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THE MAGAZINE FOR MODEL ENGINEERS

ENGINEERING in Miniature



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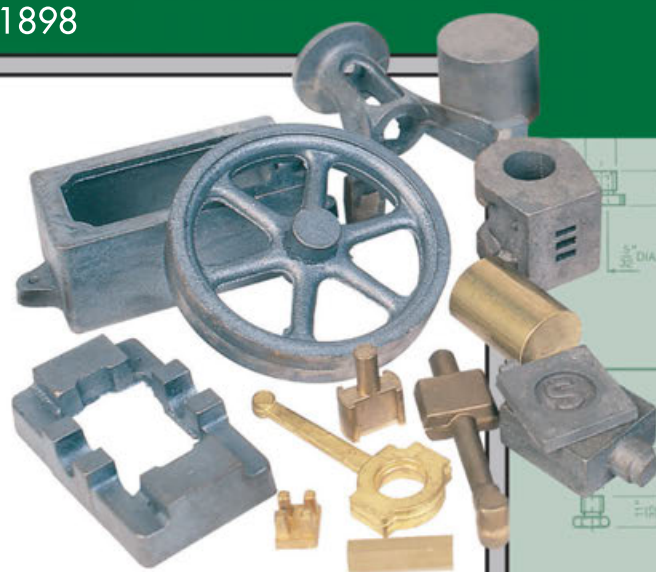


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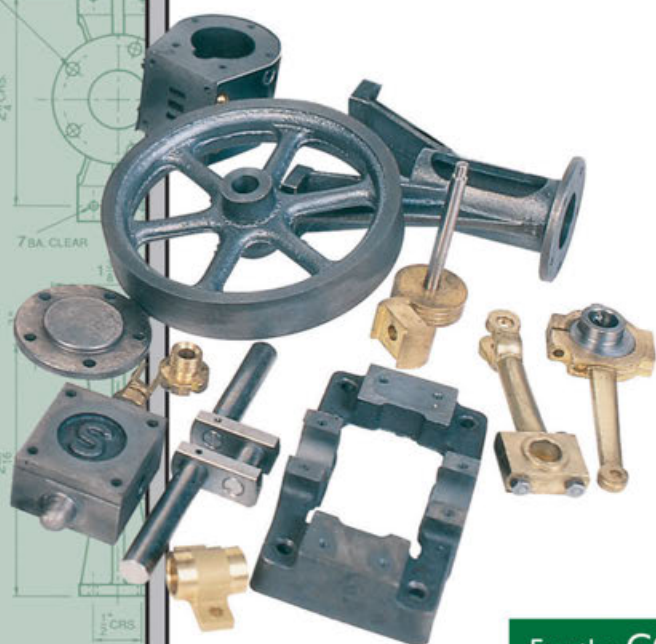
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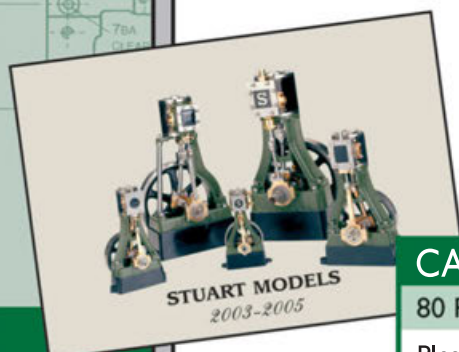
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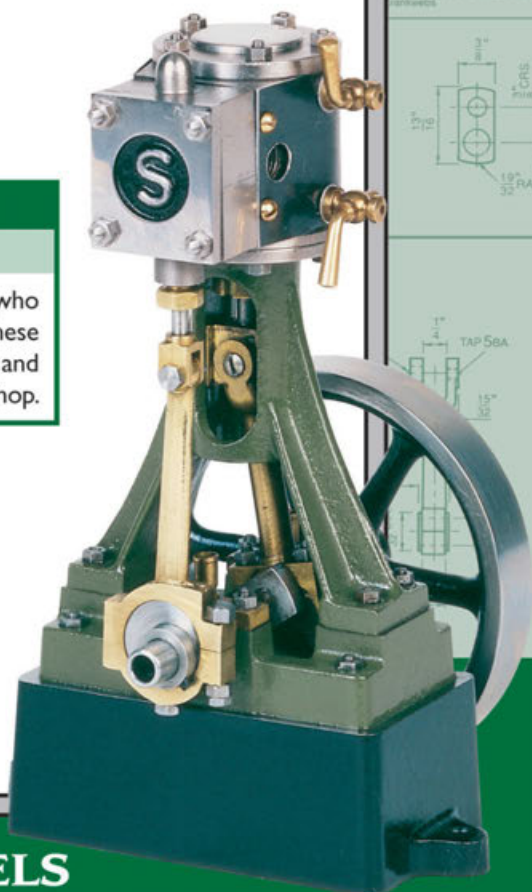
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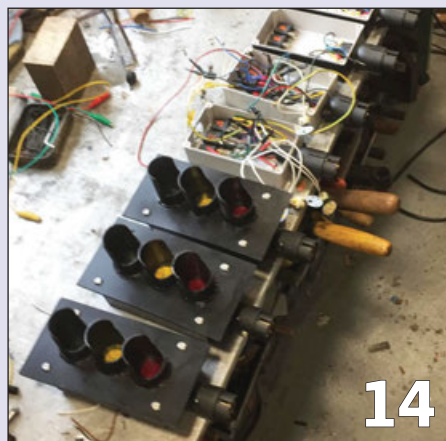
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FRONT COVER

Mutant model engineering? Our editor is one of many who believes the Fairbourne Railway bridges the gap between model and full-size. We take a closer look in this issue. We also focus on Stirling engines, Alan Pickering describing his passion for hot-air propulsion and building this example.

Photos: Andrew Charman/Alan Pickering



EDITORIAL

Motorsport innovations in the model workshop?

Welcome to the October **EIM** as we continue the long, slow path to some form of normality. It's particularly good to see from the various club newsletters that activities are resuming, though I suspect we might not have reason to publish our diary of events until the start of 2021. It's sad but not surprising to lose the Midlands show this year, one I always greatly enjoy.

