westland and Yeovil MES

Running the track at Yeovil Junction – Steam Train Day. Contact: Michael Callaghan, 01935 473003

25 Sutton MEC

Afternoon run from 13:00. Contact: Paul Harding, 0208 254 9749

28 Westland and Yeovil MES

Track running day 11:00. Contact: Michael Callaghan, 01935 473003

May

1 Bradford MES

Meeting: 'Helicopters' by Derek Round, 19:30, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999.

2 Sutton MEC

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

3 Rochdale SMEE

General Meeting. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

5 Plymouth Miniature Steam

Public running, 14:00-16:30, Pendeen Crescent, Plymouth,

PL6 6RE, Contact: Rob Hitchcock, 01822 852479

6 Sutton MEC

Fete at Lower Kingswood. Contact: Paul Harding, 0208 254 9749

11 Bradford MES

Annual Exhibition & Competition, 12.30 – 16:00, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999.

11 Bromsgrove SME

Open Day – all gauges are welcomed – 5, 3½, 2½, Gauge 1 and 16mm. Contact: Doug Collins, 01527 874666. See www.bromsgrovesme.co.uk

12 Cheltenham SME

2½ inch gauge rally. Contact: csme@cheltsme.org.uk

17 Rochdale SMEE

Models Running Night – 17:00 onwards. Springfield Park.

See www.facebook.com/RochdaleModelEngineers

18 Bromsgrove SME

Polly Rally. See www.bromsgrovesme.co.uk

18 Northampton Society of Model Engineers

Bassett-Lowke Rally. Contact Kevin West at westkev58@gmail.com

19 Bradford MES

Public Running Day. Members from 11:30 public from 13:30 To 16:00, whatever the weather, Northcliff. Contact: Russ Coppin, 07815 048999.

19 Guildford MES

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

19 Plymouth Miniature Steam

Public running, 14:00-16:30, Pendeen Crescent, Plymouth, PL6 6RE, Contact: Rob Hitchcock, 01822 852479

NEXT ISSUE

Butterside Down

Steve Goodbody devises an effective solution to the problem of 3 inch Allchin *Ruby Swann's* lacklustre draughting.

Northampton

We visit the Northampton Society of Model Engineers.

Propane Burner

Graham Astbury converts a burner design by T.E. Haynes to run on propane rather than town gas.

Federation AGM

John Arrowsmith travels to the Boscombe Down Aviation Museum, host to this year's Federation of Model Engineering Society's AGM.

A Cautionary Tale

Chris Rayward discovers the hard way that you need to know the composition of a non-ferrous alloy before trying to silver solder it.



Pre-order your copy today!

Visit www.classicmagazines.co.uk
or call 01507 529 529



Content may be subject to change.

ON SALE APRIL 19 2024

DATES FOR YOUR DIARY

SAVE THE DATES FOR THE BIGGEST AND BEST MOTORING EVENTS IN THE UK



Classic & Performance Car Spectacular

Tatton Park, WA16 6QN

JUN 1-2, 2024

Classic American Stars & Stripes

Tatton Park, WA16 6QN

JUL 6-7, 2024

Passion for Power Classic Motor Show

Tatton Park, WA16 6QN

AUG 17-18, 2024

theclassiccarshows.com



CLASSIC BIKE SHOWS
HOME OF THE BIGGEST CLASSIC BIKE SHOWS IN THE WORLD .COM

The International Classic MotorCycle Show

Staffordshire, ST18 0BD

APR 20-21, 2024

The Classic Motorcycle Mechanics Show

Staffordshire, ST18 0BD

OCT 12-13, 2024

classicbikeshows.com



VanLife Fest

Scampston Hall, YO17 8NG

JUN 21-23, 2024

vanlife fest.co.uk

AUTOJUMBLE.INFO

KEMPTON • NEWARK • NETLEY • STRATFORD

Normous Newark

Newark, Notts NG24 2NY

**APR 14, JUN 9, JUL 7, AUG 11,
SEP 15, OCT 20, NOV 24**

Kempton Autojumble

Kempton, TW16 5AQ

**MAY 11, JUL 20, SEP 21,
OCT 26, DEC 7**

Stratford Autojumble

Stratford-upon-Avon, CV37 9SE

MAR 24, MAY 12, JUN 23, SEP 1

Eurojumble

Netley Marsh, SO40 7GY

SEP 13-14, 2024

autojumble.info

**SAVE
£££**

When you purchase
your tickets
online.





