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THE MAGAZINE FOR MODEL ENGINEERS

ENGINEERING in Miniature

NOVEMBER 2020 | £4.50

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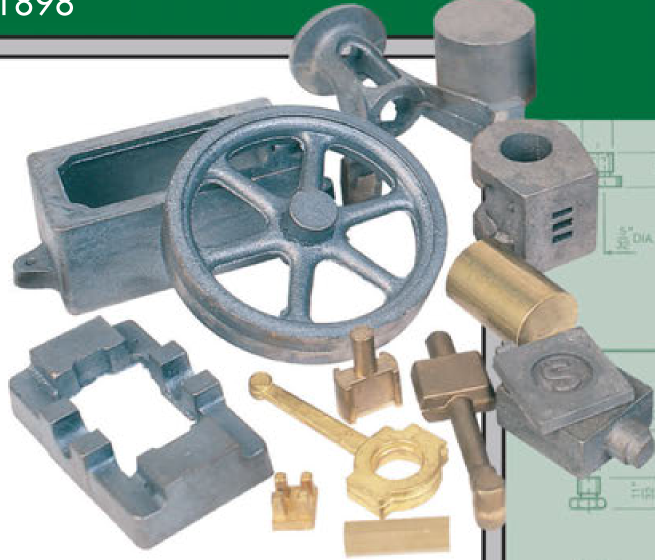

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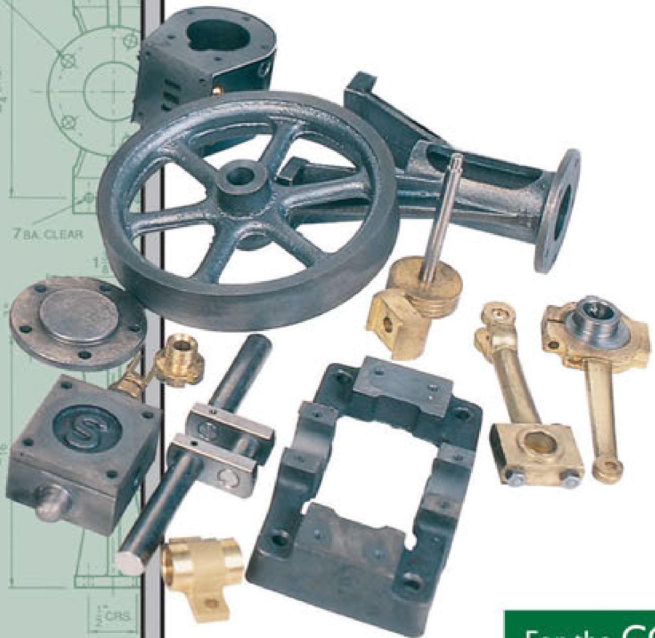

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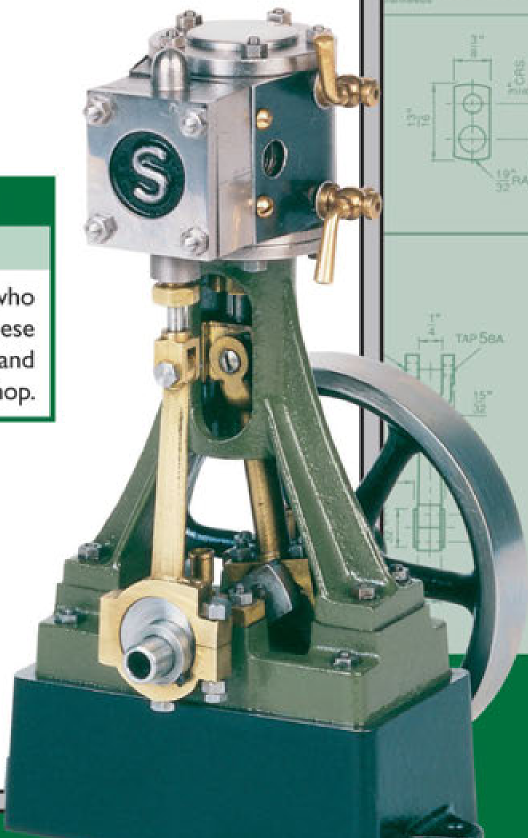

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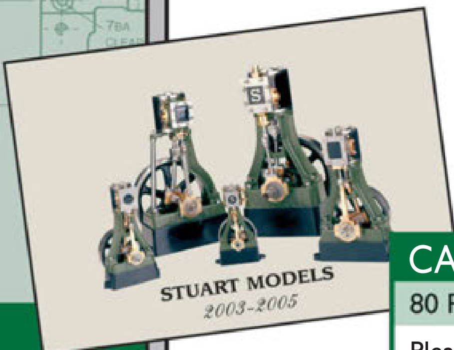

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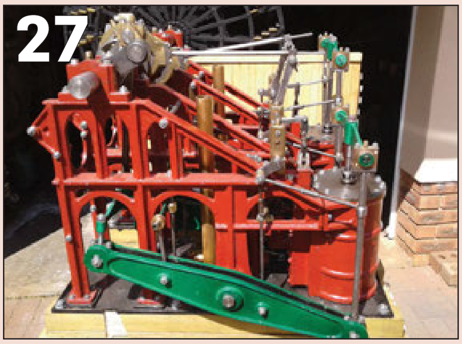

FRONT COVER

Producing nameplates by means of etch-plating is not as difficult a process as one might think, as we demonstrate in this month's issue.

Photo: Rich Wightman

EDITORIAL

Second wave? Let's get in the workshop...

Welcome to the November EIM – just where is the year going? Of course this is anything but a normal year and keeps serving up disappointments, the latest being the news that the London show in January won't be happening.

Coming just after the cancellation of the Midlands event in October this will I'm sure be disappointing to many of you – for far too long now we model engineers have been starved of opportunities to meet up and put the world to rights while viewing excellent models, and sadly the news coming out of Government suggests that things are not going to get much better any time soon, in fact they could be getting worse.

If a Covid second wave does happen, it will be in the winter, so the clubs won't see yet more public running sessions fall victim to lockdowns. However it will mean the very busy winter meeting programmes enjoyed by so many members could be under threat, which is a great shame as these meetings are as much about being social occasions as being informative.

One thing you might be interested in if you are locked down is catching up on some reading and perhaps filling any gaps in your EIM collection (yes, it does happen!). If so a very special offer from our founder TEE Publishing will be worth a look, see page 38 for details.

What can we do if we get stuck at home again? Get into a workshop of course, and shock horror, your editor has been doing just that. As predicted last month, I've been working on big miniatures at the 12¼-inch gauge Fairbourne Railway with tech-ed Harry. It was a bit of role reversal, Harry being the newly-appointed engineer was telling me what to do!

My task was a simple one, machining up a couple of steel bushes to reduce the diameter of the coupling holes on one of the line's diesel locos, so that coupling pins inserted in said hole don't keep bending. But as the picture above shows it did involve me happily creating swarf for a couple of hours on a suitably vintage Myford lathe, interspersed with shunting carriages using said diesel – great fun and I'm going back for more.

So yes we are lucky in having something to keep us busy whatever the challenge. Enjoy your workshops, and if you make something interesting, do share it with fellow readers!

Andrew Charman – Editor

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Articles: The Editor is pleased to consider contributions for publication in Engineering in Miniature. Please contact us to discuss your work.

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At this time, we would usually be announcing our next Warco Open Day. With the current Covid-19 restrictions it is not possible to hold this popular event. In the meantime, please view our Used Machine list on our website. Our showroom is now closed to the public

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Machining suspension for a 6-inch engine

In the latest instalment from Ashley's project to build a 6-inch scale Fowler crane engine, he describes the workshop time taken up by the complex rear suspension.

BY **ASHLEY TEMPEST**

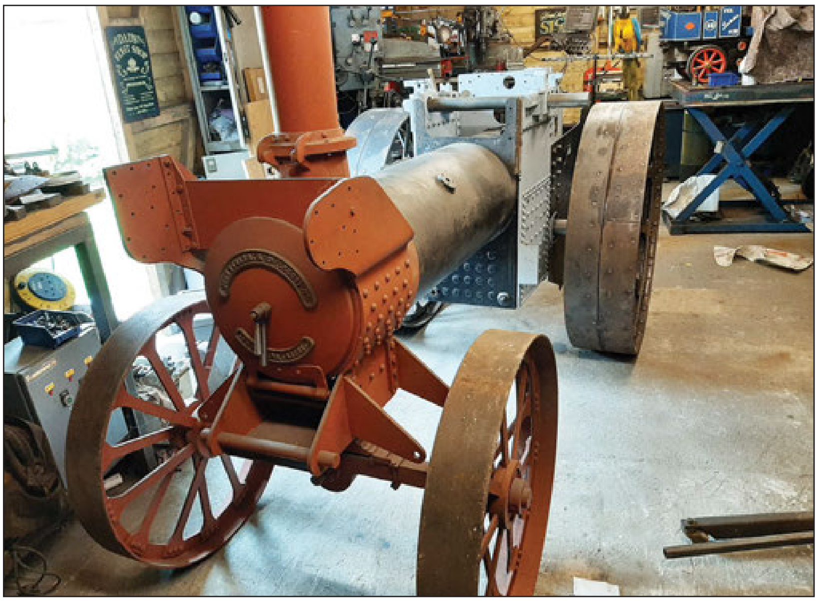
The first rear suspension component to be machined for my 6-inch scale Fowler crane engine was the third shaft and rear axle horn block – this piece slides up and down, attached to the springs at the bottom, while holding the third shaft and rear axle gears in mesh.

I mounted the block on the mill as flat as possible, then ran a face cutter over it to give me a clear face for marking out. I then painted the top faces with a small amount of white paint before running an old tap held in the milling chuck over the faces to give me a clear centre line for the horn block. (Photos 1-2).

Using this centre line and then clocking the sides of the casting to get the position of the rear axle correct, I used a 2-inch boring head to bore the rear axle housing to a size producing a press fit with the bronze bushings (Photo 3) Then I repeated the steps above, but first having moved the table across to the correct centre for the third shaft bush to fit (Photos 4-5).

To finish the machining of this side of the horn block, I ran a ¾-inch side cutter up the side faces at the top and bottom ends of the block. At the top end this is the full width of the block, but at the bottom it is only the width of the axle housing.

The final pass was to take the height of the block down to size using a 60mm face cutter. (Photos 6-7). Photo 8 shows a comparison with the unmachined casting.



HEADING: The Fowler, on its wheels after the work described in these pages.

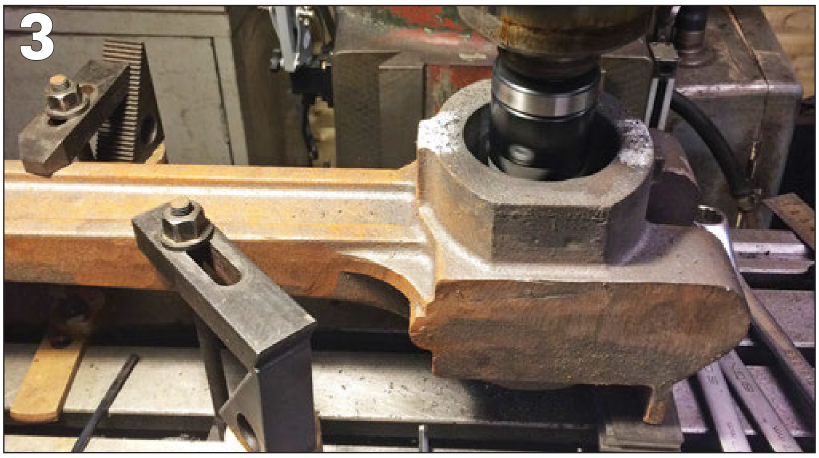
PHOTO 01-02: Old tap used in chuck to produce centre-line for horn block.

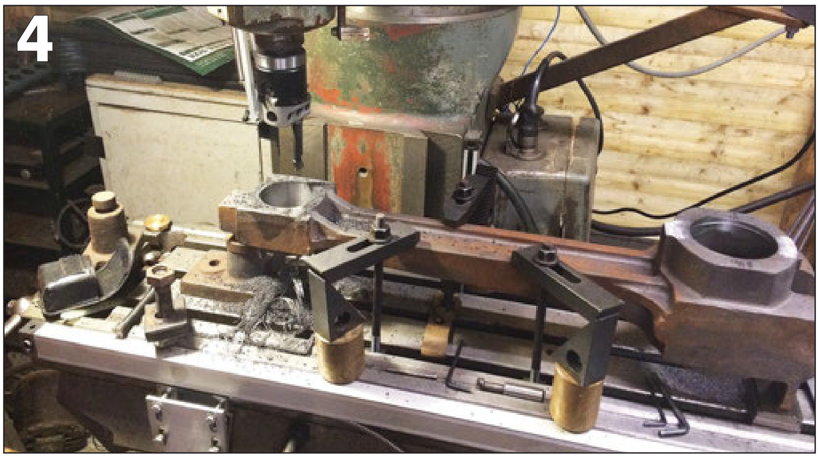
PHOTO 03: Boring out the hornblock.

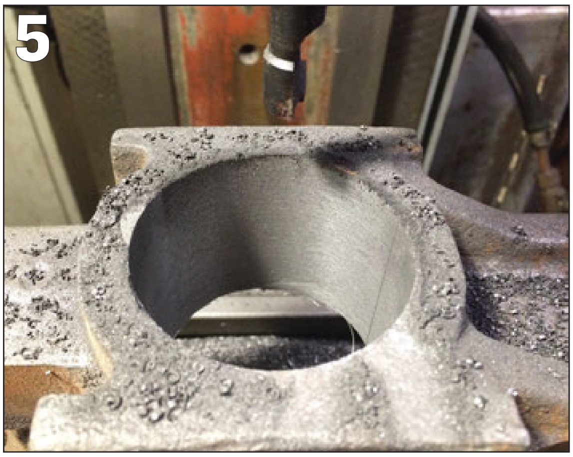
All photos in this feature by the author

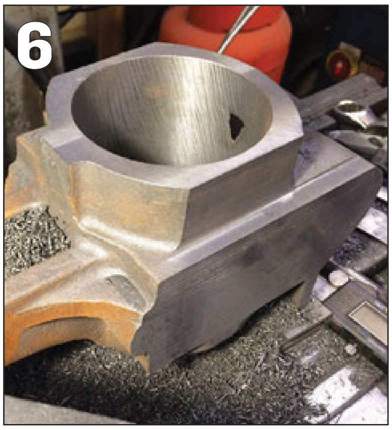
The horn block was then flipped over and set up along the centreline again by clocking onto the bores already machined. It was then machined down this side to the final thickness (Photos 9-10). These steps were then repeated in full for the opposite side horn block.

The blocks were then set up on their sides and using the already









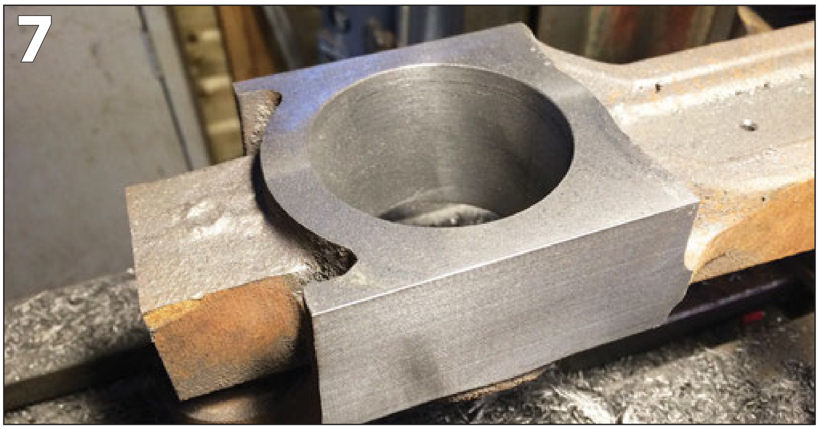


PHOTO 04-05: Operation repeated for third shaft.

PHOTO 06-07: Blocks reduced to final height.

PHOTO 08: Boring out hornblock.

PHOTO 08: Comparison of finished block with the unmachined original casting.

PHOTO 09-10: Block flipped to machine down rear side to finished width.

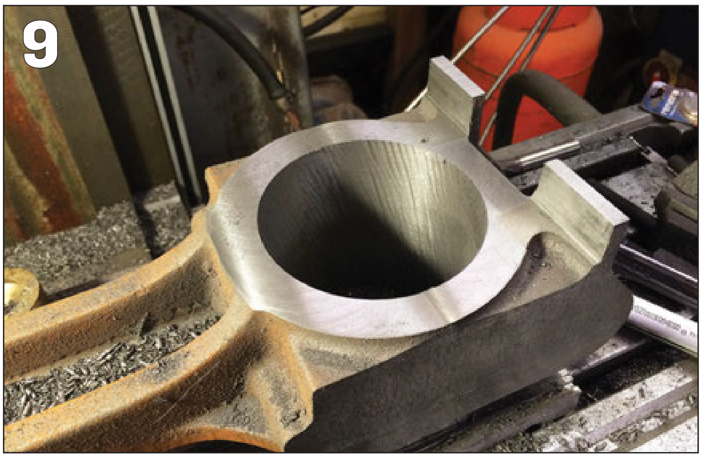
PHOTO 11: Drilling out hole to take the suspension hook.

machined faces as references I drilled and reamed the hole to take the suspension hook. (Photo 11).

Due to the constraints of my machine shop, I had to get somewhat creative to machine the bottoms of the blocks and the oil wells in their tops. I bolted a large angle plate to the bed of the mill, slightly overhanging the edge to allow the block to hang down.

To avoid the knee of the mill, I had to rotate the machine's turret around so the tool was off to one side of the knee. This process required a lot of patience and the use of an angle finder to ensure the block was set true to the tool (Photos 12-16). This completed the machining of the horn blocks.

The next components to make their way onto the mill bed were the



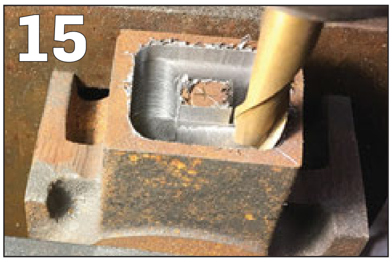


PHOTO 12-16: Creative setup for machining bottoms and oil wells in top.

PHOTO 17-18: Machining horn guides followed similar process.

PHOTO 19: Drilling and tapping the mounting holes in horn guides.

PHOTO 20: Block turned and clocked true after datum patch machined on either side.

PHOTO 21: Left-handed boring bar aids machining boss.

PHOTO 22: Boss faced to final thickness.

horn guides. The setup process for these was very similar to that for the horn blocks, with a bit of white paint and some careful measuring being used to set the castings up true to the bed of the mill.

The first operation was to use a ¾-inch side cutter to take the guides to their finished dimensions from the centre line (Photos 17-18). I then drilled and tapped the mounting holes (Photos 19). Before turning the guide over I machined a datum patch on either side to allow me to clock it true once it was turned over (Photo 20).

To machine the outside faces of the bosses I had to make up a holder to fit a left-handed boring bar to fit into the 2-inch boring head, this allowed me to machine the boss true to centre (Photo 21). Once it was at the correct diameter I used a face cutter to take it and the mounting pads down to their final thickness (Photo 22).

While the horn guides were still mounted on the mill, I double checked their fit to the horn blocks, then briefly bolted them into place on the engine to get an idea of how they will look when they are finally mounted (Photos 23).

Axle bushes

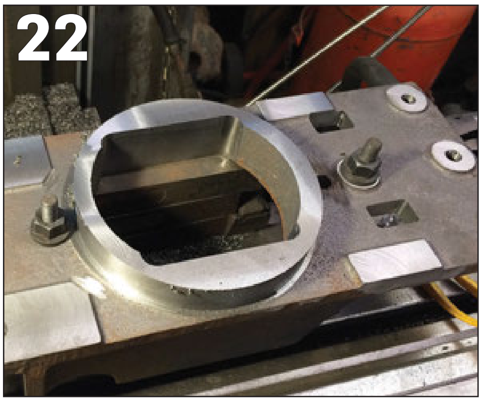
For a change from machining cast iron, next up was some SAE660 cored bronze, in order to turn the rear axle bushes and third shaft bushes. The machining operations are again very similar. Having set up the bronze in a three-jaw chuck, a facing cut was taken before a live centre with a bung (Photos 24) was used to support the piece for turning the diameters.

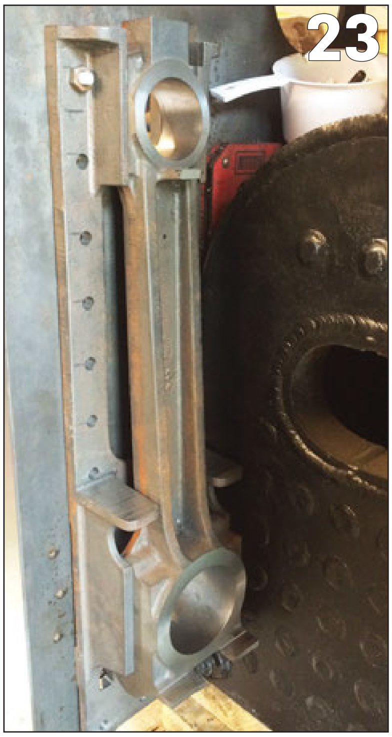
Once the outside diameters were to size (Photo 25), I then fitted a steady to hold the end of the bronze for boring, having turned the work piece around to face that end down to final size too (Photos 26).

Photo 27 shows a comparison between the bronze blank and finished bush, while in Photo 28 the bushes are in position waiting to be pressed in. The third shaft machining was again carried out in similar fashion, the main difference being the lack of a flange to be machined.

The machined bushes were then pressed into the horn blocks using a hydraulic press before I carried out another trial fit in the horn plates. A small square is useful when starting to press bushes in to ensure they go in square and do not pick up on the bore walls (Photo 29).

In my haste to deliver the platework to the laser cutters, I completely forgot about the rivet pattern in the horn plates. On my engine these will only be cosmetic details, however it did then mean I had to spend a bit of time drilling the





holes to fit the ⅜-inch rivets (Photo 30). These needed cutting to length before being welded from the back side, leaving the mounting holes for the horn guides clear for bolting. They then had a coat of primer applied and were fitted to the boiler (Photo 31).

The next component to be tackled was the rear axle. With only two keyways to machine and the wheel retaining pin holes to drill it is not too complicated. Unfortunately, however, the bed on my mill is not long enough to machine both ends in one operation, so as a reference piece I mounted an angle plate to the bed before mounting the axle on V-blocks. This saved me a reasonable amount of setting up faff for when I turned the axle around (Photo 32).

Photo 33 shows the aftermath of a painting session, horn blocks with spring hooks attached, spectacle plate, horn guides and a couple of other minor parts added.

I cut the bottom rear stay from a piece of 10mm plate I had to hand in the workshop, using my plasma cutter, before drilling the centre hole and

PHOTO 23: Horn blocks tried in place.

PHOTO 24-26: Stages in turning axle bushes.

PHOTO 27: Bronze blank and final bush.