There is a real hot-air flavour to this issue, and I'm not just referring to this column! Alan Pickering describes both his passion for Stirling engines and his latest project while tech-ed Harry reveals just how these engines work. And after a bit of a gap I'm delighted to have another article in this issue from a young engineer, especially as Daniel Bell is not only building a Stirling engine but designing it as he goes.

I particularly enjoyed Daniel's use of 3D-printed attachments to test whether his engine worked properly before making final pieces. This is an excellent example of industry practice, rapid prototyping, and familiar from another world in which your editor works, top-level motorsport. Leading race teams use 3D printers extensively, for example to create various slightly different versions of an aerodynamic component which they can then take testing over the winter to determine which version will work most effectively before committing to making the parts they will go racing with. It's an important process especially as in many series a finished part has to be homologated by the rule makers, after which it cannot be changed for an entire season. So well done Daniel for using very modern engineering practice!

Congratulations are due to our tech ed as Harry has recently been appointed to head up the engineering department of the 12¼-inch gauge Fairbourne Railway, a lovely little line which as our feature this month describes really straddles the gap between the miniature and full-size worlds. Rest assured Harry's new role will not prevent him continuing to contribute his technical knowledge to these pages (far superior to your editor's!), and in fact it should open up some opportunities for new, interesting features. After all as I point out in the feature, the Fairbourne engines are effectively the rail equivalent to 6-inch scale road locomotives which are a popular model engineering subject!

Andrew Charman – Editor

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Stirling efforts...

Alan explains his passion for hot-air engines and constructs a bespoke example.

BY ALAN PICKERING

My fondness for hot-air engines has taken about 50 years to develop – it's just been lying dormant playing the waiting game.

The subject of this article is the fourth engine I have built since 2016 – I've probably made about ten over the years, good bad and indifferent, learning the hard way, so creating yet another configuration I was happy with took some sorting.

It was the lockdown crisis that actually fired my brain cells into action – mind you I've been practicing lockdown, like other model engineers, for 50 years, it's no hardship for me. There were certain criteria I imposed in order to be happy with the design, but more of that later.

The Stirling cycle is indeed fascinating and very attractive to the model engineer for many reasons, but first I should explain how it came into my life.

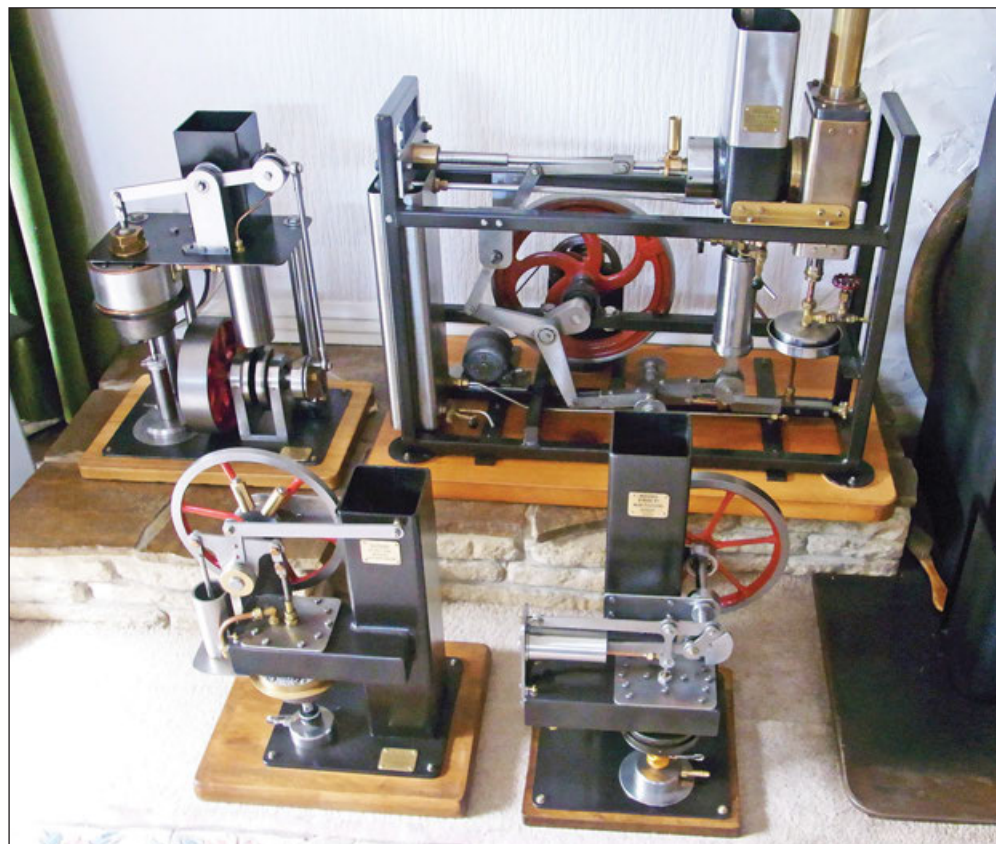
I started model engineering at around the age of 30 (after wasting 12 years in the RAF as a highly trained ground radar fitter, never ever to see a radar set). I stumbled across a model engineering exhibition in Southampton and I have never been the same since, it was a total life changer with my instantly knowing that this was for me.

I read everything on the subject and made a typical start with Stuart Turner engines, then everything in between including converting a full-size Ransomes Crawler to steam power. This ended up on the front cover of a Christies catalogue, and I believe now is in a Swedish museum, though I have not had this confirmed.

Fools rush in where angels fear to tread – my first serious model was a four-cylinder GWR King 4-6-0. I was young and daft and what a massive error that was – I was warned but ignored it. But looking back this engine set me up for life as it programmed the brain cell never to fear any project ever again, so long as I followed the rule to never enter a tunnel unless the light at the end can be clearly seen.