QUALITY ASSURED
MADE IN THE UK
By PNP Railways Products Ltd

Manufacturers of Authentic Reproductions
of Historical Railway Components
in 3½", 5", 7¼" & 10¼" Gauge Specialising in
Vacuum Brakes & Trackwork

Tel: 01453 83 33 88 | www.pnp-railways.co.uk

PRODUCTS

- Taps and Dies
- Endmills
- Centre Drills
- Special Sizes
- Clearance Bargains
- Reamers
- Diestocks
- Slot Drills
- Thread Repair Kits
- Boxed Sets
- Tailstock Die Holder
- Drills
- Tap Wrenches
- Drills HSS
- Thread Chasers

• All British Cycle Threads Available

**Drill
Sets**



**Taper Shank
Drills HSS**



Reamer



**Taps &
Dies**



Tracy Tools Ltd

Tap & Die Specialist, Engineer Tool Supplies

Tel: 01803 328 603 Fax: 01803 328 157

Unit 1, Parkfield Ind Est, Barton Hill Way, Torquay, Devon TQ2 8JG

Email: info@tracytools.com

www.tracytools.com

MAXITRAK.COM

The best of model rail and road.

Tel: 01580 893030 Email: info@maxitrak.com

**5" Gauge
Electric
Loco's**



5" Brush



5" Class 25

**Complete Garden
Railway Discount
Available!**



**5" Planet
Painted Kit
Or
Ready To Run**

10-11 Larkstore Park, Lodge Road, Staplehurst, Kent, TN12 0QY

MAIDSTONE ENGINEERING SUPPLIES

01580 890066

MAIDSTONE-ENGINEERING.COM

info@maidstone-engineering.com

**One stop model
engineering shop**

Leading suppliers of fittings,
fixings, brass, copper, bronze, steel,
plastics, taps, dies, drills, machine tools,
BA nuts and bolts

Browse our website or visit us at

**10-11 Larkstore Park, Lodge Road,
Staplehurst, Kent, TN12 0QY**

**New
Copper
TIG Welded
Boilers**



Model Engineer *Classified*

MODEL ENGINEER

To advertise please contact

Mason 01732 442144
mason@talk-media.uk

Chris 01732 442144
chris@talk-media.uk



Talk Media
In association with **MORTONS**

Complete home Workshops Purchased

Essex/Nottinghamshire locations
Distance no object!

Tel: **Mike Bidwell**

01245 222743

m: **07801 343850**
bidwells1@btconnect.com

MODEL ENGINEER BUILDER

1000s OF MODEL ENGINEERING, AIRCRAFT & MARINE PLANS

sarik hobbies

www.sarikhobbies.com
01684 311682 info@sarikhobbies.com

Civil Engineering
Marine Engineering
Internal Combustion
Model Railway
Steam Engines
Plant
Workshop

WESTERN STEAM

Model Engineers

Founder Member Assn of Copper Boiler Manufacturers (ME)

COPPER BOILERS

For Locomotive, Traction, Marine & Stationary engines, to PER cut 2. All copper construction, silver soldered throughout using quality materials to the standards required by the APCBM(ME), PER, & relevant Model Engineering Associations. CE marked and certificates of proof test and conformity supplied.

Write or phone to Helen Verrall:
Unit 4A, Love Lane, Burnham-on-Sea
Somerset, TA9 1EY
Tel 01278 788 007
Visit our website: www.westernsteam.co.uk



M-MACHINE

Unit 6 Forge Way, Cleveland Trading Estate
Darlington, Co. Durham. DL1 2PJ

Metals for Model Makers

Contact us for Copper, Brass, Aluminium, Steel, Phosphor Bronze, etc.

PHONE & FAX 01325 381300

e-mail: sales@m-machine.co.uk
www.m-machine-metals.co.uk

www.model-engineer.co.uk

MODEL ENGINEER



Make referencing easy and keep your copies in perfect condition

Each binder stores 12 issues

Only **£11.99** each

Free delivery to UK

For EU and RoW delivery charges, see www.classicmagazines.co.uk

Call: **01507 529529**
bit.ly/modelmags

webuyanypworkshop.com

Re-homing model engineers' workshops across the UK



It's never easy selling a workshop that has been carefully established over a lifetime. I will buy your workshop so you don't have to worry about finding a new home for much loved workshop equipment and tools.



