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Vol. 227 No. 4678 • 19 November - 2 December 2021

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IN THIS ISSUE

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ON THE COVER...

Frances Mayall at the Federation of Model Engineering Society rally hosted by Reading SME with her 'Conway' locomotive (photo: John Billard).

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IMLEC 2022

I am pleased to announce that the 2022 International Model Locomotive Efficiency Competition (IMLEC) will be hosted by the Guildford Model Engineering Society (GMES) at their Stoke Park track. The competition will be held over the weekend of the 22nd-24th July 2022. Guildford has a dual gauge (3½ and 5 inch) raised track, 1405 feet long, and a ground level 7¼ inch gauge track, 990 feet long. The minimum radius of the raised track is 50 feet and the maximum gradient is 1:110.

I'm told the GMES dynamometer car is a fully mechanical device, employing a ball and disc integrator (described in *Model Engineer*, 20th May 1983). From my point of view, that alone is worth going along to see.

So – do reserve the date and start preparing your entry for this competition! Further details will be published here early in the new year and the closing date for entries will be in May.

Modern Times

We live in modern times – we certainly do. So Charlie Chaplin thought in 1936, when he shot perhaps his greatest film, *Modern Times*. The film imagines a dystopian future, not far away, where people are reduced to mere machines, and treated as such. Chaplin's character works in a huge, highly mechanised factory where, paradoxically, the simplest tasks are carried out by humans. In Chaplin's case, his job is to tighten a pair of nuts with two large spanners as they pass him on an assembly line – a task that could far better be accomplished by a robot. Chaplin has in fact become a human robot and even has his lunch fed to him by another, rather more sophisticated machine. Eventually he becomes entangled in the gigantic factory machine. He is then, both literally and metaphorically, driven round the bend by his situation but eventually finds happiness when he wanders off into the machine-free sunrise with Paulette Goddard (well, who wouldn't?).

I suppose all times are 'modern times' while we live them but what distinguishes our own modern times is how fast they are changing. My grandfather was born before powered flight had been achieved but lived to see men walk on the moon. When I was born, digital computers (the few that existed) were a new-fangled invention, cost more than a house, occupied an entire room and required a small power station to run them. Now, they are everywhere, cost virtually nothing and are a million times more powerful, require a millionth of the power and are the size of a pin head. The mobile 'phone in your pocket contains several of them.

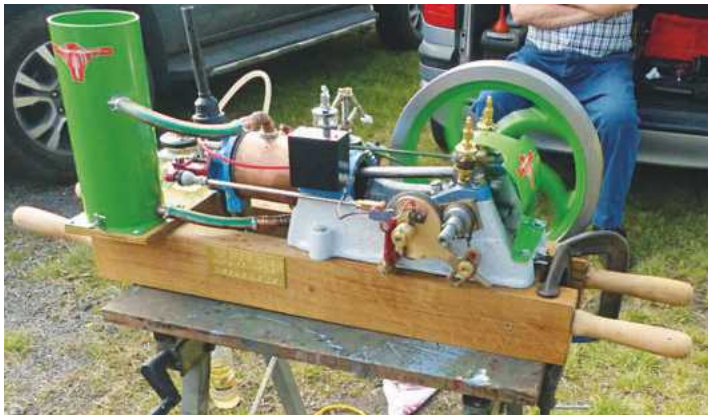
The same is surely true of our own hobby. Lately, in this very magazine, we have been introduced to new concepts, like (controversially) 'parameterised instantiations', and seen many examples of the use of 3D CAD, laser cutting and 3D printing. These, surely, must now be considered to be 'mainstream' aspects of what we do. We may fear that these new ways of doing things displace more traditional skills but I don't believe that is so. We still need to bore out cylinders to close tolerances, beat sheet metal into interesting shapes, silver solder copper boilers, finish and fit parts. These modern techniques, though, can relieve the tedium of many of the more mundane tasks – how many times, for instance, do you want to cut out a random shape in a sheet of brass?

What doesn't change is that things are always changing. What does change though is the pace of change, which seems only to get quicker and quicker. That can be rather frightening but it does give us plenty of opportunity to expand, rather than replace, our skill set, which can only add to the scope and interest of our hobby.

Magnetic Drive Clock

I have a request from a reader, who writes as follows.
'I followed an article in *Model Engineer* which started in the 2nd -15th February 2007 issue. I made the model and it has kept good time to this day. A friend has asked me to make him one and although I have all the original paperwork, the DXF files which I obtained via the editor were lost years ago following a Windows blue screen event. Does anyone still have these files?'

Is anyone able to help?



Alan Thatcher's Hit'n'Miss engine. For those of us not familiar, let us quote from Wikipedia – A Hit'n'Miss is a type of internal combustion engine that is controlled by a governor to only fire at a set speed. They are usually 4-stroke but 2-stroke versions were made. It was conceived in the late 19th century and produced by various companies from the 1890s through to approximately the 1940s. The name comes from the speed control on these engines: they fire ('hit') only when operating at or below a set speed and cycle without firing ('miss') when they exceed their set speed. This is as compared to the 'throttle governed' method of speed control. The sound made when the engine is running without a load is a distinctive 'snort POP whoosh whoosh whoosh whoosh snort POP' as the engine fires and then coasts until the speed decreases and it fires again to maintain its average speed. The snorting is caused by the atmospheric intake valve used on many of these engines. Alan's is a Reeves 'Centaur'.

Ivy, a 4 inch Burrell single crank compound road locomotive owned by Michael Allwood.

Reading Society of Model Engineers hosts Federation Rally

David Goyder drops in to the Federation of Model Engineering Societies rally at Reading.

September 18th was the chosen date and Reading opened their facilities for the 2021 Annual Federation Rally and having missed the 2020 one this was surely a sign that our lives may be getting back to some sort of normal.

Reading had prepared a splendid show and the hobby was well represented with 19 steam locomotives, three traction engines, 5 diesel outline, 2 petrol hydraulic and one splendid if rather eccentric 'hit and miss' contraption!

Comfortable areas to sit and watch, delicious catering and lots to see made for a very happy day. Those who attended were given a souvenir cup, a prize was awarded for the longest travelling attendee and of

This magnificent Duchess was brought by Geoff Elliot from North West Leicester and driven by his son Nick Elliot.

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A pair of petrol hydraulic locomotives running in tandem, the creation of Aubyn Mee, Rugby's chairman. The power is provided by Honda industrial engines adapted for this interesting role (photo John Billard).

No. 1370, a Kingscale pannier driven by owner Alan Redgrave from Oswestry and North Shropshire pulling a small train of goods wagons.

A happy Frances Mayall with her husband David's GWR 15XX 'Speedy'. David was placed second at the 2021 IMLEC held at Maidstone. Frances and David are members at Bracknell.

Martin Parham receives the Australia trophy from Federation secretary Peter Squire.

Martin's winning GWR 2-8-0 No. 2889 with a rake of twenty coal wagons.

course the Australia Trophy was presented to the 'best' locomotive attending. Credit for the hard work in preparing for the rally must go to Peter Harrison who had sleepless nights worrying if any locomotives would show up or what to do if too many arrive. It turned out he got it about right.

A 'rare treat' is the award of the Australia Trophy. The proper name is 'Australian Association of Live Steamers Trophy'. Commemorating their affiliation, the Australian Association of Live Steamers and the Federation of Model Engineering Societies promote mutually supportive annual competitions.

Trophies are awarded to miniature working steam locomotives judged to be the best examples of Commonwealth prototypes in any gauge between and including 2½ and 7¼ inches. Open to all members of affiliated Clubs and Societies, competitions are held in Australia at the Association's Easter Convention and in the

UK at the Federation's Autumn Rally, the first of which was contested in 1988. Only the owner, who is preferably also the builder of the locomotive, is eligible to compete.

This year's winner is Martin Parham from Maidstone with his GWR 2-8-0 No. 2889. The significance of the running number is that Martin started construction in 1984 when this locomotive was first described in *Model Engineer* and he finished it in 1989. There were no commercially available castings so he found suitable ones from other locomotives - as he commented, 'typical GWR practice'! Congratulations to Martin.

It's over to the photographs now - more pictures, less chatter! **ME**

The wagons seen behind 2889 were courtesy of Bill Hall from Sutton Coldfield, seen here with police diesel 37999. Making the wagons was his physiotherapy after an accident to his arm.

A long-time member of SMEE, Peter Wardropper joined when he was 16 years old and today brought us his 3½ inch gauge County of Dorset.

John Denton loves diesels and owns a few. Today he was driving a Class 52 Western in a golden ochre livery.

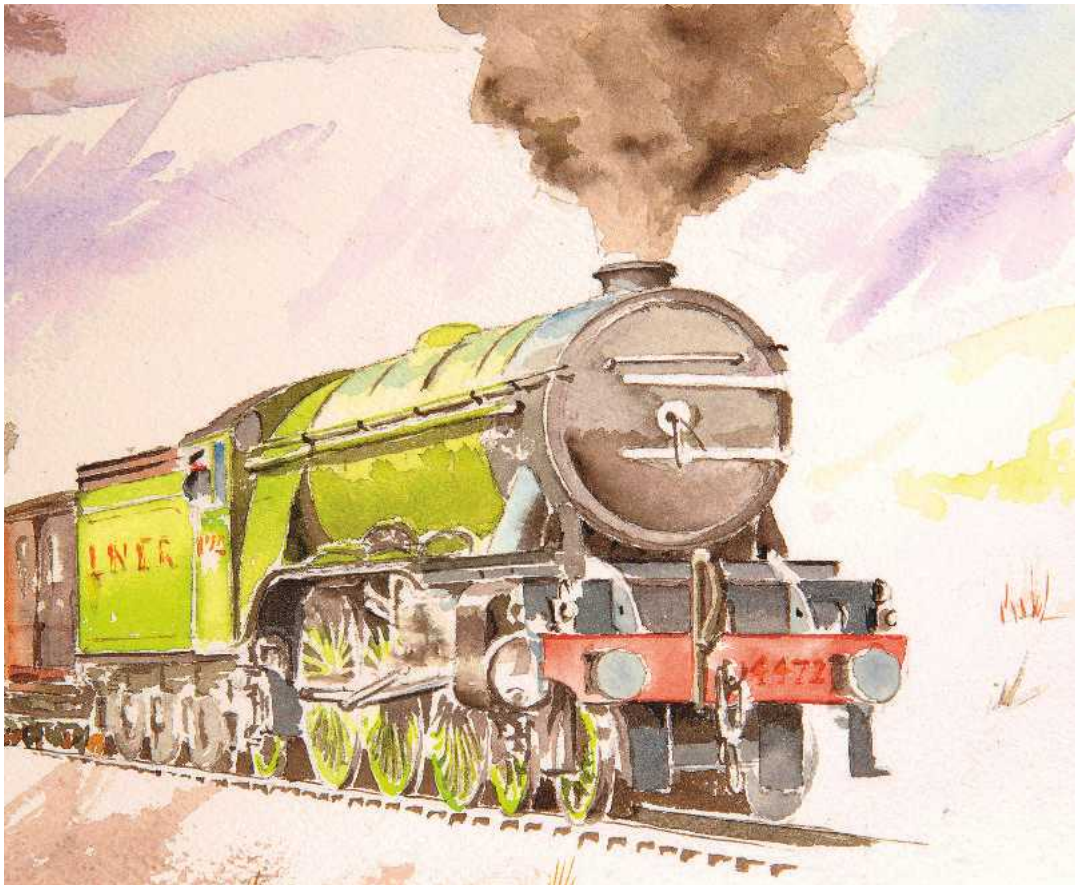
We suspect this may be another John Denton diesel, driven by Dave Giddings. Today Dave was driving a Class 40 that was built between 1958 and 1962 and this particular one was involved in the Great Train Robbery. On withdrawal it was cut up at Doncaster with indecent haste (as they say) to avoid souvenir hunters.

This is Spitfire*. Owner Andy Nash tell us, 'she was built (with 2 cylinders) in 1934 by G.W. Smith - I know no more about him. It was a* Flying Scotsman*, so it should really be referred to as an A1, I guess. Her last owner, Stewart Christenssen (also a Romney Marsh model engineering society member), rebuilt it with a new boiler in 2013. He has made her resemble the RH&DR locomotives* Typhoon *and* Hurricane*. She is painted in BR experimental express locomotive blue with black and white lining. Stewart's wife's grandad was a Spitfire pilot in the war, so the fighter plane name follows on, although of course the locomotives' names are inspired by winds'.*

Andy Nash's 'blue Pacific' seems to have a rich history. How many 5 inch gauge locomotives can claim to have been driven by the designer himself, Sir Nigel Gresley, seen here at the 1937 Model Engineer *Exhibition, watched by Percival Marshall (far left).*

Peter Seymour-Howell builds a fine, fully detailed model of Gresley's iconic locomotive to Don Young's drawings.

Continued from p.649
M.E. 4677, 5 November 2021



Painting by Diane Carney.

PART 22 - SMOKEBOX DOOR AND NAMEPLATES

Flying Scotsman in 5 Inch Gauge

1. This first picture shows the cast iron lump held in the four-jaw chuck having been clocked for concentricity.

Smokebox door ring

Now for the smokebox door ring. I'm lucky as my son had given me a few off cuts from his work, two of which were perfect for the smokebox ring so it would have been rude not to make use of one of these very heavy lumps of cast iron. A point to note is 4472's smokebox ring today looks different from her early career - today there's not much evidence of a radius to the outer ring where it meets the smokebox tube. Anyway, Don had stipulated a ⅛ inch radius and that's what I have done.

2. Here most of the initial machining has been completed and we are ready for parting. The black marker line is a guide for where I want to part off leaving the final machining to ⅜ inch width to be done while reversed in the three-jaw chuck. I will also finish machining the instep and test fit the smokebox tube while still held in the chuck. Before parting off, the radius is added using a file. I used a length of timber to catch the part as it parted and I also laid one of my sanding pads underneath just in case as I wanted to avoid any dinks.

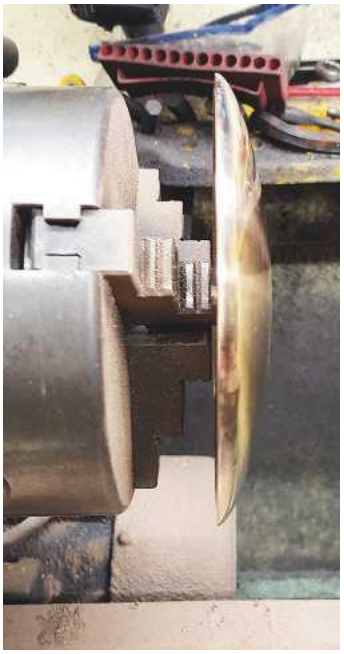
3. After a quick clean-up of the copious amounts of iron filings left all over the lathe (yes, I did use the magnet in a bag trick) I refitted the three-jaw chuck, clocked the part and finished to size.

4. The finished part pushed into the smokebox tube to check fit. I then gave some thought to the sealing of the door to the ring. On the full-size Scotsman there is a groove cut around the ring for packing to seal the door. I decided that I would do the same, for two reasons. Firstly, it would give me the best seal and secondly the packing is visible around the door on full size, so in my wish to make as close a representation of the prototype as possible, I had to follow suit.

5. The back of the door casting is concave, very similar to the prototype with only around a 3/16 inch lip, of which around half will be lost when the door is turned to size, so I need to get the sealing ring groove in its correct position to work.

Smokebox door

I made a start on the door and machined off the casting's centre disc/boss so that I can replace it with the correct material, in this case stainless steel. I spent a couple of hours on the lathe machining hand-filing/sanding/shaping the door as it's important to try and get this part right. I left the centre except for a pilot hole until I had the stainless steel to hand.



6. Here is a side profile of the door. It is currently a couple of thou oversize, which I'll remove in the final stages. The radius on the edge will be 3/32 inch and it's very close to that now. The rear is machined flat with a small curved recess ready for a planned 'O' ring seal that will be fitted as in the prototype (although the prototype uses packing). I'll machine a groove into the smokebox ring face to accept the seal once I have obtained the various seals.

7. Here we have the smokebox door parts assembled. The centre boss is in two parts and is over length for now. I will machine up the baffle plate first and fit to match the prototype before machining the boss to length. I also need to plot, drill and tap 6 BA holes for bolts to hold the centre of the baffle plate to the boss (an extra to match full-size) and there will be other fasteners around the outside to do too.

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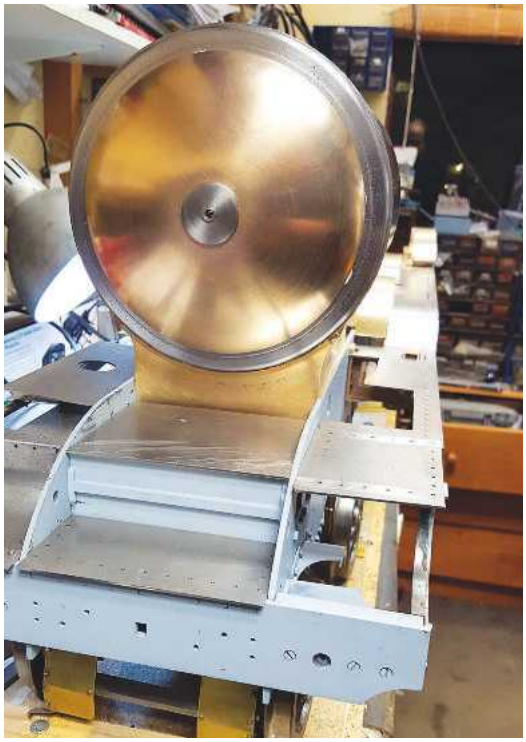
Nameplates

At this point I decided to do the name plates. Some years ago, Diane Carney produced my set of plates for 4472 and they are a true work of art, not just in their quality but in their accuracy too.

I have cut most of the excess material away from the edges and removed the raised edging along the bottom edge as there isn't any on the prototype. When I first noticed this some time back I was a little confused as the rest of the plates were perfect. I thought this was an error but now it all makes sense as it was very easy to work to this raised line, removing it to give me the arc required. It also became clear why the etch had the extra raised tab each end.

●To be continued.



8. Thanks to the wonders of 'blue tack' here we have the door sitting in place – well, as close as I could get the blue tack to hold it, being pretty heavy. I have also removed approximately 1/32 inch from the back of the ring radius to match the prototype.

9. I profiled a piece of tool steel to machine a suitable groove around the door ring face with a slightly smaller outside diameter than the door itself. I left the final depth of this groove until I have fabricated the dart etc. to see how much the ring will compress as I would like to have the door up tight against the ring face with the seal doing its job. Here is the seal in its groove. I have since made the groove deeper than shown here; this I did a few times, testing how much I could compress the seal in its groove and I stopped when I could nearly force the seal flat in one spot although of course doing the same around the whole seal pressing the door down was impossible.

10. Here we have the two plates ready for the next stage.

11. The next job was to roll a suitable piece of brass for the base support. I drew this shape up on paper following photographs for the details. I silver soldered the parts together, cleaned up and glued the paper templates to each. I machined the outer edge of the support first 6 mm wide and then took away the recesses at 3 mm wide. After a tidy up with files I concentrated on the strengthening webs between plate and support. There are two sizes, four 6 mm and three 3 mm for each plate, these aren't equally spaced with the webs being offset for the mounting points. These were soft soldered in place.

12. Now we come to those extra raised tabs mentioned. I believe that Diane included these to aid in machining away the steps at each end, although there were no instructions to state this, but to me they looked right and most certainly shouldn't be there as etched, so I used them as my guide for machining.

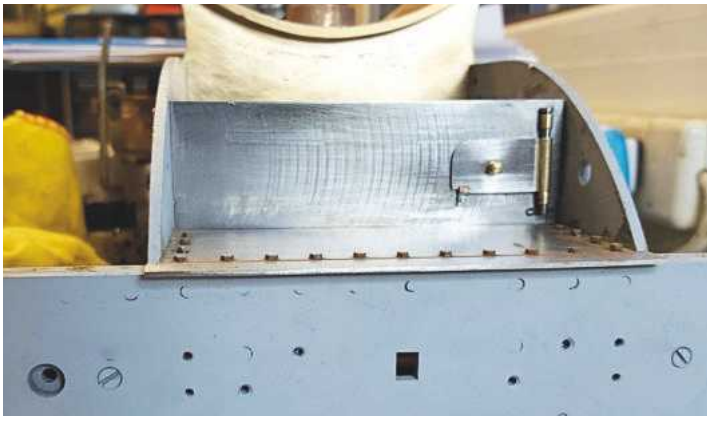
13. The two plates showing both sides.