Going large

My models inevitably grew into the larger and heavier scales, big is beautiful in the steam world, size matters! In order to prevent boredom, if you stick my name and model



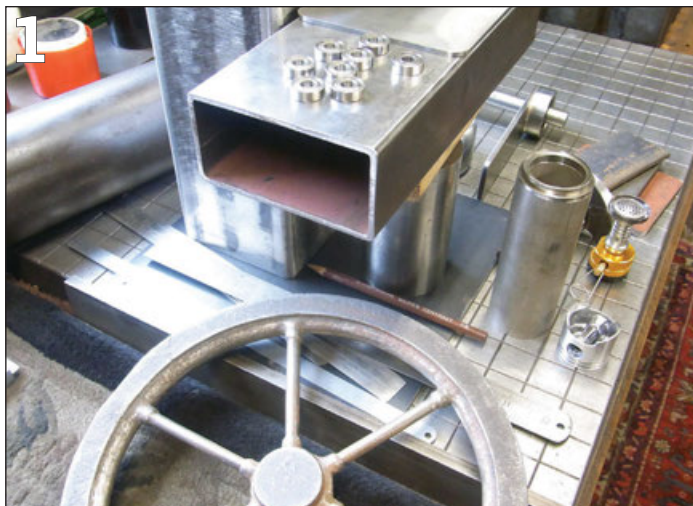
"A steam engine will always work even if built by Mickey Mouse, but a Stirling engine demands perfection..."

ABOVE: Alan has built four very different hot-air engines, each with their own appeal.

RIGHT: The latest engine, the subject of this article.

All photos in this feature by the author





engineering into Google and Youtube you will find plenty of videos of my various models running at shows or in the workshop. Before the age of the digital camera lots of work was unfortunately never recorded, mine included, we just had photo albums which us oldies love to handle for nostalgic reasons – they possess a charm that is lost on the computer and can't be deleted.

Musical interlude

Over the years, however, I became demoralised with model engineering, that's when I started my traditional jazz band which occupied me for 20 years – you will find more at <http://tradjazzband.co.uk> which also includes videos of my hot-air engines.

My modelling was disillusioned by red tape, EU regulations, boiler testing by officials who couldn't boil a kettle – in my view the only objective appeared to be how many passengers would the model haul and for how long.

I do engineering for its own sake, and I entered the world of Stirling engines. It amazes me that they even work at all and many don't – a steam engine will always work even if built

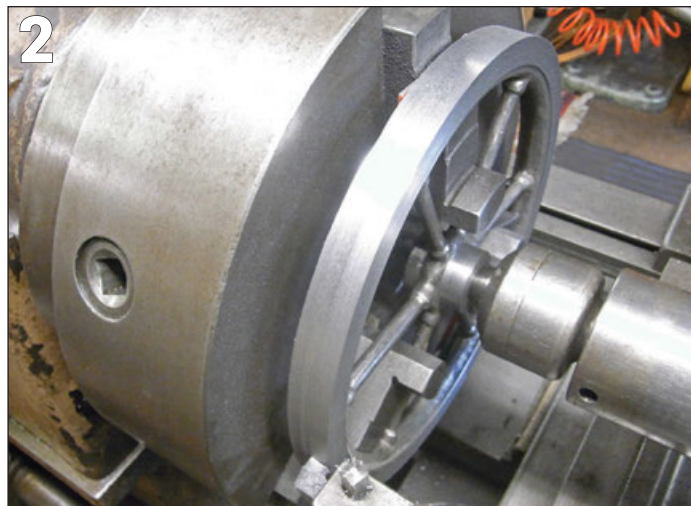
by Mickey Mouse, but a Stirling engine demands perfection. Between 2016 and 2020 I built the four engines in the heading photo to this feature, I wanted them all to be different.

If you want to run for hours then water cooling is essential – all my engines are water cooled and it's this requirement that I find is the main difficulty without resorting to expensive cylinder castings. The small high rpm air-cooled Chinese CNC-made engines are brilliant, but they are not for me. There are so many themes on the same thing – amazing.

The assets required for success in hot-air engine building make different designs awkward to achieve. My criteria includes;

- 1) Water cooling
- 2) Power cylinder oil must never migrate to the displacer hot end
- 3) An open power cylinder draining oil to earth
- 4) Heated from the baseplate
- 5) Smooth and balanced slow running
- 6) Lots of moving parts to see – not an efficient box with a flywheel
- 7) Large/heavy and solid engine that can be left safely unattended.

My biggest engine uses two water towers with a water pump – one uses



"If you have a lathe and a welder then nothing is scrap..."

thermic syphoning, the others just thermal activity.

The Stirling cycle is amazing, pure physics in motion. Heat it with any heat source and the flywheel turns, freeze it and it turns backwards, drive it and it glows red, drive it backwards and icicles form, it's a heat pump.

As Stirling engines are totally silent mini submarines have used them while they can be solar powered in a desert to pump water up from the ground needing high tech and special gases. Good power is only obtained through the use of large cylinders, my big engine is 2-inch x 4-inch stroke. These are wonderful model engineering exercises done simply for their own sake.

The engine focused on in this feature is based on the Robinson linkage motion, designed after much thought and a desire for wanting something different. As usual water cooling it was the major challenge. Over time enough material was unearthed which basically decided the scale along with the available flywheel, due to my policy of never throwing anything away – if you have a lathe and a welder then nothing is scrap. The only purchase was the grotty flywheel, which cost £12 from Ebay (Photo 1). It was full of blowholes and rough as a horseshoe, however it turned out to be superb and true. This was the total cost of the project, not bad for 2020 prices.