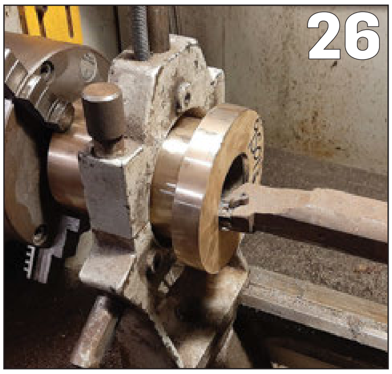
PHOTO 28: Ready to be pressed in.

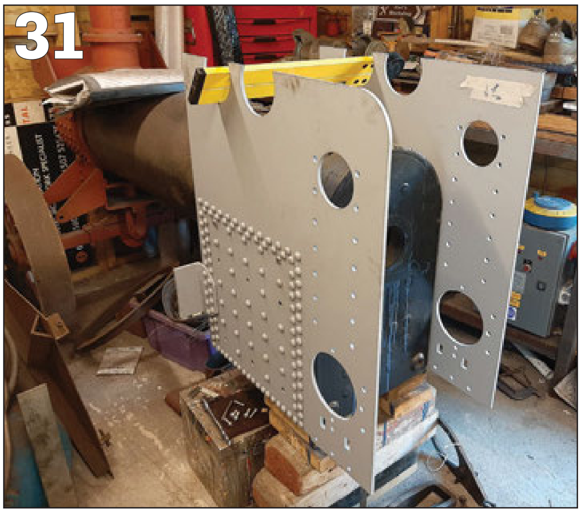
PHOTO 29: Pressing process.

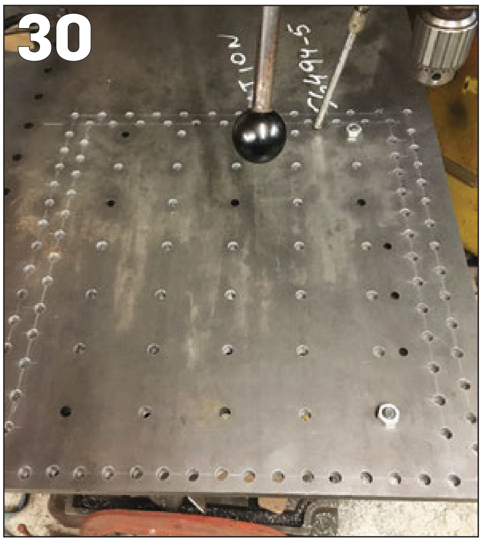
PHOTO 30: Drilling holes for cosmetic rivets.

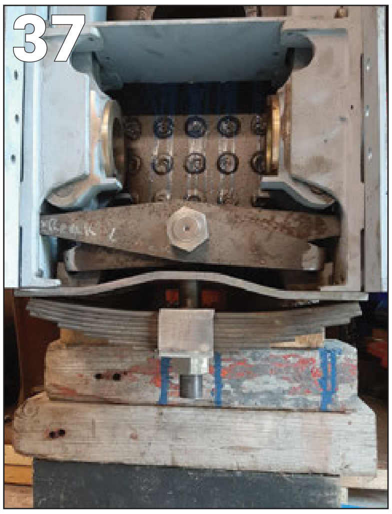
PHOTO 31: Horn plates fixed to boiler.

PHOTO 32: Drilling keyways in axle.









marking out where the folds needed to go. To get the folds reasonably crisp I made up a press brake tool out of a piece of heavy angle welded onto a chunk of plate – this worked fantastically well.

To help ensure the dimensions were correct, I drew out the final shape that I needed in full size on a piece of plate in chalk, this allowed me to place the piece on it to check the amount of bending carried out at each line was enough. Once all the bending was done I rough cut the clearance holes for the rear suspension hooks before tidying them up to size in the milling machine (Photos 34).

The suspension was loosely assembled (Photos 35) – I had previously had the cross levers flame cut and then welded together to form their basic shape.

PHOTO 33: Aftermath of painting session.

PHOTO 34: Bottom stay bent to shape and machined.

PHOTO 35: Suspension trial assembled.

PHOTO 36: Top stay fitted in place.

PHOTO 37-38: Assembling suspension.

PHOTO 39: Tender built in situ on engine.

PHOTO 40: Ashley's daughter demonstrates that this is one big engine!

The top stay for the hornblock required little in the way of machining. However careful marking out was required to ensure the holes that the horn block oilers poke through were in the right place and oriented correctly with the rest of the casting, as you will be able to see these while driving (Photo 36).

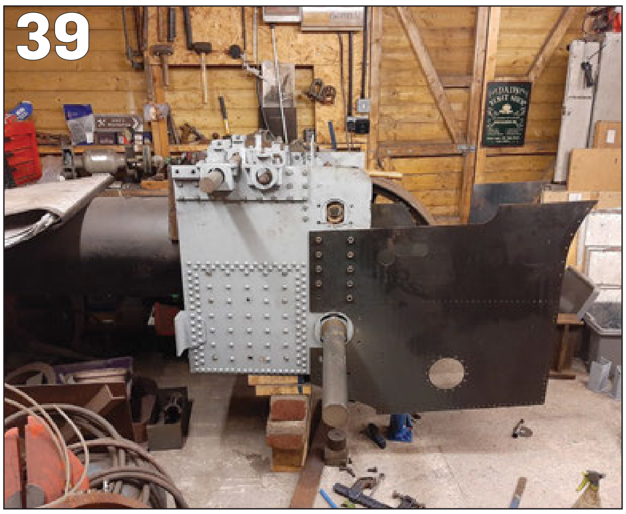
Parts previously machined were fitted to the cross levers – the spring drop link passes through the bottom stay which had been finally fitted with countersunk bolts. The drop link is attached to the levers by a large pin, passing through both levers and the spring drop link.

Leaf springs

I found a pair of new old-stock leaf springs of the right size that only needed the eyelets on their ends cutting off. To link the pair together and to the spring drop link a cradle was fabricated from four pieces of plate, drilled to take the drop link and to fit over the locating buttons on the springs. These were then fitted and a little tension added to the drop link – this can be adjusted later to alter the ride height of the back end (Photo 37). Photo 38 shows the full suspension mechanism all fitted together.

To enable me to move the engine around while working on it, I took the decision to build up the tender in situ on the engine, this required fitting the tender sides to the horn plates before fitting the rear wheels. They simply bolted on through the machined holes on the horn blocks (Photo 39).

Finally I was able to fit the rear wheels, a momentous occasion! (heading photo). With the engine on its four wheels for the first time, I loosely fitted a few other bits, such as the cylinder block to see how it was all going to look, with my 13-year old daughter and occasional workshop helper stood to one side to give an idea of the scale of the thing (Photo 40). As it stands now I estimate it weighs a little over 1.5 tons... EIM



Etching in the workshop

Having tried out three methods of protective coatings, Rich concludes his experiments by trying out another useful technique, but this time in construction.

BY **RICH WIGHTMAN** Part four of four

HEADING: A completed pair of etched nameplates for the author's locomotive.

PHOTO 1: Use of ferric chloride proved a method of etching not favoured...

PHOTO 2-7: Components for the etching process, see text for details.

All photos and diagrams in this feature by the author

I was in need of a couple of nameplates for my loco, 'Conway', so investigated the various ways that I could make them. Casting is something we are looking into but is a way off as yet. My good mate Julian is getting to grips with his CNC mill and has made some nameplates in the past so that was a possibility. But I did some research and came across the process of etching.

Etching is a process that is widely employed to make printed circuit boards using a chemical called ferric chloride (Photo 1). I borrowed some from a friend and tried it but quickly abandoned this method. Rather foolishly I tipped some of the chemical into an open dish and dropped in my brass test piece. An hour or so later the etching had started but there was also a nice brown stain on steel parts, tools and the like that were in close proximity to the dish.

Another method I came across in my research is electro etching in salt water , and this seemed like an interesting method to try out. After all I already had the power supply, alligator clips and salt from my various protective coating experiments detailed in recent editions of EIM.

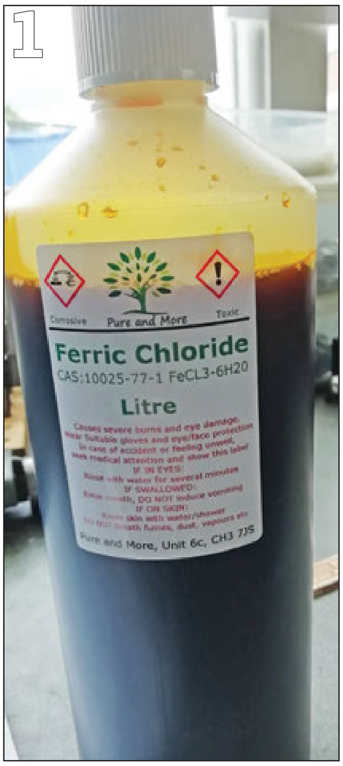
Materials

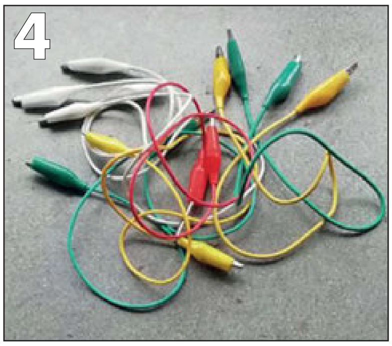
To electro-etch you need the following;

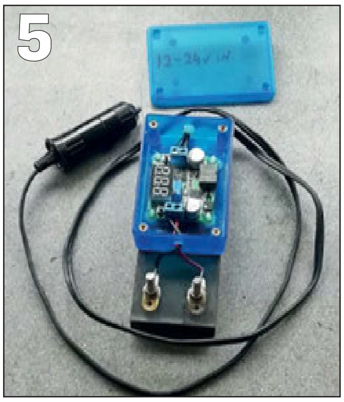
1) A plastic container with a lid (Photo 2)
2) Salt (Photo 3)
3) Alligator leads (Photo 4)
4) A power supply (Photo 5)
5) A bit of scrap copper (Photo 6)
6) Thick copper wire (Photo 7).

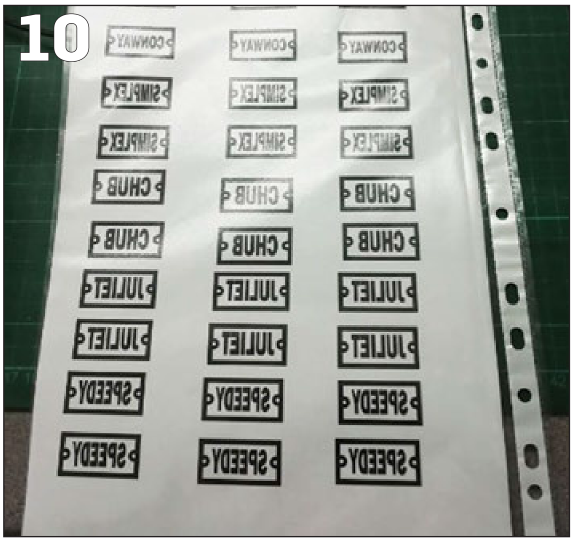
The plastic tub I used came filled with mixed nuts at Christmas but was ideal for what I needed. Sketch 1 shows the setup.

First you fill the tub with water and mix in the salt until a fully saturated solution is obtained. Heating the solution in a pan can speed up the process but I didn't bother. Pure or rock salt is the best to ▶

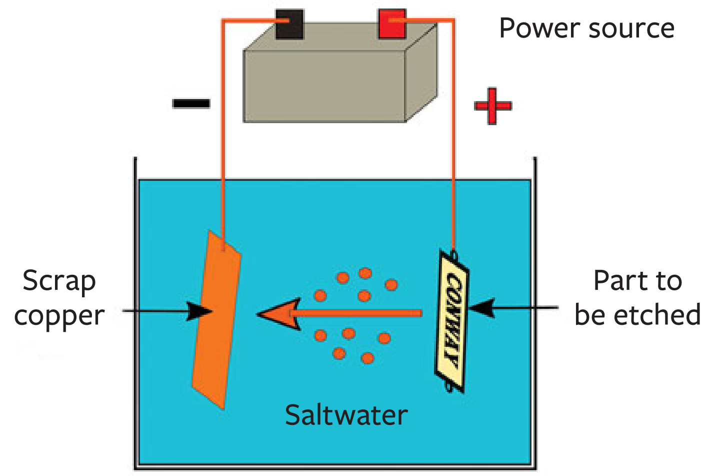








SKETCH 1



SKETCH 1: Setup for electro-etching.

PHOTO 8: First effort, a box lid.

PHOTO 9: Friend produced better version using CNC!

PHOTO 10: Laser-printed name sheet.

PHOTO 11: Image ironed onto brass.

PHOTO 12: Complete Conway plate.

PHOTO 13: Nameplates painted red.

use as some table and cooking salts also contain other chemicals. It's also recommended that you use de-ionised water, the sort you top up your car battery with or use in a steam iron. For my experiments I used tap water which worked perfectly.

Design for etching

The etching process, unlike plating, removes metal from the part so we have to protect the parts we want to keep and expose the parts we want to remove. Now it all depends on how artistic you are (I'm not) as to how you achieve this.

Simply blacking out the part with a marker pen will work – Photo 8 shows a lid I made using the freehand method, you can see that my artistic skills are quite poor. So much so that my mate Julian took pity on me and made me a new one on his CNC machine, (Photo 9).

Another method is to apply vinyl tape (electrical insulation tape) and cut out the desired design with a craft knife. This was still not an option for me, I neither have the skill nor the patience to try it.

A further method I came across is to use a laser printer to print out the design and transfer it to the part to be etched. Now here was a possibility – I don't own a laser printer but we do have one at work. Note that inkjet printers won't work.

So the first thing to do then is draw the design. My design was fairly simple, the word CONWAY in a black surround. But between us Julian and I have a few locos on the drawing board so I filled the sheet with the various names. They must of course be a mirror image so that when they are transferred to the part they come out the right way round.

I printed out the designs on

normal printer paper for the trial but I think photo paper would be better and also print on a higher resolution (Photo 10). There is also some paper you can buy for ironing the image onto T-shirts that might work.

At the time of writing this article we were on lockdown because of the coronavirus so I couldn't get out to do any further prints but it might be worth pursuing this method further.

To transfer the print the brass must first be cleaned – wire wool or fine Wet and Dry paper works well. Cut out one of the designs, wet the brass with water, lay on the design and with a hot iron press it. If needs be, wet the design again and re iron. When it has cooled wet again and rub the paper off with a finger. If all has gone well the design will be left on the brass. Photo 11 shows the two Simplex name plates – any odd little bits can be touched in with a marker pen.

The back and edges must also be protected to prevent them from being etched away. I used black insulation tape on the back and a marker pen around the edges.

Etching process

Now suspend a bit of scrap copper in the saltwater with copper wire. Incidentally I stripped the copper wire out of some domestic wire offcuts as it's nice and thick.

Next suspend the part to be etched in the saltwater. The name plates I was experimenting with needed two holes drilling so these were the ideal place to attach the wire. Another method is to soft solder a wire to the back of the part and then remove it after the etching process. Twist a good thickness of wire to the part to be etched because the wire itself will also be etched away.

Connect the negative lead to the bit of scrap copper and the positive lead to the part to be etched and turn on the power supply, about 3 volts to start with. Very quickly you should see bubbling appear around the bit of scrap copper.

Some experimentation will be required now. How deep you want the part to be etched will depend somewhat on the size of the part, the concentration of salt and the voltage used. I checked the progress every ten or 15 minutes and in total it took about one hour to achieve the result seen in Photo 12.

The solution turns a brown colour while in use and after use the sediment sinks to the bottom and the solution clears. This solution can be reused many times.

After a good clean and scrub I spray painted the name plates red and after the paint had thoroughly hardened I gave them a rub on some fine Wet and Dry, Photo 13. They were not perfect by any means but not too bad either.

"Between us Julian and I have a few locos on the drawing board so I filled the sheet with the various names..."

Laser-cut letters

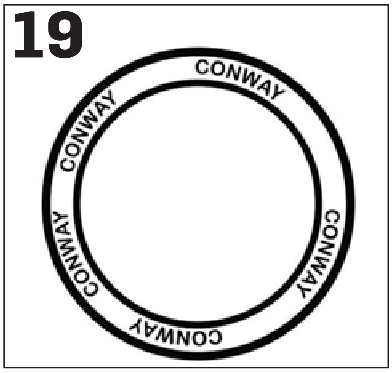
I mentioned earlier that because of the current lockdown I couldn't get out to do further prints on different types of paper and at different resolutions to see if the quality could be improved, something I will try at a later date. What I did have, however, was a sheet of peel off and stick on letters (Photo 14). These are the type that are laser cut and do not have a surround or backing. They are 13mm high and cost about £1.50 per sheet.

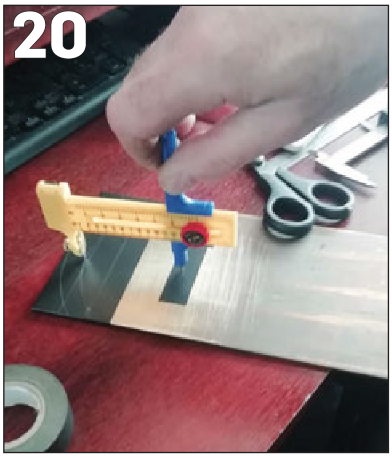
With the previous nameplates I etched I cut the brass to size first but this time I decided to use a larger piece and cut to size after etching, allowing more room for my clumsy digits to operate in. I used a straight edge clamped to the brass then applied ▶

PHOTO 14: Laser-cut stick-on letters proved useful to etch experiments.

PHOTO 15: Letters were applied to brass plate.

PHOTO 16: Other areas masked with insulation tape to protect from etch process.





a strip of masking tape to give a guide to position the letters (Photo 15). Then I applied the insulation tape to make a border and then covered the back and sides with insulation tape (Photo 16).

After about an hour in the solution the etching was deep enough, about .017-inch (.45mm for my metric friends). A short video of the etching process underway can be found at https://youtu.be/etf0wFFwvpE

The tape and letters were removed to reveal a near-enough perfect result (Photo 17). This was just a test piece and at 3½-inch x 1-inch is obviously too big for Conway but flushed with success I went on that well-known auction website, found letters in sizes ranging from 2mm up to 10mm and ordered some (Photo 18).

Feeling ambitious I drew out a design that looked to be about the right size and nicely curved (Photo 19). The dimensions looked about right so the next step was to get it onto some 3mm brass.

The brass was firstly cleaned then electrical insulation tape was applied to an area big enough to produce two name plates. A circle cutter set and two arcs cut into the tape, (Photo 20), which was then removed (Photo 21). Then I made a trial fit of the paper templates to make sure there was enough room for the 8mm letters (Photo 22).

Applying the letters requires a little patience, tweezers helped, but they were applied by eye with reasonable accuracy (Photo 23). The brass was cut to size and then the back and edges covered in insulation tape.

Out in the workshop the etching kit was set up. Unfortunately the brass was too big to fit in my pot so I had to do one end at a time. Each end was etched for an hour then inspected. In total each end had about two and a half hours (Photo 24).

PHOTO 17: The nameplate after etching.

PHOTO 18: Search online produced plenty of stick-on letters.

PHOTO 19: Curved design template for naemplates.

PHOTO 20: Arcs produced by means of circle cutter.

PHOTO 21: Tape removed, design revealed.

PHOTO 22: Testing the fit of the letters.

PHOTO 23: The stick-on letters applied.

PHOTO 24: Brass plate after etching.

PHOTO 25: Etched brass set up on the rotary table...

PHOTO 26: ...and final nameplates cut out of brass.

Cutting the plates

The brass now needs to be cut. To do this I set up my 11-inch rotary table, which I described the construction of in the January 2020 edition of EIM. Use a centre in the quill and bring it down into the centre of the table then bolt it down.

I have digital readouts on the mill so they were zeroed. The process is to move the X axis over by the required amount and lock the table. Position the brass plate on the rotary table and bring the quill down to not quite touching. By swinging the table back and forth and watching the point of the centre it's fairly easy to line everything up quite accurately by eye. Once set screw the brass plate to the table (Photo 25).

With a 3mm cutter taking light cuts swing the table back and forth by hand until it is almost through. A

short video of this can be seen at https://youtu.be/zicvKfYhBes Move the X axis again to cut the other side right through then go back to complete the first cut **(Photo 26)**.

Peel off all the tape and letters and give the plate a light rub on some fine Wet and Dry. The two name plates are then separated and cleaned up. I drilled each plate in the back to a depth of 2.5mm and tapped 6BA. I had some 6BA brass screws which I cut down to make studs.

After a final clean up I spray painted the nameplates firstly with etching primer then black gloss. When the paint had thoroughly hardened it was back on the Wet and Dry with plenty of water **(heading photo)**. Very pretty I think...

"Feeling ambitious I drew out a design that looked to be about the right size and nicely curved..."

Well that's it for my etching experiment – quite successful and I'm sure I will use the process many times in the future. I hope you have found my trials and scribblings interesting and of some use to whatever branch of model engineering you are into. If you do have a go at any of the processes I've described in the past four months do drop a line to the magazine, show what you have done and any improvements you have made. EIM

■ Previous parts of this series appeared in the August to September 2020 issues of EIM, describing in turn zinc, nickel and copper plating. To download digital back issues or order printed versions go to www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or call 01778 392484.

PHOTO EXTRA

■ This superb picture comes from Tim Gregson and shows a very rare event in 2020, a railway Gala! In this case it was a mini Gala at the 10¼-inch gauge Hastings Miniature Railway on 26th September. Bullock 4-6-2 'The Empress', built in 1933 and visiting from the Eastleigh Lakeside Railway, is pictured pulling the first trains of the day out of Rock-a-Nore station, with the Sussex seafront town's 5ft gauge East Hill Cliff Railway in the background. With the clearly glorious weather this looks as if it was a lovely day out...

Inside the Smokebox

Mike offers his views on front-end factors that can provide an important element of a locomotive's efficiency.

BY **MIKE BODDY**

I have recently heard several people asking questions about the front end of a locomotive. The front end or smokebox of the engine is an important part of how well that engine will perform, and with the following explanations I hope to provide a basic understanding and concept of the design criteria for the size of the blast nozzle and the choke point.

There are several details that need to be understood before the blast nozzle and choke can be looked at. Over the years there have been several articles written about this subject, each highlighting the formulas needed to calculate the size and positions of said blast nozzle and choke point.

Let us start with the blast nozzle. This allows the exhausted steam from the cylinders to blast up the chimney and to create a vacuum within the smokebox. This vacuum draws the heat from the fire through the fire tubes in the boiler, heating the water. If there is not enough vacuum the fire will go out and you will run out of steam very quickly, whereas too much vacuum will draw ash into the smokebox, choking up the system.

Sizing the blast nozzle

In 1922 the noted designer of miniature locomotives Henry Greenly came up with a formula to optimize the blast nozzle orifice. Table 1 shows a list of variously sized cylinders mounted on two-, three- and four-cylinder engines. I have optimized the scale factors shown in colour at the bottom. To check your nozzle size, divide the diameter of the cylinder by the appropriate average scale factor. This will now give you your optimum nozzle orifice size.