14. Here are the plates in situ. *Something that I did pick up on is that the position of the nameplate seems to have moved over time. There are pictures in preservation where the plate seems to be mounted either right up to the splasher face or set back a little, and from what I can see on photographs from my chosen era the plate was stepped back which is what I have done here. I drilled and tapped 12BA, which seems to be about the right size. I have used countersunk screws for now for ease of removing, but these will be replaced with hex heads for the final fitting.*

16. The cover plate is 1.2mm steel and according to the drawing the hinge itself is 5/32 inch. In scale terms that's far too large and so I reduced it closer to the prototype. I used brass tube here as it's quicker than machining up some bar. I used an oversize off-cut of steel, filed one edge flat and silver soldered the tube to the edge, marked the width and trimmed with a hacksaw as shown in the picture. I filed it down to size and profiled to shape. The cover is opened via a small knob more or less centrally positioned on the cover.

17. After some time I ended up with this kit of parts. The hinge bosses where made of the same brass tube with 8BA mounting lugs silver soldered on and the hinge pin is stainless steel with a small hole drilled (not done yet in the picture) to accept a small split pin. The split pin was made from fine piano wire, about 15 thou diameter, and the hole in the hinge pin is 31 thou. The catch is a small piece of brass and the rivets are 1/32 inch - I only used one rivet in the end.

15. Next I moved on to some detail work at the front on the 2:1 gear stay. After taking everything apart the first job was to machine the front face flat as shown here. I clocked this first as the back has curved ends that had been annealed and unlikely to be flat, having not needed any machining. As it turned out it was pretty square, being only 5 thou out. I then machined the slot that gives access to the 2:1 pivot pin for oiling; this is along the horizontal centre line. Now, if I was building 4472 as built this would be the end of the story as she had no cover until the 1930's, just an elongated slot. It seems strange to leave this open just below the smokebox door but that is how it was. It would seem that this caused problems to the 2:1 gear (no surprise there) and so a cover was later added which I'll cover next. After the slot I drilled/tapped 8BA the two mounting bosses for the hinge.



18. Here is the cover. You lift the cover to clear the latch and then open the door, just as on the prototype from the mid 30's until the larger sliding hatch was fitted.

19. Last picture to show progress so far - looking more like a Gresley Pacific at each stage.

Injector Wars! PART 3

Warwick Allison relays the stories of the three Aussie protagonists, James Sanders, Simon Collier and Andrew Allison.

These are the stories of three model engineers from a land far, far away, vying to make the best injector.

The challenge!

Utterly meaningless!
Everything is meaningless.....
What has been will be again,
what has been done
will be done again;
there is nothing new
under the sun.

Ecclesiastes 1

Continued from p.620
M.E. 4677, 5 November 2021

Dramatis Personae

James

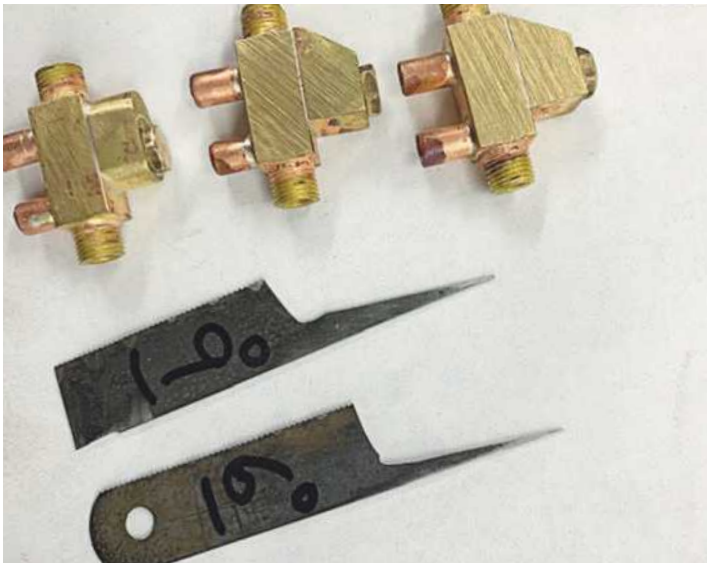
James is a young passionate model engineer who works at a furious pace with many locomotives already evidence of his work. He is new enough not to be worried by those things that would make more experienced model engineers shy away from the challenge! He leads with such pioneering enthusiasm that others are left behind in his wake.

Simon

Simon is a meticulous model engineer who can focus on precision and making things correctly. He discards his failures and pushes on to achieve that which is often unachievable! A technical challenge is Simon's big come on! Like a dog with a bone he carries on until the impossible is achieved!

Andrew

Andrew is a model engineer romantic, dreaming of that perfect prototypical miniature that performs superbly. He is something of a wily Mr Fox, hanging back and watching the successes and failures of those that go before him, while simultaneously building up an armament of jigs, reamers and fixtures ready for a late but substantial push into the unknown.



Three injectors and the hacksaw reamers by Andrew.

Andrew's Tale

Well as Simon said, James started it! I had long thought making an injector would be something I'd like to do. The injectors on the market are cheap and I don't think I've experienced a particularly bad one, so saving money or obtaining better performance are not driving factors. However, the classic miniature injectors don't look much like the full size ones. Mostly this does not cause significant aesthetic issues but on some locomotives the injectors and associated pipework are very prominent, for example the WAGR W & V class and most BR standard locomotives had both injectors and the associated valves and pipework all highly visible hanging down on the fireman's side. The pipework and injector configuration becomes quite a feature worth trying to represent well. If one could make one's own injectors this objective would become a little easier to pursue... still that was a 'one day' challenge!

The entry end of a steam cone bell-mouthed using the hand scraper. Note the highly burnished smooth entry, this is the kind of finish that should be aimed for.

Research

With James and Simon keen on making injectors, it was a good time to jump on the bandwagon and hopefully share some knowledge and learn from each other's trials and tribulations! None of what follows is anything new but simply the things I have read, learnt and experienced which may interest others too. See part 1 (M.E.4676, 22nd October) for some of the better key literature on model injectors which is worth getting hold of.

My first step was to do a literature review. I read everything I could find,

trawling through *M.E.* back issues in the club library. There is a lot available which is all interesting reading. And by interesting I don't necessarily mean informative or correct! Much more than fact, there is opinion, debate, pseudo-science and personalities! There is quite a variation across authors in writing style, what it is perceived an amateur model engineer may find easy or difficult or the importance or insignificance of various design details.

I am glad I studied fluid mechanics and thermodynamics at university. I've forgotten most of it but probably there are some ingrained concepts still there that make understanding injectors a bit less mysterious. I can still hear the lecturer's voice shouting; "There's no such thing as a free lunch!" as he paraphrased the second law of thermodynamics. Probably in an effort to provide a simplistic explanation some authors end up describing injectors as a perpetual motion device and claim you get something for nothing! No wonder people think they are magic. Most describe the fluid dynamics component correctly in the form of the Bernoulli principle as the operating mechanism i.e. using cones to decrease/increase the velocity of the flow with a corresponding increase/decrease of pressure. However this does not explain how a volume of steam can be mixed with more water and then put all of it back into a boiler at a higher pressure than what it started at.

14 oz injector components - note the side water entry.

Taking a step back from Bernoulli and even forgetting that the steam is under pressure, an injector is actually a heat engine. The missing element from most simple explanations is the considerable thermal energy contained in the steam. The latent heat released when the steam is condensed by the feedwater provides the energy required to power the system. So the combined stream of condensed steam and feedwater can be put into the boiler, *but with a reduced thermal energy.* When the thermal energy expended to perform the work is accounted for it brings the system firmly back into the real world! It also helps understand why warm feed water is a problem for injectors. If the steam cannot be condensed the latent heat required to power the system is not available so the injector fails.

From left to right, knife tool, parting tool (0.025 inch wide) and 0.625 inch radius round nose tool are all the tools required for injector production.

Published Designs

Injectors have gained notoriety primarily due to many published designs that don't seem to work! In some cases it would appear the designer was protecting their own commercial interests and errors or omissions were not necessarily accidental! In one article, LBSC - I assume in response to criticism that his injector design doesn't seem to work - claims that he knows the secrets to make them work but wasn't going to publish it lest someone commercially benefit from it!

Fortunately, there are a number of well proven published designs available (and have been for at least 50 years). As far as I can tell the major work deriving the key proportions of the classic model injector was determined experimentally by Linden and Keiller and LBSC and essentially every model injector has been derived from this, or else independently arrived at similar designs. In particular Laurie Lawrence, Eric Rowbottom (as described by Basil Palmer) and D.A.G. Brown have published complete designs with fully dimensioned drawings that are well proven for the sizes we are typically interested in.

For any of these well proven designs, assuming you can make things exactly to the drawing, you can be guaranteed to have a working injector. This is the challenging part! In actual fact there are only a few *relationships* that are really critical and only a few *fits & finishes* that are quite demanding (i.e. you must be accurate with thou-splitting precision). Most other things are relatively arbitrary to a degree. However, any change you make is likely to have

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knock-on effects so if building to a published design, working with extreme accuracy is the only way to go. With a little experience then you can then start experimenting with design changes and seeing what you can get away with! It is worth saying, though, do not believe all that you read. Some people, I imagine after making a successful injector, ascribe its success to particular traits and then try and make some rules around why that trait is essential. It is better to look at the common features of successful designs and take the 'essentials' people agree on!

Some real essentials

- A ratio of delivery/combining/steam cone sizes very close to 1/1.18/1.5;
- Good, smooth surface finish;
- Correct annular gap;
- Concentricity of cones.

Some less important 'essentials'

- Massive overflow passages;
- Throat lengths must be very short (under 0.005 inch long);
- Exact angle of cones, radius of bell mouths etc;
- Low body mass (some claim a thick/heavy body will remain too hot).

The measures of success

- It will have a useful operating range, say, work over at least a 50 psi range;
- The high limit of the dry range will be closely aligned with the intended working pressure;
- It will not require any external regulation of steam or water supply;
- It will lift water.

Construction

The more constructible the design, the better the workmanship is likely to be and the more you can be assured at getting the true essentials correct. This is not to say that the less important claims are unimportant, but rather if needed they can be sacrificed a bit to get the real essentials. For example, when reaming the taper into the combining cones it is better to allow for a longer section of parallel throat rather than risk opening out the throat diameter by going too far. You also want to allow enough material for re-reaming once the cones are pressed into the body to ensure concentricity and no step between combining cone halves. However, bear in mind that if you leave a longer parallel throat the entry end of the taper will be smaller and the steam cone will need to be adjusted to ensure the annular gap is correct. Any change will cause a flow on effect!

Even though my end goal is to enhance the scale appearance I first wanted to ensure I was capable of making a working injector and learn some of the tricks on a proven design to gain some confidence that I would not be wasting time on my own design. For starting out, it appeared to me that the Basil Palmer design had the easiest bodies and I liked his writing style the best so my decision was to build based on his articles. I will not go into the construction *ad nauseam* because it is all covered by the various designers. The D.A.G. Brown description is very much blow-by–blow for a specific injector (e.g. centre this x deep, advance the cross slide by 2 turns… etc.) which may take other people's fancy more. Brown seemed to have a better method of manufacturing the combining cones, so this was used, and one area where Brown's book is particularly excellent is showing in detail, with drawings and photos, all tooling and set-ups. Even if you don't follow his methods or tooling (which I didn't) he does detail all processes and so helps you to visualise the full task and plan how you may get the same result.

One challenge with construction is that a lot of what you make is extremely difficult to inspect and measure – for example the smallest combining cones halves I have made, 4mm diameter and 2.5mm long

This shows an advantage of designing and making your own injectors. This batch of four are 14oz with ¼ inch x 40 connections and side water entry. These features are unavailable in commercial injectors, yet ideal for 3.5 inch gauge locomotives.

with a 0.4mm throat - are hard enough to even pick up and hold on to! Measuring things can also be a bit of a challenge once they have tapers and radius machined on them and if you do determine your part is incorrect, re-machining it is probably impossible. The key here in not to rely on inspection and measurement of parts but trust your tools and manufacturing. Keep your tools sharp and to spec, on centre; have the job as close to the chuck as possible and make any tools, guides, gauges; ensure backlash is taken up before the cut is made etc. Know how wide a cut the parting tool makes (not just how wide the tool is!), what radius is on your round nose tool etc. Do whatever you need to be confident that the fit and finish straight off the tool is correct. These do not have to be flashy at all – simpler is better!

For example, to achieve the correct depth for the taper reamer on the cones required some thought. The critical thing here is where the throat diameter is, and to go too far would open out this critical dimension. A spacer was machined to the length from the end of the cone to where the throat diameter is to be. This was placed over the reamer and the stop collar was adjusted until the throat diameter was measured

A square reamer with its depth stop holder.

across the reamer on top of that spacer. The diameter at the end of the cone can also be checked by measuring against the stop collar. This is something that would be almost impossible to measure after manufacture - so set the tool up to get the right result!

It is worth stating that your workshop equipment does not have to be flash. My lathe is an ML7 with a maximum spindle speed of 800 rpm. Woefully slow for the tiny drills but you can manage. It has the usual backlash and saddle wear you would expect in a machine of this vintage. The only measuring device used was a $20 digital Vernier calliper from ALDI. I did splash out and finally bought a collet chuck and some quick-change tool holders. Injectors are one of those things that lend

themselves to production and so the ability to quickly set up tools and accurately chuck and re-chuck pieces is a huge advantage. Small drills (have plenty of spares), a pin chuck and size 00 centre drills are the other main tools required.

One area in particular that seemed difficult and was quite off-putting was making the taper reamers from silver steel. James and Simon who had gone before confirmed this was a struggle; they had persisted, however, and finally achieved success. Basil Palmer describes an alternative in the form of a triangular reamer ground from HSS. This took my fancy as it seemed well supported in the hole and the only thing in contact with the job was cutting edges, whereas the D-bit style reamer looked like it could rub and cause surface defects. One disadvantage of the triangular reamer over the D-bit is that you cannot directly measure the diameter of the hole from the reamer. You could measure from flat to apex and work it out, but there are so many numbers going around your head it is easy to get confused. I considered, instead, a four-sided reamer would work just as well and it seemed to have the advantages of both. A few quick experiments with the shank end of broken drills on the bench grinder didn't show any problems with forming or their cutting ability.

To form the square reamer, a table with a long bit of bar to act as an angle guide was made for the bench grinder. A piece of 5⁄32 inch round HSS, Loctited into a square holder, could then be advanced along the edge of the bar, onto the side of the grinding wheel to cut the faces, with the square used as an indexing method. A set of spacers was machined that could be inserted into a hole 6 inch along the bar which set the guide angle. In practice these spacers turned out to be pretty useless due to tool flex and possibly some wheel wear changing the intended angle. Still, the angles required were relatively easily, if slowly, obtained by measuring the angle you had produced and then adjusting the guide a little one way or the other to make any correction. After grinding, the faces were rubbed smooth on 600 grade wet and dry and the cutting edges checked for straightness and smoothness. This method took about an hour to produce each reamer. It was important to take it easy with frequent cooling to keep it from overheating.

Instead of the traditional bellmouth reamers to create the entry to the cones, I made another tiny square reamer, effectively like a square needle. This was left glued into its square holder and is used by hand to hand scrape in the bellmouths and break edges. This is a bit more like artistry than traditional machining but with a little bit of practice I have found a beautifully burnished, smooth and transitional radius can be achieved.

The steam cone is fairly critical in its dimensions, but that does not mean it is very difficult to manufacture. The main difficulty is the diameter of the snout that forms the annular gap in the combining cone. The Basil Palmer method is to leave the snout oversize, which means the steam cone will not push fully home. Slowly reduce the diameter of the snout a thou or so at a time, trying the injector on it as you go. When the cone starts closing up, you know the snout has begun entering the combining cone. When the cone is fully home, the snout can then have the required annular gap machined off it. This is an excellent method as it takes into account any errors in cone angle or combining cone entry radius.

The real difficult work is in making the tooling correct, as things have to be correct off the tool. The hardest thing to manufacture was the 6 degree reamer. The most difficult bit of the injectors themselves is getting the correct interference fit on the combining cones. The first I made were 3⁄16 inch diameter and these were

Tests of the taper reamers to check surface finish.

difficult to get right. The next batch had bores only 5⁄32 inch diameter - these were much harder still! Working with very small drills at slow speeds is tricky but other than that, the machining operations of the cones are relatively simple and the correct sequence of operations will ensure concentricity. Being small, the cones are pretty quick so if you stuff one up you have not lost a lot of time. You have to be mentally on the ball though because the tooling is slender and delicate. I have broken my 0.025 inch parting tool twice by accidently knocking the tip on the chuck while moving the saddle out of the way. Also, the 6 degree reamer, with its slow taper, is very easy to feed into small holes. I broke one by absent-mindedly winding it in quickly without withdrawing to clear the chips. Having to remake these tools drains time considerably!

More recently I had started re-reading all the injector material and Ted Crawford recommends making reamers from hacksaw blades, 'The cheap Chinese kind, the type that snap, not bend.' This all seemed too easy! A quick experiment produced a reamer in about 2 minutes. The surface finish when a cone was sectioned was impressive. It seems that some reamers are more equal than others(?) four sides good, two sides better?? A few more injectors were made using these reamers, including a tiny 3.5 oz./minute (~#83 delivery cone hole) which proved they work just as well as the time consuming 'real' reamers! The reality is that you are really

A hacksaw blade reamer.

only ever using the tip of a reamer, so the flatness of the hacksaw blade never really comes into it.

Out of interest I measured the time taken to produce the first batch of 5 injectors. The tooling took 5 hours to produce. The injectors themselves, including time to test and make adjustments to get them all working, was 17.5 hours. If you don't count the tooling time this averages 3.5 hours/injector. The time to produce individual components varied significantly, for example the first delivery cone I made took 40 minutes but by the end they only took 15 minutes. This time would be hard to beat. With small batch production it would be difficult to get much better than 3 hours/injector – for a quite unrefined looking, square bodied variety. That makes the price of commercial injectors seem very reasonable!

●To be continued.

NEXT TIME

The day of reckoning – the injectors are tested!

Workshop Disposal

Part 1 - Planning in advance

Roger Backhouse tackles what can sometimes be a sensitive subject.

It is said that the only two certainties in life are death and taxes, to which we can add a third: at some time the contents of a model engineer's workshop will have to go. Sadly, death or infirmity can force workshop disposal, as can moving to a smaller home or taking on major caring responsibilities (**photo 1**).

These articles draw on the experiences of disposing of workshops from Dr. Dermot O'Brien and members of the Society of Model and Experimental Engineers (SMEE), York City & District Society of Model Engineers (York Model Engineers) and Dockland and East London Model Engineering Society (DELMES). They don't cover the disposal of models as this is regarded as a specialist subject.

Many model engineers live into their 90s and continue to be active in their workshops. With memories of happy hours spent there, the thought of parting with its contents can be traumatic and a task to be put off. As we age, the work and worry of workshop disposal seems an increasing burden.

Dealing with the aftermath of death is distressing enough and those with executor responsibilities may not wish to carry out workshop disposal. When my model engineer neighbour in Ilford died his widow left his workshop untouched for over ten years until she too passed on. Her son who lived with her only disposed of the workshop when he moved house. Fortunately SMEE members were able to assist him (**photo 2**).

A model engineer's workshop - what will happen to the contents eventually?

Martin Cook of SMEE goes through items from a workshop. This can be a sad and dirty task but SMEE members have helped dispose of the contents of numerous workshops.

There are often different matters to be taken into consideration when it comes to workshop disposal. One may be to make as much money as possible - there may be dependents to provide for or care home fees to be paid. Another priority could be to ensure tools etc. go to good homes, perhaps to friends or a Society. Sometimes quick clearance is needed, especially if a property has been rented or is to be sold.

Planning in good time

Wills

There is no doubt that advance planning helps eventual disposal. It is important to make a will, and vital if you are not married and in a relationship. Unfortunately, it is a task that many put off until it's too late. Whilst home-made wills are possible they must be done correctly to be viable and, in most cases, having a will written by a solicitor is simple and not expensive. Several charities like Prostate Cancer UK use Will Aid in collaboration with certain solicitors whereby simple wills are drawn up free. (www.prostatecanceeruk.org) Such offers usually operate in May and October.

Wills may need revising to take account of changing circumstances, including marriage. Some people include bequests to charities or a model engineering society. Many societies have benefitted from money or equipment left by deceased members, to be acknowledged in clubhouse plaques or annual prizes. For example SMEE has a board listing benefactors and named a workshop the Van Rijn room after a donor.