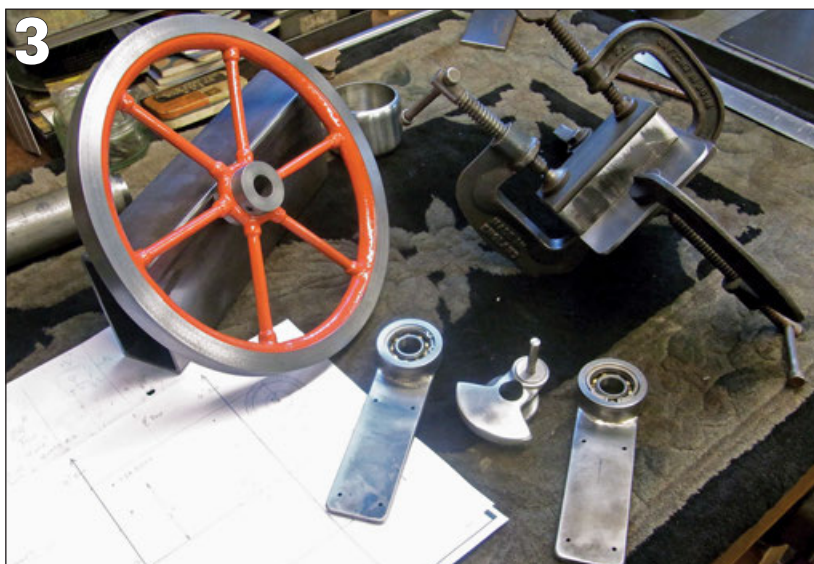
The flywheel was all turned at one setting then reversed for facing (Photo 2). When you drill a flywheel for a crankshaft use a smaller drill then bore it out with a boring bar, only then ream it if you feel you need to. Drills never drill true and the reamers simply follow the error, using a boring bar is the only way to be 100 per cent true. I painted the completed flywheel to stop it rusting away (Photo 3) which it threatened to.

A Seagull outboard motor provided me with two crank webs. I used the other on my Ross yokl

PHOTO 1: Parts gathered to build the engine – only the flywheel was bought-in and then only for £12.

PHOTO 2: Turning the flywheel on the lathe.

PHOTO 3: Completed and painted flywheel with crank web donated by an outboard motor.



**PHOTO 4:**

Squaring up the 4-inch box section.

**PHOTO 5:**

Water spacer welded up.

engine, these have the supreme advantage of being soft and hacksaw friendly giving me a 1½-inch stroke, also seen in photo 3. The displacer stroke is less due to the top link configuration, that's why the link is as long as possible.

The attraction of using the Robinson linkage is without doubt the displacer rod. Its action is vertical, which is almost as good as Watts parallel motion – there is no side thrust therefore a smaller diameter rod can be used with no gland, friction or air leaks. The weight of the descending piston helps to stop the motion locking up.

While looking dead simple, for me this proved to be a very difficult engine to build. The big problem was the marking out – I used an optical centre punch, dial height gauge, surface plate and lots of big measuring gear.

Not as it seems

The 4-inch box section looks square, but try telling that to a surface grinder. These sections are great for skyscrapers but not hot-air friendly without some work to square them up (**Photo 4**). Once you think it's square then it's time to start welding, resulting in all the references being lost, so it's back to the surface plate. This becomes a constant routine until the piece looks like a crossword puzzle and ripe for mistakes which come thick and fast.

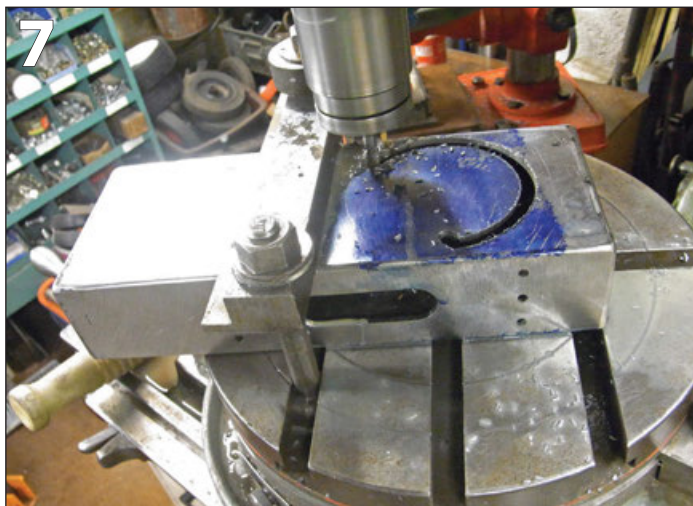
The water spacer was particularly painful to make and get square in all planes, (**Photo 5** and **6**). There are some 50 2BA screw holes altogether, all providing potential air and water leaks. When tapping into a tube only use the first taper tap halfway and keep trying the screw until it can be forced in tightly, the same applies to the clearance hole – find a tight drill then letter stamp so that it all goes back together after painting. The

whole engine is as if it had been built with dowels.

The Robinson engine doesn't follow the conventional rule of thumb for Stirling engines, such as 1:1.5 swept volume ratios. The length of the displacer piston is one third the length on the cylinder stroke, two thirds of d/cylinder length. A long displacer cylinder is desirable as the temperature gradient is more gradual, however in this engine the diameter of the hot end is much larger giving more red heat where it matters most to compensate. The ratio of swept volumes is 1:3, this gives superb results, better than expected. All my other engines have bowed to convention but don't seem any better for it. This is my first over square engine and it is consequently faster.

Photos 7-12 follow the build sequence for the displacer. A tricky job was to produce the two 3.5-inch holes (**Photo 7**) in the 4-inch box section, ensuring they were accurate on both sides. The stainless steel sugar basin piston only has 60 thou clearance all round (**Photo 8**).

What made this engine difficult was basically the framework, originally I planned to weld it together as two pieces but soon discovered that it would be impossible to assemble,



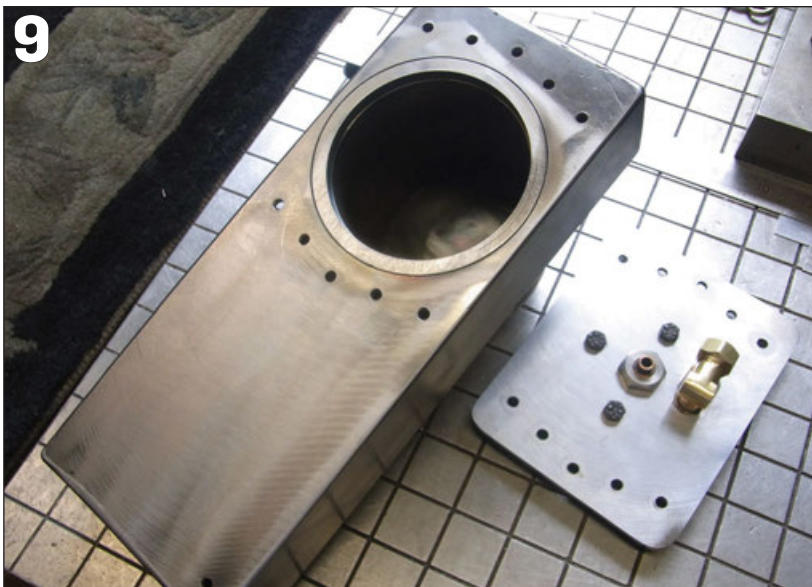


PHOTO 8: Stepped displacer with its completed cylinder alongside.