Sizing the Choke

Next, you need to establish the diameter of the choke point – the point in the chimney where the blast from the nozzle will be focused at its greatest efficiency.

To explain what the choke point does, you must first consider the steam that is blasting out of the blast nozzle. In thermodynamics superheated or supersaturated steam though an orifice has an expansion rate of 1.30 and if steam though the nozzle is within the critical pressure ratio the flow will not change.

Critical pressure ratio is the differential of the pressure into the nozzle (1) as compared to out of nozzle (2). To calculate the ratio, divide 2 by 1. Consider the blower nozzle to be like a pressure regulator; variable pressure in gives a constant pressure out.

To size the choke diameter, while in full-size engines the choke point diameter is approximately 1/20th of the grate area, noted model engineer Jim Ewins came up with a formula to size the choke for model engines; D = 0.25 * square root of the grate area. This is important – as explained above, the exhaust leaving the blast nozzle expands as it blasts up toward the petticoat (*the flared-out base of the chimney, Ed*) to an angle of between 16 and 24 degrees inclusive or 1:3. The blast must be concentrated to fill the choke point so it will create a strong vacuum in the smokebox.

Blast nozzle positioning

So now that we understand that the steam from the blast nozzle has an expansion rate of 1:3 we must consequently find a position for the blast nozzle. To do this, we must go to the top of the chimney or the chimney casting. This casting is a set height and will be the finished height of the chimney on top of the smokebox.

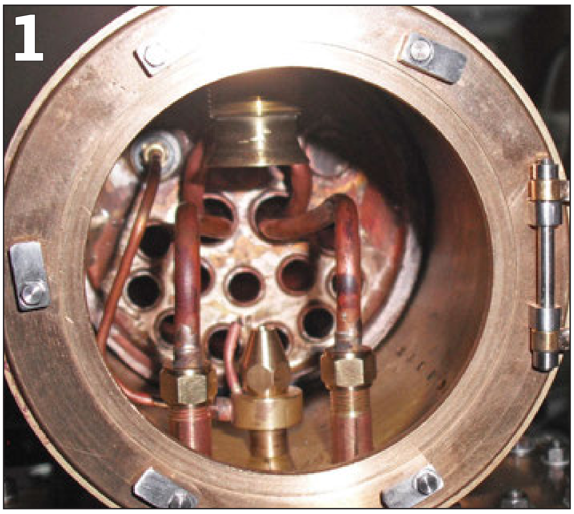

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TABLE 1 — Single Blast Pipe Orifices — Date: 11/07/2020

Size	Cylinder Diameter.	2 Cylinder Nozzle	Size in Fractions	3 Cylinder Nozzle	Size in Fractions	4 Cylinder Nozzle	Size in Fractions	2 Cyl. Scale Factor	3 Cyl. Scale Factor	4 Cyl. Scale Factor
1	1/2	0.094 Ins	3/32					5.333		
2	5/8	0.117 Ins	7/64					5.342		
3	3/4	0.141 Ins	9/64	0.172 Ins	11/64			5.333	4.364	
4	7/8	0.161 Ins	5/32	0.188 Ins	3/16	0.218 Ins	13/64	5.419	4.667	
5	1	0.185 Ins	11/64	0.219 Ins	7/32	0.250 Ins	1/4	5.408	4.571	4.000
6	1 - 1/8	0.208 Ins	13/64	0.240 Ins	15/64	0.282 Ins	9/32	5.400	4.696	3.996
7	1 - 1/4	0.219 Ins	7/32	0.263 Ins	1/4	0.313 Ins	5/16	5.714	4.752	4.000
8	1 - 3/8	0.238 Ins	15/64	0.286 Ins	9/32	0.343 Ins	21/64	5.781	4.800	4.009
9	1 - 1/2	0.266 Ins	17/64	0.313 Ins	5/16	0.344 Ins	11/32	5.647	4.800	4.364
10	1 - 5/8	0.282 Ins	9/32	0.344 Ins	11/32	0.375 Ins	3/8	5.773	4.727	4.333
11	1 - 3/4	0.297 Ins	19/64	0.371 Ins	23/64	0.406 Ins	13/32	5.895	4.717	4.308
12	1 - 7/8	0.323 Ins	5/16	0.383 Ins	3/8	0.438 Ins	7/16	5.806	4.896	4.286
13	2	0.344 Ins	11/32	0.422 Ins	27/64	0.484 Ins	31/64	5.818	4.741	4.129
14	2 - 1/8	0.368 Ins	23/64	0.443 Ins	7/16	0.521 Ins	33/64	5.774	4.799	4.080
15	2 - 1/4	0.380 Ins	3/8	0.469 Ins	15/32	0.552 Ins	35/64	5.918	4.800	4.075
16	2 - 3/8	0.392 Ins	25/64	0.495 Ins	31/64	0.583 Ins	37/64	6.053	4.801	4.071
17	2 - 1/2	0.422 Ins	27/64	0.516 Ins	33/64	0.594 Ins	19/32	5.926	4.848	4.211
18	2 - 5/8	0.440 Ins	7/16	0.540 Ins	17/32	0.618 Ins	39/64	5.968	4.862	4.247
19	2 - 3/4	0.464 Ins	29/64	0.563 Ins	9/16	0.635 Ins	5/8	5.933	4.889	4.328
20	2 - 7/8	0.483 Ins	15/32	0.586 Ins	37/64	0.657 Ins	21/32	5.947	4.904	4.373
21	3	0.505 Ins	1/2	0.609 Ins	39/64	0.700 Ins	11/16	5.938	4.923	4.286
							Average	5.720	4.766	4.182

PHOTO 1: Smokebox on Mike's 2½-inch gauge Fayette – adjusted to the 1:6/1:3 ratios, it steams perfectly.

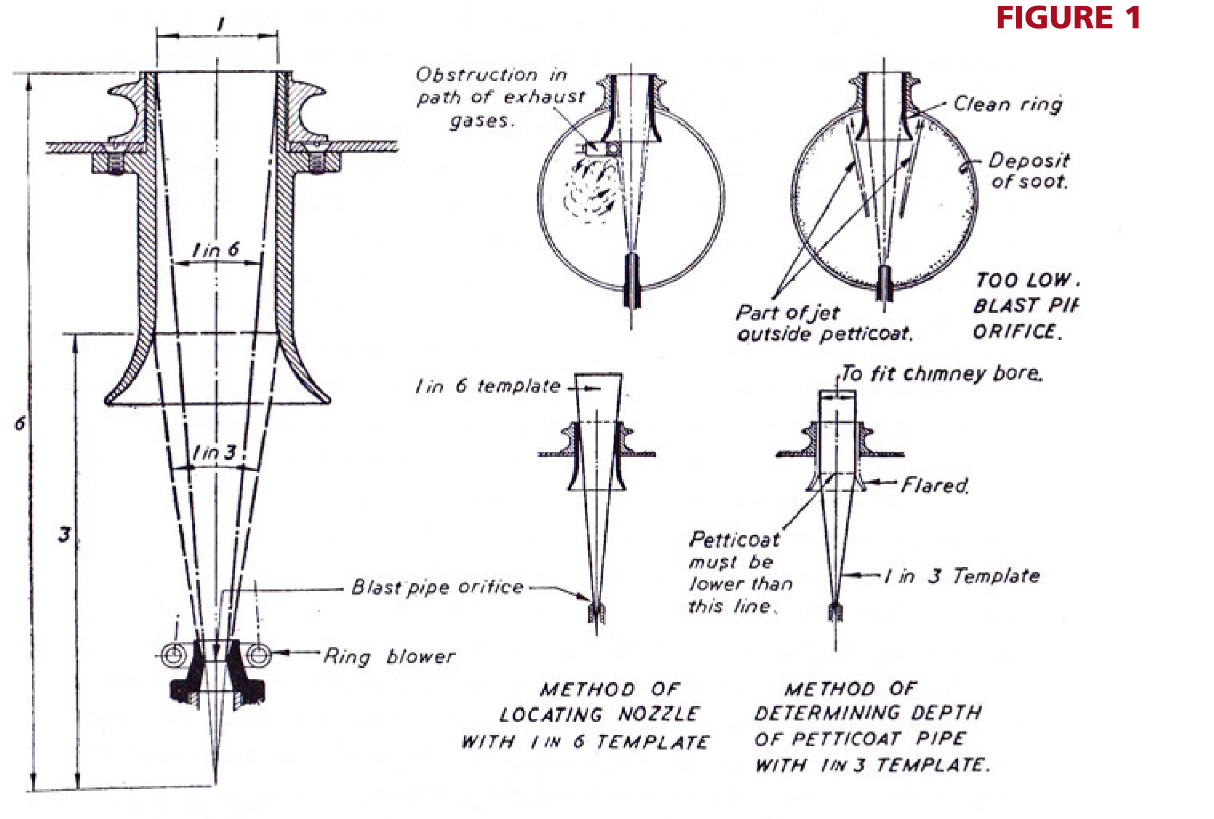
PHOTO 2: Issues such as this are likely to be, Mike believes, due to incorrect positioning of the blast nozzle and of the petticoat/choke.

TABLE 1: Formula to optimise size of blast nozzle orifice, created originally by Henry Greenly.

FIGURE 1/2: Greenly's 1:6 and 1:3 ratios visualised.

All photos and diagrams in this feature by the author unless stated

FIGURE 1



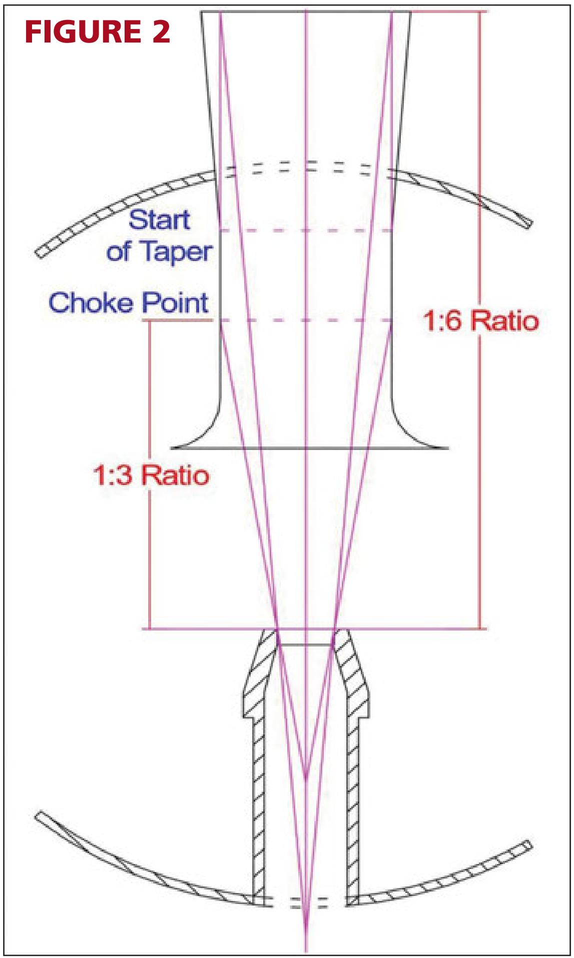
There are two types of chimneys: a) those of a constant diameter from top to bottom and b) a chimney with a tapered bore. A tapered chimney works better than a parallel one as it has a venturi effect at the top of the chimney, increasing gas flow which helps to increase the vacuum.

This is where the 1:6 ratio is used. To find the position of the blast nozzle you need to make a 1:6 wedge to the following specification.

You first take the calculation for the diameter of the choke and multiply it by 6, then you make a wedge to this size and place it in the blast nozzle through the chimney. The top of the wedge should be flush with the top of the chimney – if not, you will need to adjust the position of the blast nozzle accordingly.

Next you make a second wedge using the choke diameter and multiply it by 3 to create the 1:3 wedge. You now replace the 1:6 wedge with the 1:3 wedge. The top of the 1:3 wedge will indicate the position of your choke point. Note that the choke point position may vary from the start of the parallel section to approximately halfway up the chimney. Note too that with a tapered chimney, the taper must start after the point where the 1:3 meets the inside of the chimney. Figure 1 shows Greenly's detail of the 1:3 and 1:6 ratios, expanded in Figure 2.

FIGURE 2



Smokebox vacuum

There are other factors you need to consider as well. Is the smokebox fully sealed and are there no air leaks? To check for air leaks, you can use a manometer – a clear plastic tube approximately ⅜th inch in diameter half filled with water attached to a board in a U-shape.

The tube attached to the board needs to be approximately 500mm long and the water lever around 300mm from the bottom of the U. One end of the tube is open to atmosphere, the other end is attached to the smokebox – I suggest you make a dummy smokebox door, to allow the attachment of the manometer pipe to the smokebox.

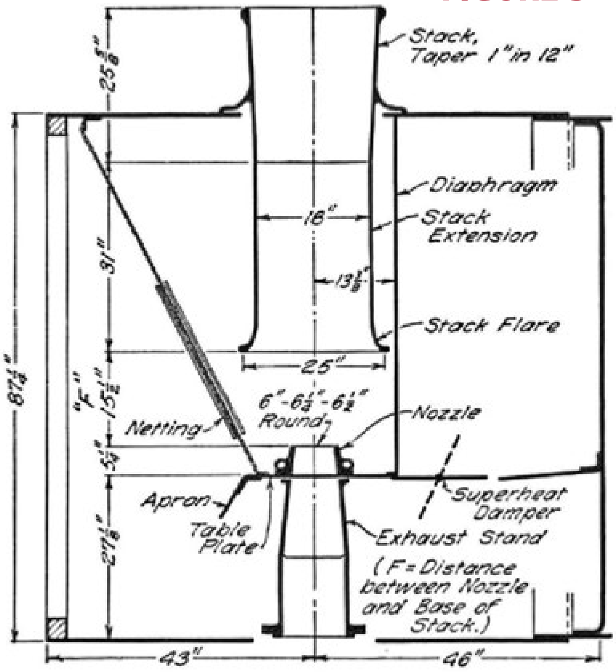
First take note of the water level in the tube – both sides should be even. Then using compressed air in the boiler, open the blower valve and check the water level in the manometer. Note the change in the water level, it should have a differential from ¼-inch to ½-inch or more, this should give indicate a vacuum when the engine is running.

Blower jets

This process is unfortunately not as straightforward as you would think, as the position and size of the blower jets will also affect the vacuum. To optimize the vacuum, you may need to adjust the blower until you have a good vacuum reading shown on the manometer. Photo 3 shows a typical blast nozzle with four blower jets.

Figure 3 shows that the parallel section goes up 31 inches and then it tapers at 1 in 12 inches to the top of the chimney. Figure 4 is the same chimney but it has the 1:3 and 1:6 ratios projected onto it. The position of the nozzle is adjusted to the intersection point between the two ratios. I have checked several engines, both full size and scaled size, and ▶

FIGURE 3



they all appear to use these ratios for the blast nozzle and choke point.

Tall chimneys

Focusing on tall chimneys such as used by the Stirling Single locomotive, the 1:3 ratio choke point has been put up into the bottom section of the chimney but the 1:3 ratio to the blast nozzle is still maintained (**Figure 5**). The 1:6 ratio is then positioned from the blast nozzle up into the parallel section of the chimney and then at that point it is tapered up at around 2 to 4 degrees to the top of the chimney. The calculations for the blast nozzle and choke point are still the same as for the shorter-style chimney.

So in conclusion, the 1:3 and 1:6 ratios are designed to optimise the efficiency of the smokebox and provide a good vacuum to draw the heat from the fire through the boiler tubes, a process that maintains a reliable head of steam while the locomotive is running. EIM

"There are other factors you need to consider as well. Is the smokebox fully sealed and are there no air leaks?..."

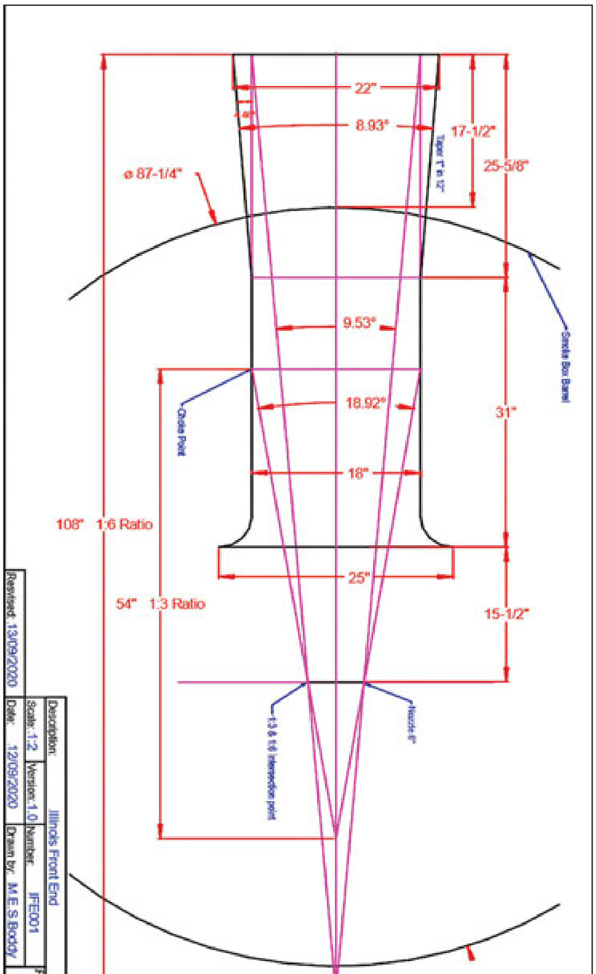


FIGURE 4

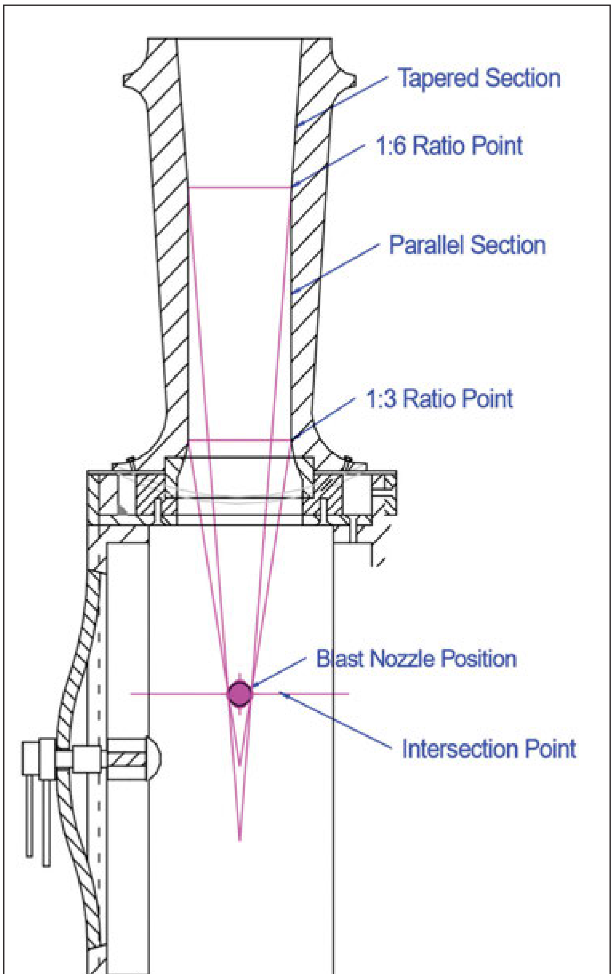


FIGURE 5

PHOTO 3: Typical loco blast nozzle, with four blower jets clearly visible.

FIGURE 3: Arrangement with chimney section which starts off parallel but then tapers outwards.

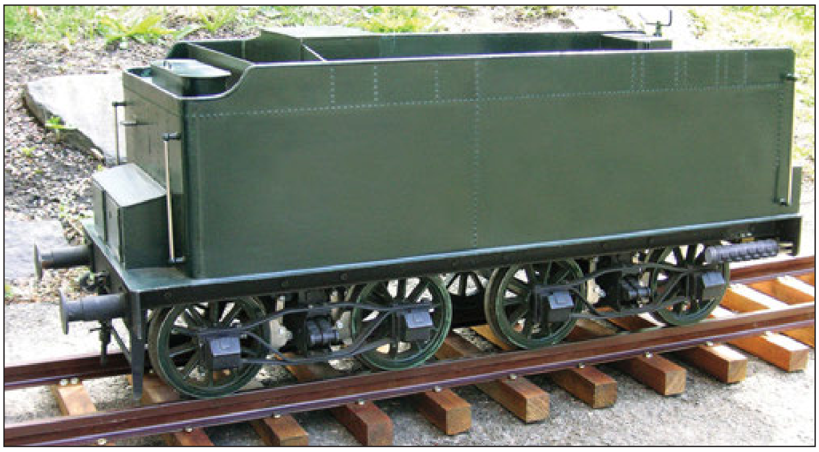
FIGURE 4: Same chimney with the 1:3 and 1:6 ratios projected on it.

FIGURE 5: The ratios applied to a locomotive with a tall chimney.

Building a Ten-Wheeler

Somewhere to sit occupies Jan-Eric in his 7¼-inch gauge loco project this month.

BY **JAN-ERIC NYSTRÖM** Part Ten of a series



A 4-6-0 locomotive needs a tender, unlike the little 0-6-0 tank engine I've been running for the last few years, sitting on an ugly 'driver's car', containing the propane tank. The Ten-wheeler's tender, seen completed in the lead photo, is eminently suitable for sitting on, provided a simple seat is added on top.

There is no provision for storing propane in the tender, so a special car is needed for carrying the fuel – that car was described in the article *More Convertible Rolling Stock* in the June 2017 issue of EIM.

I was able to acquire a copy of the original factory drawing of the prototype ten-wheeler's tender, Figure 33, archived at the Finnish Railway museum. This drawing gave me all the necessary dimensions, which were scaled down to one-eighth, for 7¼-inch gauge.

Constructing the tank

The tank is made of 2mm thick stainless-steel plate and has a capacity of 35 litres. This tank was CAD designed and constructed with the tab-and-hole method described in the first instalment of this article series, but all the seams had to be welded in order to make it watertight. Since the tank is of a rather complicated shape, I first made a cardboard mock-up, Photo 112, to ensure that all parts would fit, and that I had not forgotten any, before taking the CAD files to the laser-cutting company.