Make sure executors know where your will can be found and ensure your computer passwords are available. Take a moment to think about all those family photographs

or bank account details that could be inaccessible and lost forever. It is also sensible to inform your family, executors and any possible beneficiaries of your plans and be mindful that not everyone could accept responsibilities for a workshop disposal and some may not feel up to the task physically.

Letter of wishes

John Chambers of York Model Engineers revised his will three years ago and wrote a 'Letter of Wishes' to go with it. The purpose of such a letter is to support the will and aid the persons dealing with your estate. It should not contain anything that conflicts with your will. A letter can cover any aspect of your estate, such as funeral wishes or the distribution of personal items, for example particular models or items of workshop equipment, materials etc.

One benefit of such a letter is that you can alter and update it at any time if your circumstances change. It doesn't have to be formally drawn up or witnessed, so it's easy to review. This can be helpful if, for example, you have a long list of specific items that you wish to give to various people. (See also www.thegazette.co.uk/wills-and-probate/content/103504)

Power of attorney

Sadly, some will become infirm or incapable of looking after their affairs. We probably know skilled and intelligent people who have lost short term memory or suffer dementia. A lasting power of attorney (LPA) covering property and financial matters, drawn up whilst in good health, enables those nominated by you to look after your affairs - including operating bank accounts, dealing with pensions and benefits and selling property - *only* if you become incapacitated. An LPA can be applied once it has been registered with the Office of the Public Guardian. It costs more than a will but can save enormous difficulties later. A second type of LPA covers health and welfare. Remember it is never too early to make a will and draw up an LPA.

Advance planning

One member of York SME decided that in the event of his death the contents of his workshop will go to a young friend who is a keen model engineer. That way his family won't have the worry and work of dealing with tools and equipment built up over many years, though the family will retain his models.

Drawing up an inventory with photographs of significant tools, plus a note of realistic values, will help hugely anyone disposing of a workshop. Not all executors or family members will be well informed about engineering tools or their likely values leaving them open to possibly being ripped off without prior information to hand.

Early disposal

Some model engineers dispose of workshop equipment before they become incapable. Don Paton, a member of York Model Engineers, explains why he chose to act.

He says; 'Approaching four-score years can bring some benefits, but also carries some risks. My ability to operate heavy machinery safely was becoming doubtful; I had given up motorcycling the previous year because of an accident and a realisation that at 70+ I wasn't as capable as I thought. In my previous profession we are retired at 55/60 depending on the size of the aeroplane being flown. If you transfer that logic into ownership of a well-equipped workshop there can be good reasons for downsizing ... so I started the process by emailing all the 'clearance' advertisers in *Model Engineer* and *Model Engineers' Workshop* with a pictorial list of my fully equipped workshop. The only offer I had - from a rather brusque bloke - was accompanied by much whining about the costs of transport and labour. He offered me £1500 for a complete clearance of my workshop, which I had valued at just over £30,000. His offer was for total clearance and included three locomotives and accompanying gear; everything gone plus a brush out. I did not take him up on his offer!'

It is fair to say that others have more positive experiences of dealers but one or two clearly try to take advantage.

'I changed tack and targeted online engineering firms within 50 miles - and struck gold in South Yorkshire! Steve Lilliman had the services of a man with truck and crane so I had my heavy machines collected within a couple of hours. Job done. No need for my wife or children to dread clearing out the old guy's assorted squirrelling over 50 years..... much relief all round.'

Don also used eBay saying, 'I made a couple of grand on eBay but fairly quickly tired of the time-wasters and/or whingers so the remains will go to the Club along with a lathe I have donated to the pending workshop.' (York Model Engineers are redeveloping their clubhouse and Don's lathe will have an honoured place in the new workshop.)

Fortunately, Don hasn't given up model making and running, having recently built an 0-gauge railway around the roof of his shed to run DCC model locomotives.

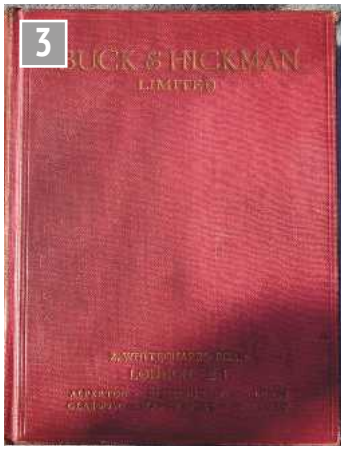
Free adverts

Disposal while in reasonably good health gives some control over the process. You will probably have a good idea of values and perhaps where you want items to go. Adverts in *Model Engineer* and *Model Engineers' Workshop* will reach a likely audience and give an opportunity to test the market. And they are free!

Don't forget archives and memorabilia

Photographs and memorabilia acquired over many years may be valuable records of former industrial and engineering processes. When clearing my neighbour's workshop I found old catalogues from London based engineering suppliers and tool merchants. Local history librarians and archivists for Southwark and Ealing took these for their collections and others might appreciate relevant photographs of local industry or transport in their boroughs (**photos 3** and **4**). The same can be said for other areas of interest; indeed after sorting out my old colour slides many went to local archives and local history libraries.

●To be continued.



FAR LEFT: Buck and Hickman Catalogue from 1958. Now a period piece and donated to a library.

LEFT: Item listed in the 1958 Buck and Hickman catalogue. Such catalogues are worth preserving.

The RSME Spring Live Steam Meet

Luker reports from the Rand society's spring rally in Roodepoort, South Africa.

Introduction

It feels like ages since we steamers have had the opportunity to meet up with other clubs and just enjoy a couple of days of live steaming. With the blossoms in bloom, and the local vaccination rollout on a roll, the Rand Society of Model Engineers (RSME) decided to host our traditional spring steam meet on the first weekend of September. For the first two days the club was closed to the general public for the guys to let off some steam without the public around. I had been looking forward to the meet, not only for the chance to steam up my locomotives, but also to put on my club reporting hat and share with everyone what we get up to in our neck of the woods. I am secretly hoping some of the readers get a little envious (in a good way) as I do, when I read about the top-notch steam events overseas.

I volunteered the young members of our club to help with interviewing the visiting model engineers and take some videos and pictures. The spring meet videos were entirely their production, and what a job they did! The videos are well worth having a look at and can be found on the RSME Facebook page (web.facebook.com/RandSocietyofModelEngineers).

The RSME spring live steam meet (photo David Bricker).

The Rand Society of Model Engineers

The RSME is situated in Roodepoort, a small town that was annexed by the greater Johannesburg as it expanded and was eventually demoted to a suburb. The RSME track is a multi-gauge ground level track consisting of 3½, 5 and 7¼ inch gauge (**photo 2**). The track has two circular loops: the shorter of the two is about 450 metres long, while the longer is about 850 metres long. The vertical height difference between the highest and lowest points is 5 metres which puts tractive effort to the test with the average gradient 1:100 to 1:80, although there is a section of track which is graded to 1:50 for approximately 60 metres ¾ of the way into the longer loop, testing any driver's boiler management.

Some of our track features include a single-track concrete bridge, three single track steel structured bridges and a set of parallel tunnels. There are also three dead-end sidings, two by-pass loops through the station and two through sidings adjacent to the station. The station area contains 14 sets of multi-gauge points (railway standard point type). There are gradient markers, whistle boards and two (gated) level crossings for pedestrian traffic which all makes for an interesting loop on a locomotive.

The main steaming bay (which is raised) can accommodate over 20

Panoramic view of the station and steaming bay from the viewing deck.

locomotives and consists of two traverses, a ground level turntable and a hoist to lower the locomotives from the steaming bays to the track (**photo 3**). All steaming bay facilities are fitted with quick-connect water and air fittings.

Panoramic view of the steaming bay, stitched together from photographs during quiet times to avoid blurred people in the pictures.

Friday: locomotive offloading, pitching tents and quick hellos

Friday was very well attended, considering it was a normal school day. We had visitors from as far as Bloemfontein and Pretoria that made the trek to our little track. The tents were pitched and the locomotives were offloaded in a blink of an eye. In no time the locomotives were on steam and we had a few on the track before tea on Friday morning. Charles Wright, a master builder from Bloemfontein, brought two lovely little 3½ inch gauge SAR locomotives that made light work of our gradients (**photo 4**). Charles told me that due to an interesting series of domestic events the one locomotive was moved from its safe storage to outside where it was knocked over by his dogs. He came out to find the locomotive, wheels-up, on the ground looking very sorry for itself. The cab was a little bent and after some minor repairs in the steaming bays the locomotive was steamed and ran the whole weekend. It says something about the workmanship when you can steam up a 3½ inch gauge locomotive after many years of storage, like it was built yesterday!

Charles and his Class 14 and 19 3½ inch locomotives from Bloemfontein (photo Jaydan Clarke).

The author's 7¼ inch Stirling single cooling down after an enjoyable first day (photo David Bricker).

Garth's 5 inch Simplex in the foreground and the author's 7¼ inch Stirling single in the background (photo David Bricker).

Alex Nicholl on his 5 inch Lawley (photo David Bricker).

Brian Nicholl on his 5 inch Lawley with his full set of carriages (photo Peter Townsend).

Sir George *(club locomotive and the original Lawley), that the young lads steam most club days (photo David Bricker).*

By the end of the day the steaming bays and track had quite a few locomotives ranging from a pre-1900 British single wheeler to the more 'modern' locomotives (**photos 5** and **6**). The Lawley (SAR class NG6 4-4-0) is no stranger to our little track and I have yet to steam up in the bays without one of these fine locomotives to one side of me; there are four in the Nicholl family alone (**photos 7** and **8**). Two of our club locomotives are of this class and the young lads take the smaller one out often for a run on our track (**photo 9**).

Then finally, no steam day would be complete without Steve Headland and his faithful 7¼ inch *Romulus* (**photo 10**). I don't know any 0-4-0 that's as reliable and works as hard as that locomotive. It must have hauled hundreds of passengers hundreds of times around our little track generating much needed funds. Even though Friday wasn't open to the general public, the faithful blue locomotive and its builder/driver was on the track to inaugurate the event.

Saturday: a few more locomotives and drivers join in the fun

Most of the locomotives that made the trip on Friday stayed overnight in the steaming bays under the watchful eye ≫

of our caretaker (Daniel) and his family. During the morning we had a few additional locomotives that joined us. Shawn Spaan brought a newly acquired Baldwin 0-4-2 *Husky* (**photo 11**) which ran beautifully and looked like an outback American cousin of *Wahya* (**photo 12**), which also made an appearance. I made the comment, jokingly, that the commercial pressure gauge fitted detracted from the otherwise great workmanship. He brought the whole family with him and they made a caravanning weekend of the meet.

Charles Viljoen and Lukas Nel (two master builders and designers) from Pretoria brought an interesting 0-4-0 narrow gauge saddle tank locomotive with Joy valve gear (**photo 13**). As with all of Charles' locomotives it's an easy steamer, never to give any issues or falter on a steam day. Charles is one of those builders who could have brought a different locomotive on every one of the steam days a few times over.

Steve's blue narrow-gauge Romulus *(photo Jaydan Clarke).*

The author's Wahya *taking the top of the steepest hill, on the long track, slowly, multiple times, for the photographer (photo Jaydan Clarke).*

Sunday: our last steam day for the weekend

Late on Saturday our local bureaucrats (*sic*) sent out orders that there would be 'planned' maintenance from 0800 to 1600 on Sunday, which in local vernacular means there was a cockup and the technical department from the municipality needs to call a private contractor who knows what he's doing to fix the problem. Fate was kind to us and in the end the power was on the whole day and we had yet another day of fine weather and good steaming.

You would think that after two days of hard steaming the enthusiasm would have waned a little. Not a chance; we had a number of fine locomotives on our track for yet another day and the public was invited to join us to view the visiting locomotives and take a paid ride around the long track.

By Sunday we were getting a little tight for space in the steaming bays. I had brought my little *Ballaarat* (**photo 14**) and one of the larger locomotives needed to get around me. The comment was made that the larger locomotive would easily go **over** *Ballaarat*; such is the banter in the steaming bays. *Ballaarat* had the last laugh running circles around the larger locomotives for most of the day.

Leon Kamferr from the Centurion club (a master builder of note) was there with his 5 inch 16DA SAR, a regular passenger hauler for our club (**photo 15**). This not-so-little locomotive was built to an incredible standard and can pull quite a few passengers with little effort. Leon, like Charles, is one of the very few builders who could have brought a different locomotive each day.

I thought Darren Bedford's *Sweet Pea* (**photo 16**) had died an untimely death in the cold dungeons that are the RSME storage bunker but it was just hibernating. Like an angry bear it growled, frothed at the chimney, spat some condensate out and it was off for a day of spring steaming. Darren showed me the baffle modification he did on the marine-type boiler grate allowing much better steaming with a thicker anthracite bed. He also

The Spaan family with their Baldwin Husky.

Charles Viljoen's 0-4-0 saddle tank driven by Lukas's grandson with a proud granddad on the tender (photo Peter Townsend).

Steve taking a closer look at the author's little Ballaarat *(photo Patrick Ackerman).*

David on Leon's 16DA (photo Patrick Ackerman).

spaced the wheels out to 7¼ inches for a very stable ride.

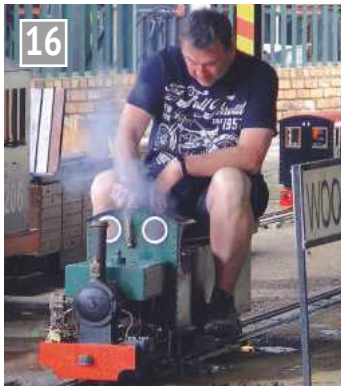
Sad goodbyes

On the final day I made a point of asking our visitors how they found the weekend. Everyone said they had a great time and the track was in very good condition (thumbs up to our Tuesday gang that maintain the track!). As the locomotives arrived and left there were always RSME members to help with the loading and fittings in our steam bays; it's that spirit that makes a model engineering club!

To the best of my knowledge we never had a derailment or accident the whole weekend and there was no locomotive that didn't have a go around our track. I can honestly say everyone looked like they had a good time. There were enough helping hands over the whole weekend which made the workload light and everyone had a couple of hours of good steaming. Even Daniel (**photo 17**) (not only our caretaker but also a master driver) found some time to take our large club Lawley for a couple of loops around our track, just for fun.

Looking back on the weekend I found an interesting correlation between the relative dirtiness (that's the technical term) of the drivers and their locomotives. There were a few locomotives that arrived very dusty due to years of storage; these locomotives looked cleaner than their drivers when they left for home. Yours truly was invited to an early evening *braai* (local vernacular for barbeque) on Sunday, which due to my tardiness in leaving the club, had to be attended in my steaming attire, dirt and all. I could swear Sting's 'don't stand so close to me' was playing in the background and I was banned from sitting on anything other than the floor (not sure why?).

Sadly, describing every fine locomotive that visited our humble track on our spring weekend would require a little more than just a single article. Having said that, I tried to feature a wide range of very different locomotives, which I think I managed to do nicely.



Darren's Sweet Pea *in the station growling like a hungry bear ready for spring (photo Patrick Ackerman).*

Daniel, our caretaker, taking the large 7¼ inch club Lawley for a spin (photo Hannes Paling).

Special thanks to...

Everyone that made the effort to bring locomotives and spent a very enjoyable weekend with the members of the RSME. Old friends were seen again, new friends were made and most importantly, the young guys picked up a little motivation and knowledge from the master builders and old hands; the value of this cannot be overstated!

Everyone that helped the visiting steamers with loading, connections in the steam bays etc. Here there are just too many people to mention!

Everyone I saw with a camera was asked to send me the pictures they had taken on the weekend to use for this article so that I could steam up and have a good time as well. Live steamers can never be faulted for not wanting to help and I had a very large library of photos to go through for the article and the club Facebook page (web.facebook.com/RandSocietyofModelEngineers). Thanks to everyone that sent me pictures.

David Bricker, our youngest club member, who 'reluctantly' took Friday off school to photograph the event. I normally would not condone missing school but his maths and science marks are very good and he is clearly very good with parental management!

Jaydan Clarke for publication of the video (which is brilliant!), all the pictures and the help during the event.

Our caretaker, Daniel and his family for all their help and looking after us.

ME

NEXT ISSUE

GCR Festival

Graham Gardner takes a trip to the Great Central to enjoy their vintage weekend and beer festival.

Harris Engine

Geoff Walker builds a small oscillating engine designed by K.N. Harris.

FMES-Polly Awards

Matthew Kenington tells us about the Polly Awards for young engineers, awarded jointly by Polly Model Engineering and the Federation of Model Engineering Societies.

Injector Wars

The results are out and the winner announced!

Content may be subject to change.

ON SALE 3 DECEMBER 2021

Write to us

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Responses to published letters are forwarded as appropriate.

Lubricators

Dear Martin,
I refer to Duncan Webster's letter (M.E.4673, 10th September) in which he points out that, since 'the tank is mounted in the cab well below the condenser', the column of water within that pipe will exert pressure on the oil within the hydrostatic lubricator.

That the height of the water has an effect is perfectly true. As stated in the article, the height of the oil in the delivery pipe will also have an effect on the oil delivered to the steam chest and cylinders.

There will also be some resistance to the flow because of fluid viscosity.

On a typical British locomotive the height of the condenser above the point of delivery to the steam chest or cylinders will be of the order of 3m. Let us neglect the resistance arising from viscosity and make the conservative assumption that the density of the oil will be equal to that of water (although it will in fact be less because the device works because lubricating oil is displaced by water).

The pressure of a column of liquid is given by the formula:

$P = \rho gh$

Where P is pressure, ρ is density, g is the acceleration due to gravity and h is the height of the column of liquid.

The density of water is about 1,000 $kg.m^{-3}$, the acceleration due to gravity is about 10 $m.s^{-2}$ and the height is assumed to be 3 m, so that:

$P = 1000 \times 10 \times 3 = 30{,}000$ Pa

Pa here stands for Pascal, or the force of one Newton acting over one square metre. 30,000 Pa is 0.3 bar or about 4.4 pounds per square inch. This pressure is small when compared to the pressure difference between the boiler and the steam chest.

While a pressure difference of 0.3 bar would probably provide some flow of oil when the steam chest pressure was equal to the boiler pressure, I would expect this flow to be considerably less than that provided when the steam chest pressure was much lower than the boiler pressure.

In the case of the 5 inch gauge model locomotive that Duncan mentions, the height in the above calculation would be scaled down, so that the combined water column and oil pipe pressure would probably be less than 0.44 PSI or 0.03 bar. The point I was trying to make in the article was simply that the flow of oil would be influenced by the pressure in the steam chest.

However, I am quite prepared to believe that this is complicated by possible 'choked flow' in the restrictor but I think the calculation above shows that the pressure due to the water column is but a small part of the overall pressure acting on the oil.
Regards, Rhys Owen

Dear Martin,
All I really need to say in response to Duncan Webster's letter (M.E.4673) regarding my erroneous understanding of hydrostatic lubricators is kindly to read the articles that I wrote in M.E.4642 and M.E.4643 last year and all should become clear. If it is only the hydrostatic pressure between the condenser coil and the rest of the system that pushes oil into the cylinders I fear our editor is in trouble as I gather his pannier tank has the condenser coil under the cab floor! No, the position of the condenser makes not a jot of difference - it is boiler pressure that feeds oil into the cylinders and if the steam chest pressure is low a bit more will be fed in compared to fully open regulator.

In reality the system has to be set for small or closed regulator situations, as this is the usual operating condition. Full regulator running on any model steam locomotive usually results in a lot of speed pretty quickly along with not much fire left in the firebox! I have a manual valve to shut off steam to the system if I am going to be sitting in the station for a while, which saves the build-up of oil in the steam chest and the resulting spotty black face.
Best regards, Nick Feast

Dear Martin,
Referring to the letter on hydrostatic lubricators (M.E.4673), I am bemused by the comment that Duncan was surprised that Roy Amsbury got his system to work. Back in 1975 I built a 5 inch gauge 45xx tank to Martin Evans' drawings and, as it was a GWR design, opted to fit a hydrostatic lubricator as described by Martin Evans for his Manor. I believe this was based on Roy's design but beefed up a bit(!). I followed the drawings to the letter and suffice to say the lubricator has worked without any faffing on or alteration since 1975 without any problems at all. None of the problems associated with mechanical lubricators, i.e. blowing back, ratchets wearing out, too much travel with driver and passengers covered in oil etc. My locomotive has run at the Ryedale track and main Line Rallies since 1985 and it is nice to be able to alter the amount of oil supplied to suit the working so the chimney top is just wet with oil and I'm sure all the other locomotive owners I have seen at the rallies with working hydrostatic lubricators will support what I say.