PHOTO 9: Displacer top ground for gasket. **PHOTO 10:** Brazing hot end only.

PHOTO 11: Water spacer setup. **PHOTO 12:** Completed displacer assembly.

PHOTO 13: Clever flameguard, crafted from stainless steel top of a coffee jar.

braze or machine hence the need for a water spacer and 40 screws. It comprises three pieces, all needing gaskets. The difficulty as always was keeping everything square, with too many parts it's not easy.

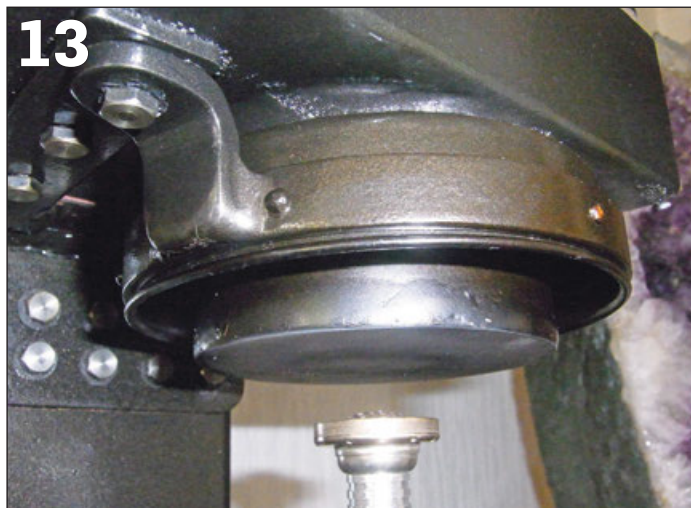
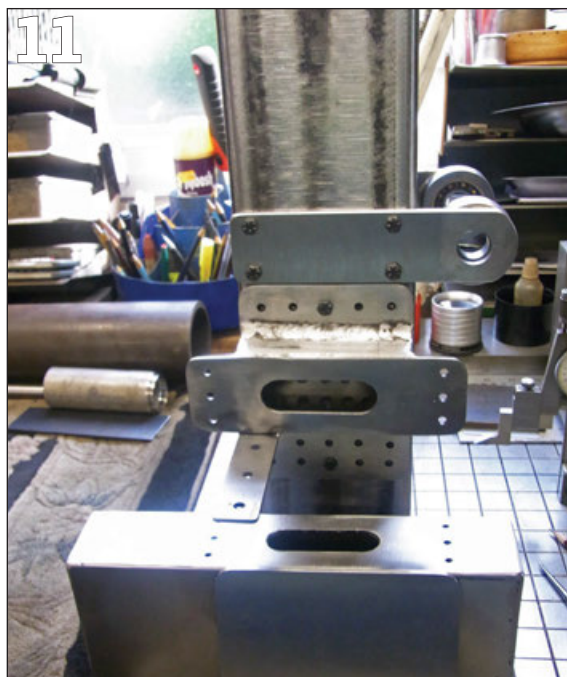
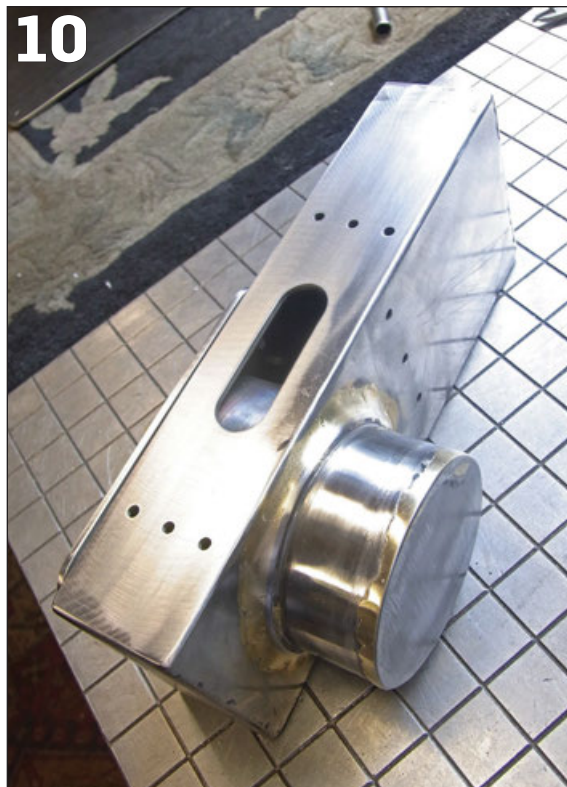
Photo 9 shows the top of the displacer cylinder ground flat for a gasket and **Photo 10** the brazed underside – I learned not to braze the top from the problems encountered with the distortion I had when building the Ross yolk engine with its thin stainless steel cylinder. That's why I opted for using a 1/4-inch thick steel cylinder in this engine, a wise move. **Photo 11** shows the water spacer setup and **Photo 12** the finished displacer assembly.

I installed what I considered a nice touch, the flame guard, **Photo 13**. This was the stainless steel top of a coffee jar, the use of which turned into a

nightmare as I had no spare. It's about 5 inches in diameter and had to have a 3 1/2-inch hole in it but how?