Here again, my little TIG-welding unit proved to be invaluable. Stainless steel, which has a reputation of being difficult to weld, actually seemed to be easier than ordinary steel – for a while, at least... The tabs fused very nicely into their holes, leaving an almost totally flat surface, as seen in Photo 113. I was even able to make the ▶

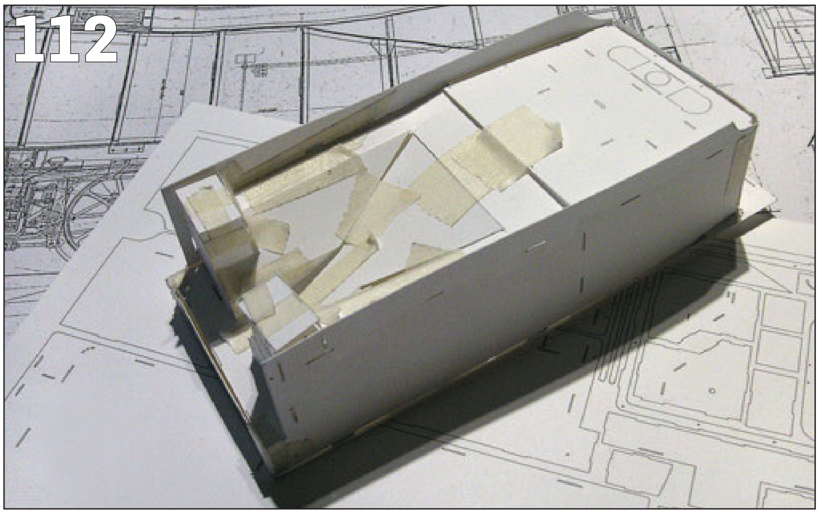


PHOTO 112: Cardboard mock-up of tender tank.

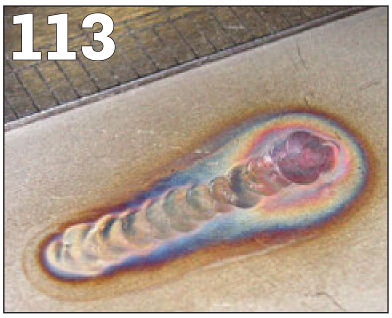


PHOTO 113: A tab fused into its hole by the TIG arc. No filler is used.

FIGURE 33

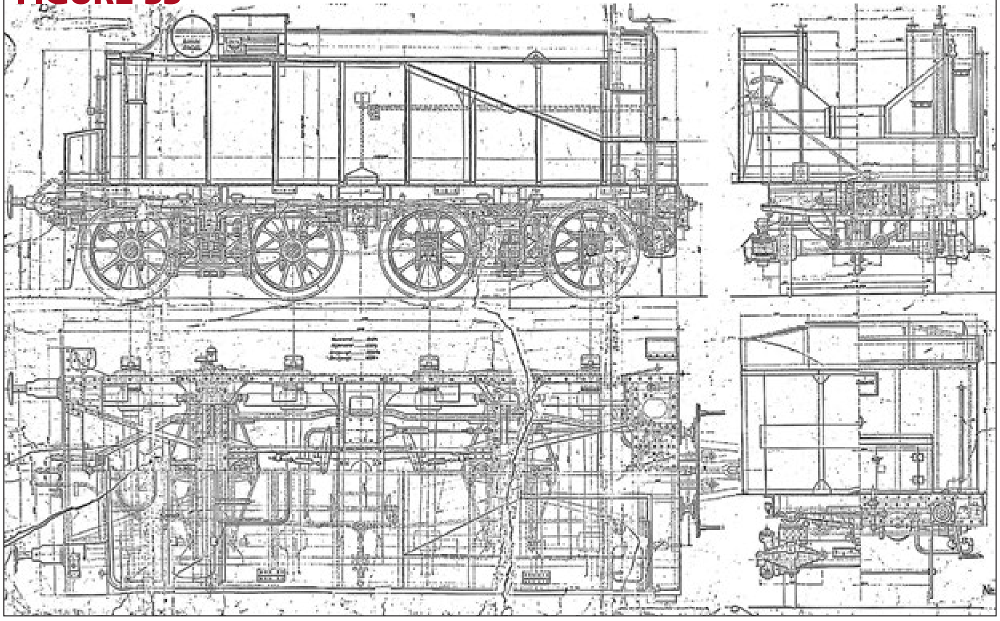
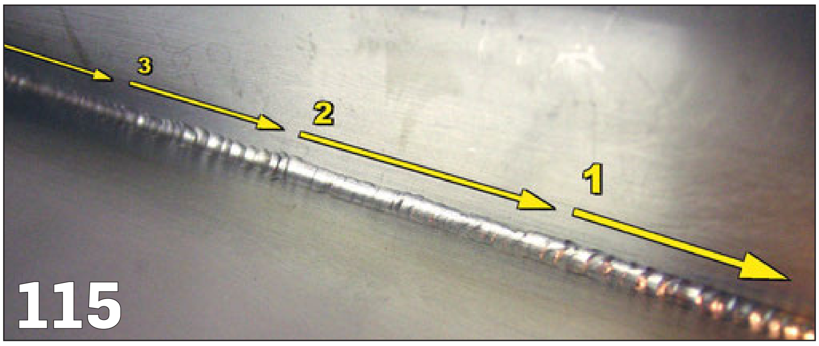
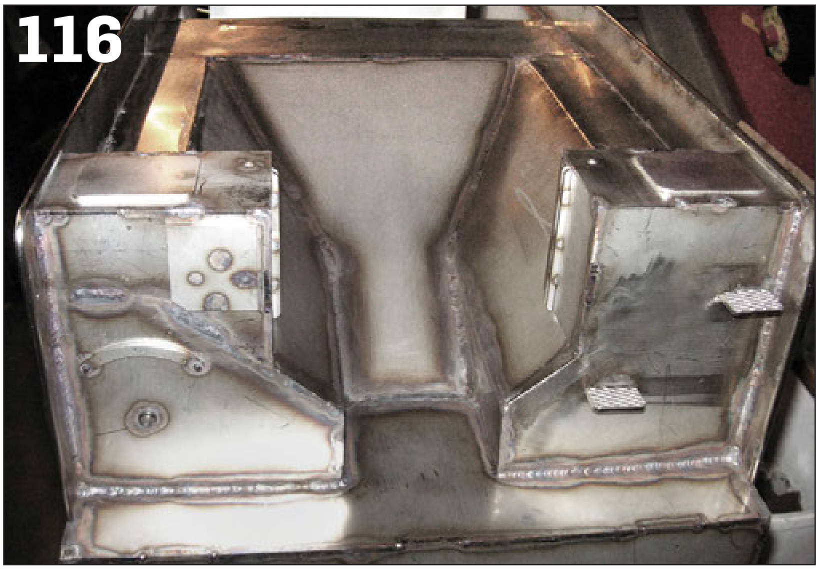


FIGURE 33: Original works drawing by Schwartzkopff, Berlin, 1921.

All photos and drawings in this feature by the author unless stated





round corners of the tender tank by welding in a 90-degree section cut from a stainless tube. In Photo 114, this piece is tack-welded to the flat plates of the tender.

The problems started when I began to weld the longer seams. Since stainless steel deforms when heated, much more so than ordinary steel, the sides of the tender tank showed a tendency to buckle. I had tacked the parts together at intervals of only a few inches, but still, the plates had a life of their own.

I did manage to minimize the problem by using the 'back-step' method of welding a long seam, shown in Photo 115. I started at position 1, welded a few centimetres towards the right, and then stepped back to position 2. From there, I welded towards the right again, until I reached position 1. Continuing like this, I made the whole weld in small steps.

The advantage of this method is that you 'lock' the plates in position 1 with the first step of the weld, and since you only proceed a couple of centimetres, the plates will not deform very much. Continuing from point 2, you again lock the plates together, and no movement can happen when you continue the weld toward position 1. (Note that I'm left-handed – a right-handed builder may feel more comfortable doing the welding in the opposite direction, but the principle is the same).

PHOTO 114: Round corner of the tank is a piece cut from stainless steel tubing.

PHOTO 115: Principle of 'back-step' welding joint.

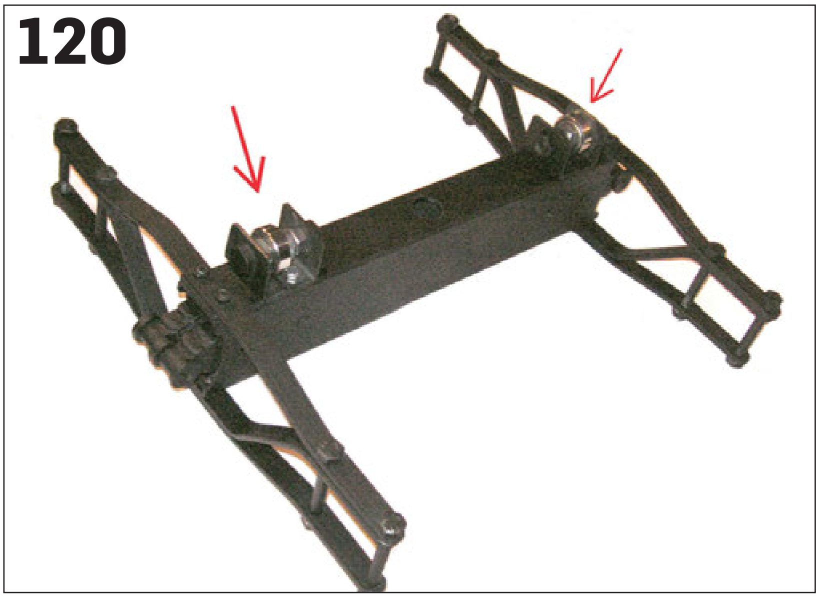
PHOTO 116: Welds on tender tank before painting.

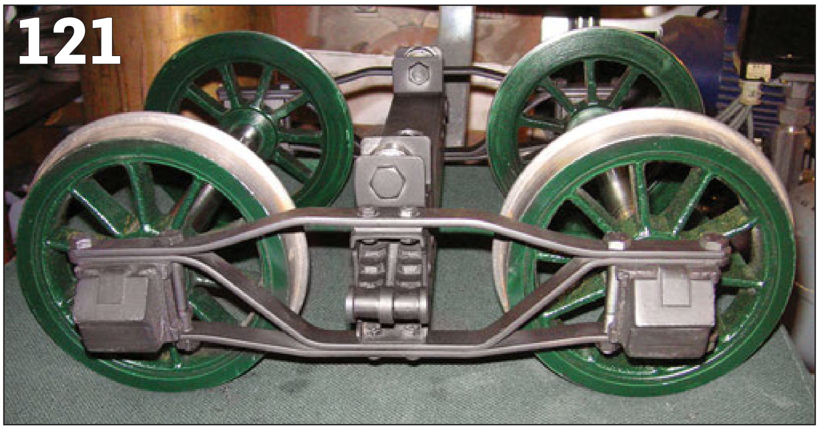
PHOTO 117: Tank on the tender frame.

PHOTO 118: Leather punch used to make fake rivet heads from 'iron-on' melamine strip.

Before starting on the tank, I had made a test with 400mm long, surplus strips of this 2mm thick, hard stainless plate, welding continuously from one end to the other – a disaster! The plate distorted by several millimetres at the seam, and was severely twisted. Fortunately, I became aware of the back-step method before attempting to weld the tender tank itself! Still, there is one obvious buckle on one side of the tank, which is impossible to correct. I console myself with the fact that the sides of the real, full-size tenders were nowhere near flat, either!

Overall, as Photo 116 shows, my welds turned out well enough – considering that this was the first stainless job I've ever welded. Since the tender tank will be painted, the slight irregularity in the seams will be covered up.





In Photo 117, you see the rear end of the unpainted tank, after the welds on the side and in the rounded rear corners have been cleaned up with an angle grinder. The aforementioned buckle, only about a couple of mm deep but almost 200mm wide, can be seen to the right of the two short welds in the middle of the tank side.

A final little trick to share with you – fake rivets! Since the full-size tender tanks were riveted, I needed a way to simulate that but drilling holes into the welded tank didn't appeal to me! Using a leather punch, I made hundreds of little fake rivet heads from 'iron-on' melamine strip, of the type used on edges of shelves made from chipboard, Photo 118.

This material has a heat-sensitive adhesive on the back, which made it easy to attach the 'rivets' onto the tender: I heated the tank with a small propane flame, until it was hot enough to melt the glue. Then it was a simple job to place the little melamine 'spots' onto a scribed line at regular intervals, using tweezers, Photo 119. Once the tender tank is painted, no one will notice the difference – at least from a few feet away!

Building the bogies

The tender has a pair of two-axle bogies. Ball bearings attached to the bogie bolsters, at the arrows in Photo 120, ensure frictionless rotation of the bogies around their kingpins. The bogie frame is very simply constructed of narrow flat iron strips bent to shape. A rectangular steel tube functions as bolster. A hole drilled in the tube accommodates the king pin, a piece of 16mm axle steel which is firmly attached to the tender frame.

Photo 121 shows one completed arch-bar bogie, with the cast-iron axleboxes held in place with two M6 bolts each. A fake leaf spring protrudes from the rectangular tube. This fake, made of cast iron, has no function, it is purely cosmetic.

The construction of the tender frame can be seen in Photo 122. Rectangular tubing is used throughout; the 'channel' frame sides are made from such a tube split in half! Short pieces of angle iron are used to bolt the pieces together and 25mm thick Delrin 'washers' are situated between the frame and the bogies. This plastic material is very slippery, thus suitable for thrust bearings, but Nylon or Teflon could also be used.

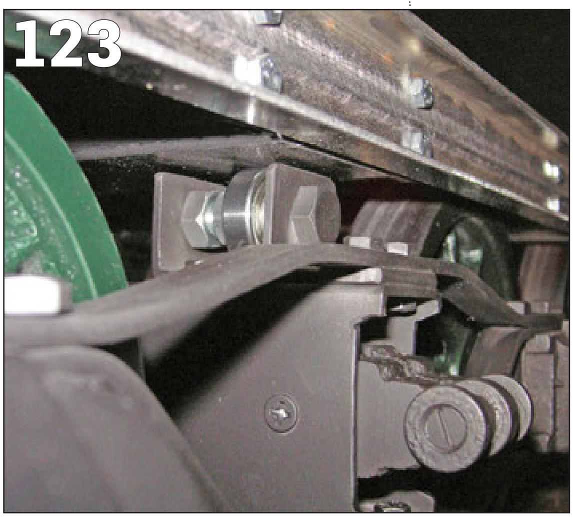
PHOTO 119: The circlets immediately stick to the heated metal.

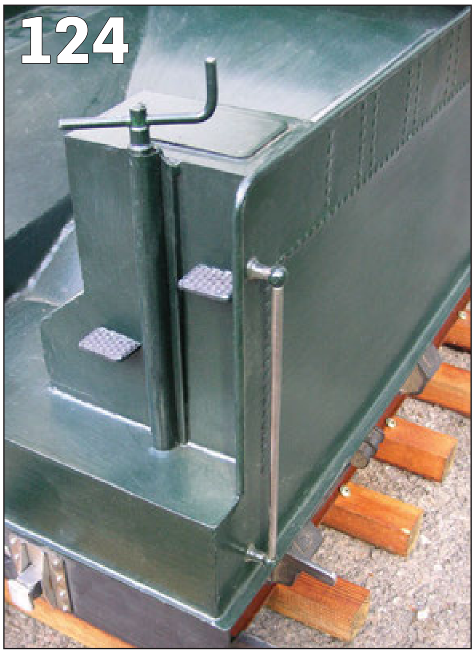
PHOTO 120: Arch-bar bogie bolster. Arrows point to the ball bearings.

PHOTO 121: A completed arch bar bogie.

PHOTO 122: Rectangular tubing used to build the tender frame.

PHOTO 123: Ball bearings allow bogie to rotate freely.

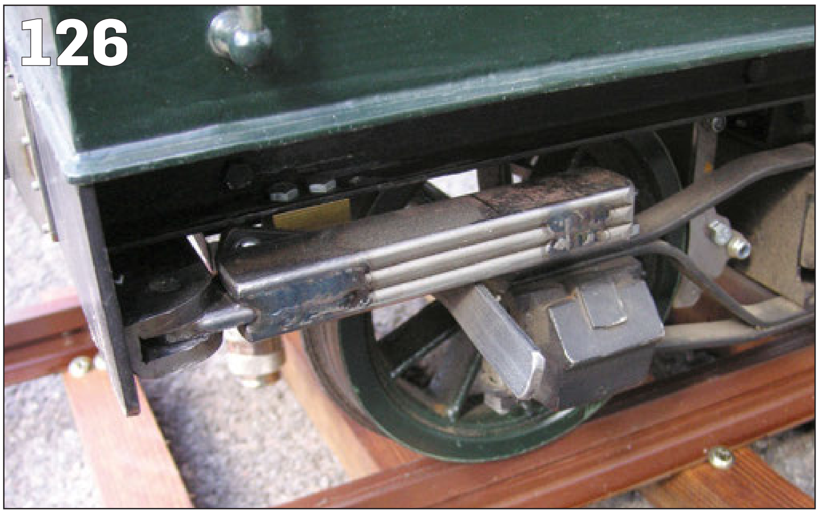




It is important that the bogies can rotate freely, otherwise the tender might derail when it enters a curve. The aforementioned ball bearings also ensure this.

Note that there is no spring suspension at all in these bogies – the arch-bar frames are themselves slightly flexible. If springs were to be added, the tender might become unstable and uncomfortable, if not directly unpleasant, for the driver. (I definitely prefer a 'hard riding' tender over one that sways sideways!). One of the ball bearings is shown in Photo 123. There is a gap of about 1mm between the bearing and the tender frame, and a similar gap on the other side, at the other bearing. This gives enough flexibility to the entire system, while preventing the tender from rocking noticeably.

"Drilling 937 tiny holes in 2mm stainless-steel plate, and plugging them up again with rivets isn't my idea of a pleasant weekend..."



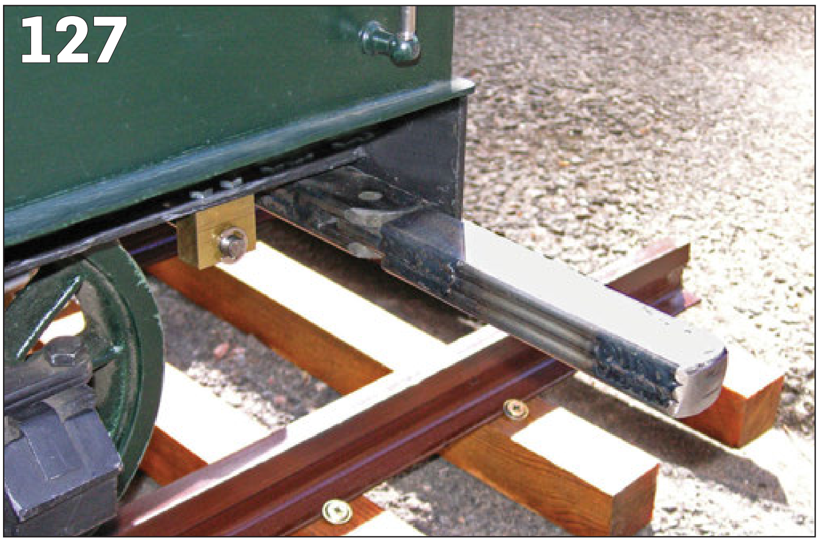


PHOTO 124: The tender brake crank.

PHOTO 125: Construction of brake system.

PHOTO 126: The foot rest folds in, and keeps the brake pedal down.

PHOTO 127: The bearing for the brake axle and the foot rest hinge.

Four-way braking

The Ten-wheeler loco does have its own brake rigging (to be described in a future instalment), actuated by a lever in the cab, but I felt that I needed a bit more brake power, which could also be applied quickly and instinctively.

The full-size tender has a screw brake, actuated by a crank (some full-size tenders had a brake wheel instead of a crank), seen in Photo 124. The axle passes through a hole in the bottom part of the water tank – but no glands are needed, since I welded in a stainless tube, going all the way through the tank!

The lower part of the axle is threaded, and it moves a large, pivoting nut up and down as it is rotated. The movement of this nut actuates the brake rigging. Also attached to the nut is a simple 'foot-brake pedal', made of a piece of flat iron, bent to a right angle. This again is welded to an axle going across the tender frame, through bearing blocks of brass – the construction can be seen in Photo 125.

This isn't perhaps the most elegant solution, but hey! – it works, and in four ways to boot: First, you can brake by pressing down your heel on the brake pedal, just like you do when riding a bicycle. This lifts the nut (and also the crank) with considerable force, and applies the brakes immediately – good in an emergency, when you need to stop quickly.

Second, you can brake gently by grabbing hold of the crank, and lifting it. Third, you can brake very firmly by screwing down the brake by turning the crank several turns. And finally, fourth, you can apply a 'parking brake' by pressing down the brake pedal and folding in the foot rest on top of it, as in Photo 126. I think it's all the tender braking I will ever need...

The foot rests are constructed in a very simple way: three layers of 5mm thick cold-rolled steel, with the middle layer a bit longer, providing a tab for a hinge. Photo 127 shows the other side of the tender, with the brake axle secured from slipping out of the brass bearing block with a simple clip ring.

The construction of the footrest hinge can also clearly be seen – there is a 3-ply, welded 'stack' of the same 5mm cold-rolled steel attached to the buffer plate, with the middle piece shorter than the others. The hinge pin is riveted in place – this provides suitable friction so that the foot rests stay in place when they are turned into their operating position. The buffer bar prevents them from folding too far forward, so they give a firm support to the driver's feet.

I have attached tubular, rubber bicycle handles to the foot rests in order to improve their appearance and provide a non-slip surface. The finished foot rests can be seen in Photo 128, as well as the quick-release water connection to the loco's feedwater line, here hanging loose in front of the tender's first axle.

Additional details

One important working detail is the water-level indicator, seen in Photo 129. The pointer is welded to a stainless rod, which passes through an O-ring gland in the front of the tank. The other end of the rod is in the middle of the tank, and has a lever with a soldered, hollow brass float attached to it. This follows full-size practice, seen in Figure 33. A quick glance at the pointer will alert the driver if the tender needs filling.

Photo 130 shows the rear of the tender tank. Most of the detailing is 'fake', only the hinged lid on top is functional, for filling the tank with water. All other hinges, rivets and small details are cut-outs made of the earlier mentioned melamine strip, glued on and painted over.

The toolbox at the rear end of the tender is also only an ornament – it is too small anyway, so I store any necessary tools in the tender coal space. 'Quick-and-dirty', for sure, but I'm not the rivet-counter type! Besides, drilling 937 (or so) tiny holes in 2mm stainless-steel plate, and plugging them up again with rivets isn't my idea of a pleasant weekend – and having all the holes pierced during the laser cutting of the plates would have cost a fortune... Others may disagree regarding my methods of detailing, and that's fine, too – there is room for all in this hobby of ours. Just don't expect me to spend 15 years, 14,000 hours, building a perfect, painstakingly detailed Decapod...