Regarding the condenser, my steam supply to the tank is a straight piece of 3/32 inch pipe down the backhead to the tank below the cab floor and that works just fine. I believe the aim of the jockey valve is a) to shut the oil supply off when the regulator is fully shut and b) to atomise the oil on its way to the cylinders.
Bob Willis

2K Paints

Dear Martin,
I am following *Luker*'s articles on painting with interest as I'm about to start painting my

Polly *Trojan*, having had a year steaming it in 'bare metal'. He says he uses 2K automotive paints. As I understand it 2K paints contain isocyanate and require some serious safety equipment virtually precluding them from being sprayed in a domestic environment. The following HSE document gives more details: www.hse.gov.uk/mvr/bodyshop/isocyanates.htm

Peter Howell

Luker replies:
You are absolutely correct - 2K paints contain isocyanates. Not only that, they contain xylene as well. I know this because it is written in large red text next to the safety precautions on the side of the hardener containers (which you should of course follow). It may have been an oversight on my side not to point this out but my articles are more for the model engineers that take the time to read and understand warning labels and I would never insult a fellow model engineer by pointing out something that would be written in large bold red on the side of the container.

I honestly can't think of any paint that can be sprayed in a domestic environment; at the very least you'll end up in serious trouble with the domestic COO for getting paint on the walls and furniture. You should be painting in a well-ventilated area and because you are spraying away from yourself (with no wind, otherwise you'll get a poor finish) any overspray will be away from you. None-the-less a suitable mask will be available from the paint shop; just hold up the tin and show the sales guy the little mask on the label.

Parameterised Instantiations

Dear Martin,
I refer to the post from Tony Reeve (M.E.4671, 13th August). Tony's article refers to an article of mine *An Experiment in Parametric Design* published in *Model Engineer* issues 4664 and 4665.

My article describes, with many examples, an experimental software tool MPM (My Parametric Modeller). In input, MPM accepts text files describing, in a special language, parametric interfaces, parametric designs of parts and assemblies and their 'instantiation' (i.e. generation of instances with numeric values assigned to all parameters) to compose complex assemblies of fitting parts and sub-assemblies. The main output produced by MPM is a text file containing a script to drive automatic production, by the 3D modeller of a non-parametric CAD, of 3D models of all the instantiated parts and assemblies. My article is not easy to read and I am thankful to Tony and others who have taken the trouble to do so.

Tony does not comment on the experiment I tried to describe. The technical part of his post provides a summary of the support in Autodesk's *Inventor* for parametric design and parametrized part libraries. Perhaps I am wrong but his unwritten question seems to be that since MPM offers little or nothing not already supported by *Inventor* and by most other modern CAD tools, why did you bother to make it?

In fact, the reason I embarked on my experiment was to attempt to support not new design features but a better design methodology, even at the expense of losing access to design features supported by the backend CAD tool. This approach derives from concepts and methods evolved by the systems engineering and software engineering disciplines in their attempt to help designers and developers to dominate design complexity and favour re-use.

The main features of this target methodology are:

* Saveable, parametrised design process, supporting modifiability and reuse of designs via expression, in text files using a special language, of fully parametrised design processes.

Brighouse

Dear Martin,
It was good to read John Arrowsmith's account of his visit to Brighouse, not least because this was where I first visited a model engineer's track. At the age of seven or so I was taken by my father to visit. We were staying with my grandparents in Greetland at the time so it wasn't far away.

Obviously, I cannot remember much about the afternoon but I was impressed by the tunnel and by the model boat pond, featuring a radio controlled fire float which actually squirted water. Oooh, the excitement!

Perhaps I should blame that visit for giving me a lifelong interest in model engineering. Although I have never revisited I hope to make the trip sometime. My great nephews live not far away so maybe they too can acquire a lifelong interest when they visit.

Yours sincerely, Roger Backhouse (York)

* Interfaces, with explicit definition and specification of interfaces for use in the design processes of parts and sub-assemblies that must fit.

Saveable parametrised design process

Today's CAD products are essentially interactive; the user gives commands and information via the keyboard, mouse and other such devices and watches the screen to see the outcome of his input. To correct mistakes or to abandon unsuccessful trials the user gives commands to cancel or undo one or more steps and then tries again. This process adopted by the user to develop the designs or modifications of parts and assemblies is in his head; the fruit memorized by the CAD tool is the result to which this process converged but not the process itself. Once the design is finished, the only trace of the design process itself is in the memory of the user.

When using MPM, the user employs a special language to describe the design process itself in one or more source text files. Parameters in this description determine not only values like positions, lengths and angles but also the sequences of modelling steps required to generate 3D models of instantiated parts and assemblies. Much like a compiler, MPM in a jiffy reads all this input source text and executes the design processes for the instantiated parts and assemblies, generating an output script file. This script then drives generation, in a second jiffy, by a suitable CAD tool, of the 3D models all the instantiated parts and assemblies. When errors occur, the user corrects the design process described in the source files. When the design is finished, the entire design process (including all the numeric values), is documented, not only in the input source files but also in a design log file and a design build file generated by MPM.

Interfaces

The early identification and specification of the interfaces between parts and assemblies that must fit is arguably the most important recommendation of systems engineering. Perhaps surprisingly, the copious Help information of my usual CAD tool does not use the word 'interface' (except to refer to its own Graphical User Interface). In MPM's user language, interfaces are separately defined, named collections of parameters, constants and logical validations. As well as using its own local parameters and constants, the processes defining the designs of parametrised parts or assemblies can use the parameters and constants of one or more Interface definitions.

Ian Martin

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Doug Hewson says why have any old driving truck when you can have one that looks the business?

Continued from p.633
M.E. 4677, 5 Noveber 2021

Doug's Y4 coupled to the driving truck.

Building a Driving Truck for 5 Inch Gauge

PART 2

First of all, we will just have a look at a couple more photos I took many moons ago. In **photo 8** we can see the loco shed at Gilling before the day began. Here there are seven of our driving trucks in the photograph and not one of them the same! They all have seats of varying heights and positions. **Photograph 9** shows our own loco shed with Peter Layfield's NER 0-8-0 with a driving truck in its original LNER livery but he has a large water tank on there and a little seat on the front end, along with Ballan's K1 and Chris Lee's J39.

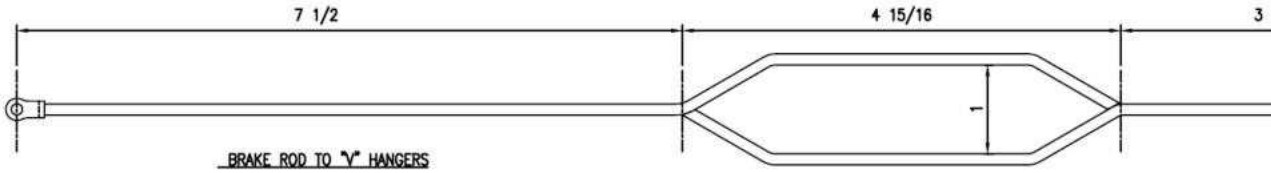
From the General Arrangement of the driving truck bogie (**fig 2**) you will see that the bearings have a square housing so all they need is a few thou clearance to give them a bit of movement up and down so that they can equalise. If you raise one wheel it should lift off the track by at least 3⁄16 inch without affecting any of the others. When you go out and buy some bearings just tell them that they only need to run at about 500 revs a fortnight, otherwise they will probably try to rip you off. Mine have lasted now for forty-five years and have never been a problem. You will need eight 6202 ZZ bearings and they are packed with grease so will last forever. They have the built-in

Locomotives assembled for the start of a Gilling rally.

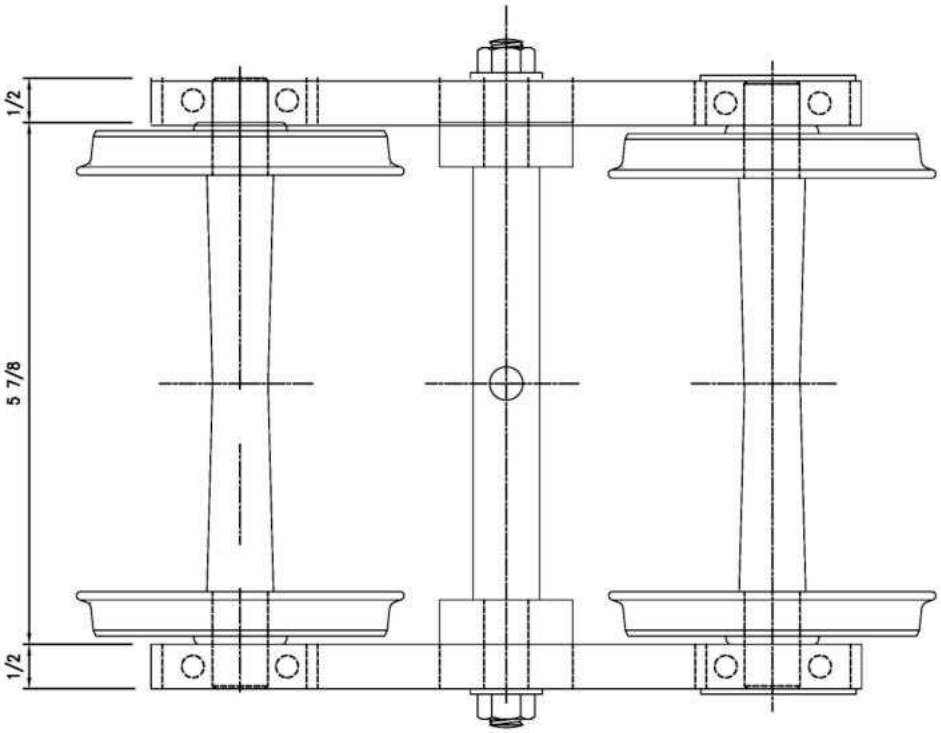
Locomotives ready for duty.

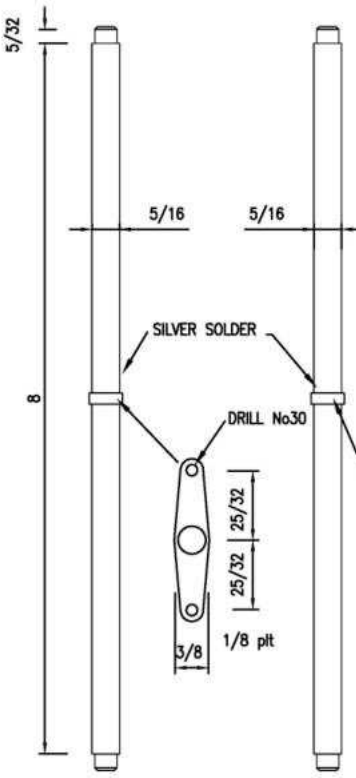
≫

Fig 2

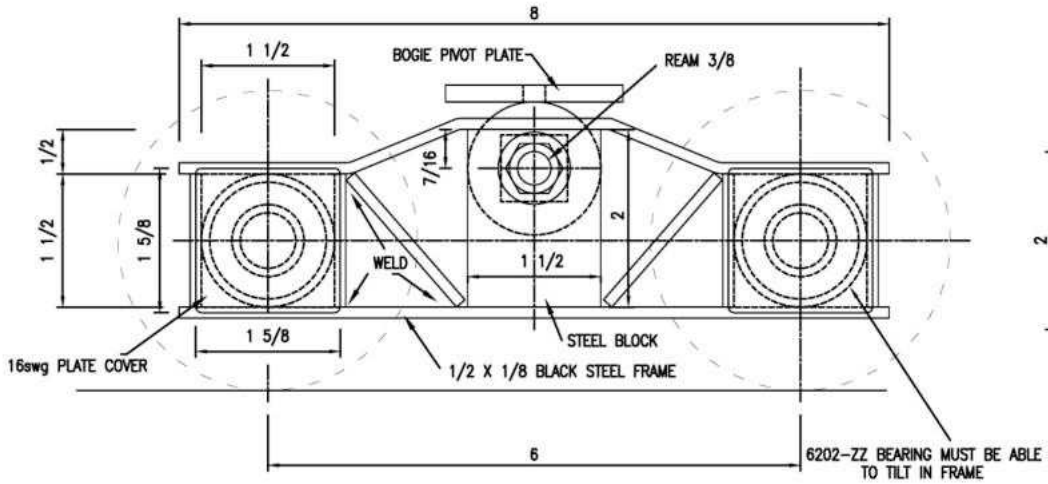


BRAKE ROD TO "V" HANGERS

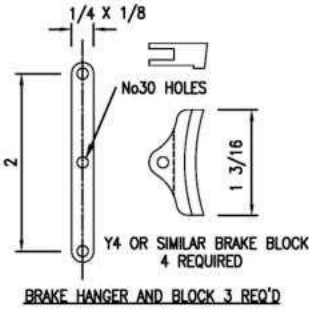




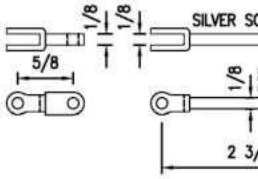
BRAKE SHAFTS – MS



GENERAL ARRANGEMENT OF BOGIE



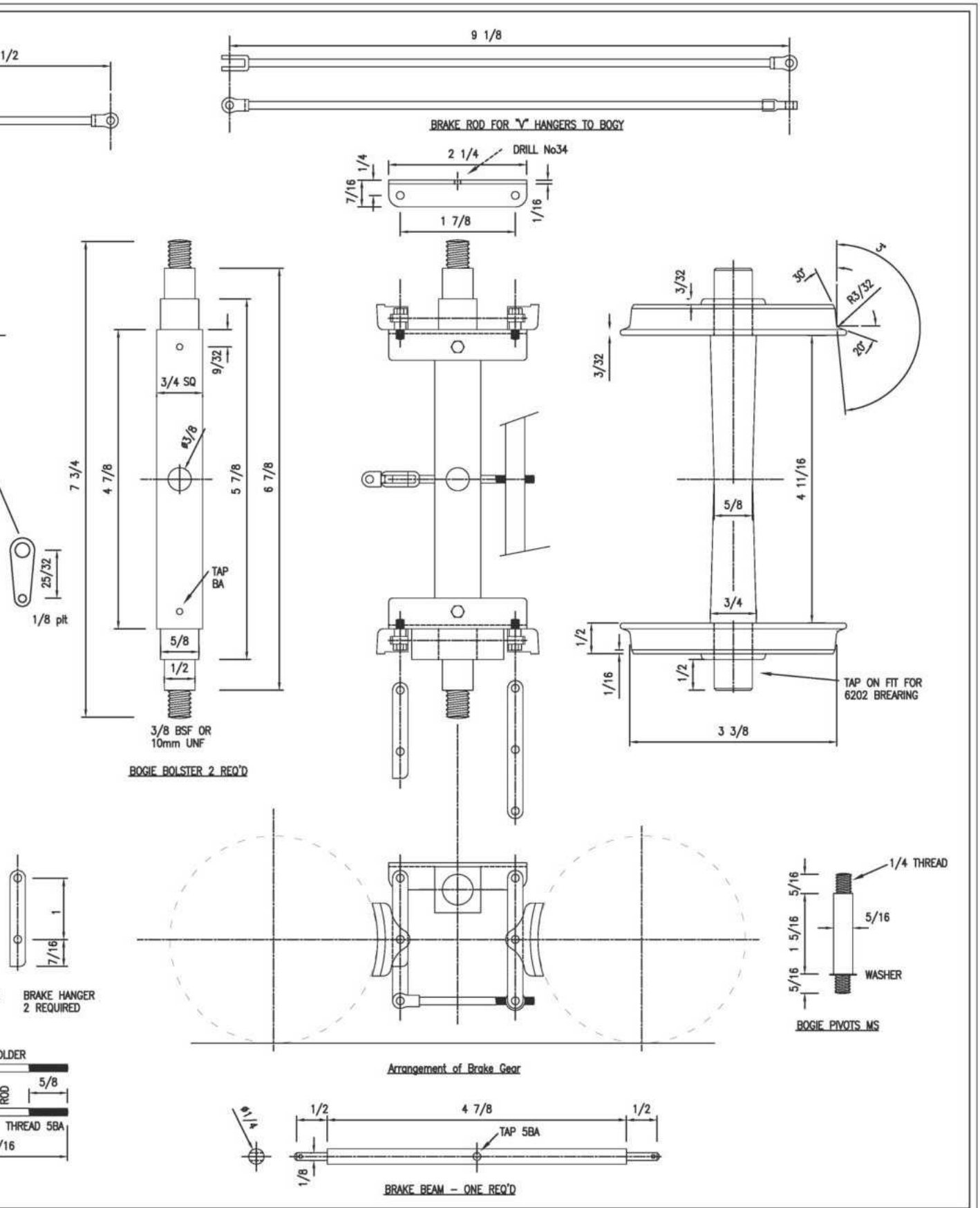
BRAKE HANGER AND BLOCK 3 REQ'D



LINK BETWEEN BRAKE BEAMS

D. HEWSON (MODELS)
73, VICTORIA ROAD, BARNETBY - LE - WOLD,
NORTH LINCOLNSHIRE,DN38 6HY. TEL 01652 688408.
E Mail doug@doughewson.co.uk

General arrangement and details of Bogies


9 1/8
BRAKE ROD FOR "V" HANGERS TO BOGY
2 1/4
DRILL No34
1/4
7/16
1/16
1 7/8
3/4 SQ
9/32
Ø3/8
TAP
BA
7 3/4
4 7/8
5 7/8
6 7/8
5/8
1/2
3/8 BSF OR
10mm UNF
BOGIE BOLSTER 2 REQ'D
3/32
30°
R3/32
20°
4
4 11/16
3/4
1/16
TAP ON FIT FOR
6202 BREARING
3 3/8
25/32
1/8 plt
BRAKE HANGER
2 REQUIRED
1
7/16
Arrangement of Brake Gear
1/4 THREAD
5/16
1 5/16
WASHER
BOGIE PIVOTS MS
OLDER
ROD
THREAD 5BA
Ø1/4
4 7/8
TAP 5BA
BRAKE BEAM – ONE REQ'D
DRAWN BY:
DOUG HEWSON
SCALE:
ONE INCH AND ONE
SIXTEENTH TO ONE FOOT
OCTOBER 2020
FIVE INCH GAUGE
©
DRAWING NO.DT_003

Bogie top bar bending jig.

Bogie side frame assembly jig.

shields at either side and my original ones cost me 67p each as they were Polish - so what!

We will make a start on the bogies and if you are only making one set that will be fine but we made dozens of them so we made jigs to hold all the parts in place so that they could be welded up. We also made another jig for bending up the top members of the side frames. One thing that we did then was to weld a nut on to the side frame of my hand lever guillotine, so that a piece of threaded rod could be screwed in it and a guide could be set to chop all the pieces up for the vertical and diagonal members and also the bottom member. All these pieces need making from ½ x ⅛ inch flat black steel bar. While you are doing that you can also set your bandsaw and chop off four two-inch lengths of 1½ x ½ inch black steel bar, or the nearest you can get to it. If you have to buy it in metric, then you need to make the block flush with the outside of the bogie side frame and then make an allowance for it in the bogie bolster.

Photograph 10 is the jig which we made for bending the top bar of the side frames and **photo 11** is the other jig which we made for assembling the bogie side frames. Once all these parts are made the whole lot can be dropped into the jig and you can put a tack of weld on the ends of all vertical and diagonal members and the centre blocks. You can now remove it from the jig, turn it over and do the other side except that this time you can weld the whole lot up. You then need to weld up some plates on over the axle boxes 1⅝ inches square but miss off the bottom weld so that a drop of rain can drain out.

You can buy a set of all the laser cut plates from the Steam Workshop or G & S Supplies as they have been warned! These sets include the brake levers and all the cranks for operating it and the square plates for the axlebox covers and all of the fork joints etc.

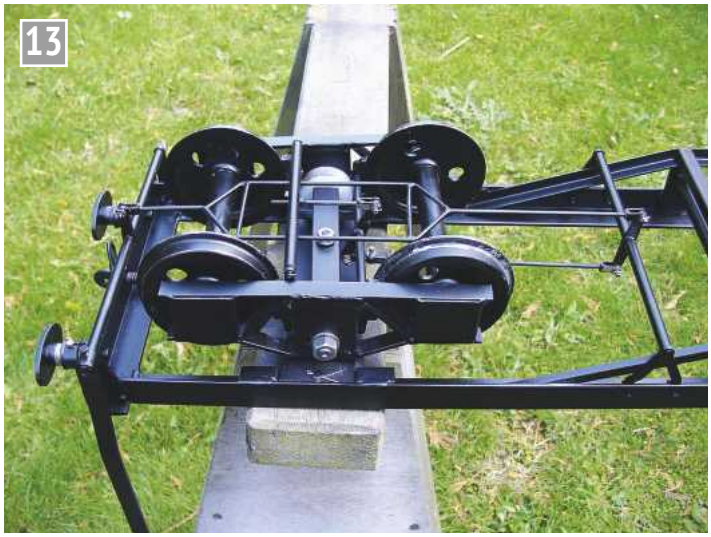
The bogie bolsters are made from ¾ inch square BMS bar and they just need turning down as shown on my drawings but make sure that there is no shake on the bogie side frames. We had someone who made a pair of frames and the bogies but it just would not stay on the track. When we had a look at it for him, the fit of the bolster was so bad it was trying to run crabwise along the track and then he wondered why it kept coming off but persuading him that that was the problem was a bit of a job!