I bolted it onto a piece of plywood then put the lathe in back gear. I aimed a pointed boring bar at the piece from behind a riot shield – the shrieks could be heard for miles. An approximate hole appeared with a razor-sharp edge and was ground to size using a 3-inch flap wheel in a drill. These are very useful items, I also used them to hone the power cylinder to size.

Photos 14 to 17 show the construction of the cylinders and motion, following traditional methods. The 34mm diameter piston has to fall through with its own weight, there are no piston rings only a bit of soft graphite packing. Again there were alignment issues as the gasket thicknesses were not taken into



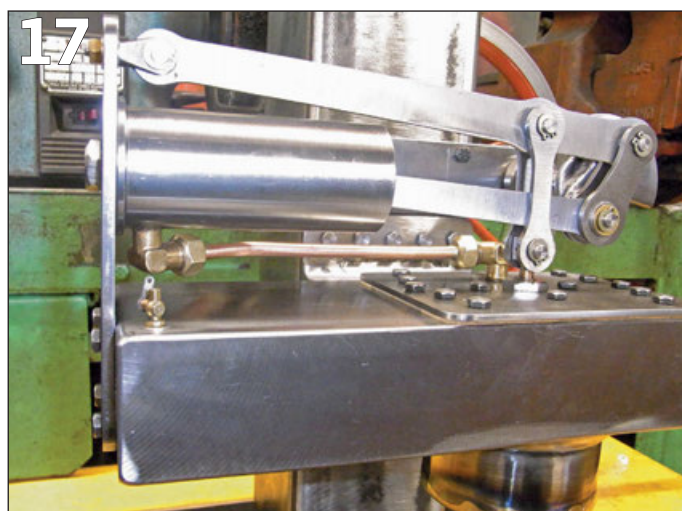
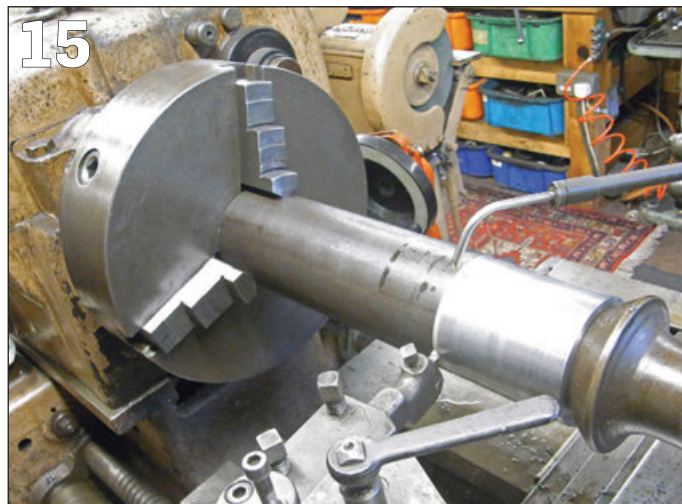


PHOTO 14: Boring the stainless steel power cylinder....

PHOTO 15: ...and the displacer cylinder.

PHOTO 16: Horizontally milling the motion.

PHOTO 17: Mock-up gasket.

PHOTO 18: Completed engine running, delightfully slowly.



account. Building freelance you can't think of everything, it helps if you commit your thoughts to paper now and again but that's far too obvious, old habits die hard. Height, length, width, centre lines, bore and stroke are important though before metal cutting starts and then the fun begins, I love it, keeps the brain cell active.

A point worth mentioning is the transfer pipe, it feeds the bottom of the power piston but this is just an illusion. The first 1 inch of the stainless steel cylinder is solid, drilled for its m10 fixing bolt right through on centre line. The transfer pipe elbow is tapped into this drilling ensuring that no cylinder oil can migrate into the displacer hot end.

There are lots of water drillings in all the box sections, a copper pipe connects the bottom of the tower to the 4-inch x 2-inch displacer cooling section, hopefully this encourages thermal activity to develop.

First-time success

Robinson engines soon heat saturate after a few minutes of running but this one will go on all day, it's very successful and silent and the only Stirling that I've made that worked instantly on completion with no hassle, something previously unheard of.

In practice after two hours of running it hurts to keep one's fingers in the top of the water tower yet the base is only at blood heat along with the copper pipe so it works fine and seems unaffected by running time.

This engine is more efficient than my other models only needing a low flame to power it, while the warm-up time is just 10 seconds.

The burner is a cannibalised camping stove with a magnet underneath to keep it in its keyway.

Big hot air engines are rarely seen at exhibitions – the public fall into two groups, the know-alls and empty heads. The latter will just walk past but the know-alls tell you what it is, how fast will it go and such, ask if it has a whistle or a bell then educate their offsprings about steam.

These engines have a charm that is exclusively their own. They are hypnotic when running slowly – it's easy to make a fast engine but to work very slowly that's where the skill comes in. Everything that moves is on ballraces, no friction, perfect alignments and balanced.

It's a great satisfaction to turn scrap into what is basically an ornamental talking point, eventually to spend its days in a museum educating visitors for 100 years. **EIM**

How Stirling engines work

Hot air from our technical editor, unravelling the mysteries behind one of the less-understood avenues of model engineering...

BY HARRY BILLMORE

Stirling engines operate on a different principle to most other propulsion sources familiar to model engineers. A Stirling is a form of hot-air engine – a regenerative heat engine using the differential in heat between two areas of a closed cycle to generate mechanical energy.

Due to the closed loop design the same working fluid (usually air, but in some cases this can be exotic gases as discussed in Alan Pickering's build article) is expanded (heated) in one portion of the engine and compressed (cooled) in another, resulting in a net conversion of heat to work. The inclusion of an internal regenerative heat exchanger is what differentiates Stirling engines from other hot-air engines and increases their efficiency.