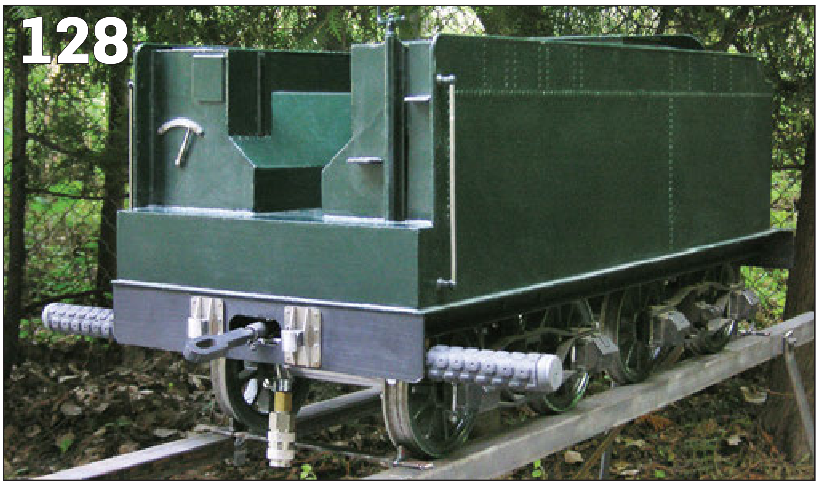
The buffers are spring loaded, and function just as the full-size ones when the hook coupler is used. The coupler follows the prototype, but when running my train with passengers, I always use drawbars for safety. I have dimensioned my drawbars so that the buffers do not make contact, even in tight curves – this prevents them from getting tangled when I run on my own, very uneven, portable lawn track.

A tender seat

In order not to acquire a tender seat myself when running the loco, I made a padded one to sit on, Photo 131. This consists of two plywood sides and a rectangular piece of wood with rounded corners, covered with thick, soft foam and imitation leather. The slots in the plywood sides mate with a vertical plate on top of the tender tank, which keeps the seat securely in place.

The completed tender, ready for the track, is shown in Photo 132. Now, all that remains in the rest of this multi-year project includes all the steam and water piping on the ten-wheeler loco, the boiler lagging, the paintwork, etcetera, etcetera, before the loco's maiden journey! EIM

■ Parts 1 to 9 of this series appeared in the February to October 2020 issues of EIM. Digital back issues can be downloaded or printed versions ordered by going to www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or calling 01778 392484.



128

PHOTO 128: Front end of tender. Note the rubber foot rests.

129

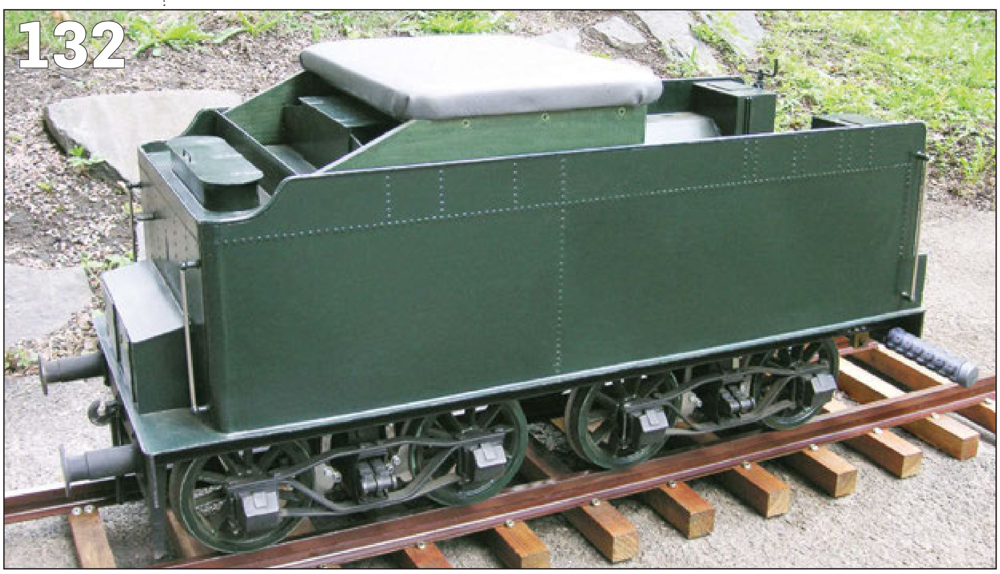
PHOTO 129: Close-up of the water level indicator.

130

PHOTO 130: Apart from the working buffers, the coupler and a hinged tank top lid, all details are cosmetic.

131

PHOTO 131: Padded seat provides a comfortable experience for the driver.



132

PHOTO 132: The completed tender with seat attached.

A coffee table – from a jet fighter...

Rugby ME member Steve likes to recycle whenever he has the opportunity – and as a result has built himself some bespoke and rather special furniture....

BY **STEVE BOUCHARD**

I have always had a fascination for things metal. It all started in the early 1960s, when we moved to a house right next to the LMS line on the north side of Leicester. The view from my bedroom window was wonderful – it was dead level with the top of the embankment, which supported four tracks, and with signals in sight. It was a spotter's paradise! Over the next seven years I witnessed the demise of steam traction, and the onset of dieselisation.

School provided very good workshop facilities, setting me up for an apprenticeship later. Fortunately, I've enjoyed continuous employment in engineering up to and beyond retirement age.

My loco spotting wasn't just number logging, as I compared all the different loco features that one saw back then. And this proved a help in my design life, as I adopted the maxim 'never work to the first idea you have, there are so many different ways to consider'. Also (to a degree) I followed the famous phrase 'if it looks right, it is right'!

Another passion I have is recycling. Nothing is discarded until the possibility of a future use has been investigated! The power bogies for my battery-powered 7¼-inch gauge battery diesel mentioned in *Club News* in the July edition of EIM are using a fair amount of material retrieved from the scrap bin. Design tweaks and concessions were made to accommodate where necessary. It certainly has made the project more interesting, whilst saving some money! I aim to provide more coverage of this project to readers as time goes on.

Out of the bin

Anyway I've been lucky enough to obtain some aviation items, again saved from 'the bin'. The following describes the new life I have given to parts salvaged during the scrapping of six English Electric Lightning jets at the RAF training airfield and college at Cranfield in Bedfordshire.

I was part of a small team in the 1990s, keeping two of the survivors in ground running order. The main task leading up to the scrapping, was to cannibalise spares for 'our' aircraft. Before the carnage began (I'll never forget the awful crunching sound), I was able to remove an access panel from a fuselage side.

I have used this panel to create an unusual coffee table. The legs are aluminium square tube, and the brackets are laser-cut stainless steel. The N2 pressure gauge, now fitted in the front leg bracket of the table, was also removed from a fuselage side of the Lightning. I believe this gauge was used to indicate the pressure held in a gas-over-oil accumulator as a back-up for a hydraulic system.

I had an English Electric plate in

1

All photos in this feature by the author unless stated.

2

The aircraft that donated its parts for Steve's furniture has not only a fascinating history in its own right but its manufacturer a provenance across many aspects of engineering.

English Electric was formed after the First World War, from the merger of five companies which during the conflict had built aircraft but also armaments and munitions.

As its name suggests, English Electric quickly became renowned for electric motors and transformers, but also produced electric railway locomotives to fit them in, as well as diesel engines and traction motors.

From the 1950s when British Railways began its modernisation that led to the end of steam, English Electric supplied almost 1000 diesel and electric engines, many of which were still working until recent times.

Two classics

The firm expanded significantly back into the aircraft market from the Second World War, initially building the Hampden and Halifax designed by Handley Page. English Electric formed an aviation division in 1958, and while it only produced two designs under its own name, the Canberra and Lightning became two of the best-known UK jets of the Cold War era.

The Lightning first flew in 1954 and went into production in 1960. Some 337 were built and the last RAF examples were not retired until 1988. The type was praised for its Mach 2 speed (twice the speed of sound) its phenomenal rate of climb and its maximum height – some pilots reputedly described flying it as "like being saddled to a skyrocket."

English Electric later also produced consumer electronics, computers, guided missiles and even nuclear reactors! All this lasted until 1960, when the firm merged with fellow plane makers Vickers and Bristol to form BAC, the British Aircraft Corporation.

Andrew Charman

"Before the carnage began (I'll never forget the awful crunching sound), I was able to remove an access panel from a fuselage side..."

PHOTO 01: The English Electric Lighting, front-line of Britain's defence in the Cold War era. This example is preserved at the RAF Museum, Cosford near Telford. *Photo: Kev Gregory/ Shutterstock*

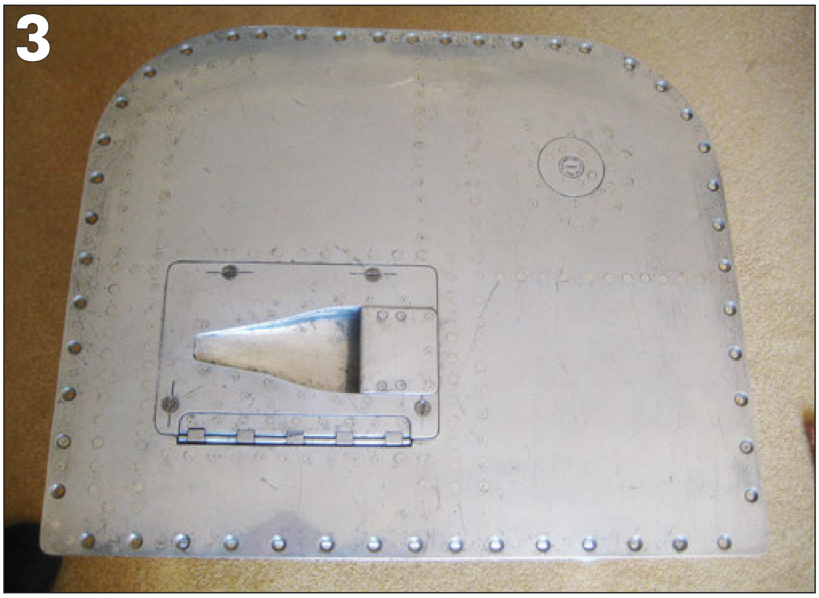
PHOTO 02: Steve's table, a real talking point.

PHOTO 03: Starting point – a fuselage panel from the Lightning jet.

PHOTO 04: Legs formed from aluminium square tube.

PHOTO 05: Pressure gauge from the aircraft adds an extra interest factor to the front leg.

3



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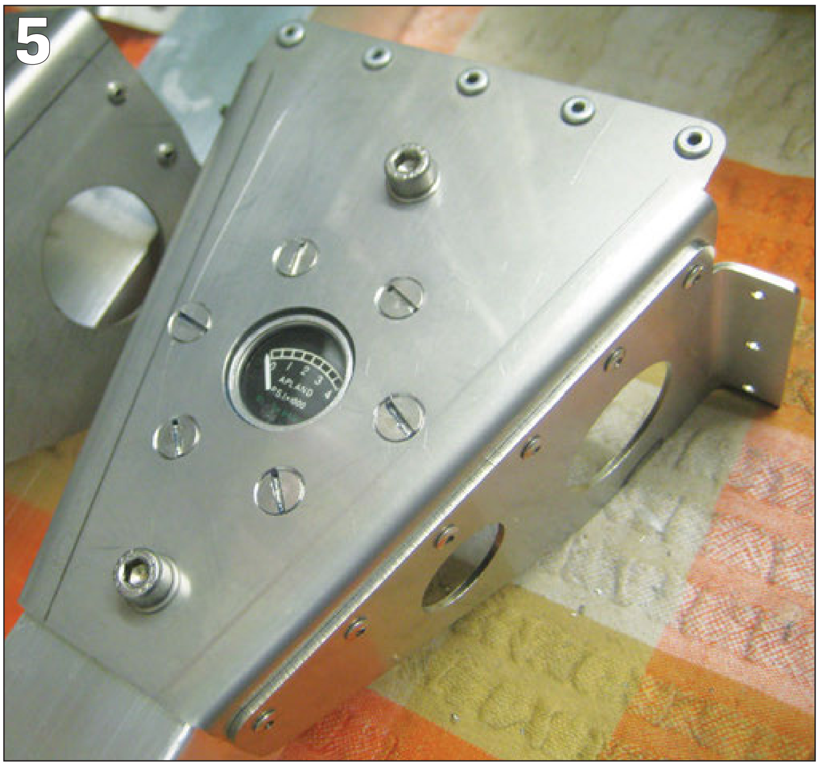


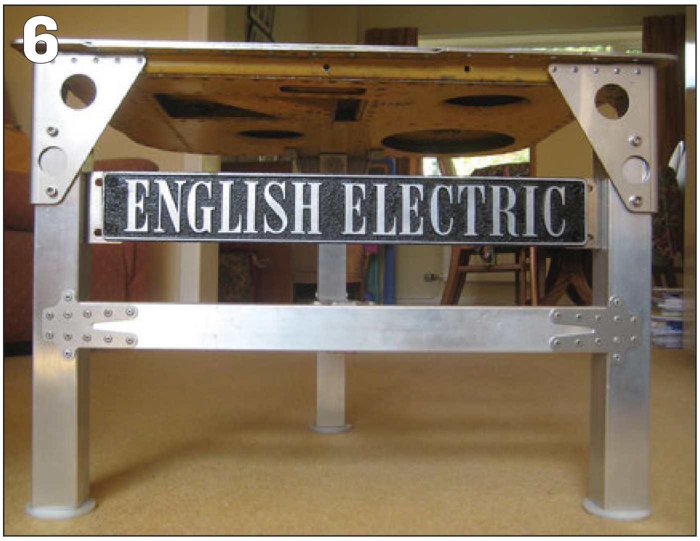


PHOTO 06: English Electric nameplate adds final touch to the table.

PHOTO 07: Navigation light from wingtip now serves as reading light .

PHOTO 08: Preserved example of UK's first jet fighter, the Gloster Meteor, in flight. Tailplane elevator used by Steve clearly visible. *Photo: G Smudger/Istock*

PHOTO 09: Starting point for office desk.

PHOTO 10: Fitting desk to useful recess.

PHOTO 11: Neatly balanced desk in use.

the loft, so I thought it appropriate to unite it with another 'EE' product.

Also during the scrapping session, a navigation light was cut from a starboard wing tip. I removed almost 1mm thickness of rock-hard paint, buffed it up, then got the light working as shown. It is now fitted above 'my' armchair in the front room. It's just a shame we no longer have the ejector seat which stood for years in the same room!

Flying a desk

Literally a tail piece to this feature, I've also shown the installation of our new office desk! It is an unused tail plane elevator from a 1952 Gloster Meteor IV (*the original Meteor being the RAF's first jet fighter – Ed*).

I drew up and had made all the mounting bracketry and end-actuating lever. These components are laser-cut stainless steel.

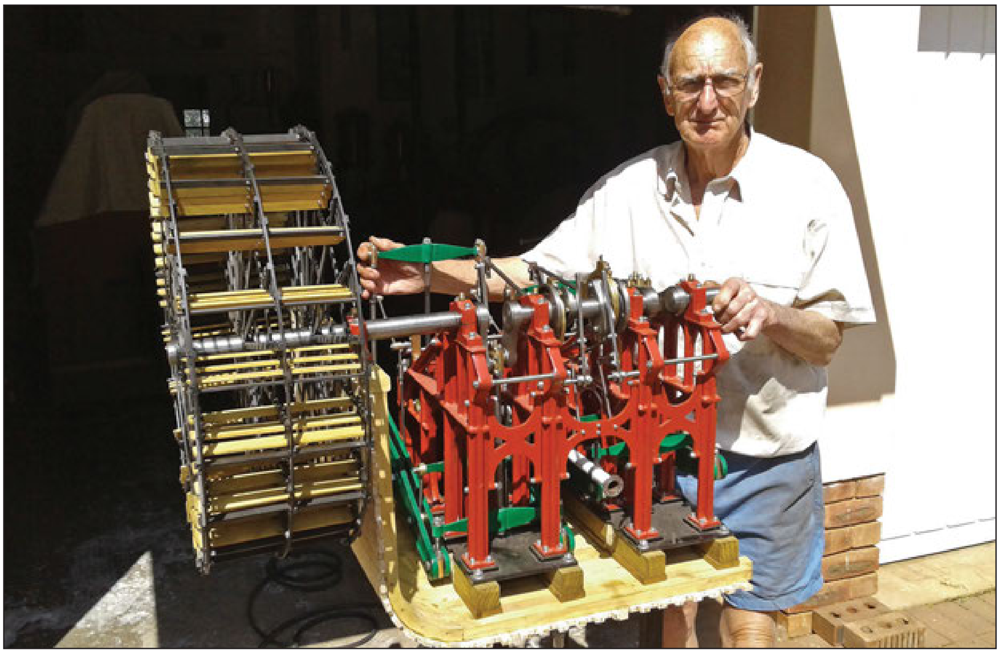
When mounted as shown, before fixing the end lever back to the wall, the elevator is evenly balanced about its hinge axis by the lead-filled 'horn' at the left end. Before fitting, it really didn't look as if it would balance!

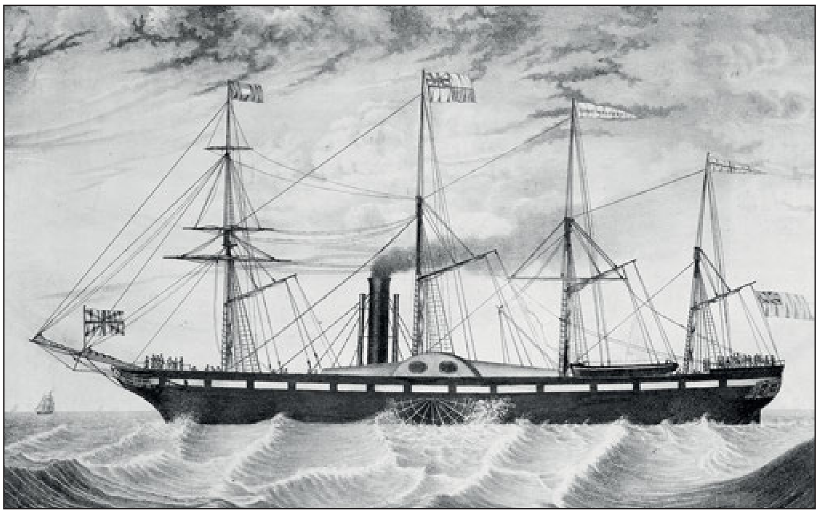
As a lucky coincidence, the chosen wall had a handy recess into which the horn just fits. As my first technical director always said, "Isn't engineering fun!" EIM

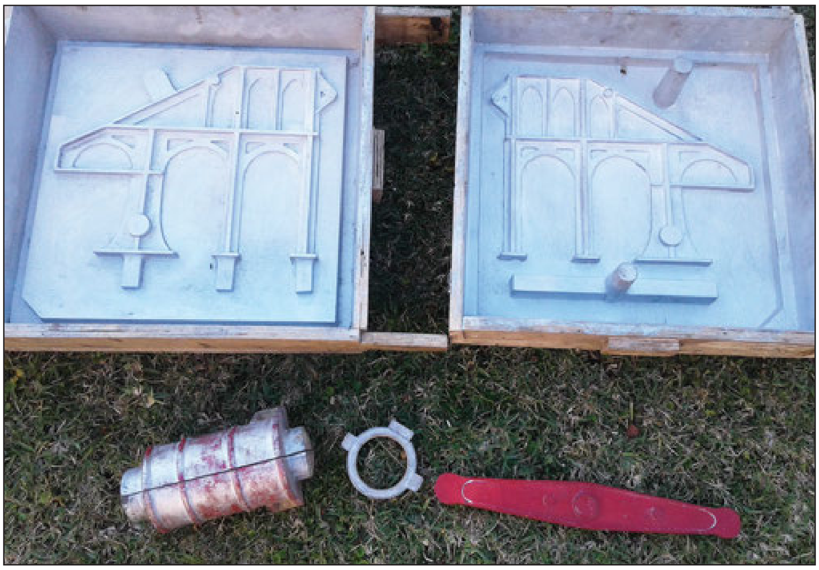
A Great Western Engine

Colin has produced an impressive model of the 19th century Brunel steamer's engines.

BY **COLIN HEALEY**







ABOVE: Colin and his impressive model – both in size and quality of construction – of an engine and paddle wheel from Brunel's 'Great Western'.

ABOVE LEFT: A contemporary engraving of the 'Great Western.'

LEFT: Casting the platework for the mainframe required some creative thinking.

All photos in this feature by the author unless stated

The first ship to be designed to cross the Atlantic Ocean on steam alone (not using sails at all) was Isambard Kingdom Brunel's paddle steamer the SS 'Great Western'. The Great Western was a wooden-hulled ship measuring up at 236 feet long.

The four-masted side-wheel paddle steamer was launched on 19th July 1837 in Bristol and at the time was the largest ship in the world, a title it held for just two years.

The ship's career began badly when prior to its maiden voyage across the Atlantic a fire broke out in the engine room, during which Brunel was injured. But once put to work on the Atlantic route between Bristol and New York the ship proved highly satisfactory and influenced the design of later vessels.

The Great Western served eight years until an incident which saw its younger sister the 'Great Britain' run aground resulted in the firm going out of business. The Great Western was sold, later working on routes to the West Indies and Rio de Janeiro in Brazil and ending its days as a troop carrier in the Crimean War, before being broken up on the River Thames in 1856.

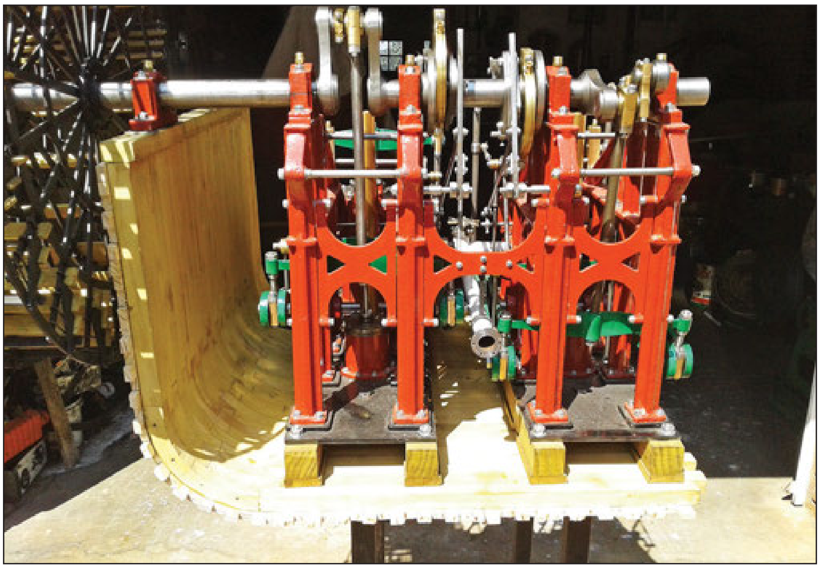
Two engines four boilers

The ship used a pair of side-lever steam engines built by Maudslay, Sons & Field in London and fed by four boilers. These engines had cylinders of 73-inch bore and seven feet stroke, and were joined by a common crankshaft, developing around 450 horsepower. The low hp for such a large engine was due to the steam pressure of only 5psi. The ship's two paddle wheels each measured 29 feet in diameter.

My model of the Great Western engine is about one 15th scale. A side lever engine is basically a beam engine but instead of it having a beam on top – which would be too high for a ship, it has two side levers.

My main challenge was to find sufficient information about the ship – there was very little available and the only drawings I found were general-arrangements in Denis Griffiths' book *Brunel's Great Western*. These were fine but I had to do a lot of guesswork to produce the details I needed.

Not having woodworking machines available to me, I made the pattern for the main frame by



ABOVE: Prominent in this view of the model are the side levers that replace the overhead version on a typical beam engine.