The axles need making from ¾ inch steel bar (black or bright) and they look much nicer if they have to usual taper on them. However, we had one chap ask us if we could leave his axles parallel. When I asked him why, his reply surprised me, as he said that he wanted to fit disc brakes on his driving truck. I asked him if he was thinking of taking it for a run on the M1 as, if you are not, then our brakes will stop you on a new penny with very light finger pressure!

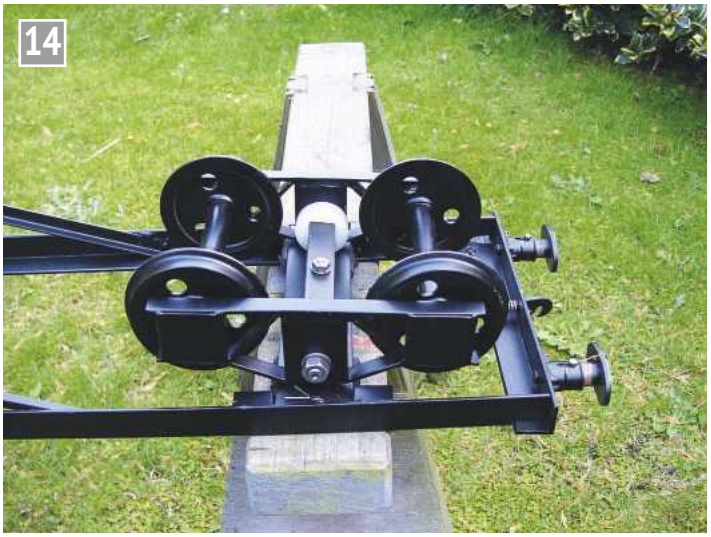
The brakes are copied exactly from the full size LNER wagon bogie and to make the beams you just need a couple of lengths of ¼ inch rod, one of which is 5⅞ inches long, and the other one is 5$^{7}/_{16}$ inches long. The longer of the two needs turning down to ⅛ x ½ inch at both ends, leaving a little bit so that you can put a chamfer on each end, and the other one needs turning down to ¼ x ⅛ inch at both ends. You also need to tap a hole in the middle of the longer one 5BA.

You then need four lengths of ¼ x ⅛ inch steel; two of them need to be 2¼ inches long and two need to be 1$^{9}/_{16}$ inches long. The first one needs drilling No.30 at two centres with a hole in the centre and the other two shorter ones need a hole at the top similar to the first one, and then another hole 1 inch from that and then a bit spare down the bottom to fit the brake block so that it does not drag on the wheel. For the brake blocks we always use the Y4 blocks. You then need a pair of mountings for the brake hangers. These consist of a pair of angles $^{7}/_{16}$ x $^{7}/_{16}$ inch, which you can bend up from 16swg mild steel. These are included in the laser cut kit, they are 2¼ inches long and they need a couple of No.30 holes drilling in one leg at 1⅞ inch centres and another at the centre back mark in the other leg. The back mark is a structural engineer's term for a

A view of the brake gear.



Underside view of the brake gear.



Unbraked bogie.

I asked him if he was thinking of taking it for a run on the M1...

hole in an angle in the centre of the inside leg of the angle.

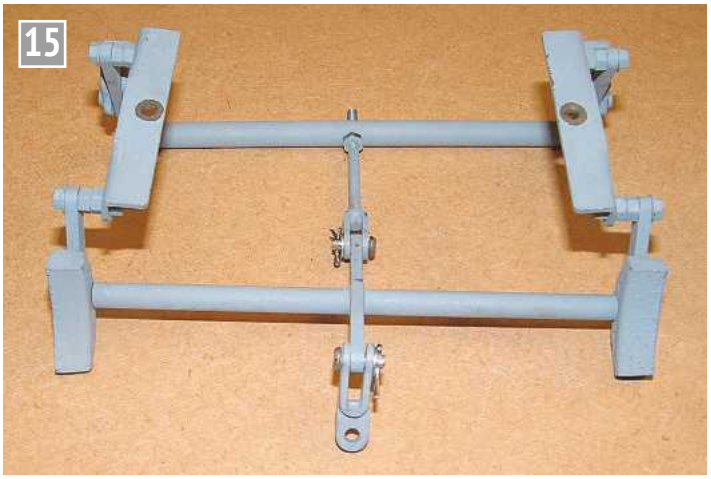
Photograph 12 shows the arrangement of the bogie with all of its brake gear on. **Photograph 13** shows the braked bogie from the underside and **photo 14** shows the unbraked bogie. **Photograph 15** shows the brake gear off the bogie before it was fitted to the underframe. On each end of the bogie bolster is a nylon 6_6 or brass roller which is 1½ inches diameter and ½ inch wide. This gives the bogies freedom of action and helps with the running.

There are a couple of cross shafts to make for the underframe and these are 8$^{5}/_{16}$ inches long and are turned down at the ends to ¼ inch diameter by 5/32 inch long. One of the needs a single crank silver soldered onto it and the other one needs a double crank, all as shown on the drawings. There are then four 'V' hangers to make (also included in the laser cut kit); two are normal type of 'V' hangers and the other two are vertical down one side to miss the front bogie.

You will then need a couple of pull rods, one of which has to miss the bogie pivot pin, so it is similar to the ones on a Commonwealth bogie and fits between the two cross shafts, and the other one is just a plain length of ⅛ inch rod with a fork joint silver soldered to each and this needs to be 9⅛ inches centre to centre. One end needs to have the fork joint at 90 degrees.

There are two more small pieces to make. One is the brake adjuster, which is just a piece of ⅛ inch rod, with ⅝ inch of 5BA thread on one end and a fork joint on the other, and the other one is a fork double fork joint with one end at 90 degrees. This is so that the brake gear will go round corners!

We made dozens of these bogies when I had my shop and, at one point, we just could not keep up with them. We had to make the underframes ten at a time after putting an advert in *Engineering in Miniature* for completed driving trucks. They were very popular, and I know that Hull Model Engineers built some in 7¼ inch gauge! We also made lots of pairs of bogies for ourselves and fitted then under 'Weltrols' which seated children one at each end on a rubber cushion and in the middle there was a croquet type hoop for the kids to hang on to. These were removeable of course, which then left a more or less scale wagon. These wagons were four feet long over buffers so that they would just fit in my small car trailer cross ways on. The buffers needed just squeezing up a little to get them in and then they did not rattle about.



Brake gear before painting and fitting to the bogie.

ME

Bolton Corporation No. 140 in 1:16 Scale

PART 3

Ashley Best builds a model of the first of the fully enclosed Bolton trams.

Continued from p.617
M.E. 4677, 5 November 2021

*In 1927, Bolton Corporation Tramways took delivery of twelve new large bogie tramcars. These were built by the English Electric Company and were of interest in more ways than one. They were Bolton's first totally enclosed tramcars and the last trams in England to use the Brill designed 22E trucks and were almost the very last traditional style tramcars to be built by English Electric. One of these trams, number 140, forms the subject of this article (**photo 1**).*

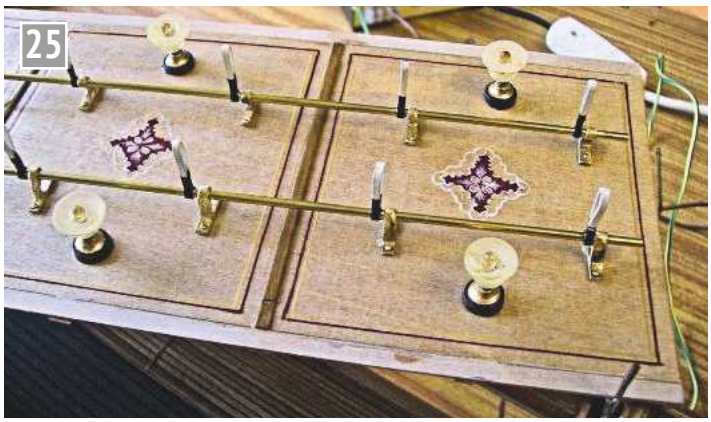
Bolton Corporation No. 140.

Order of working

Where possible it is good to make parts that can be taken down for adjustments during construction. This is not difficult and really is essential during initial trial assembly when small adjustments are often required. Finally, because it is necessary to fix parts so that they cannot be taken apart again, there is the need for careful planning, especially the order of events for assembly and for painting.

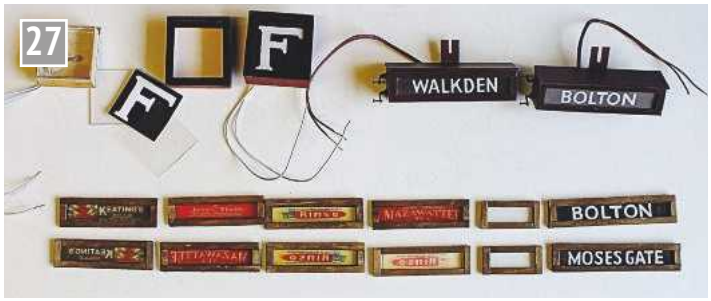
The scale of 1/16th is just about large enough for many prototype features to be included in a model, but too small for access to be gained for much detail work. Once the upper saloon floor is in place, access to the platform bulkhead becomes difficult and of course, impossible once the stairs are in place. Thus, all the painting and lining needed to be completed early. In the same way the saloon interior had to be completed, including the fitting of the ceiling, lined out, varnished and with lights and strap handles in position (**photo 25**). This would be impossible after the ceiling had been glued in place. The floor slats, motor hatches and seats were all fixed before the bodywork was ready to fit (**photo 26**). I try to leave the final fixing of the bodywork as late as possible. Window glazing was also left until the final assembly of the tram. I found it best to cut and fit all the windows early, and to number them and put them to one side. The half lights were made as double frames with glazing between which included advertisements from the era, reproduced from reference on preserved trams at Crich (**photo 27**). These frames were then trial-fitted before being removed to leave the window spaces open, so that clamps could be used when fixing the upper saloon.

A point of interest concerns the strap handles. Early

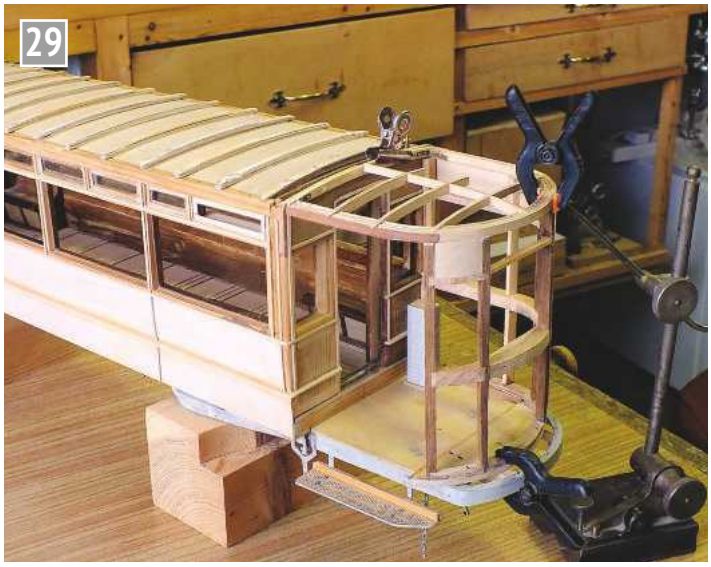


Lower saloon ceiling.

Seats in place.



Half lights.



Setting up.

tramcars had full length saloon grab-rails suspended from the ceiling. Usually, looped leather strap handles were added and hung from the rails. On the 1927 cars there was an improved design where the brackets holding the grab-rails were combined with plastic coated handles. I made these from metal as shown in **photo 28.** When painted, the handles passed for plastic coated items.

Platforms and end frames

The framework is quite a tricky job. I made both ends identical taking care to use joints throughout to ensure strength and rigidity. Setting up the work was accomplished with the lower saloon on a pair of height blocks and careful use of a height gauge in order to ensure the levels were accurate and all the rails, especially the top canopy bend, would be absolutely level. I did not want

Brackets and handles.

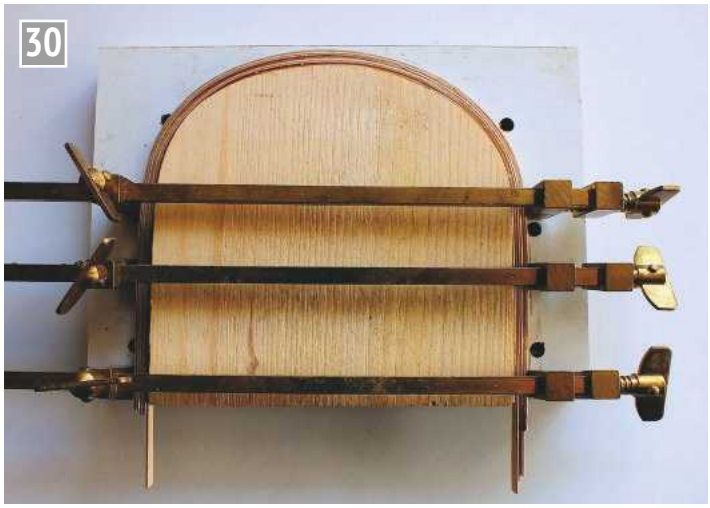
the platforms to sag or to bend slightly out of line as could sometimes be observed on some real trams when getting old and run down (**photo 29**).

For both decks, canopy bend frameworks were formed by first using a simple jig (**photo 30**) round which strips of cross-grained ply were laminated with PVA glue and left for 48 hours to set firmly. Roof-sticks and an end board were then fitted (**photo 31**). Both the platform frames and upper deck ends were assembled completely with necessary adjustments made. The lower structure has a metal dash and the upper one is entirely wood. It took some time to accurately position handrails, stanchions and electrical wiring for lighting. Rails and stanchions were fitted during the final assembly as it would have been be impossible after the main structure had been glued together.

Windscreens

The platform framework and the upper saloon ends obviously are glazed. Each platform includes a windscreen which is a two-part item with a fixed lower pane and a top hinged section with limited degree opening. The 1927 cars also had the window alongside the platform, fitted with a drop-down opening top. This feature was not repeated on the three 1928 cars where a plain, full height window was used and helps to distinguish these later cars, but only in early photographs as later, some of the 1927 cars also lost the opening windows.

In the model, this two-part window had to have a hinged opening top section – a problem solved eventually by small concealed pins inserted in the main window pillars and which engaged with the top of the opening window frame. The small drop window next to the screen was provided to allow the trolley rope to be brought inside the tram rather than left to flap about outside (**photo 32**). On the upper deck, the front screen above the destination route letter was a drop window surmounted by an opening vent. On the model, this was made non-working with the main window in the closed position as it usually appeared (**photo 33**).



Jigs for canopy bend.

Platform roof frame.

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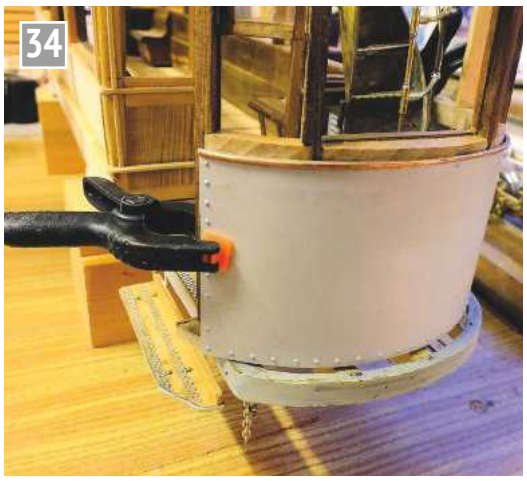
Small drop window.

Upper saloon end window.



Aluminium trial dash.

Enclosed ends

Bolton's own workshops designed the new ends and the 1927 enclosed cars from English Electric came with the top saloon ends to the same design. These were the last new trams to be bought by Bolton and were, at the time, the only enclosed cars in the fleet. They were not quite the last enclosed trams to be acquired by the Corporation, however, as during the war, suffering an acute shortage of trams, Bolton purchased three large enclosed bogie cars from nearby Bury. These second–hand trams were also made by English Electric but used British designed 'Burnley' bogies rather than the 22Es favoured by Bolton. A fully enclosed four-wheeler was also purchased at the same time, thus becoming the only enclosed four-wheeler to operate in Bolton. In 1933, Bolton also acquired eight cars from South Lancashire Tramways when that company converted to trolleybuses. These ex-SLT trams were open balcony bogie cars and were on E.M.B. Burnley trucks.

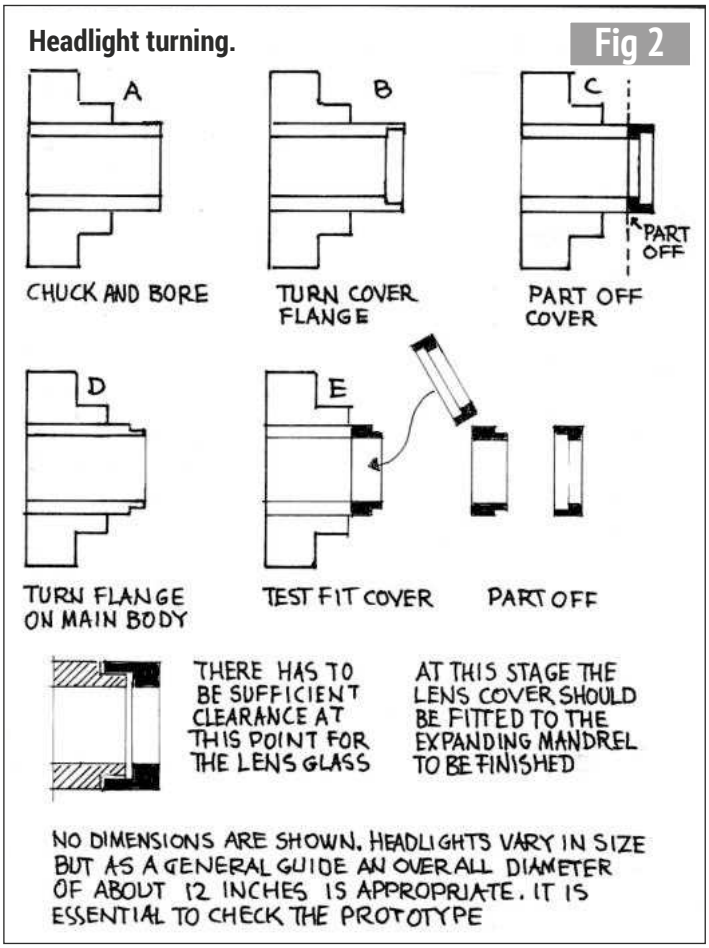
The dash plates can be made from thin ply but I do not favour this as it makes fitting the headlamps and beading difficult. I used brass but not before trying aluminium (**photo 34**). These would look fine and were easy to cut and bend but I felt uneasy about the fixing of the beading which would have to rely on an adhesive. I tried Superglue and epoxy resin. Both tended to fail so I went back to brass and soldered the beading and the headlamp in place. This was so much more satisfactory, but did require the application of self-etch primer before final painting. The dashes were made complete with all beading, headlamp and rivets, fully painted and lined before fitting. Painting and lining out is so much easier before finally fixing it in place (**photo 35**).

Finished brass dash.

Reflectors.