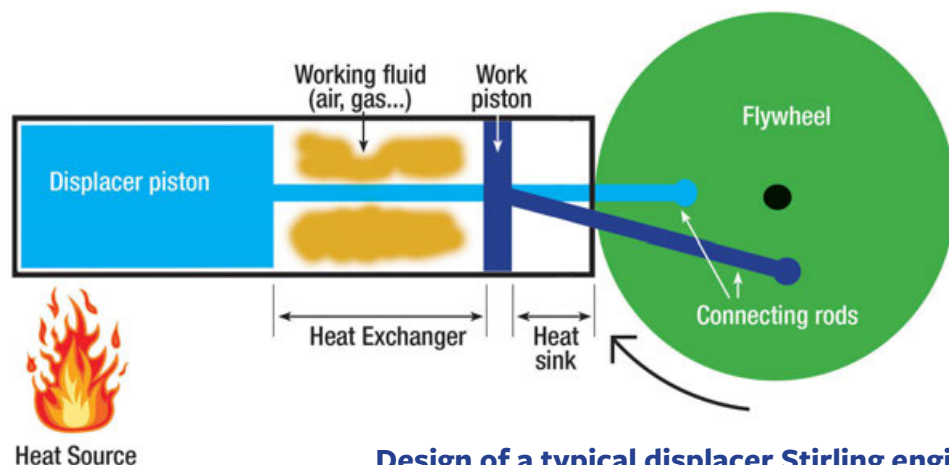
So that's the technical explanation, now we can move on to a description of the physical components, which are:

- 1) A **heat source**, which is usually combustible fuel
- 2) A **heater** or hot-side heat exchanger, usually the bit sat in the flame from the heat source – the better the thermal conductivity of this component the better
- 3) A **regenerator**, usually a mesh, but it can be a foam. This is present to recycle heat from the hot side to the cold side as the working fluid passes through it. This increases the efficiency of the engine while also increasing the power available from a given temperature differential between hot and cold exchangers
- 4) A **cooler** or cold-side heat exchanger, usually a finned section or water cooled to increase the amount of heat differential
- 5) A **displacer**, usually a loose-fitting piston that moves the air around in the working cylinder
- 6) A **power piston**, usually a sealed piston to transfer the changes in heat to useful work output.

Engine varieties

There are several different configurations that Stirling engines can take:

- A) Two power pistons at around 90 degrees to each other, operated from a single crank on a crankshaft. The closed end of each cylinder is joined by a tube which contains the regenerator. One piston is heated and the other cooled, and the direction of rotation can be changed simply by



Design of a typical displacer Stirling engine

swapping around which cylinder is heated and cooled.

B) A single-cylinder engine, with a hot end and a cold end, containing both a power piston and a displacer piston, set out of phase from each other.

C) Two parallel cylinders, the first containing a power piston and the other a displacer piston set at 90 degrees to each other. The cylinder with the displacer has a hot and a cold end and usually contains the regenerator. The cylinders are joined to form a single space for the air to move in.

All of these combine to create four thermodynamic processes working on the fluid:

- 1) The air in the hot heat exchanger is heated and expands.
- 2) The gas passes through the regenerator, cooling and transferring heat to the regenerator to be used in the next cycle.
- 3) The gas is cooled in the cold heat exchanger, compressing and reducing in volume.
- 4) The gas then passes back through the regenerator on its way to the hot

BELOW RIGHT & BELOW:

Modern Chinese-made models on show at the 2018 Stirling Engine Rally. Photos: John Arrowsmith

heat exchanger, heating up as it goes.

It is the differences in the volume of the hot air and the cold air that operates on the power piston to produce the mechanical force. The displacer piston is present to assist in the movement of the air between the hot and cold heat exchangers. **EIM**



New signalling? Simple...

Chris describes the project to design and build a new and safe signalling system for the Rugby Model Engineers' complex Rainsbrook track

BY CHRIS HILL

A note from the author – As this is a safety system it needs to be said that this is written in good faith, and if the design is repeated it is expected for that party to acknowledge and communicate with RMES for any updates to the system as a result of development. Following the system is at the readers own risk and I or RMES are not accountable for omissions in design, working practice or issue arising outside of our control. Our view is that this is merely an informative share of our system in its current guise.

Back in 2017 as a member of Rugby Model Engineering Society I was involved in a working party to discuss how we could update and renew our ageing signalling installation. First step was a brainstorm of ideas but most importantly to set out the working specification of the system. We also considered other systems in existence and merits of them as a benchmark.

As with all ideas we came up with complicated ones, simple ones and very comprehensive ones using microcontrollers, wi-fi, Bluetooth, identification modules on trains... – as you can imagine when a few ideas start flying around it's amazing how complicated you can make something that in essence is quite simple. We even thought about putting the signal in a cab module.

All things considered, we boiled down the good, the bad and the ugly ideas and came up with what we wanted, rather than what was available at the time.

We listed out the specification into six clear objectives;

- 1) It must be simple and modular
- 2) It must be simple and safe
- 3) It must be simple and repairable
- 4) It must last for 30-plus years
- 5) It must have full three-aspect signalling
- 6) it must be simple (I thought we covered that above but I added it just in case...).

As you see simple figured high in the design specification. The main overriding reason for this was that a lot of the club's members past, present and future are not engineers by trade and the current system, although quite proficient for many years, had a complexity that made it difficult to fix



ABOVE: The new Rugby ME signalling system in action, adding both track safety and extra interest for visitors.

All photos and diagrams in this feature by the author

by the uninitiated. Additionally the number of interconnects meant that mowing accidents caused many a headache for the signalman.

Simple designs are often comprised of well-used and understood technologies. Simple in this case also meant throwing in water, oil, steam, spiders, the odd mowing incident, fluctuating voltages and all the things that exist in the outside world.

Next hurdle to be associated with simple was durable. Unfortunately anything with a memory aspect is on borrowed time. Those microscopic switch junctions have a finite life and cause chaos when they fail and the same unit can no longer be sourced 10 years down the road, let alone being able to find the guy who programmed it, you would be in the realm of "bin it and start again".

Following closely was complexity of wiring – the existing wiring and the increased size of the site, pointed to

using a 'minimal is best' philosophy. That strayed us away from a central controller and concentrated the mind on a local block controller that merely talked to the previous and next block.