ABOVE LEFT: The two large cylinders of the engines are well reproduced on the model.

LEFT: Note how Colin has included a section of the ship's hull, giving a scale indication to the engines.

fabricating it from preformed wood, this worked well. The only problem was it did not have enough 'draw', so withdrawing the pattern from the sand mould proved a bit tricky.

The design of the side-lever castings made them very thin which meant that once they had been cast they cooled very quickly, and as a result were too hard for machining. A session in a friend's kiln at 900 degrees C solved the problem.

Cardboard solution

I had trouble getting the parallel-motion right. On this engine the parallel-motion connection is close to the fulcrum of the side-lever, so the usual formulas did not work. I solved this problem by making a gadget with pieces of cardboard to simulate the working of the motion to get it working correctly.

The paddle wheel components were laser cut and they needed 720 holes drilled for 360 rivets, plus 240 hook-bolts which were made from 2mm wire threaded 2mm metric.

Two interesting points of the engine – the crankshaft is carried on six bearings and the outer two were mounted on the hull of the ship. With the hull being built of oak there would have been movement, therefore use of a solid crankshaft would have caused problems with the bearings.

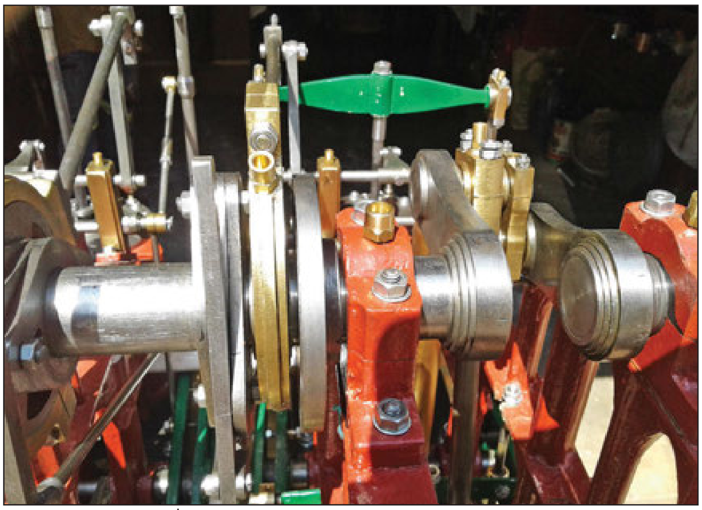
Brunel solved this problem by splitting the shaft into three sections, joined at the cranks with straps. As the valve gear had no way of altering the cut-off, an additional 'expansion' valve operated by cams was fitted.

The paddle wheels' multiple floats are staggered to reduce shock on entering the water. Because the use of hook bolts gave trouble, the ship had to be stopped occasionally to tighten these bolts.

This is not my first such engine – the other photo on this page shows a beam engine I built which may be of interest to you. It is a quarter-scale replica of a James Watt engine built in 1788, which drove a polishing machine in a buckle factory in Soho, Birmingham. The full-size original is in the Science Museum at South Kensington in London.

In 1912, a group of German engineers who considered this engine to be of great historical interest went to the Science Museum and made a full set of drawings. On returning to Germany they built a full-sized replica for their museum in Munich.

They left a full set of these drawings at the Kensington Museum, of which I obtained copies, all 72 of them, all in German! So unlike the Great Western engine I had no shortage of information available when building this model! EIM



ABOVE: Fine modelling of the motion.

ABOVE RIGHT: Components for the paddle wheel were laser cut and needed 720 holes drilling for 360 rivets.

LEFT: Colin is no stranger to impressive models, his previous work including this Bolton & Watt beam engine, the original of which is in London's Science Museum.

PHOTO EXTRA

In a normal year you might have picked up this copy of EIM at the Midlands Model Engineering Exhibition, a highlight of the model engineer's year – but sadly this is anything but a normal year with the show one of many falling victim to Covid-19 restrictions. So here's a memory of a former Midlands event, in this case the 2009 show and the entertainment always provided by the Fosse Way Steamers. *Photo: Andrew Charman*

Current Affairs

In this new series Peter uncovers the mystery behind issues in battery-electric loco wiring and how these can cause premature motor failure. Later episodes will show how to diagnose such faults and how to extend battery life.

BY **PETER KENINGTON** Part one of a short series

Some years ago, I was doing some passenger hauling using a (supposedly) commercially-built diesel-outline electric loco belonging to a fellow club member – we'll come back to the 'supposedly' bit later in this series. The powerful 0-6-0 design had three electric motors, one per wheel set. I'm being deliberately vague about the type/design/origin of the loco to spare a few blushes on the part of the manufacturer although, to be fair, he was just as much a victim in this as the purchaser/owner of the loco, as we'll see in later episodes.

This particular loco would usually pull nine adults very easily, the passenger limit set by the design of the line and its turntables and not the power of the loco. On this particular day, however, it was struggling and was withdrawn from service.

Given that it was an electric loco and that I am an electronics engineer, plus the fact that my father was also present and he is a retired electrical engineer, we felt well qualified to take a look. The sight that greeted us was nothing short of horrifying...

The wiring was all over the place, one spade terminal on the controller unit was blackened and had clearly tried to de-solder itself from the printed circuit board on which it was mounted and the board itself was black on the underside, close to this terminal. Only the robustness of the electronics in the loco controller allowed it to survive this onslaught.

Moving on a couple of years, I was asked to take a look at a 5-inch gauge Class 37 diesel-outline electric loco which had a habit of blowing its 80A rated fuse when setting off, even with a light passenger load (driver plus one adult). The owner of the loco (a good friend) had built most of it but had asked another friend (from a different club) to do the necessary electrics and wiring, as he didn't feel competent to do this part of the build. In this case, as with the 0-6-0 loco just discussed, the wiring was inadequate for the job.

These two incidents clearly show the importance of suitable wiring and connectors in electric locos and the fact that at least some people skimp in this area, either through ignorance or in an attempt to save money. Thick copper wiring is relatively expensive, and used to be hard to get hold of in shorter lengths (i.e. less than a reel), hence there is the temptation to use scrap wire – perhaps old mains cable – lying around the workshop. The aim in the first parts of this series is to provide you with the scientific means to judge whether your scrap cable is adequate and, if not, what type and grade of wire you should purchase.

"The sight that greeted us was nothing short of horrifying..."

We will also discuss the problem of connectors and corrosion and explain how to diagnose and fix problems with electric locos and their wiring. Don't worry if you're 'not very good with electrics' or even if you struggle with the explanations given to try and help you to understand the science behind typical problems – the conclusions will hopefully furnish you with all you need to have a happy and trouble-free time with your 'hairdryer on (lead) acid'.

Resistance is Useless

"Resistance is useless" is a quote often spoken by the baddie in films, when the hero is cornered with seemingly no way of escape (he or she always does, of course). But in our context, resistance is a nuisance which we have to live with. In order to understand it a little, we need to begin with some materials science and, in particular, a discussion of resistivity.

Resistivity is a property of all conductors (and strictly-speaking, all materials) – it is defined as: 'a measure of the resisting power of a specified material to the flow of an electric current'. Its units are typically specified as Ohm-metres, although this definition disguises arguably the most important aspect: the cross-sectional area of the conductor.

The standard definition is based upon the situation in **Figure 1**, i.e. a 1m^2 cross-sectional area. Needless to say this is a bit large for our purposes...

A more useful definition takes account of the cross-sectional area in mm^2; based upon this definition, the resistivities of common conductor materials are given in **Table 1**.

Table 1 allows us to draw some interesting conclusions:

HEADING PHOTO: Designing the wiring of battery electric locos to be fit for the job is essential, especially if they are expected to be employed on frequent passenger trains as in Jan-Eric Nyström's example here.

TABLE 1: The resistivities of some common conductor materials.

All photos and diagrams in this feature by the author unless stated.

TABLE 1

Material	Resistivity (Ohm-metre)	Resistivity (Ohm mm^2/m)	Comments
Aluminium	2.8 x 10^{-8}	0.028	Often used in underground and overhead cables due to its low cost (Photo 2)
Copper	1.78 x 10^{-8}	0.0178	Best option for locos/general wiring
Brass	6 – 9 x 10^{-8}	0.06 – 0.09	
Iron	10 x 10^{-8}	0.10	
Steel	15 – 25 x 10^{-8}	0.15 – 0.25	
Stainless Steel	~70 x 10^{-8}	~0.7	
Silver	1.6 x 10^{-8}	0.016	Best conductor this side of a low-temperature superconductor. Used in some radio/hi-fi applications
Gold	2.4 x 10-8	0.024	Used as a coating on high-quality connectors as it doesn't tarnish

1) Even if we were extremely rich model engineers able to make our wiring from solid silver, we wouldn't gain much over using copper.
2) There is no need to melt down your wedding ring, as gold is a relatively poor conductor when compared with copper or silver. Its key benefit lies in the fact that it won't tarnish, hence a thin gold plating is often used on connectors and switch contacts. Corrosion is an issue we will come back to, in some detail, so gold-plated connectors (where available) may be a worthwhile investment...
3) Brass is a poor conductor given its ingredients – poorer than either copper or zinc (5.5 x 10-8), which are its main constituent metals, and much poorer than aluminium, which is also much cheaper.

So, is copper the 'obvious' choice? In general, yes, although the low cost of aluminium may make it viable for some connections. For example, a loco frame could be fabricated from aluminium and used as the negative conductor, in much the same way as the chassis is employed in a car's electrical system. By contrast, using a steel frame in this way could be much less sensible (depending upon its cross-sectional area, of course), and a stainless steel one even worse.

An interesting area

Having decided upon our conductor material (we will assume that this is to be copper from now on), we need to calculate the cross-sectional area we should be using for our application. But first it is worth examining the consequences of not doing so. These are highlighted in the two stories at the beginning of the article, but why did they occur? There are a number of possible answers to this question and we will examine each below.

Consider the following example (Figure 2): a loco with a 2hp motor and a cable distance between the motor terminals and the controller of 1 metre – don't forget that the cable distance will typically be much longer than the straight-line distance due to the need to bend the cables around obstacles or through holes.

Both the 'outward' and 'return' cables matter – delivery of electrical energy to a load (such as a motor) requires a flow of current through the load and back (ultimately) to the battery. Both cables thus must be rated for the required load and not just that connected to the positive (+) terminal.

There are two issues to consider here, first the wiring from the battery to the controller and second the wiring from the controller to the motor. In the first, inadequately-rated wiring will result in:

A) Heating of the wires, possibly leading to a fire or explosion in extreme cases (if very thin wires are used). This may sound unlikely, but if the wiring gets suitably hot then the insulation may melt sufficiently for the positive and negative wires to short together, perhaps via the frame or chassis (especially if there's a rubbing motion due to the loco trundling its way along a track) – we will discuss the thermal properties of PVC insulation a little later.

Note too that the temperature coefficient for the conductivity of copper is negative, i.e. conductivity decreases with temperature (and therefore wire resistance increases with temperature), meaning that the conductivity could easily halve as the wire heats up, exacerbating the problem. The low internal resistance of a lead-acid battery means that an enormous current (hundreds of amps or more) can then flow through any resulting short circuit, with explosive consequences and possible rupturing of the battery itself.

B) A reduction in the running time of the loco relative to that which could reasonably be expected, based upon the battery capacity and the motor rating. Note that running time depends on many other factors, not least the condition/age of the battery and the outside temperature – battery capacity will be lower in cold weather, as we will see in Part 3 of this series.

In the second case, we can add:

C) Excessive heating or overloading of the controller – this is what was happening in the first story at the beginning of this article (although this probably had multiple sources – both wiring and connector related). This can cause a shortening of the life of the controller – the mean time between failure (MTBF) of the semiconductor devices within the controller decreases dramatically with increased temperature.

D) Shortened life of any fuse(s) in the circuit – this may have been a factor in the second tale, although other factors (outlined below) were likely bigger contributors. Repeatedly heating and cooling a fuse, by running currents through it which are close to its rating, causes the fuse wire to work-harden and the fuse to fail much sooner than it would otherwise do.

Fuses may be internal or external to the controller (or both) or the controller may simply 'current limit'; this may negate the need for a fuse if the controller is rated to closely match the motors used (otherwise the motors may act as the fuse by burning out!).

The impact of wiring is, perhaps best illustrated with the practical example introduced above. The finite conductance of the cables can be represented by a resistor (the value of which takes account of both the outward and return cable lengths), resulting in the equivalent circuit shown in Figure 3.

If it is assumed that the outward and return cable lengths are the same (1m each), then the total cable length is 2m. We also need to consider what happens if the cables warm up, in the event that an inadequate cable cross-sectional area is chosen – this can be crudely divided into a 'hot' case (inadequately-rated cable) and a 'cold' case (adequately-rated cable).

In the former, the resistivity may

FIGURE 1

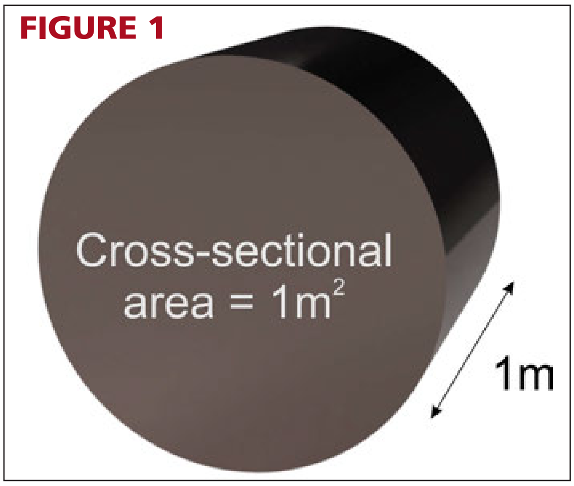


FIGURE 1: Definition of resistivity.

PHOTO 1: A length of 120A aluminium mains cable – a little thick for our use!

FIGURE 2

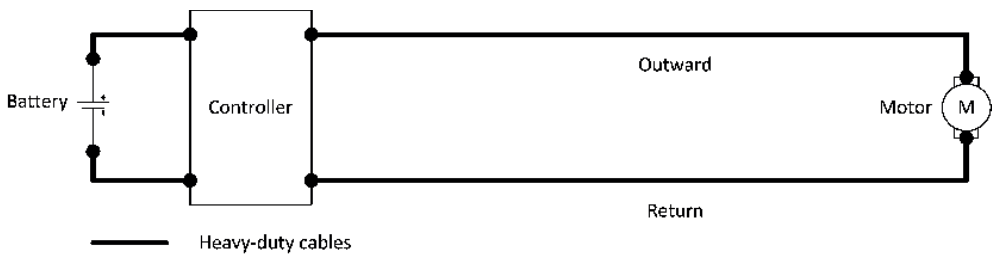
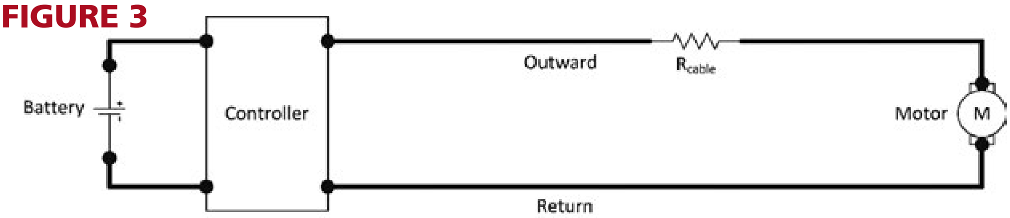


FIGURE 2: Simplified loco wiring diagram.

FIGURE 3



be assumed to be double that of the latter (with the latter using the value shown in Table 1); this is not an unreasonable assumption given the temperature coefficient of the resistivity of copper.

Let's consider the case of a 2hp motor (or 2 x 1hp motors). The motor (or motors, together) will have a steady-state current (at full power and assuming they are 100 per cent efficient) of around 62A when fed with a 24V supply. They will probably be able to cope with a starting current (from standstill) of perhaps four times this figure, for a short period, i.e. 240A (assuming that the controller is capable of providing this current).

If we assume an 'inadequate' cable cross-sectional area of 4mm², then the cable resistance, R_{cable}, is 0.018 ohms and the voltage drop along the cable is around 4.2V. The power wasted in the cable (I^2R losses) when starting off is just over 1kW!

If we now assume an 'adequate' cable cross-sectional area of 16mm², then the cable resistance, R_{cable}, drops to 0.0022 ohms (almost an order of magnitude lower) and the voltage drop along the cable reduces to around 0.5V. The power wasted in the cable (I^2R losses) is then just 128W.

In steady-state, when the loco is running normally (but at full power, with a heavy passenger load) the cable losses for the thicker cable are not far short of a tenth of those which result from using the thinner cable.

The other factor to consider is the effect of the temperature rise on the insulation surrounding the conductor. Above about 60 degrees C, PVC begins to distort and lose its strength. This means that even if the temperature is not sufficiently high to cause the PVC to become liquid and fall off (which could occur around 100 degrees C, depending upon the precise composition of the PVC), it can still be removed more easily by rubbing or pressure (such as at a 'pinch point' somewhere on the loco). If we consider the 'inadequate' cabling discussed above (4mm² cross-sectional area), then the temperature *rise*, in steady state running, with a full load, will be over 100 degrees C. And this is the temperature rise above ambient, not the absolute temperature – so on a hot summer's day the absolute temperature could be 130 degrees C! It goes without saying that at this temperature, the insulation will undoubtedly part company with the conductor.

By contrast, the 'adequate' cabling (16mm² cross-sectional area), will experience a negligible temperature rise (a few degrees) under the same conditions. Note too that the above discussion is based upon a conductor in 'free air'. Since our conductors will be buried within a loco, the temperature rise experienced will be a little higher – particularly if the heat from the motor(s) raises the internal ambient temperature in the loco.

Whilst the above discussion has (deliberately) taken an extreme case (would anyone wire up a loco with 4mm² cable?), it hopefully illustrates the problem and provides the tools to allow you to check whether your 'scrap' cable is up to the job.

High-current connectors

We have discussed above the rating of the cable and the importance of an adequate cross-sectional area of conductor in order to prevent the cable from overheating and possibly shorting, due to weakened/melted PVC. There is, however, another issue to examine: the connectors.

Whilst heat can also be a problem here, there is another more important consideration: connection resistance and its impact upon the current flowing through the motor. The two issues are, of course, partly related, as a connector with a non-negligible contact resistance will heat up and a hot connector will oxidise/corrode much more quickly than will one at ambient temperature, hence further increasing its connection resistance. This results in a downward spiral, although not one which will generally happen quickly (it might take months or years, not minutes or hours)

"This higher current also flows through the motor and may, in extreme cases, be enough to destroy the motor's windings..."

Consider again the situation illustrated in Figure 2. This has been re-drawn, concentrating on the relevant aspects for this discussion and with some essential added detail, in **Figure 4**. Specifically, the connectors (P1 – P4) which would typically appear in this (fairly minimalist) circuit have been explicitly added – Jan Eric Nystrom's circuitry from his electric loco construction series (**EIM**, June to Oct 2019) was much more involved, although the same principles and issues could arise there also.

The connectors are often of the 'spade' type frequently used in car electrics (**Photo 2**) and therefore have two principle interfaces to consider: the crimped cable-to-spade connection and the 'spade-to-socket' (or 'male to female' as it is more correctly referred to) connection of the connector system itself. I will ignore the battery-side connectors for the present, although the same issues can appear there.

Note also that there is nothing special about spade connectors in this context, as in they are not especially bad – any form of mechanical electrical connection (such as screw-terminals for example) can suffer from the same issues.

The actual electrical situation for the configuration of Figure 4 can be illustrated by means of its 'equivalent circuit' – essentially this replaces each aspect of Figure 4 with an electrical component with equivalent characteristics (at least, characteristics relevant to the current discussion). From this, we can illustrate what is happening electrically, and learn what needs to be avoided.

In essence, each connector will exhibit some resistance (as will any fuse used and its contacts with the fuse-holder, along with connections to the fuse-holder, the same applying to ammeters or anything else through which the main motor currents flow). Usually, these contact resistances should be small (a few milliohms) and essentially impossible to measure with a standard digital multimeter, which would just show a short-circuit (0.00 Ohms or something close – the error usually being the multimeter probe-to-conductor resistance when performing the measurement). In **Figure 5**, resistors R1 – R4 represent the resistance of connectors P1 – P4.

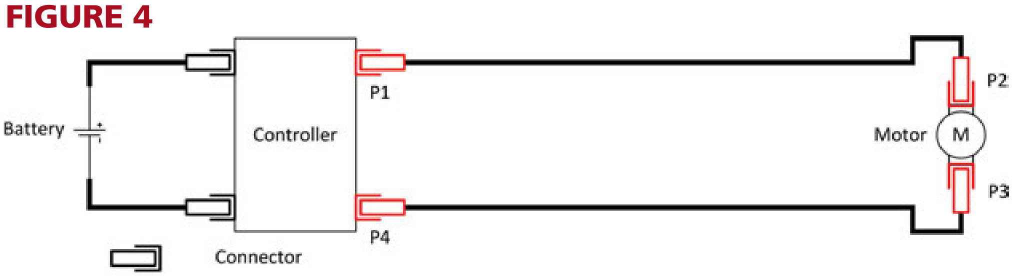
Theory into practice

So, what's the point of all of this complicated electrical theory? The answer lies in what happens if any of R1 – R4 becomes non-negligible. This is more common than you might

FIGURE 3: Equivalent circuit to that in Figure 2, taking account of cable resistances.

FIGURE 4: Simple motor control circuit, including its connectors.

FIGURE 4



think and can develop relatively rapidly. A little corrosion on a connector will increase resistance. This increased resistance will generate heat which will speed up the corrosion process (it being a chemical reaction), as highlighted earlier. If the loco is used regularly and stored in a damp environment (does anyone put their electric loco on the mantlepiece?), this may well become an issue over time.

Let us examine the case where R1, for example, increases to 0.5 Ohms – still something you would struggle to measure with a typical multimeter (the aforementioned probe contact resistance may well exceed this). To put it another way, doing a multimeter resistance test you would probably conclude that there wasn't a problem.

Consider the example of the 2hp 24V motor discussed above. The rated current for this type of motor (without damage to the motor) may be typically around 70A (real motors not being 100 per cent efficient). The starting current, however, may be much higher (if allowed to be, for example if the controller will source such a current).

When a DC motor starts, by definition its rotational speed is zero; it therefore generates no 'back EMF' and presents an almost short circuit to the battery or controller to which it is connected. Once the motor rotates, the 'back EMF' generated reduces the voltage required across the motor's windings and hence the current through those windings (the rotating motor acts partially as a generator, with the resulting voltage generated being referred to as its 'back EMF').

Consequently, an electric motor produces its maximum torque at zero revs (just like a steam engine!). This is the reason why even relatively humble electric cars can boast of a 0-60mph time which would embarrass most conventional sports cars.

Turning up the power

In the case of a model electric locomotive, an electronic controller is incorporated and this limits the power flowing to the motor, under the control of the driver (via the 'speed controller'). If, however, some contact resistance is present, then the driver will naturally 'turn the wick up' in order to get the loco moving, thereby overcoming the voltage drop across this resistance (at the expense of wasting some power heating up the contacts, as discussed above).