Headlight

The single headlight, such a feature of first generation British tramcars, is mounted in the centre of the dash. This light is, along with the spiral stairs, a difficult thing to make. I use brass to make them as realistic as possible with a hinged opening front glass. A hole is cut in the dash and the lamp very carefully soft-soldered in place, to avoid melting the beading solder. An aluminium reflector holding a grain-of-wheat bulb is eventually fixed with epoxy glue behind the dash (**photo**



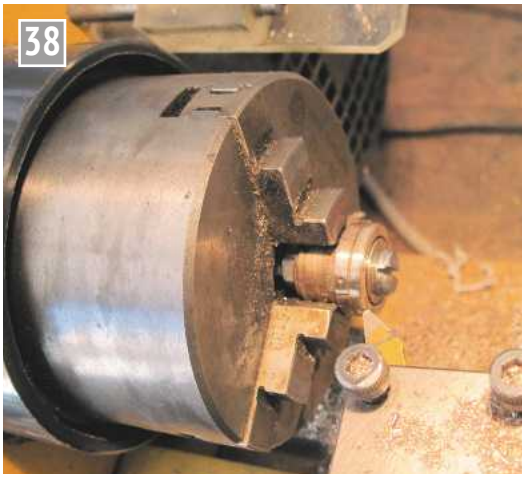
36). The stages of construction of the lamp body are shown in **fig 2**. It would of course be simpler to make the lamp as a dummy with fixed front and false hinges, but making it functional is more satisfactory. As such, it is a model in itself (**photo 37**). The initial lathe-work to turn the main body and cover is straightforward as is clearly shown in the figure. I found the main problem was in finishing the hinged cover (turned first in the process). This needed thinning down to a scale dimension and, although possible in a three jawed chuck, it is extremely difficult to align accurately and, with so little gripped in the jaws, prone to catch, fall out and be ruined. I solved this problem by making a simple expanding mandrel (**fig 3**) which made the job easier. It still required delicate care while turning (**photo 38**). All the added bits on the hinged cover and the main body were silver-soldered and finished with piercing saw and needle files. Drilling for the hinge pin required great care. The closure nut can be either 14BA or 12BA.

Planning the upper saloon construction followed much the same process as the lower saloon, again with the ends made as separate items for eventual fitting. It was so much better to paint the ends completely when they were easier to handle, unlike the lower saloon sides with their tumblehome. The upper saloon sides are flat which allowed them to be made complete with mouldings, finished, painted and lined out before fixing to the saloon frame (**photo 39**). As in the lower saloon, all windows and half-lights were cut to size and stored. Floor slats, seating and stair traps were next (**photo 40**).

In the upper saloon, the ceiling, supported by roof sticks, is also the roof - in other words, a single skin. The roof sticks were made to fit a detachable frame (**photo 41**). Lighting in the upper saloon was difficult as there is no space between the roof sticks and roof panels. Careful use of very thin wires placed as unobtrusively as possible solved the problem. The upper saloon lights were fitted against roof sticks (**photo 42**).

●To be continued.

Headlight.

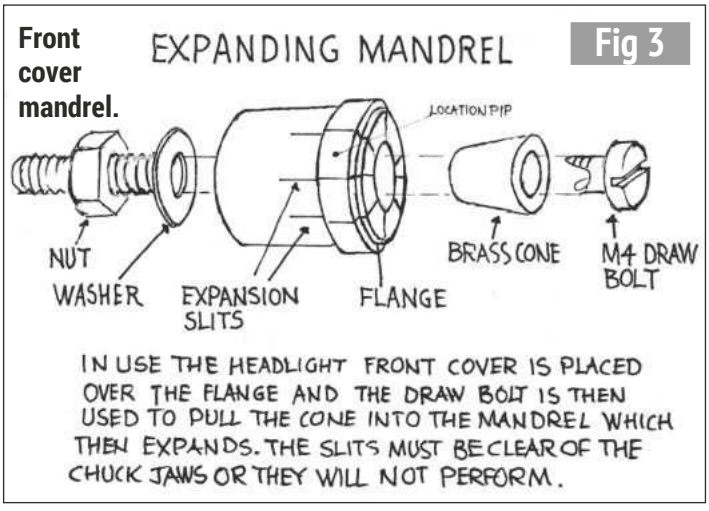


Turning the cover.

Saloon side.

Details.

Front cover mandrel.



Roof stick framework.

Lighting – upper saloon.

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Tramways in Bolton, Tony Young and Derek Shepherd.

Robert Hobbs ventures into unfamiliar territory.

Continued from p.636
M.E. 4677, 5 November 2021

PART 3

Recycling a 3½ Inch LNER Prairie

We left part two of this series tidying up the cylinder blocks and the associated components, with the smokebox being the next to tackle. This was rolled from galvanised steel in my twelve inch bench slip rolls. **Photograph 25** shows the nearly completed smokebox in the rolls. The smokebox ring was turned to suit the rolled shell from a bronze casting in the Myford. The door was similarly turned with the front dome being finished with a file. The dart and the two handles were simple turning operations and are shown with the front ring, door and cross bar in **photo 26.** The strap hinges were formed from galvanised sheet and riveted in place, the pivots being made from modified handrail stanchions. The completed front end of the smokebox is shown in **photo 27**.

Rolling the smokebox.

The two safety valves were straightforward turning and threading operations and are shown in **photo 28**, as was the chimney (**photo 29**). The

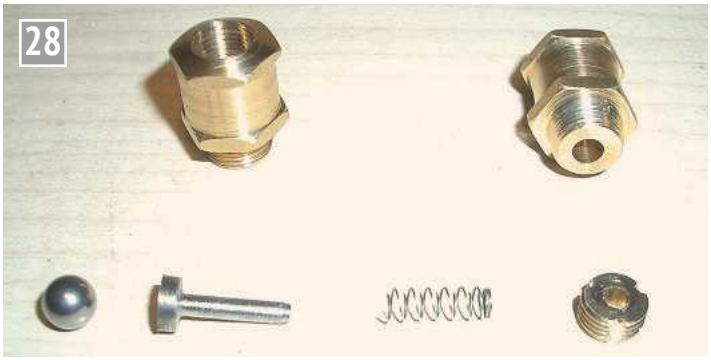
Smokebox door and ring.

Complete smokebox door.

snifting valve and the dummy whistle together with the superheater covers are shown in **photo 30.**

Continuing with the Myford the boiler backhead fittings were tackled next and bearing in mind the article from Brian Baker on how to make Unions and Nuts in *M.E.* Vol 224, No. 4633, a staged production was planned. Earlier in the year a sailing colleague purchased a box of drill chucks and he was kind enough to share a few around. This windfall lead to the chuck holder bracket now fitted to the Myford splash guard as shown in **photo 31.** Using the centre drill followed by the bore size drill and then tapping made short work of the items. The chuck holder is not as efficient as Brian's six station tailstock tool holder but was far quicker that changing drills and taps in one tail stock drill chuck. Like Brian Baker, I prefer to turn the lathe chuck by hand with the tap tightly in a drill chuck which is loosely supported by the tail stock and held in the other hand. This process gives gentle control, ensures the threads are true and no undue pressure was placed on the tap.

The nuts and their spigots, together with the clacks, turret, water gauge and control valve made by the planned/ stage method are shown in **photo 32.** The overall view of the Myford set-up is seen in **photo 33.** (Please excuse the build-up of swarf.) The final backhead fitting was the fire door. In the past oval hinged doors have been fabricated, however this time the challenge of a sliding type door entered my mind. **Photograph 34** shows the component parts which were cut from sheet steel, a piece of brass channel and some brass rod off-cuts. The rod pieces were silver soldered to the channel, as was the fixed hinge pin. **Photograph 35** shows the door open on a wooden test mount when almost finished. The fire door was another interesting project in its own right and sorting the geometry involved two tries at the cross bar length before the doors



Safety valve parts.

Chimney.

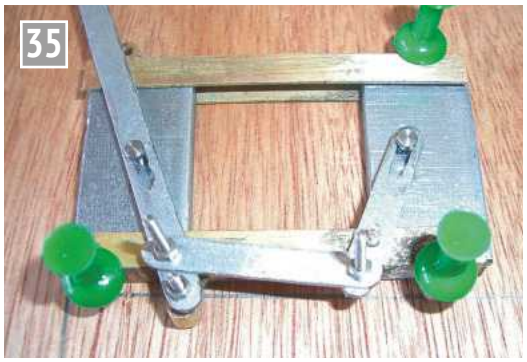
Snifting valve, whistle and covers.

The author's chuck collection.

A handful of fittings.

Myford at action stations.

Parts for the firehole door.



Completed firehole door.

would open evenly and, to my mind, the extra effort was worth it.

Putting the Myford to one side, so to speak, the sheet metal work for the locomotive was started with the two cab sides formed from galvanised steel, cut, filed and bent to produce the outlines. The window openings were machined in the vertical mill, thus ensuring they were square and even sized. The cab sides are shown in **photo 36.**

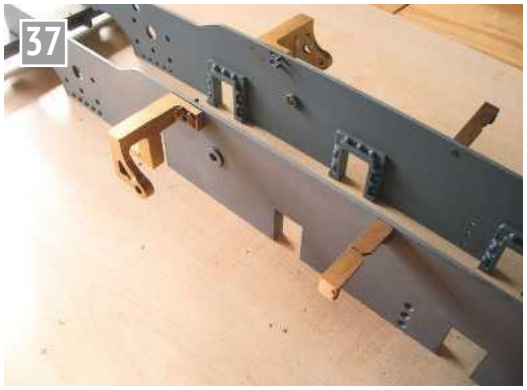
The motion brackets and two support brackets were fitted to the main frames (**photo 37**). These, together with the top of the valve casing, support the running boards. This allowed the running boards to be made next. Theses were fabricated from 2 x ¼ inch galvanised steel angle. The flanges were cut out at the curve changes, which allowed the longitudinal profiles to be formed with the aid of a round bar of the appropriate diameter (**photos 38** and **39**). Gussets were cut from sheet steel to replace the edge flange on the curved sections; these gussets were then soft soldered in position and finished off with filler and wet and dry. **Photograph 40** shows the partially fabricated running boards in position on the main frame. The front apron was fabricated in three pieces and the outer ones were fitted with profiles, soft soldered in position, to running board flanges with the buffer beam. **Photograph 41** shows the front apron. The cut-out for the firebox was determined using the boiler profile and the reversing stand. These two components were a real surprise when the packages were opened as I had not expected these to arrive with the chassis, making the eBay purchase even better value for money. The reach rod was fabricated which established the aperture for the rod to pass through the running board. **Photograph 42** shows the loosely assembled reverser stand and reach rod.

Just to round off the third section of this project, in **photo 43** I have included a view of the sheet metal equipment that was used in creating the platework. Working from left to right, we have the 24 inch vice mounted folder (red); a bearing press that, with a knife edge and vee block, makes a very accurate folder for smaller sections (grey); a bench knife that I also hold in the vice (blue) and the 12 inch bench rolls (green). The swivel vice is an important accessory and as it is located near the entry door, it is useful to be able to rotate it out of the way when not in use. Finally, probably the most used item in the workshop is the vacuum cleaner. I always seem to be creating swarf and dust!

The next part of this series will continue with the fabrication of the spectacle plates for the driving cab, the smokebox and the saddle.

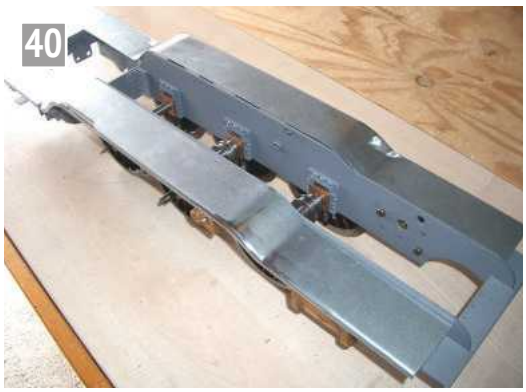
●To be continued.

Machined and formed cab sides.



Motion brackets fitted to the frames.

Checking the curve on the platforms.



Platforms fitted to the frames.

Front apron.

Reverser.

Sheet metalworking tools.

The Stationary Steam Engine

PART 27 - THE REVERBERATORY FURNACE AND THE SHAFT FURNACE OR CUPOLA

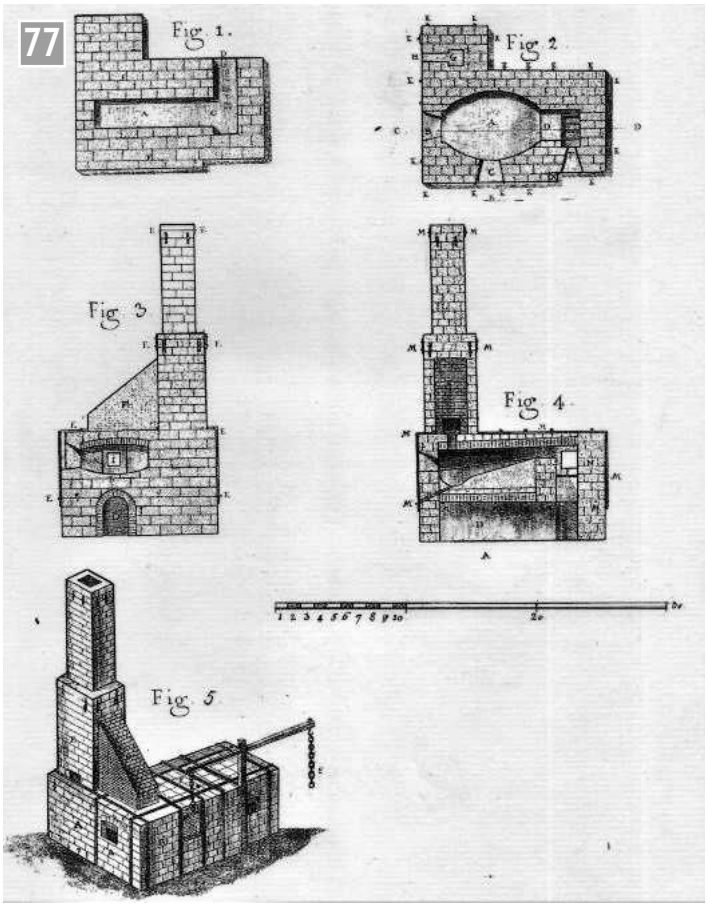
Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.515
M.E. 4675, 8 October 2021

The foregoing discussion of engine builders emphasizes the central role that the iron foundry was coming to occupy in the development of the steam engine. This connection assumed even more importance as the eighteenth-century merged into the nineteenth-century but before describing these momentous changes in steam engine construction it may be helpful to know something of the nature of foundrywork as it was when the atmospheric engine was at its height of popularity and Boulton and Watt's engines were gaining ground.

Casting iron for steam engines has hitherto been discussed purely as an adjunct to the ore smelting furnace but in the seventeenth-century a new generation of foundries began to break this tie. Urban foundries situated on a separate site from primary reduction of the ore first come to notice at the turn of the century. *The Postman* of 24th to 26th December 1700 has the following advertisement:

At Mr. Stringer's Iron foundery and refinery in Blackfriars near Ludgate are cast without wood, charcole or bellows cannons, bombes, shot, shells &c. Bells of any size or tone, potts, kettles hollow rolls, stoves, cockles and bars for sugar works, solid large rolls for flatting iron, brass, copper, lead, rolls for mints, stoves, backs, and hearths for chimneys, flower pots and balconies and hatter basons, plates for packers and hot presses, very large plates for looking glass grinders, cylinders for water works, various things for millwork, boxes for coaches, carts and drays, anvils for smiths and forges. All sorts of chymical vessels that can be made of stone or glass. Iron is there made of any temper desired; either so hard that no file cannot touch it or so soft as to turn and bore as wood. Those who have any quantity of guns or other old cast iron may have money for them… This iron foundry meeting with such encouragement requires the best founders in Loom and those that can mould in sand will find suitable encouragement.



An eighteenth-century reverberatory furnace for re-melting iron. Voyages Metallurgique, 1774. Gabriel Jars.

Several significant points underpin this advertisement. The first is that Blackfriars was distant from the nearest producers of pig-iron and fuel. Stringer was clearly intending to rely largely upon re-melted scrap iron which would make him largely independent of the blast furnace for his iron supplies although he would probably also need to supplement his scrap with a proportion of pig-iron from iron smelting works in the Weald of Kent. Furthermore, ≫

as he excludes wood as fuel, a highly controversial subject as English forests were currently being ravaged by the charcoal iron makers, it can be assumed that he was to use the less objectionable coal brought by sea from the north-east of England. It is also notable that Stringer claims that he was to dispense with any bellows powered air supply to his furnace.

Collectively these facts leave little doubt that Stringer was intending to make use of the reverberatory furnace to melt his iron. The reverberatory furnace has already been mentioned in connection with John Wilkinson's activities by which time it had been in use for re-melting iron for at least half a century but a fuller description of its construction will make clear why it conferred a new independence upon the iron foundry.

Photograph 77 shows a reverberatory furnace observed by Gabriel Jars in the Newcastle area when he toured Britain in the seventeen-seventies. The furnace was a fully enclosed horizontal, hollow-box structure built of firebrick and covered by an over-all arched brick roof. At one end it contained a furnace chamber which was separated from a fireclay-lined melting chamber by a low vertical wall. The furnace chamber had a firebar grate with an ash pit below, which also acted as the primary air inlet. Hot gases from the furnace passed over the dividing wall and were deflected downwards by the roof onto the metal to be melted which was contained in the second chamber. Jars showed a level roof but most later reverberatory furnaces had S-shaped roofs in order to drive the hots gases down onto the metal. Draught to draw the furnace and induce the gases to pass through the melting zone was provided by a high chimney beyond the melting chamber. The metal charged into the melting chamber could be pig iron, scrap iron or a mixture of both. A tapping hole, sealed between tappings with a clay plug, released the molten metal either into a ladle or into channels cut into the foundry floor sand.

Casting iron from this type of furnace had several major advantages over directly running the metal from the conventional ore-smelting ironworks furnace. In separating the fuel from the metal it allowed coal to be used without contaminating the iron which would have been the case in a shaft furnace where coal and iron are intermingled. Moreover, the passage of the hot gases over the iron had a decarburizing and desiliconizing effect, improving its purity. The open hearth also gave some flexibility as to metal quality which could be adjusted during the melt by mixing different grades of iron and varying the proportion of scrap.

These were fundamental improvements in the techniques of iron production but perhaps the most revolutionary attribute of the reverberatory furnace arose from the fact that by relying upon a chimney for draughting it overcame the need for bellows equipment thus freeing the iron melting process from its attachment to water power. The reverberatory furnace permitted the proliferation of foundries that had no connection with iron smelting sites. Improvements in river navigations and subsequently canals, by allowing pig-iron and coal to be transported to foundries without incurring prohibitive costs, reinforced this diaspora. The urban foundry became possible and the finished castings, which were often more vulnerable to damage in transit, were closer to the market.

The reverberatory furnace was capable of producing bulk quantities of high-quality metal but it was slow in operation and relatively inflexible. By the first years of the eighteenth-century an alternative melting device was in common use, the small vertical shaft furnace or cupola, effectively a miniature blast furnace. The cupola furnace could be either square or cylindrical in plan with a vertical iron casing lined with refractory material. Open at the top, it was charged from above with coke, pig iron and scrap along with some fluxing mineral such as limestone. After the fuel had been ignited an air blast was blown into the cylinder through ducts or *tuyères* set into the lower side wall. The blast promoted an exothermic reaction in the combustion space, raising the temperature of the stock and reducing the iron content to a molten state. The melting iron trickled down to the lower part of the cupola where it accumulated and when sufficient in quantity it was released for casting by means of breaking out a clay plug sealing a tap hole near the base.

Rees' *Cyclopedia* of 1819 under *Foundery* (sic) says of the cupola:

…The most complete foundries are provided with two or more reverberating furnaces… They also have two or three cupolas or small blast furnaces to melt small quantities of metal particularly when it is wanted in haste as the reverberating furnaces are much longer in filling their charge of metal though it is in greater quantity. Because of this latter fact the reverberatory furnace is reserved for large casting… otherwise the cupola is used…

Under *Furnaces* in the *Cyclopedia* Rees illustrates (**photo 78**) a cupola with a cylindrical shaft made up of an external casing composed of four curved cast iron plates bolted together to give an external diameter of 2 feet 6 inches and an overall height of 5 feet. The casing is lined with firebrick, which reduces the internal diameter to 1 foot 6 inches. At the rear, a blast main and tuyère introduces air whilst at the front a tapping hole is made 6 inches above the base. W.H. Pyne's *Microcosm* depicted a similar furnace of the same period, used for casting cannon balls and pots (**photo 79**). Here the furnace is blown by a large set of hand powered, folding leather bellows. The casing appears to be of cast iron and the cylinder tapers to a smaller diameter towards the open top. Three ascending holes are shown in the lower half. The upper two are almost certainly tuyère holes suggesting that the blast nozzle could be moved upwards as the melting zone advanced. The lowest opening is probably the tapping hole.