Please email photos to
andrew@webuyanypworkshop.com
Or to discuss selling your workshop, please call me on **07918 145419**

All equipment considered: Myford, Warco, Chester, classic British brands etc
Polly steam locomotives also purchased, especially those needing a bit of 'TLC'

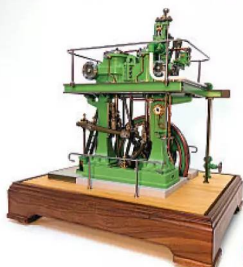
ALL LIVE STEAM ENGINES WANTED

ANY SIZE & CONDITION INCLUDING PART BUILTS

Stationary Engines inc. Stuart Turner, Bing etc
Traction Engines and Locos in all sizes.
Especially wanted 4" and 4½" gauge Traction Engines.
Any Locos from gauge 1 to 7¼".

Also any Electric models locos, buses etc
Will collect personally. Distance no object.

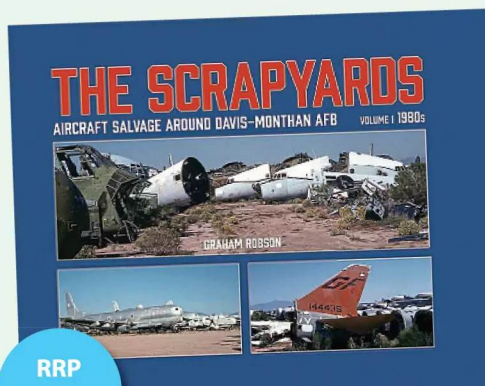
Call Kevin on **01507 606772** or **07717 753200**



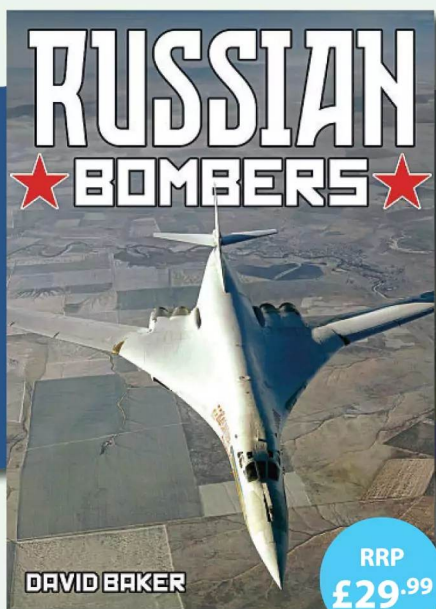
Get 20% off a selection of aviation and railway reads from Mortons Books

'FLASH20' for 20% off

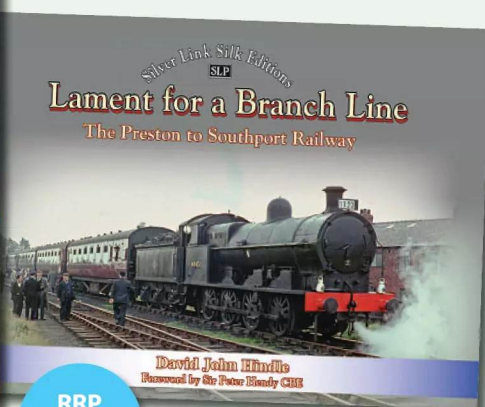
Use code 'FLASH20' at the checkout



THE SCRAPYARDS:
AIRCRAFT SALVAGE AROUND
DAVIS - MONTHAN AFB VOL 1 1980s



RUSSIAN BOMBERS



LAMENT FOR A
BRANCH LINE



SECRET PROJECTS
OF THE LUFTWAFFE



RONNY BAR
PRESENTS SPITFIRE -
THE MERLIN VARIANTS



EAGLES OF THE LUFTWAFFE:
FOCKE - WULF FW200 CONDOR

MORTONS
BOOKS

Excludes bookazines

ORDER NOW: www.mortonsbooks.co.uk

Tel: 01507 529529 Offer expires: 31.12.24

5" GAUGE WAGON KITS

Email: sales@17d.uk

Phone: 01629 825070



BR/LNER Brake Van

5 Plank Wagon

Kits start from around £470

See our website or call
for full details



Banana Box Van

7 Plank Wagon



NEW! GWR Shunters Truck
from £599



5" GAUGE WHEELS



*8 Spoke Wagon
Wheels*

4 wheels / 2 axles
£89.99



Machined Axle Boxes & Bearings
£14.99 each



*Plain Disc
Wheels*
£12.98 ea*

** Quantity
discount
available*



3 Hole Disc Wheels - with profiled face
£79.99
4 wheels / 2 axles



www.17d-ltd.co.uk

MINIATURE RAILWAY SPECIALISTS
LOCOMOTIVES, ROLLING STOCK, COMPONENTS
CNC MACHINING SERVICES

17D Limited, Units 12 & 13 Via Gellia Mill, Bonsall, Matlock, Derbyshire, DE4 2AJ