If this contact resistance becomes excessive, then a large amount of current is required to overcome it and enable a reasonable voltage to exist across the motor. This higher current also flows through the motor and may, in extreme cases, be enough to destroy the motor's windings.

Likewise, when running, the current through the motor is higher than it need be to generate the torque required to transport the passenger load. Whilst the start-up torque and associated high current is a short-term issue, the running torque and the excess current needed to generate it is not – this can heat up the windings in the motor and cause it to burn out.

This is not the only problem, however, as the controller needs to supply this excess current and this can, again in extreme cases, cause the controller to fail. This was what was happening in the first story at the start of this article – while the controller had not yet failed, it was in the process of doing so through its de-soldering of the main output terminal, the process being exacerbated by the heating of the terminal speeding up its corrosion, increasing its resistance and therefore its localised heating. The whole process forms a vicious circle: more current equals more heat equals more corrosion equals more resistance equals more heat and so on...

If the contact resistance of any of the connectors P1 – P4 is 0.1 ohms, then just under 500W is wasted in heating up this contact at full load (the motor itself will only consume around 1700W at full power, for comparison). A higher contact resistance or a greater number of contacts exhibiting this level of resistance will multiply this power wastage accordingly. It is unlikely that the motor will be running at full load all (or even most) of the time, but it may be doing so on 'that challenging bank on the back straight', or your club's equivalent.

Whilst this is a problem, a much bigger issue is the voltage drop across the resistance (7V @ 70A, but probably much higher at zero revs, when pulling out from the station) – the driver will naturally increase the voltage to overcome this loss, to get the loco started (as just discussed) thus compounding the problem.

Evolving issue

One other thing worth bearing in mind, as a driver, is that this problem tends to 'creep up' rather than suddenly becoming apparent. As a connector corrodes, a little more voltage is required to set off, so the control is turned a little further (for a given passenger load) – this is usually masked by, for example, the variability in the passenger load that the loco is pulling, from journey to journey, and so goes unnoticed.

Gradually, the connector corrodes a little more and the control needs turning a little further, but this could occur over weeks or months. So each incremental change goes unnoticed by the driver, until eventually a controller or motor fails.

Even at this point, the real fault may not be rectified (for example by the replacement of the failed motor, which may then, itself, burn out relatively soon thereafter). It may be rectified largely by luck, since the new motor's terminal won't be corroded, hence probably lowering the contact resistance. But note that the spade connector which attaches to this terminal probably won't have been replaced and may well still be corroded. In the event that the motor does, indeed, burn out relatively quickly, then the driver's (or owner's) conclusion may then be: "we're overloading the loco", which may well not be the case.

Note that the above argument holds true for the single-motor case illustrated in Figures 2 to 5, however as we shall see, if more than one motor is involved, then replacing a failed motor may not also (even fortuitously) solve the contact resistance issue discussed above – in effect, the 'wrong' motor will have been replaced, from this perspective (even though it would clearly be the 'right' motor from a purely functional perspective, since it is the motor which had failed). This probably sounds somewhat counter-intuitive, but hopefully the discussion below will help you to understand why this seemingly bizarre situation exists. **EIM**

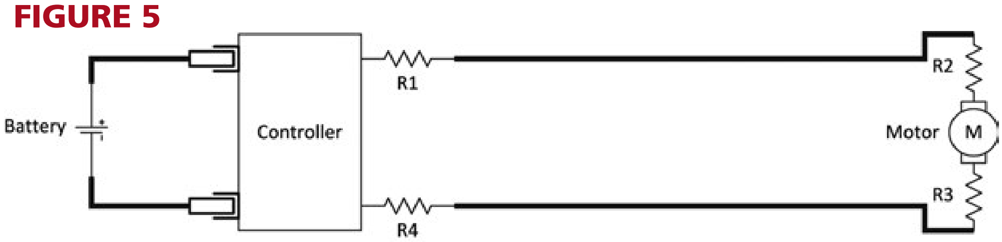
■ Next month Peter looks at multiple motors and the issues they can add.

"The whole process forms a vicious circle: more current equals more heat equals more corrosion equals more resistance equals more heat and so on..."

PHOTO 2: Examples of spade-type crimp connectors.

FIGURE 5: Equivalent circuit of Figure 4 (see text).

FIGURE 5



Dot – a micro engine

Stewart tackles the reversing mechanism of his tiny stationary engine construction project, particularly suited to those with not a lot of space to model in.

BY **STEWART HART** Part three of a series

Continuing our short construction series launched in the September edition of EIM, this time we focus on the reversing mechanism of 'Dot', a stationary engine based on a design by noted US model engineer George Britnell and measuring just 2 inches (50mm) tall.

Part 11: Eccentric

The eccentric has a double throw and is made from a length of 3/8-inch mild steel bar, this is prepared by machining two flats 132 degrees apart in the spin-indexer Sketch 3. An Eccentric Throw turning bush is also required, Fixture 3, this is quite easily made by either using a four-jaw chuck and a wobble bar to give the offset, or using a 1mm packing piece between one of the jaws in a three-jaw (Photo 58). Centre and drill ⅜-inch then drill and tap an M3 cross hole to take an M3 flat-nosed grub screw.

The first operation is to chuck the bar up and to face and drill 2.5mm, then insert the bar in the bush, and grip down with the grub screw on one of the two flats – the flat nose of the grub screw will pull the bar into the correct orientation.

Turn down the first eccentric to 6mm diameter using a knife tool, release the eccentric in the bush and locate the second flat with the grub screw – again the flat-nosed grub screw will pull the part into the correct orientation.

To turn the throw you will now have to use a parting tool (Photo 59). Remove from the bush, re-chuck the bar and turn down a small spigot but leave a reasonable thickness for tapping M1.6. This will result in an oval shape – keeping the part on the bar drill and tap M1.6 through the thickest section (Photo 60), return to ▶

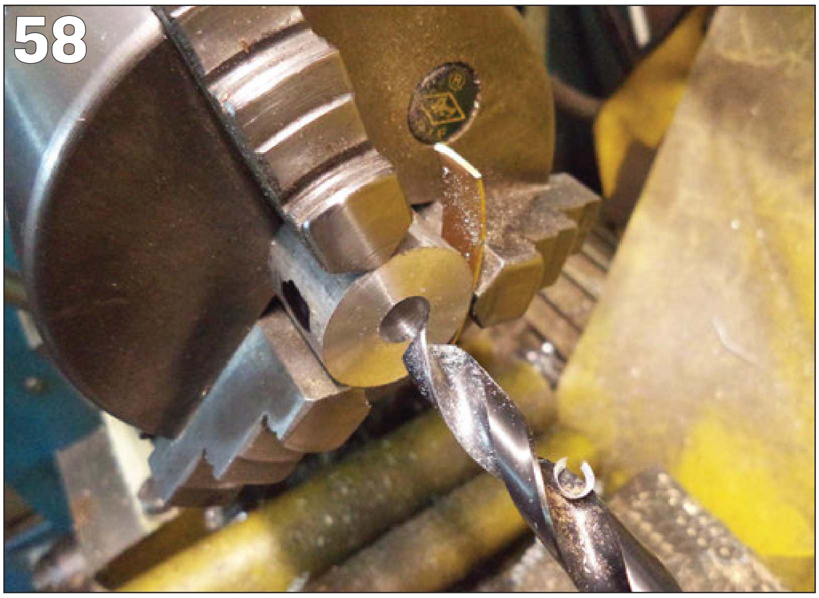


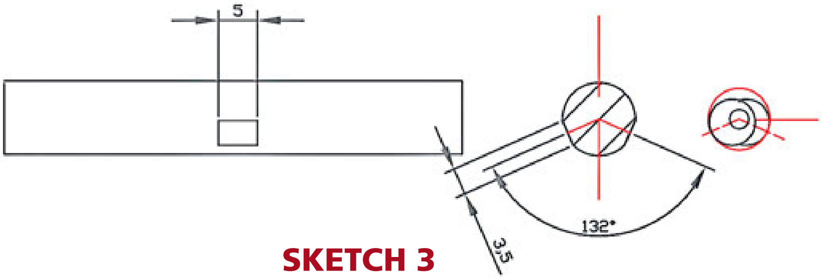
PHOTO 58: Drilling the offset for fixture 3:- Note the use of 1mm packing.

PHOTO 59: Using parting tool to turn the second eccentric throw.

PHOTO 60: Drilling and tapping the eccentric M1.6.

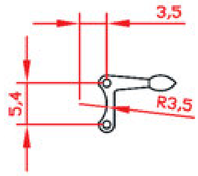
All photos and drawings in this feature by the author

All component drawings reproduced approx full-size



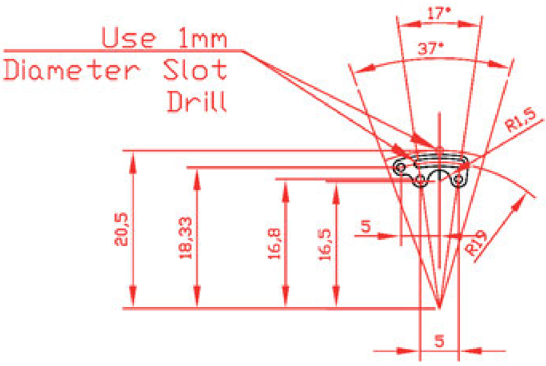
SKETCH 3

Preparation to bar stock for eccentric manufacture, bar held at correct orientation in Fixture 3 by grub screw flat



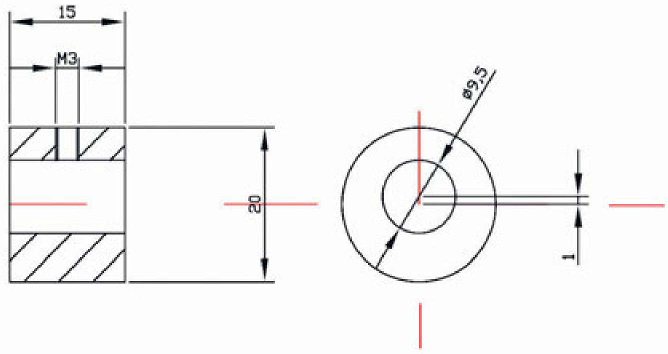
SKETCH 4

Co-ordinates for reversing lever, Part 22



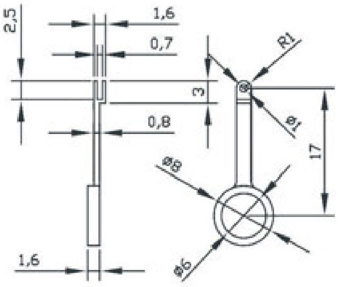
SKETCH 5

Reversing quadrant (Part 29), co-ordinates for use with rotary table and DRO



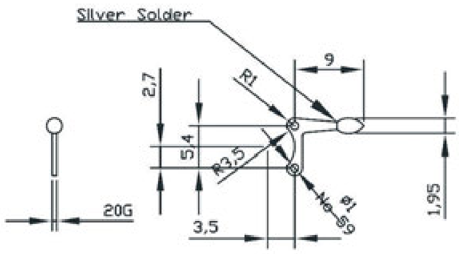
FIXTURE 3

Eccentric throw turning bush – use with flat-nosed grub screw
1 off: Aluminium



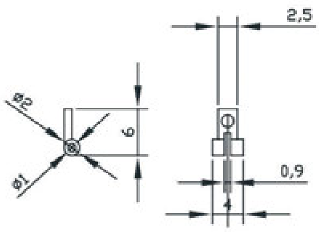
PART 10: ECCENTRIC SLEEVE

2 off: Brass



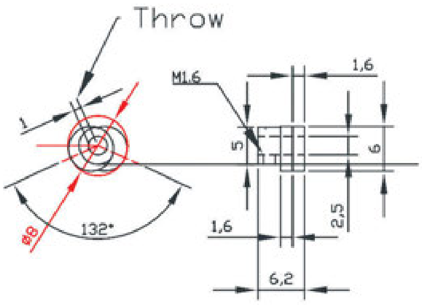
PART 22: REVERSING LEVER

1 off: Mild Steel
(see sketch 2)



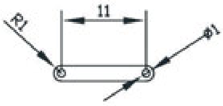
PART 28: BRACKET

1 off: Brass



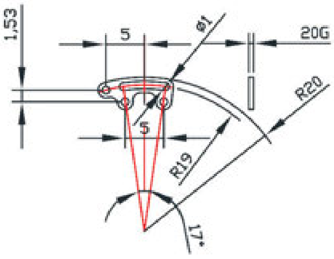
PART 11: ECCENTRIC

1 off: Mild Steel
(see sketch 3)



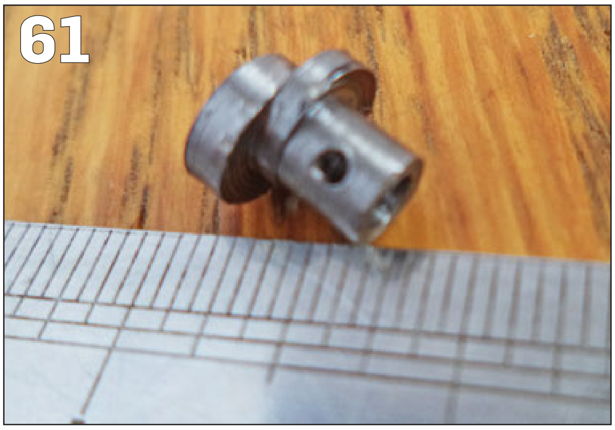
PART 23: LINK

2 off: Mild Steel

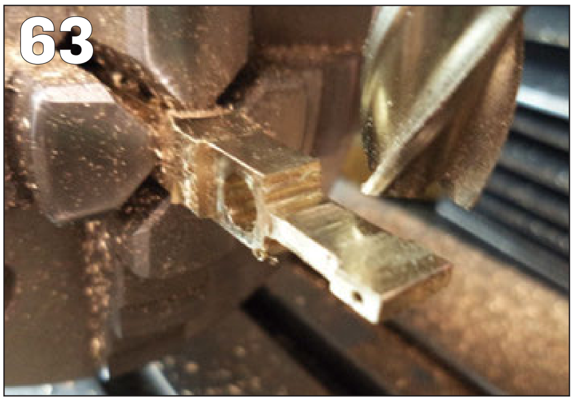


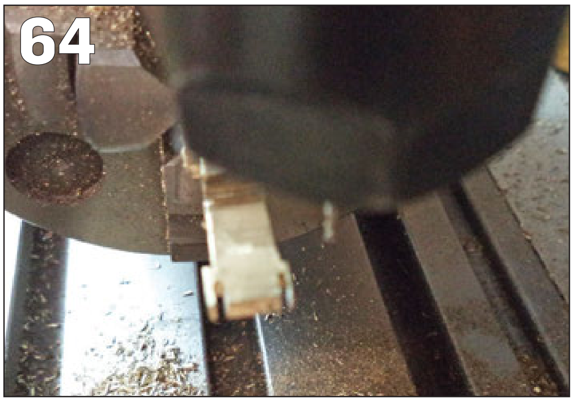
PART 29: REVERSING QUADRANT

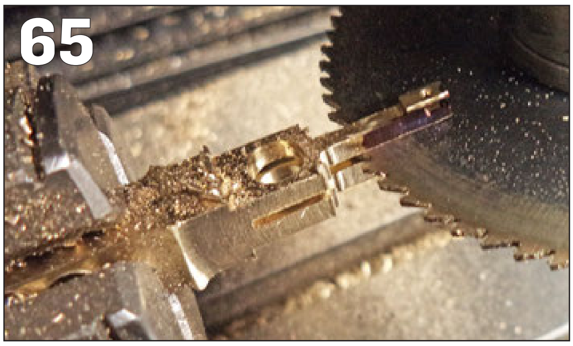
1 off: Mild Steel
(see sketch 5)



"The flat nose of the grub screw will pull the bar into the correct orientation..."







the lathe and part off (Photo 61).

It's worth pointing out an important but not obvious function of the pan-headed screw that holds the eccentric to the crankshaft, the head of this screws retains the outer eccentric arm on the eccentric whilst allowing it to rotate freely.

Part 10 (x2): Eccentric Arms

Two are required, manufactured from brass bar, I made both arms together back to back (mirror image) again using the good old spin indexer, from some ½-inch square brass bar I had stashed away.

Start by milling a length of bar down to 8mm square section. Centre and zero the DRO (digital readout) on the centre line and the front edge. Cross drill through 1mm and at a distance of 17mm drill through 6mm to match the eccentric, and work out the co-ordinates and drill the corners.

Using the indexer mill down the other edge to form the 2mm wide legs, then using a small 1mm slot drill mill the fork-ends (not four candles) (Photos 62-64). Then using a suitably-sized slitting saw cut down the middle (Photo 65).

Cut the two sleeves from the bar and clean up the back face to 1.6mm width with a milling cutter. Then turn up a 6mm mandrel and with the part held on the mandrel with a 3mm cap screw and washer, turn down the 8mm diameter.

All that remains now is to remove the flashing and to tidy up with some Swiss files (Photo 66-67). The obligatory family shot is shown in Photo 68.

Part 29: Reversing Quadrant

I made this from some 20 gauge cold rolled mild steel sheet, I started by centring my rotary table on the mill, zeroing the DRO and clamping the mild steel via a piece of sacrificial aluminium plate to the rotary table.

Using the set of co-ordinates in

PHOTO 61: Completed eccentric – not very big!

PHOTO 62: Drilling cross holes in the eccentric arms...

PHOTO 63: ...and milling them to shape.

PHOTO 64: Milling the two forked ends with a 1mm slot drill.

PHOTO 65: Slitting down the middle to make the two arms.

PHOTO 66: Finishing off with Swiss files.

PHOTO 67: The two completed eccentric sleeves

PHOTO 68: Trial assembly on the engine.

"I drilled out the basic shape and using a 1mm slot drill generated the curves of the quadrant..."

Sketch 4 I drilled out the basic shape and then using a 1mm slot drill generated out the curves of the quadrant (Photo 69-70). It was then just a matter of joining up the dots with Swiss files to complete the overall profile (Photo 71).

Part 22: Reversing Lever

This is again made from 20 gauge cold-rolled mild steel and using the set of co-ordinates in Sketch 5 to drill and file out the shape. To make the handle first a length of mild steel rod was slotted with a slitting saw and roughed to shape in the lathe. The arm was silver soldered to it (Photo 72), then in the lathe the handle was generated to shape and parted off (Photo 73).

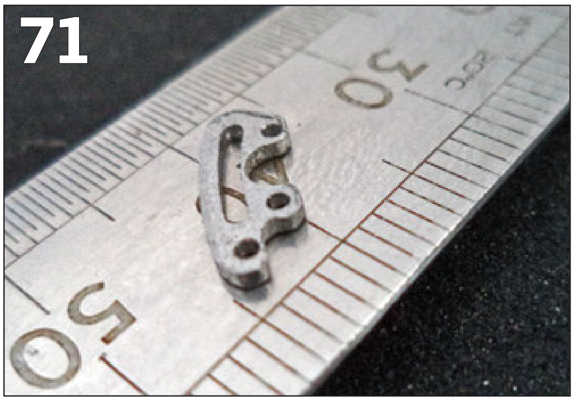
Part 28: Bracket

This was made from ¼-inch square brass bar again using the spin indexer. Cut the slot with a milling cutter first before removing the rest of the material – the slot needs to be a tight fit on the reversing lever Part 22. Drill the 1mm hole and the 1.6mm cross holes, then mill to shape and cut off (Photo 74-75).

Part 23: Links

Select a piece of 20 gauge cold-rolled mild steel, drill 1mm at the 11mm pitch then roughly cut out. Then put a couple of pins in each of the holes and with these pins resting on the vice jaws. Mill to width and radius the ends with a Swiss file (Photo 76). EIM

■ Next month Stewart completes some seriously small parts and prepares to run his engine. To download digital back issues or order printed versions of the September and October issues containing the first two parts of this series, go to www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or call 01778 392484.



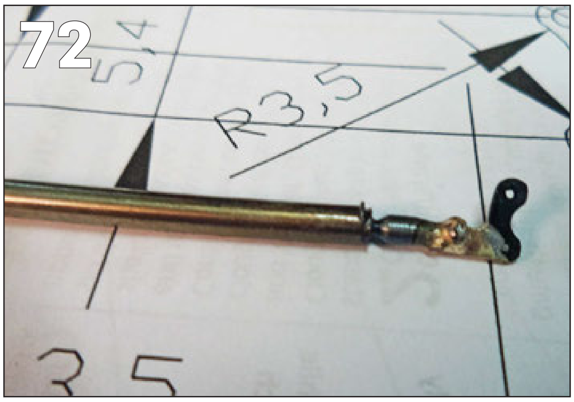


PHOTO 69: Quadrant co-ordinate drilled.

PHOTO 70: Arcs milled out using rotary table and 1mm slot drill.

PHOTO 71: Dots joined up to complete the quadrant.

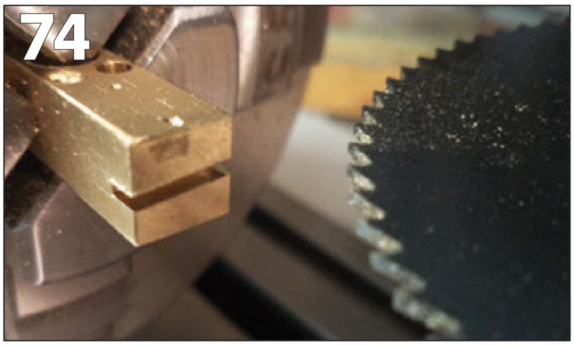
PHOTO 72: Reversing lever arm silver soldered to handle.

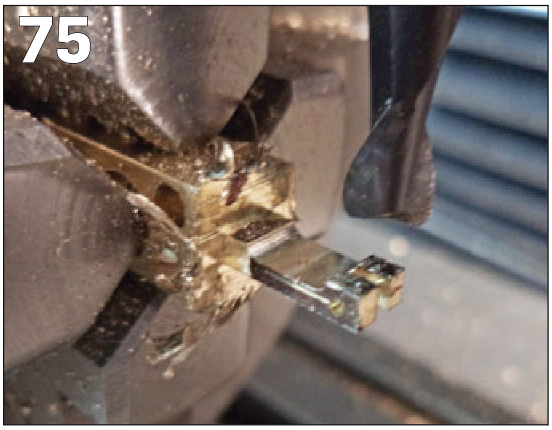
PHOTO 73: Finishing handle to shape and parting off.

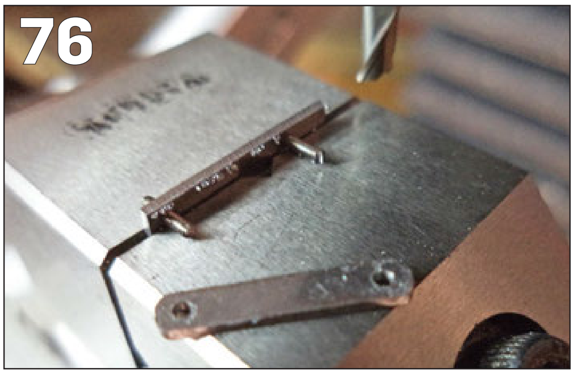
PHOTO 74: Slot cut in bracket with slitting saw.