John Wilkinson has been credited as the inventor of the cupola furnace but this is a misinterpretation of his patent No. 1993 of 1794 (**photo 80**). The patent drawing shows two patterns of furnace built up from flanged cast iron plates, one cylindrical in plan and

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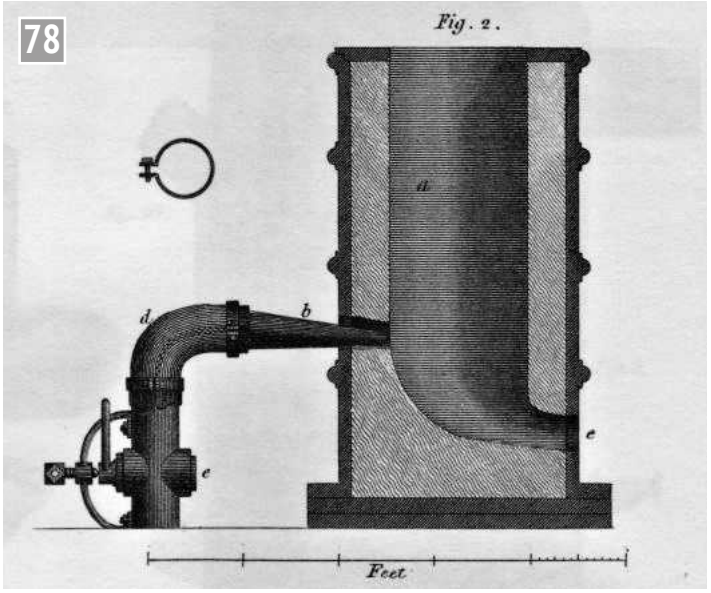

A shaft or cupola furnace of the first decade of the nineteenth century.

Pyne's Microcosm. A shaft furnace casting iron cannon balls.

the other rectangular. In both versions the charge is blown by three tuyères each disposed at 90 degrees to each other and it is this multiple tuyère system that is the subject of the patent not the concept of the cupola itself. Wilkinson was proposing to smelt iron from ore on a smaller scale in the furnace using several tuyères in order to raise the temperature of combustion in the furnace to the melting point of the iron ore.

At the time that Wilkinson took out his patent the cupola was a well-established item of foundry equipment. In 1722 Reaumur had pointed out the advantages of a small blast blown furnace for remelting iron and had illustrated a portable cupola type furnace of the type shown above in Pyne's drawing. From Wilkinson's correspondence with Gilbert Gilpin, his manager in Shropshire, it is clear that there were a number of foundries in the Bilston area that were remelting pig iron in small furnaces with the aid of blast. Gilpin refers to Kinman's foundry where such furnaces were in use, blown by bellows a year before the Wilkinson patent was taken out. The smaller furnace:

when smelting pig iron 1 cwt. will come out not loosing above a lb. … that when the articles to be cast are small such as weights, bars, baths, stoves etc. that there is not any comparison to be made. And that he never uses an air furnace but where the metal to be melted and the articles to be cast are of such a size as to require the air furnace.

John Farey in his *Survey of the Agriculture of Derbyshire* published in 1811 believed that cupolas had been introduced into Derbyshire ironworks in the seventeen-seventies:

The small cupolas or Hells as they are called, which are used in the foundries here were introduced about thirty years ago for heating pig iron instead of air or reverberatory furnaces, which I am told although they answer for cannonballs and some other purposes making very solid castings yet the iron becomes whiter and nearer to the quality of bar iron in fusibility every time it is melted in such furnaces losing 30/- per ton of its value at each melting; by adding small quantities of oyster shells or limestone to the cokes in the hells the quality of the iron can be preserved in two or three successive meltings but not more I understand.

(In using the term cupola to describe such shaft furnaces Farey is drawn into an ambiguity that persists today. In another part of his book cupola was used in a quite different context… *The cupolas or low arched reverberatory furnaces now exclusively used for the smelting of lead ore in Derbyshire were introduced from Wales by a company of Quakers about the year 1747…* Here the reference is clearly to a reverberatory furnace.)

Throughout the first half of the nineteenth century the reverberatory furnace continued as the favoured option where the best quality of metal was required and where large castings were to be made but the shaft furnace or cupola gave a quicker melt. Against this iron produced in a cupola was contaminated by its contact with the fuel. In many common iron products such impurity was of little consequence and as the shaft furnace was a flexible and cheap means of producing cast iron, castings produced in this way became an accepted part of any foundry. Often ironworks operated three types of furnace concurrently. Carron in 1792 had five blast furnaces, sixteen air furnaces and three cupola furnaces in production. Low Moor Ironworks, which began smelting in August 1791, had two blast furnaces with an attached foundry that contained four air furnaces and two cupolas by 1795.

In the first half of the nineteenth-century this balance between the reverberatory furnace and the cupola was maintained but after 1850, through improvements in design that greatly increased its output the shaft furnace began to overtake the reverberatory furnace. As the authoritative Spretson said in 1880 (**ref 154**):

…For the general character and quality of castings it is to be regretted that the reverberatory furnace for the melting of iron is fast disappearing…

Fifty years later, apart from a few specialized melting establishments, the reverberatory furnace was unknown to the majority of foundrymen and melting iron was exclusively carried out in the cupola shaft furnace. The reverberatory furnace finally disappeared with the advent of the electric arc furnace.

●To be continued.

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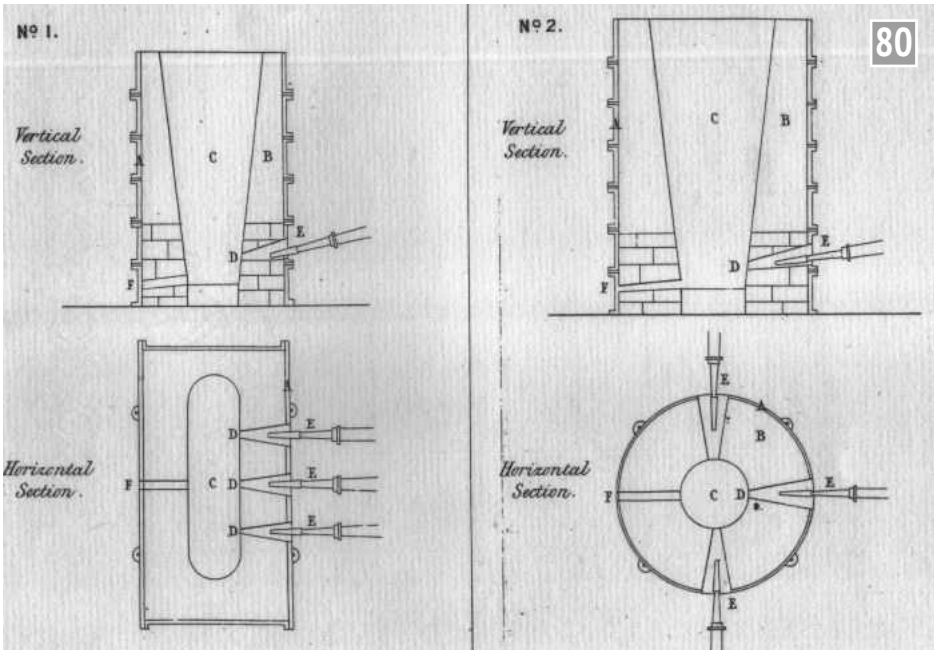


John Wilkinson's patent number 1993 of 1794 for multiple tuyères blowing a cupola furnace.

John Arrowsmith goes south to Derbyshire to visit a well-established club at Chesterfield.

Towards the lower end of the site with the raised track footbridge and station in the middle.

We Visit the Chesterfield & District Model Engineers

Following on from my club visits to Yorkshire, I travelled south to North Derbyshire to the Chesterfield & District MES and their very interesting club site at Hady in Chesterfield where my guides here were Peter Nash and Roger Smith. The club can trace its origins back to 1932 when a mention in *Model Engineer* magazine of December 1932 noted that a Mr G.C. Hornden of Chesterfield was acting as Hon. Secretary for the fledgling society. Not a lot was subsequently heard about the club until 1950 when there was an Exhibition of Models in Chesterfield Town Hall which attracted 160 models, with a number from the society. The club was re-constituted in 1963 with an initial meeting in the Bryan Donkin Ltd. canteen. This happened because a number of the members worked at the company, who allowed them to have their meeting on the premises. This meeting set up the club and they began the task of finding a suitable piece of ground on which to build a railway track. A number of locations were considered including one right in the middle of Chesterfield opposite the Town Hall. This, along with another site that was so steep it would have been impossible to build on it, was rejected and the present ground adjacent to St. Peter and St. Paul school was eventually accepted.

The amount of land allowed at the time was 200 yards by 100 yards in a heavily wooded area. The members set to work and started building a raised track in May 1965, which was an oval measuring 435ft. The first running event took place in July 1966 which was an event for the school. This was a great success and the club continued to use the site as it was until the track was allowed to be extended in 1984. Following this extension, the club were then able to purchase more or less the whole site which then gave them the security of tenure and the ability to expand their facilities. A new multi-gauge ground level track was proposed and built during the period from 1997 to 2000 when the first oval was completed on the lower level of the site (**photo 1**) and this is where the substantial steel viaduct is built carrying the track over the sloping ground (**photo 2**).

However, with the sloping nature of the ground the club had to build a spiral into this new track to rise up a height of about 20ft in order to maximise the full potential of the land. I mentioned it was a wooded area - well some kind person counted 630 protected trees in this area so the club knew the

The footbridge over the raised track adjacent to the viaduct.

Members working on replacing timbers on the refurbished viaduct.

A view from the main entrance.

Part of the impressive 'Aunty Wainwrights'.

difficulties this would bring. This involves having to have a professional assessment each year to examine all the trees for their condition regarding safety. One particular tree is now scheduled to be removed completely as it is hollow and this will cost the club in the region of £1,500 which, on top of the annual maintenance expenditure of around £2,000, is a big part of their budget, so this year the spend will be around £3,500. The cost of one replacement specified tree is around £50 per tree so you can see what potential costs the club has.

The ground level track started in 1997 and they had the first oval in operation by 2000. The spiral was built from the large steel viaduct up to the location of the current main station and then up to the top of the site where it goes through a new tunnel and then back over itself before returning to the station. This really tests the drivers with a gradient of 1 in 33 and so it provides the passengers with a good journey over its 2000ft length. At present the viaduct is being refurbished and all the track has been removed (**photo 3**). With the help of a business grant the club have had it professionally shot blasted and re-painted so it really does catch the eye as an imposing structure.

During the current lockdown and restrictions members here have been very busy installing a new hydraulic lifting platform for unloading locomotives for the ground level track adjacent to the station. With a good road access (**photo 4**) this will make it much easier for both members and visitors. In addition to this all the sidings adjacent to the turntable and station have been re-laid using new plastic sleepers.

The club is well served with a number of good storage areas and of course the notable Aunty Wainwrights Emporium (**photo 5**). This novel feature for a model engineering club is located in a new building just outside the main entrance on the access road opposite the school. Its name is exactly what is says, in that members can purchase almost anything they need from a milling machine to a set of model engineer magazines at very good prices, the name is reminiscent, perhaps, of the well-know shop in the old TV comedy show *Last of the Summer Wine*. It really is a fascinating place and I have never seen another one like it in all my visits to model engineering clubs.

The club's well fitted workshop (**photo 6**) is housed

The main workshop and some of the equipment.

in the same new building so the shop is very handy if members are busy with a particular project - they can just pop in and see if the required material or component happens to be on the shelves. Looking at the vast array of material and equipment available I am sure they are well served. All this new building work was funded by the club and its members via loans and donations. A number of machine tools etc. have also been donated to the club along with a very good selection of tools and equipment to provide most things they will need (**photo 7**).

Before this work was completed the members used to share toilet facilities with the old school, but on one occasion before their open day, they arrived on site only to find that it had been demolished so that engendered the club to bite the bullet and provide the new facility they now have.

One member told me an amazing story about one of their members who had just passed away and so like many clubs they offered the widow help in sorting out his workshop etc. However, nothing could have prepared them for what they found. The lady told them that there were a million books to start with, without the workshop, and she was not kidding - virtually every room in the house was stacked floor to ceiling with magazines, books and assorted material of every kind. The only space in one room was where the door opened. The outside space was just as congested with a huge garage which had a 20ft boat along with a couple of steam locomotives and equipment. A third locomotive could not be found at the time as it was completely buried in books.

Apparently, this was not the only time this had happened to them. Another occasion found the club members faced with a house in similar condition but this time the roof space was used as well. Having gained access to the loft which was just as full there was a space about 5ft x 2ft in between all the books and other material. Enquiring what the space was for they were told that was where the ML7 lathe was kept. I'll leave you good readers to think about what your own families would say if you have a situation like this - as I said, amazing!!

A large carriage storage shed adjacent to the station provides easy access on running days and dotted around the site are smaller buildings which are used for a variety of tasks for the other aspects of the club. Like the extensive garden railway layout, for example, which has some fine trackwork and bridges (**photo 8**) in its circuit. The raised track of course is the oldest part of the site and this has a good length of run and a very atmospheric station (**photo 9**) with a substantial footbridge over the track on the approach side of the station.

A comprehensive steaming bay area complete with traverser adds to this part of the site, as does a very pleasant seating area in the space leading up to the footbridge. There are not many passenger carrying tracks that actually pass under the garden railway layout but the nature of the land here provides an opportunity to do just that. Of course, the main maintenance problem they have is the trees, especially in autumn, which as my photographs show has a very heavy leaf fall but unlike their full-size brothers I understand they never suffer from leaves on the line!!

All the passenger carriages are fitted with a bespoke air brake system, which uses

A large modified milling machine in the workshop.

commercially available pipes and fittings but uses the club's design of air cylinders. On board compressors maintain a 15psi system pressure to ensure safety is maintained on this interesting track. Automatic signalling caters for the operations without the need for a signal box.

The well-presented club house was erected on site in 1992 and is a sectional terrapin building which was obtained from a now defunct local school. The club celebrated their 40th Amunmusnniversary in 2005 and since then the amount of work that has been put into the site by members is quite amazing. Electronic signalling, a cut and cover tunnel, the station building and the continuous track maintenance - the list seems to be endless but the members are a resourceful group who get things done and then enjoy their club.

There are regular monthly meetings but of course the present covid problem has affected that. Add to this the members' running days, the annual mid May Open Day, which is a major fund raiser for the club, and of course regular public running days which all provide a great opportunity for members to enjoy them selves. The club locomotive *Hady Belle* was built by members in 2001 and is a regular performer during the season.

I left this fine club and its hard-working members with a feeling of appreciation for the vast amount of work these people had put into their club and they are continuing to do so. It is a first-class set-up at Chesterfield and my thanks to Peter and Roger for their help and hospitality, and for showing me round and providing lots of humorous stories and information about the club and its members. I hope they continue to prosper as they are an asset to the local community - it was a real pleasure to visit them.

ME

Another view of the garden railway.

The substantial footbridge over the raised track station area.

An Astronomical Bracket Clock PART 16

Adrian Garner makes a bracket clock showing both mean and sidereal time.

Continued from p.664
M.E. 4677, 5 November 2021

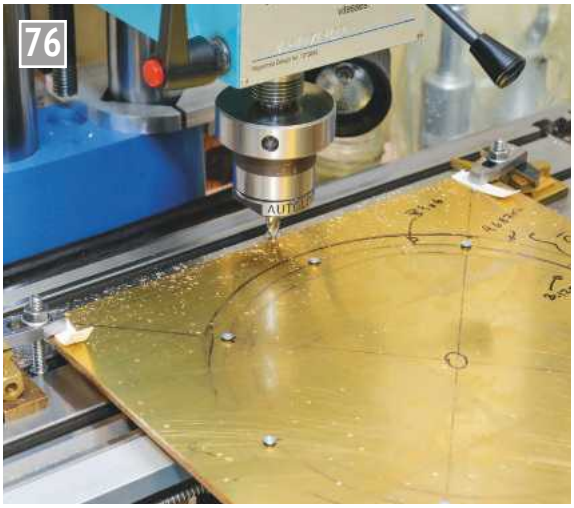
Inner and outer dial plates

The inner and outer dial plates of the clock were cut from a square of 1/16 inch brass plate. This was sawn oversize (about 11¾ inches square) and a black marker pen was used to mark the diagonals to determine the approximate centre. Two concentric circles were then drawn with diameters 9 11/16 inches and 8⅛ inches representing the inner edge of the outer plate and the outer edge of the inner plate. Eight screws through holes drilled into the ring of waste brass between these circles secured the brass to a corresponding square of wood about ⅞ inch thick. The whole was then taken to the milling machine to mill the outside edges. I used a ⅜ inch diameter end mill running at 1100rpm (**photo 76**).

With the plate square and removed from its wooden backplate precise scribed diagonals were made on the rear of the plate (i.e. the side with most scratches) and an accurate centre hole was drilled and reamed 5/32 inch.

The positions of the outer pillars were marked on the front clock plate. Using a 5/32 inch peg the dial plate and front plate of the clock can now be registered, made square to each other, clamped and the four 4BA clearance holes for the pillars drilled. These are drilled through the front clock plate and into and through the dial plate. The holes in the dial plate were countersunk after separation from the front plate. Countersinking 4BA holes in 1/16 inch brass needs care not to go too far. Countersink holes in a test piece first and note the depth needed.

This is the time to drill the holes for the spandrels. The Perspex former used to position the sidereal chapter ring can be used with the reamed 5/32 inch hole in the outer face to position the chapter ring centrally (**photo 77**). It is then easy to judge the spandrels' correct positions and drill their securing holes. I used 8BA cheesehead screws from the rear of the dial plate and tapped holes in the four cast spandrels. Cast spandrels ≫



Milling the edge of the outer dial plate.

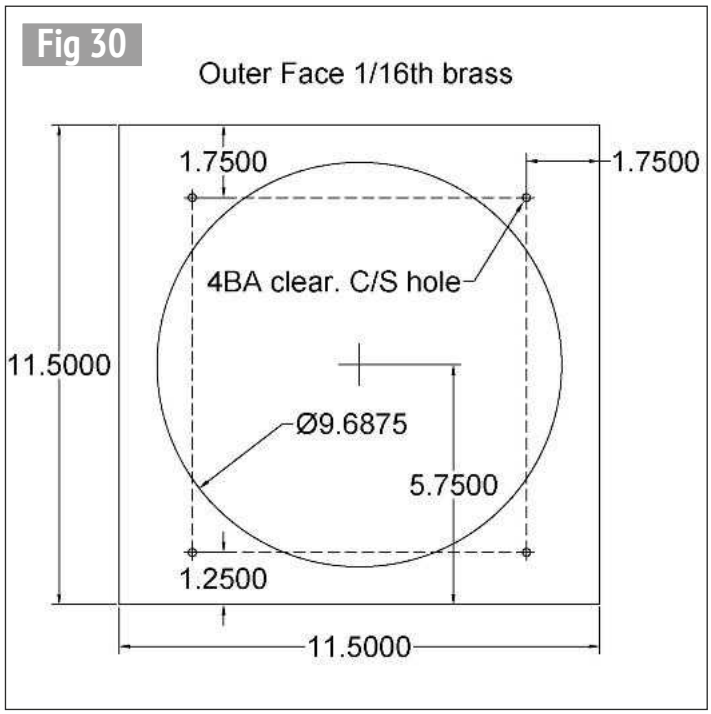
Positioning a spandrel.

look better than those made as pressings and are easier to mount. Whilst the position of the spandrels is largely artistic judgement, do ensure they are at least ⅛ inch away from the chapter ring. This is necessary to enable the sidereal chapter ring to be maneuvered into position during assembly.

Being castings, the spandrels may not lie flat. They can be judiciously bent by a small amount and a belt linisher may be used to remove the worst of any bumps on their rear.

The central hole in the outer dial plate can now be cut. This could be done by hand with a fret saw provided a large surface area supports the dial plate during the process to prevent bending the brass. Any filing would also need support to avoid bending. For those with large lathes the dial plate on its wooden mount could be bolted to the faceplate and the hole trepanned out. I opted to secure the wooden mount and dial plate onto my 8 inch rotary table on the vertical mill. As the dial plate is larger than the rotary table I secured it using 4BA studding through two diametrically opposite pillar holes with two 2 x ¾ x ¼ inch lengths of aluminium in which 4BA clearance holes had been drilled. The aluminium bars slotted into the 'T' slots of the rotary table and with matching support blocks the nuts could be tightened securing all together.

The trepanning was carried out with a 5/32 inch slot drill (two lipped cutter) run at 1100rpm. A ⅛ inch slot drill would be just as good. With small slot drills do not take large cuts. Each cut was 0.010 inch deep (**photo 78**).