PHOTO 75: Bracket milled to final shape.

PHOTO 76: Final job, milling links to their finished width.







London joins growing list of Covid cancellations

The London Model Engineering Exhibition, traditionally held in January at Alexandra Palace, will not happen in 2021.

Show organiser Meridienne Events has announced that the difficult decision has been taken to cancel the 2021 show as a result of the continuing impact of the Covid-19 pandemic.

In a statement issued on 16th September, before the Government mandated even tighter restrictions on gatherings in light of fears of a second wave of the pandemic, Meridienne said that the organising team has been looking at scenarios to try and deliver the event with the health and welfare of everyone involved at the heart of that decision-making process.

However, it has been concluded that it will not be not possible to run the event in January 2021 given the commercial implications of the Government social distancing guidelines and mass gatherings restrictions along with the numerous additional Covid-19 safety requirements.

Exhibition director Chris Deith said that the decision was incredibly hard to make. "We created this event back in 1996 and since then it has run every year since, becoming the South's major showcase of modelling and the only London-based event of its kind," he said.

"I thank all of our exhibitors and visitors for their support and understanding – our team has worked tirelessly, exploring every possible option to enable this event to run in January," Chris added.

"The current pandemic and the government's restrictions and unclear future plan for mass gatherings have made it impossible to plan and deliver an event of this size at present.

"We are aware that many thousands of our visitors will be disappointed with this decision but it would not be right to organise an event that does not meet the high standards of previous years".

While perfectly understandable the decision will prove extremely disappointing to many EIM readers and indeed our editorial team. It comes just a month after the cancellation of the Midlands Model Engineering Exhibition, usually held in October and also organised by Meridienne. The national show at Doncaster also fell victim to Covid-19 this year and indeed the last major model engineering event to go ahead before the pandemic hit was the London show back at the start of the year.

Organisers insisted that the show will return in January 2022 to Alexandra Palace and they look forward to welcoming all exhibitors and visitors safely back then.

ABOVE: No trip to the Palace in 2021.

LEFT: The London show always provides much of interest in special surroundings.

Photos: Andrew Charman

Tidy-up produces half-price offer

The cancellation of both the Midlands and London Model Engineering Exhibitions has left organiser Meridienne Exhibitions with rather a lot of time on its hands and company head Chris Deith tells us it has been put to good use undertaking a major tidy-up in sister company TEE Publishing's warehouse.

TEE founded and published **Engineering in Miniature** magazine from its launch in 1979 to September 2016 when the magazine was acquired by current publisher the Warners Group.

In sorting the thousands of books and magazines in the TEE warehouse Chris has realised just how wide is the range held of back issues and volumes of EIM, and other magazines that we hold. "Our stock covers both individual issues as well as bound and unbound volumes from the beginning almost up to the present day and we also have a substantial stock of back issues of other model engineering titles as well," Chris says.

"In the past model engineers have tended to collect, for their own enjoyment, sets of model engineering magazines and this is still the case though to a lesser extent today," he adds. "Many people still prefer to sit and enjoy a book rather than scroll through the Internet and personally I derive more satisfaction from reading and relaxing with a book but then I'm perhaps old-fashioned – it is certainly the case that I'll never complete reading all that I have collected as you will appreciate having seen our library."

As a result of the significant overstock at present TEE has decided to offer a 50 per cent discount on most of the unbound volumes of EIM, and also *Model Engineer* from the past 40 years.

Meanwhile any customer ordering volumes and choosing to visit in person to collect them will not only save the postage but have their order upgraded (subject to availability) to volumes in Easibinders at no extra cost.

"All volumes have been carefully checked and are complete but of course we'll always replace any issues or volumes found wanting," Chris added.

Details of the range of volumes on offer can be found on the TEE website at www.teepublishing.co.uk, or readers requiring individual issues or volumes can email info@teepublishing.co.uk with their needs.

Sounds a great opportunity to fill those gaps in your collection – particularly as it seems we could be spending quite a lot more time home for a while yet...

Model engineering supplier with news that our readers might find of interest? Send words and pictures to the editor at andrew.charman@warnersgroup.co.uk or at EIM, 12 Maes Gwyn, Llanfair Caereinion, Powys SY21 0BD

New owner for Little Samson

Cambridge-based Little Samson models is entering a new era (*writes* ***Paul Ritchie***) after owner Edward George sold the business to allow time in his retirement to focus on his own engineering projects, and on running his 6-inch Fowler showman's road loco 'Galanthus' at rallies.

Edward has managed the business for more than 30 years alongside his full-time teaching career, and pattern-making, engine design and castings production through his Savage Little Samson website. But now a few years into his teaching retirement he has decided to move the business to new owners.

The new home for the Savage Little Samson design and the Savage steam lorry, the 3-inch scale Universal Carrier, is Steam Traction World of Daventry. The firm has acquired the drawings, patterns, stock, brand and goodwill from Edward. The 6-inch scale designs for the Burrell Devonshire, Burrell 5nhp road locomotive and Burrell Gold Medal Tractor have been transferred to Adrian Nutting at A N Engineering.

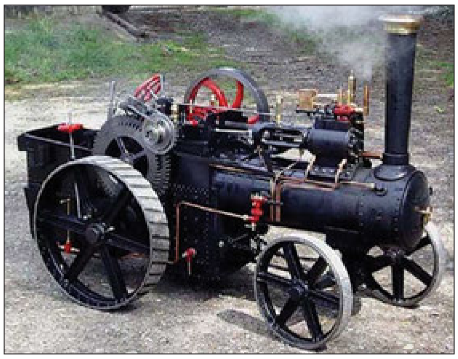
Steam Traction World has ambitious plans to imminently release a fully machined kit for the 6-inch Little Samson, with a 4-inch kit planned for 2021. The firm also plans to continue to sell drawings and castings for both existing and new Little Samson scratchbuilders while also offering the options to purchase as many or as few of the machined parts such as the boiler, or fully machined cylinder, or machined and vulcanised road wheels.

The full-size Little Samson was a 5-ton steam tractor built by Savages of Kings Lynn to comply with the Heavy Motor Car Orders of 1905. Sadly, no examples of the engine survived into preservation.

A. N. Engineering's Adrian Nutting is a familiar name within Little Samson circles as he machined numerous cylinders, cranks, and other items for the range of models. He is currently in the final stages of completing a Burrell 5nhp road locomotive for one of his own customers and is very competent and knowledgeable engineer.

Edward George built Galanthus in his garage over a 10-year period, finishing it in 1992 when it won a gold medal at the model engineering show.

"I have very much enjoyed the past 28 years researching engine designs, pattern making, and arranging for castings and materials to be available through my website," Edward said, adding; "I would like to thank all of my customers, many of whom have helped, advised, and encouraged me in my endeavours."



TOP: A fine 6-inch scale Savage Little Samson with double seating for driver and steersman. **ABOVE:** The 4-inch version of the engine minus gear guard and boiler cladding.

Warco keeps going through lockdown challenge

Warren Machine Tools, known to all model engineers as Warco, has described to EIM the challenges of operating and delivering good service to its customers during the months of lockdown.

"The offices have stayed open continuously since March – while some staff worked remotely, others carried on in the offices or warehouses, under severe pressure from busy phone lines and a high volume of orders," Warco managing director Roger Warren told us.

"While some callers were impatient and did not understand that it is difficult for reduced staff numbers to cope with six phone lines and still stay sane, in the majority callers were so kind and sympathetic to the difficulties faced."

Roger added that his staff had been just marvellous. "I am so thankful to them for their dedication and hard work – they have never complained and have taken on tasks which are not strictly speaking theirs just to keep everything running and to keep our customers happy.

"With staffing levels cut by one third, it has not been easy for them – we have not had to use the furlough scheme or ask for any Government assistance. In fact, we have now taken on two new staff members with plans for two more."

Following exceptionally high sales during the lockdown and a lack of shipments from suppliers due to factory closures in the Far East, stock levels were at an all-time low for some time, but now things are improving, with containers arriving each week.

The launch of the new Warco brochure, planned for March, was impossible due to social distancing regulations. However, the new publication will soon be finished and can be requested by email, web or phone.

Even at this difficult time, Warco has launched new products: the WM14B belt drive mill, a new drill grinding machine, a belt/disc sander, two new educational drills, an entry-level mini lathe and the GH1439 gear-head lathe.

Sadly, the popular Open Days are not possible in the current circumstances. "But when we can all get together again, this will be announced on our website," Roger said. Used and ex-demo machines are listed on line and are proving to be very popular.

Roger concluded; "we thank all customers and associates for their support during this strange time and hope that we can all stay well and safe."

Web: Warco: www.warco.co.uk

Recycled steel a rust producer...

In the August issue of EIM Rich Wightman notes the rapid rusting of the metal on his Conway locomotive but does not speak about other items in his workshop rusting. I can make a reasonable guess as to the source of his troubles, namely recycled steel.

Small inclusions of other metals form galvanic cells and in the presence of humidity electrons will flow and corrosion products appear. In the early 1970s in Canada Fiat 124 car underframes died rapid deaths from winter salt corrosion because they were made from recycled steel that was not pure enough.

In the same issue Jan-Eric Nyström points out that the water molecule is polar. I found this out when a chemist colleague went to Halifax to deal with a problem with our then-O-class submarines. On returning he mentioned that the copper distilled water distribution pipes for the batteries were rotting.

My raised eyebrows elicited the mention of the polarity of the water molecule. On the other hand we need not fear for our copper boilers since the solutes in the water we feed them satiates the aggression of the molecule.

The detailed description of the behaviour of water around the freezing point in Jan-Eric's article was very interesting. It was not covered in university, at least not in engineering.

John C Bauer

Model engineering query to have answered or a point to make to your fellow readers? Email andrew.charman@warnersgroup.co.uk or write to 12 Maes Gwyn, Llanfair Caereinion, Powys, SY21 0BD.

Another toolrack method

While reading the July edition of EIM I was interested in the toolholder racks that were produced via 3D printing by Peter and Matthew Kenington.

As a very amateur model engineer I like to look at recycling things. This way I get to practice machining and save a bit of money.

In my odds-and-ends bin I had a length of alloy extrusion that came from an old computerised mount cutter. I also had a number of alloy 20mm x 5mm bars that were tapped 5mm at every 50mm along them.

Having made my own quick-change tool post the problem of where to place the tool holders had puzzled me for a while. Then I realised the alloy extrusion from the scrapped mount cutter could be adapted to fit. This only required milling with a 60-degree milling cutter.

The end result after milling each side of each holding piece was a comfortable fit for the holders. Then having drilled and countersunk each one I screwed them to alternate holes in the drilled bar.

I was pleased with the end result. Once on the wall it looked the part. As I looked at it I thought it was better as a finished job than just in my odds and ends bin. I love to recycle odd bits and this is one of my best recycling efforts yet.

Rod Tandy

Versatility of loco lift

I read with interest the article by Jan-Eric Nyström on his loco lift modification (EIM, May 2020). In the mid 2000s I built a loco lift using a design published in EIM for use when building my Sweet Pea loco – since then it has been used for various jobs for which it was not designed.

I purchased a Chester mill drill and used the lift to raise the tool to bench height. Next having realised the 10mm lead screw was struggling it was uprated to 16mm and found to be satisfactory.

In 2016 the lift helped in the restoration of a lorry – it was used for the removal of the rear axle and gearbox and as a crawling board while wiring underneath the same vehicle.

With outriggers fitted the lift is in use while I am building my BSA motorcycle and has been used for servicing two other machines.

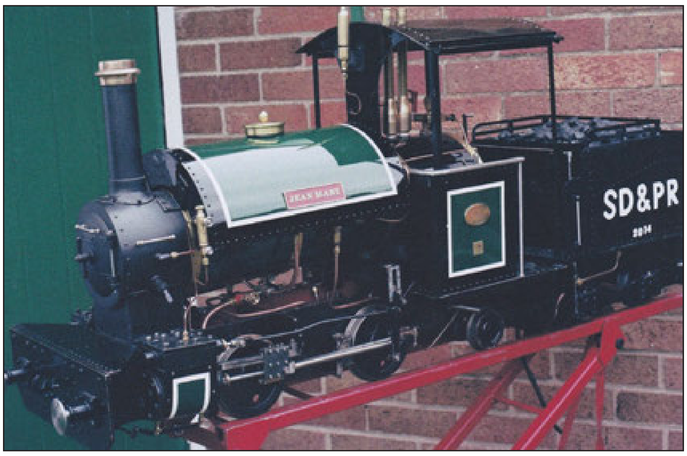
I have found no need for power to be fitted – no cables, pulleys, electric motors, control gear or batteries. And at the age of 81 I can use the winding handle with very little effort.

Graham Hughes

The Editor replies: That's what we like to hear – equipment built from our pages proving very versatile in use!

ABOVE RIGHT: Rod Tandy's methods of recycling have produced useful toolholder rests to hang on the workshop wall.

BELOW: The loco lift Graham Hughes built from a feature in EIM, and which has proved very versatile far beyond supporting his Sweet Pea loco...



Reactions and revelations

Clubs continue to battle the Covid menace, while learning more about their members...

COMPILED BY **ANDREW CHARMAN**

Welcome to the November club round-up, at a time when in a normal year clubs would be winding up their public running sessions, preparing for a winter of maintenance and indoor meetings and workshop activities for their members.

Of course this is anything but a normal year and perusing the various newsletters one can see that some clubs have only recently began to work at their sites and run trains again, while others remain totally dormant – what this winter holds with the growing evidence of and reaction to a Covid-19 second wave, one can only wonder...

It is clear, however, that many clubs are doing their best to overcome the challenges fthey are facing, while with fewer club activities to report in the newsletters, members are getting the chance to showcase their own activities.

The Autumn edition of the *Link*, newsletter of the City of Oxford SME, includes a picture of a rake of passenger carriages at the club's Cutterslowe Park track in the north of the city.

The track reopened for public train rides on 30th August, and the picture shows how this was possible, the carriages (all very neatly finished in nice blue paintwork by the way) have all had acrylic screens added to their ends to enable social distancing.

Next year, no change?

Writing in the *Link* club chairman Denis Mulford reports that the screens, which were fitted by a team led by members Graham Toplis and Josh Allen, were not cheap; "But the thoughts were that we may still be in the same situation next year so something had to be done or we would not be able to open in 2021."

Sad views, but very likely true, and no doubt such considerations are underway at most other clubs that run trains for the public – especially those that have decided not to open at all this season – surely they cannot afford to remain closed into the 2021 season?

Denis adds that reopening day was challenging but overall went well, and as the day went on such new essentials as carriage cleaning between rides were getting faster as members got used to the task. The club now intends to consult the membership about extending its season into early November.

ABOVE RIGHT: City of Oxford members have worked hard to fit acrylic screens to their passenger carriages, for what may be a longer-term solution than first thought ...

BELOW: This photo by Teeside member Nick Deytrikh shows the impressive Victoria bridge on his home 7¼-inch line.

In his column Denis also mentions the threat to future coal supplies, adding that the club's coal supplier also supplies Windsor Castle, and wondering whether the Queen can put in a word for model engineering clubs.

This threat is very real – the Government recently refused permission for a new open-cast mine raising the prospect that all steam coal for UK use, in model or full-size boilers, will have to be imported, making a nonsense of supposed CO_2 savings while raising costs to a level many will find prohibitive. I've written an editorial on this in the latest edition of EIM's sister magazine *Narrow Gauge World* urging readers to lobby their local MP alerting them to how ludicrous the situation is– it's a threat that needs to be taken very seriously...

Trackerjack is the quarterly newsletter of the Teeside Small Gauge Railway and the Autumn edition immediately stirs memories for this writer with editor John Palmer beginning his editorial "The time has come the walrus said..." My first local newspaper editor, the one who taught me most of what I know about journalism, regularly used to start his editorials with that phrase...

Of more pertinent interest to the EIM readership is likely to be the second part of a feature by member ▶

Nick Deytrikh describing his own Allerton Wood Railway – a good example of club members providing essential copy for their newsletter editors at a time when actual club news is thin on the ground.

Nick's 350-yard 7¼-inch gauge line includes two bridges over a stream, and as the picture on the previous page shows they are seriously impressive. One of them was based on a couple of redundant BT telegraph poles while the one in the picture needed to be of 21 feet in span, so was commissioned by Nick as a replica of the Victoria Bridge on the standard gauge Severn Valley Railway. It must be great fun driving over that...

While Covid is at present focusing everyone's minds, the normal challenges the clubs face do not go away as a result. The latest edition of *Whistlestop*, the newsletter of the **Hereford SME**, includes pictures showing the result of a deluge which chairman Wally Sykes described as the like of which he hadn't seen since the monsoons he experienced on RAF duty in the Far East...

While the Hereford track experienced serious flooding earlier this year and has spent a great deal of time and money since putting things right and guarding agianst future occurrences, the main issue this time was a large oak tree by the carriage shed, which fell on the track. Hereford member Fred soon had the offending branches removed and reputedly the club is now doing quite a side line in logs...

Elsewhere in the Hereford newsletter there is a whole page describing the many activities of young member and regular **EIM** writer Matthew Kenington, including a picture of Matthew driving a mini-JCB, digging out the foundations for what looks will be a very impressive dual-gauge garden line being built by dad Peter. Is there nothing this 14-year-old can't do?

"It appears that several members are at the boiler stage of their projects, with a notable selection of copper-tinted pictures to enjoy..."

ABOVE: Heavy rain caused some concerns at Hereford SME but the issue was soon dealt with.... *Photos: Martin Burgess, Hereford SME*

LEFT: Here comes the heavyweight contender – Rugby ME's new loco lift undergoes a weighty test. *Photos: Rugby ME*

Trials of tech

Modern technology, and in particular the video meeting tool Zoom, is fast becoming a part of life for many people who could never have imagined using such things, including many of us model engineers. **Bournemouth SME** has been holding regular 'tech chat' sessions by Zoom while members can't get together in the clubhouse. Your editor did smile at the apology, in the club's latest newsletter, by organiser Brian Merrifield to those who recently logged on for such a chat and found nothing happening. "I forgot" Brian admitted...

Bournemouth is among those clubs that has found it necessary to cancel all meetings until further notice, and predicts the situation is unlikely to change before Christmas – troubled times...

While members can't show their work in person the newsletter keeps them in touch and the latest includes pictures of a 5-inch gauge class 5 4-6-0 being built by member Merlin Biddlecombe, with superb detail on the cab and tender front plate,

The **Rugby ME** continues to be as busy as ever and the latest newsletter includes pictures of the newly-built loco lift being tested, by loading it with a whole lot of weights. The table passed the test with flying colours and members will be confident in entrusting their prized locos to it.

Good to see in the latest edition of the **Ryedale SME** newsletter lots going on at the club's track in Gilling, North Yorkshire. The pictures show a wide variety of locos in steam at meetings held on Sundays and Thursdays, and your editor was particularly impressed by the rake of six pristine Southern Railway passenger carriages built by member Mike Aherne. There were some equally impressive rakes of freight stock too, we hope to publish some of these in a future edition of *club news*.

Elsewhere in the newsletter it appears that several members are at the boiler stage of their projects, with a notable selection of copper-tinted pictures to enjoy!

Derby Sulzer and Class 31 diesels make for an impressive view in the latest edition of *The Blower*, newsletter of the **Grimsby & Cleethorpes ME**, accompanying a report on the club's August bank holiday weekend meeting. Traditionally the club holds its Gala on this weekend, nut possible this year, so instead a relaxed and socially distanced members day was held and apparently proved successful and enjoyable for participants.

Food for thought?

Finally for this month, regular readers will know that your editor is always attracted to the unusual, especially if it brings a smile to the face – witness a feature in this issue about building furniture from bits of aircraft... So returning to the City of Oxford SME's *Link* newsletter, browsing the pages I was surprised to be greeted by a picture of a Ginster's Cornish pasty....

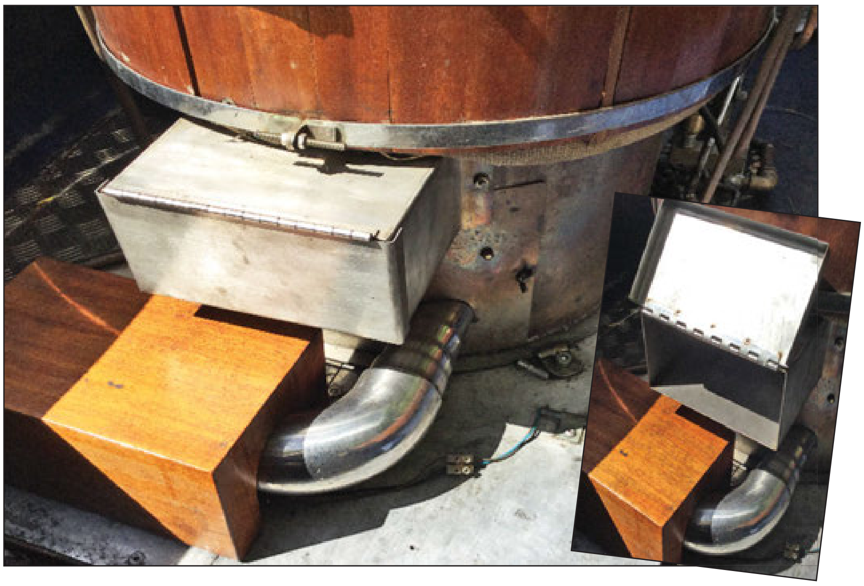
Now I'm quite partial to such delicacies, and so it seems is Oxford member John Winn, who after providing a detailed description of what comprises the savoury item (is there anyone out there that doesn't know?) describes how his passion for the half-round food has led him to build an 'oven' on the side of the boiler fitted to his steam boat!

John explains that the pasties taste much better hot, and the recommended cooking time is 20 minutes at a 160 degrees C. So he has designed and had welded up a purpose-built stainless steel box with a hinged side, and big enough to cook two pasties.

When he reaches his boat he wraps the pasty in foil. Experience has shown that he needs to pop it in the oven around 30 minutes before he reaches wherever he's going to moor up for lunch, and the radiated heat from the boiler duly cooks it, providing a perfectly heated delicacy!

Now your editor has heard of, and even tried, jacket potatoes cooked in a loco smokebox, but a purpose-built pasty oven? There's no denying the ingenuity of model engineers...

Keep the newsletters coming, and the pictures – we need views of what your club is up to that we can feature in these pages! EIM



RIGHT: A steam boat with its own built-in pasty oven – sheer luxury! *Photos: John Winn, City of Oxford SME*

BELOW: A contrast in large-scale miniatures. *Kenny Felstead* pictured the 15-inch gauge Rhyl Miniature Railway on 13th September while we couldn't resist using another of *Tim Gregson*'s shots from the Hastings Gala.

But while these pics are lovely, we'd rather have some shots from YOUR club...

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