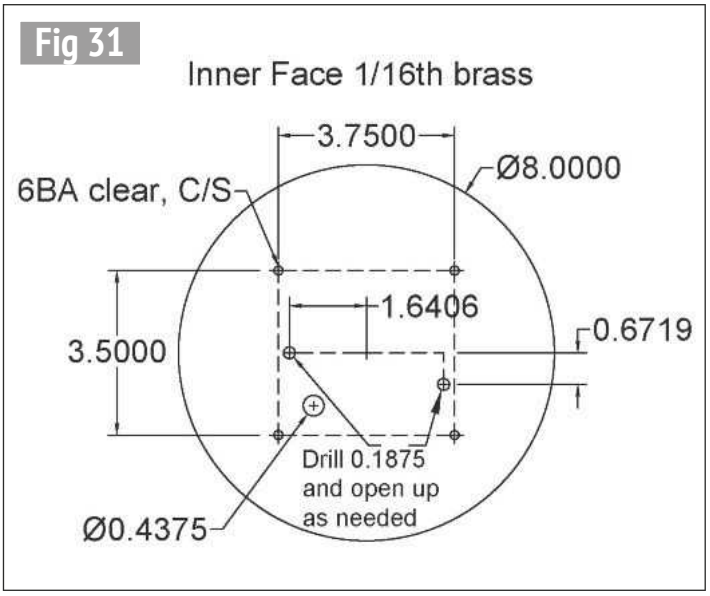


Trepanning the hole in the outer dial plate.

The last operation to complete the outer dial plate is to cross drill the holes in the pillars for the taper pins. I drilled and reamed a hole in a piece of scrap brass the same thickness as the front plate to slip on to the pillars so that I could determine where to drill.

The most difficult aspect of the inner dial plate, which is made from the trepanned middle of the outer dial plate, is the matting. This will distort the metal so carry out this process before machining to size or drilling any holes. Methods described by other authors include sand blasting, graining with emery cloth, rolling a diamond knurling wheel heavily across the area to be matted, hand engraving from many directions to produce a multiplicity of fine lines and using a hand-held vibrating machine engraver. I opted for the method described by Alan Timmins (ref 6 – see part 4, M.E.4666, 4th June) which is to make a special punch to stamp the surface. He used a 3 inch length of ¾ inch diameter silver steel on which he cut the pattern on one end. As this length of steel takes a lot of heat to harden I made my tool in two parts. The handle is a 2½ inch length of ⅝ inch diameter mild steel faced at one end with a large chamfer to minimize the sharp edge which will build up after multiple blows with a hammer. The other end was faced, drilled and tapped for a length of 6mm studding (or use a screw with the head removed) which was Loctited in place. The working end was made from ¾ inch diameter silver steel faced, drilled and tapped 6mm. After securing to the mild steel handle (but do not Loctite in place) the working end was faced in the three jaw chuck.

Alan Timmins suggested cutting the pattern on the end with a fly cutter. I did not fancy this so I used the set-up shown in the picture (**photo 79**). This allowed me to use a ½ inch end mill to cut 0.035 inch deep groves (set by advancing the X axis) spaced 0.050 inch apart (set on the Myford vertical slide). This is another example of where being able to use Myford accessories on the mill via a sub-table is very helpful. The tool was rotated 90 degrees after cutting the first set of grooves for the cross grooves which then form the diamond points. The rotation was done by eye – no great precision is required.



It will soon become clear that the brass distorts into a dish shape. Do not worry, continue until an even matt is obtained.

The silver steel head was then unscrewed and heated to red heat to harden with a small propane torch. After quenching in water, it was tempered to a dark straw/near brown colour (**photo 80**). Alan Timmins suggested tempering to light straw. I felt this too brittle for a punch, such items normally being taken down to a purple colour. I suspect in practice it makes little difference given that it is used on brass and relatively gentle use at that.

To use the punch place the inner dial plate on a steel surface. I used a ¼ inch thick spare square of steel placed on top of an old 6 inch cube type mounting block which gets used for many purposes for which it was not designed! This in turn was placed on the concrete floor of my garage. A bench would have been easier but the surface needs to have no bounce. Holding the punch upright (essential) it was hit with a club hammer. Only light blows are needed. This heavy hammer is much easier and less tiring to use than trying to make consistent heavier blows with a lighter hammer. After each blow rotate the punch and move to a new position. It is noisy so ear protection is strongly advised. It will soon become clear that the brass distorts into a dish shape. Do not worry, continue until an even matt is obtained.

To flatten the brass lay it flat on strips of wood supported only by its edge. Then either press or hammer with a leather mallet. Do not bother to test on a surface plate - a visual level of flatness against a ruler is all that is required. Softening the brass with heat will help but it takes a lot of heat to raise the temperature evenly on this size of sheet to a dull red heat. If the brass is so heated it will oxidise. This can be removed later with Horolene.

The holes for the winding square, solar and moon indicator arbors, hour and minute hand arbors and the four 6BA clearance holes for the screws to secure the plate to its pillars can now be drilled. Note the centre hole is initially drilled 3/16 inch as this will be used to register the inner chapter ring. To drill the needed holes, I mounted the inner dial plate on a wooden board bolted to the rotary table on the vertical mill and drilled the holes using the digital read-out

Cutting the pattern on the matting punch.

Hardened and tempered matting tool.

and then trepanned the 8 inch diameter disc using a 5/32 inch slot drill run at 1100rpm. I took eight cuts of about 0.008 inch. It does not take long to make each cut by rotating the table.

The four 2BA holes for the pillars in the front plate were also drilled and tapped on the vertical mill using the digital read-out after aligning the plate square to the table and registering the hour/minute wheel hole at zero.

●To be continued.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

David White's Carette. (Photo courtesy of David White.)

Welcome to the world of Buttered Parsnips…

I wanted a book on one of my favourite subjects but it was out of print. Ebay had some copies on offer for ridiculous prices (over £300) but I found a PDF copy for nothing. As it had about 250 pages, it would be inconvenient to read on the computer screen but I had heard of being able to get a 'print on demand' copy, so I investigated. I was very pleased with the results. Costing about £18 all in, spiral bound, with card covers and sent in two days. The pictures and text are contrasty and sharp, in A5 format and I am very pleased with the result. As I do not intend to sell it, the question of copyright will probably not be relevant.

The Sheffield Auction Gallery sale of Photographica on 14th October had some very fine entries. In a sale of over 2000 lots, about half were from Leitz. I look forward to the published list of hammer prices. More relevant to Club News is the sale of several live steam models on 30th Sept, including a 2½ inch gauge 2559 *The Tetrarch*, an LNER A3 built by Mr. A. J. Whittey who was president of Nottingham Model Railway Society in 1928, Guide Price £5-8,000; and a part built 7¼ inch gauge *Wenford*, an LSWR 2-4-0 WT.

In this issue: the dishwasher? A necropolis, an 'Ology', a Malaysian Tich, 'come outside' and public transport.

Now then, are you all sitting comfortably? Then I'll begin. David White of the **G3 Society**, as mentioned in M.E. 4677, acquired a Carette in need of TLC. Here it is (**photo 1**).

Welcome to *The Smokebox*, June, from **Rand Society of Model Engineers**, in Gauteng, S.A. Editor, Luke Ronné says, 'So we have a new newsletter, the horror! It's the same old stuff rewrapped and repackaged and sold for more than it's worth. (It should fit right in here, then – Geoff.) (*Speak for yourself! Ed.*) This might not be a bad thing; we have a few young, eager members who will find 'the same old' new and exciting.' A WhatsApp group has been formed, called 'Chiba Tetsu' (Japanese, I think, meaning, loosely, 'little train nerds')*. David Bricker is rebuilding an old driving truck, which meant that after its dismantling, the small parts could be degreased and then put through the domestic dishwasher, when the boss is out. Luke claims that the suggestion did not come from him, despite all the evidence pointing his way! Jayden Clarke is a student and budding engineer, building a *Ballaraat*. He is learning by doing, having acquired a lathe and lots of help from club members. He says, 'This hobby sucks (technical term - Geoff) when you do things wrong the first time or two but is amazing when you get it right.' Well said, Jayden.
W. https://www.facebook.com/RandSocietyofModelEngineers

City of Oxford Society of Model Engineers' *Cosme Link,* summer, begins with a great response from a member of the public queueing to ride on the train on their first day after Covid restrictions were reduced. Asked how long he had been waiting in the queue (which was then taking over an hour) he replied, 'about six months!' (since the last time he travelled). An item on grinding form tools, by Brian Holland, is closed with two photographs, of some dome nuts and a dummy lubricator made by such means. An interesting piece about the London Necropolis Railway includes a picture of its crest or logo, including a Skull and Crossbones, an hourglass and the motto, *Mortuis Quies Vivis Salus*. 'Rest for the dead, salvation for the living'. The company claimed that it would be 'more convenient for the dead (?) and the mourners'. The facade in Westminster Bridge Road still exists but the terminus itself was destroyed in a 1941 air raid. Richard Brown was asked to draw up a plan for the location of funerary urns in a churchyard, using a triangular area. His first idea was of concrete

blocks drilled to take a rod for marking out. A second idea used a piece of brass tube Gorilla-glued into each block, all of which were sunk level with the ground to facilitate mowing the grass. Aluminium rods could then be mounted in each block and cords used to triangulate each burial site when required and afterwards removed to leave a flat area.**
W. www.cosme.org.uk

Steve Reeves celebrated his 60th birthday at **Northern Districts Model Engineering Society** with friends and family (covered last time by John Arrowsmith) including Linda Jennings, dressed in pink and driving her pink locomotive, *Priscilla*. Boiler inspector, Phill Gibbons briefly discusses copper superheater elements. For best results, they should be welded with an oxy-acetylene flame. The temperature reached is close to the melting point of copper, so practice is needed. The Bassendean Rail Museum Expo had no working steam at the time, so NDMES was asked to provide some live steam activity. This was provided by about 15 members, who ran a portable track, some garden railway, 3½ inch gauge locomotives and an array of stationary engines, making it their best display for many years, especially for an off-site event. Peter Smith began a Clayton & Shuttleworth steam wagon to 4 inch scale. The Garden Railway officially reopened on 1st June and was very active with eight locomotives, seven in action. 30 years ago a Malasian resident, Mr. Soon Chin decided to build LBSC's *Tich*, without any national or local club or model engineering expertise to call upon but inspired by *Model Engineer*. Mr. Soon Chin's son Min and grandson Owin now live in Perth and were invited to Steve Reeves bash, together with 'the little engine that could'.
W. www.ndmes.org.au

Hutt Valley and Maidstone Model Engineering Societies, *Blast Pipe*, July, says that John Antliff has been asked to repair a Gauge 1 Basset-Lowke, LNWR S*ir Gilbert Claughton,* acquired in a very sorry state (**photo 2**). David Grant-Taylor has obtained a 5 ton lathe for the Silverstream railway. It is a Russian 1M63 machine made in 1976 but it was originally designed and produced in Germany by Hasse & Wrede in the 1920s and accommodates workpieces up to 3 metres between centres. The handbook is written for the operator, rather than being a product of the advertising department. It is comprehensive to the point of having dimensioned drawings within, so if something breaks it can be made on the spot, thus keeping production going. It has an ingenious taper turning ability, with the cross feed connected to the leadscrew by gearing, rather than having a separate drive or offsetting the tailstock. There is very little on Lathes.co.uk but a Google search found this: https://www.machinespot.com/m/machine_show/307-screw-cutter-lathe-ryazan-1m63
W. www.hvmes.com

York & District Society of Model Engineers' 'Clanger' award trophy is shown in **photo 3**.

Maritzburg Matters, July, from **Pietermaritzburg Model Engineering Society** contains very little due to the almost complete inability to hold any event due to Covid restrictions. Anyway, Alan Richter provides a very informative item on 'cam out' in the Pozidrive system v. other forms of socket, i.e. hex, Torx and Torx Plus. Otherwise, an anonymous contributor provides a potted biography of Richard Trevithick.
W. www.pmes.co.za

B&DSME News, August, from **Bournemouth & District Society of Model Engineers,** reports that the Society, represented by Chris, visited the Southampton SME track in Riverside Park. This was not too easy, since neither their website, nor that of the Park, supplied public transport directions. Despite being only two minutes away from his route, the bus driver failed to point out that the track was opposite the bus stop and his employers put their map so far up the pole that it would be of interest only to giraffes. Nevertheless he found the club very friendly and the park wonderful, with great views and a multitude of swans. (A wedge, as a term of venery – Geoff.) He also took a trip on the Chichester canal and visited the Littlehampton Miniature Railway. To say that the 'resort' is faded, would be inaccurate, it is 'dead' (says Chris). Walking across town, he encountered only a traffic warden. Even the ice cream establishment was less than cooperative… unlike the railway. The last bus is at 2.30pm and none at all on weekends!
W. www.littledownrailway.org.uk

Another restoration, John Antliff's Sir Gilbert Claughton*.*
(Photo courtesy of Stephen Sandford.)

York's Clanger Award.
(Photo courtesy of Roger Backhouse.)

The Prospectus, July, from **Reading Society of Model Engineers** begins with a picture of Mark Kirton's new industrial-style locomotive. It is rather angular but no doubt easier to make. (I would say that would I not? My locomotive, *Deborah* is similarly shaped – Geoff.) Stephen Millward documents his first locomotive build, a *Sweet Pea*. Approaching it with some disdain for its appearance, he quickly learned that it is an ideal first build and its appearance is growing on him. Terry Wood restored an old electric motor, by Bosch, with an end, or face, commutator. Editor, John Billard moves on to making the rods for his *Claude Hamilton*. **W.** www.rsme.org

Centurion Smokebox, July, from **Centurion Society of Model Engineers** brings the sad news that George Corlett has died. Born on the Isle of Man, famous for its motorcycle racing, true to form George raced a Manx Norton in the TT and owned several classic bikes.
W. www.centuriontrains.com

Gauge 1 North, Yorkshire Group, *Newsletter*, July-August, tells us the number of GTGs is rising and at two recent events were Pat Honey's works trains (**photos 4** and **5**). Something a bit different, what? Also welcome to young Woody Nurse, seven years old and train mad. He has his own r/c train which he drives extremely well, even when sharing the track with others. Pat Honey was so impressed, he gave Woody a 3 car DMU which left the young man speechless! Well done Pat.
W. www.gauge1north.org.uk

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Sydney Live Steam Locomotive Society *Newsletter,* August, has John Lyons introducing the concept of Lists. In a preamble, John refers to *The Mikado's* 'little list', the list song in *Oklahoma* and the spelling tests at teacher training college in 1960. If you hadn't passed it by the time you graduated, woe betide you! Then Bernie Courtenay lists a number of 'Don'ts' for trainee engine drivers. Simon Collier discusses lining out wheels, finding that hollow needle pens used on a wheel rotatable on a vertical axis worked best. There are lots of pictures of members 'fettling' the track and having fun in doing so. Warwick Allison celebrates 25 years of the Society's presence on the Web! The National Library of Australia has archived this presence, now part of *Trove,* so readers may visit the site to compare notes with the current state of affairs. Chris Denton tries to decide on his next project, traction engine or locomotive? Deciding finally on a Case 80HP to 1.25 scale. Chris also says, 'In keeping with locomotive tradition, my embryonic traction engine needs a name. It is definitely a male, a bit rough around the edges but with a big heart, belonging to another era with an American heritage but conceived in Australia ... *hmmmm* ... I think I will call him *Bruce*.' A new club in Peterborough were discussing the best way of negotiating the pitfalls of creating a site, with special reference to the Port Augusta club. David Lee visited the area and took in the Peterborough Rail Museum and the Pichi Richi line.

Pat Honey's Severn Tunnel rescue train. (Photo courtesy of Peter Vincent.)

Pat Honey's gauging and measuring train. (Photo courtesy of Peter Vincent.)

Steamtown Peterborough not only has a unique triple-gauge turntable but the only set of dual gauge axle stands in the Southern Hemisphere.
W. www.slsls.asn.au

MEEA Newsletter, August, from **Model & Experimental Engineers, Auckland** has Ross Purdy taking up a challenge from a friend, to build a 0.1 cc i/c engine each and see whose model runs best. Ross found that although the manufacture was relatively fast since everything was so small, with little metal to remove, he says his micrometer has never worked so hard. Small engines are notoriously difficult to start and run and initially it would not start at all but as he overcame each difficulty it began to run more easily. Finally, much later than he expected, Success! 'It was a real challenge' said Ross.

And finally: *'Aerodynamics is for people who can't make engines.'* - Enzo Ferrari

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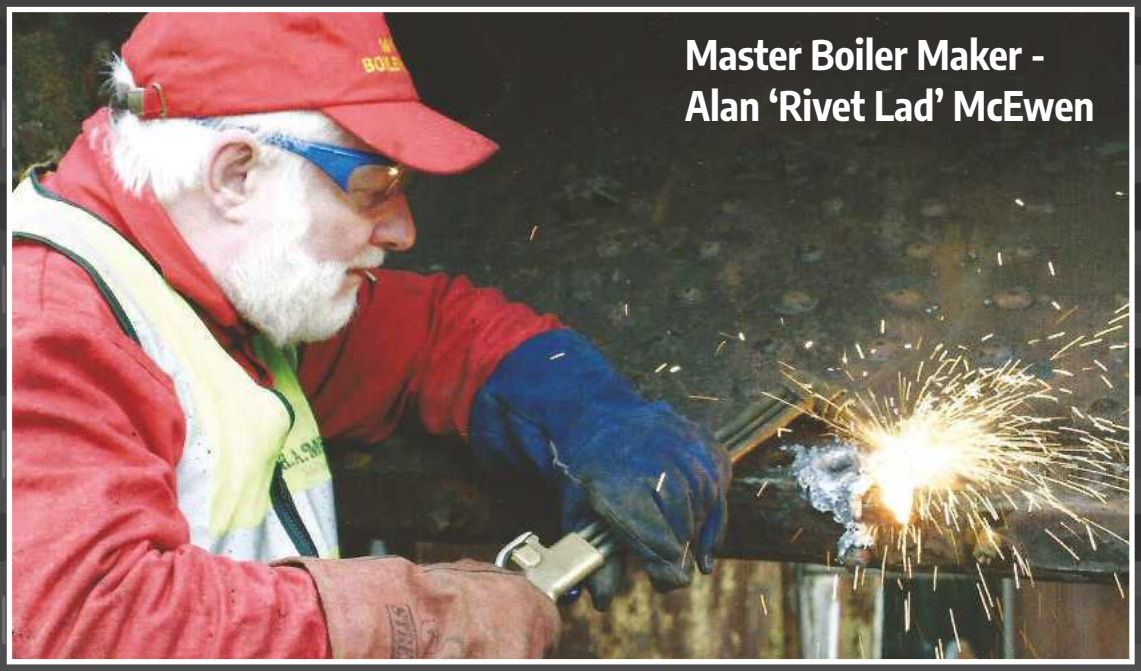
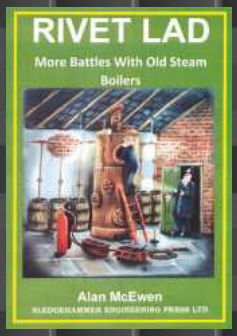
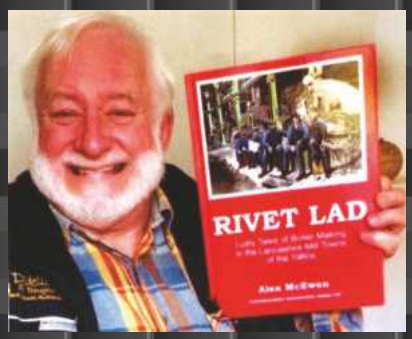


Master Boiler Maker -
Alan 'Rivet Lad' McEwen





When Master Boiler Maker and author, Alan McEwen was a young sprog, he loved banging and hammering on rusty old boilers; now that he is an old hog, he just prefers others to bang and hammer!
Alan McEwen's Boiler Making adventures and also 'potted histories' of several Lancashire and Yorkshire Boiler Making firms, can be read in RIVET LAD - *Lusty Tales of Boiler Making in the Lancashire Mill Towns of the 1960s.* The book is crammed with 'hands on' technical information of how Lancashire, Locomotive, Economic, and Cochran Vertical boilers were repaired over 50 years ago. The book's larger-than-life characters, the hard as nails, ale-supping, chain-smoking Boiler Makers: Carrot Crampthorn, Reuben 'Iron Man' Ramsbottom, Teddy Tulip, genial Irishman Paddy O'Boyle, and not least Alan himself, are, to a man, throw-backs to times gone by when British industry was the envy of the world.

Alan McEwen's first RIVET LAD book: *RIVET LAD – Lusty Tales of Boiler Making in the Lancashire Mill Towns of the Sixties* published September 2017 is now priced at £25 plus £3.00 postage and packing to UK addresses.

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