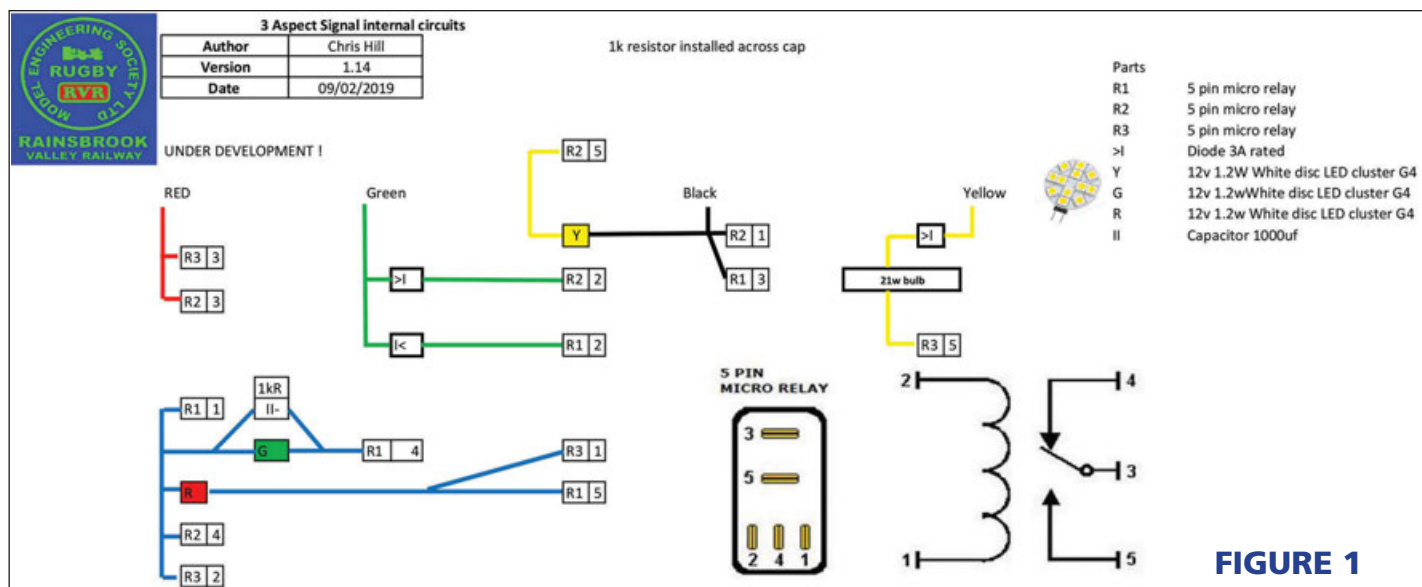
Keep it simple

So now to make something with the least amount of parts, that was 'as simple as a 1972 Land Rover'. To begin with, we wanted commonly available parts. You don't want something that is here today and gone tomorrow, I'm sure we've all been there. We tried hard here, and we ended up with some pretty basic items that aren't likely to be disappearing any time soon;

1) **20A 12V micro relays** – these have been about since the '90s and are cheap, well proven and reliable unit used in every car now and for the foreseeable future

2) **Diodes 1N5401** – robust and plentiful, again they have been about for years in all sorts of applications

3) **Capacitors 1000uF** – robust and



plentiful to debounce contact

4) Resistors – robust and plentiful, we use a couple of different types of 1K variety to deplete the capacitor and kill stray spikes

5) Low current light source – like everyone else looking for low current use we ended up with 1W LEDs, a G4 disc LED for this application which is nice and bright. We used cool white ones and stage filters to give good clear colours for the three indications

6) Power supply – we used 24V units used as supplies for 3D printers, they are very common now. They are tunable to give 8 amps output and are isolated. They have a useful ability to take either 110 or 240V input as well, giving us options depending on installation location. We use a 24V to 12V voltage dropper in the heads and these are sealed units often used on trucks for 12V accessories. They will maintain 12V even when 24V is lingering down to 18V

7) Wire – yes we tried to make it from printed-circuit boards and variboard but wire is easy, cheap and durable. We needed a three-layer board which proved too complicated for our ‘shed activity’. Plus wire ticks the ‘anyone can fix it’ box, because colour-coded diagrams and the circuit can be easily followed, even if not understood...

Why not a micro controller you ask, as they are cheap and readily available? Simple really, you still need a relay and in five years it will be outdated and the software will be lost or Windows no longer compatible! So it is of no real advantage if you can achieve the logic you demand with just a relay. A relay you can hear, measure and feel, and you can take out of the box when it is raining, and falls into the category of “if it’s broken, bin it and fit a new one”. Not only that but small-form electronics don’t like to live outside, especially with the large metal bits of high inductance

FIGURE 1: Internal circuits of signals – for full description see text.

“Simple in this case also meant throwing in water, oil, steam, spiders, the odd mowing incident, fluctuating voltages and all the things that exist in the outside world. ...”

that can deliver nasty transients that have to be harnessed and developed out of a system.

Make it safe

Why does this come second you may ask? A simple, understood system is going to be reliable, reliability gives faith that the signal is telling a driver and guard the truth, so it will be followed. It’s no good having an air bag if your car won’t start and you have to walk down the road mixing with traffic!

Firstly it needed to be fail-safe.

The system must not change aspect to green unless it has had clearance from the next block, and the block is devoid of a train.

The system must be able to be triggered to red if required by a guard or track worker. It also need full block sensing of train. In the event of a intermittent power cut the system will resume function.

So what does this mean? Basically the trigger and reset need to be linked so both states cannot be present – so if a break exists down the road the block will have triggered to red but if it cannot get a reset it has latched failed safe. This all pointed towards the use of track sensing.

The design journey

With the discussions and brief above a design was hatching in my head, which was in essence simple, but proved to be a head scratcher to get the concept fully developed, hence a couple of debounce capacitors and leak-down resistors to stop disco lighting when long trains traverse blocks.

To achieve red and green states, the left rail is used as a continuous ground, and the right rail as a switch that is made by the axles of the train. This drives a two-state relay – one pole red and the other pole green. If

we stopped at green and red and didn’t want the safety latch it would have been simple and ended here.

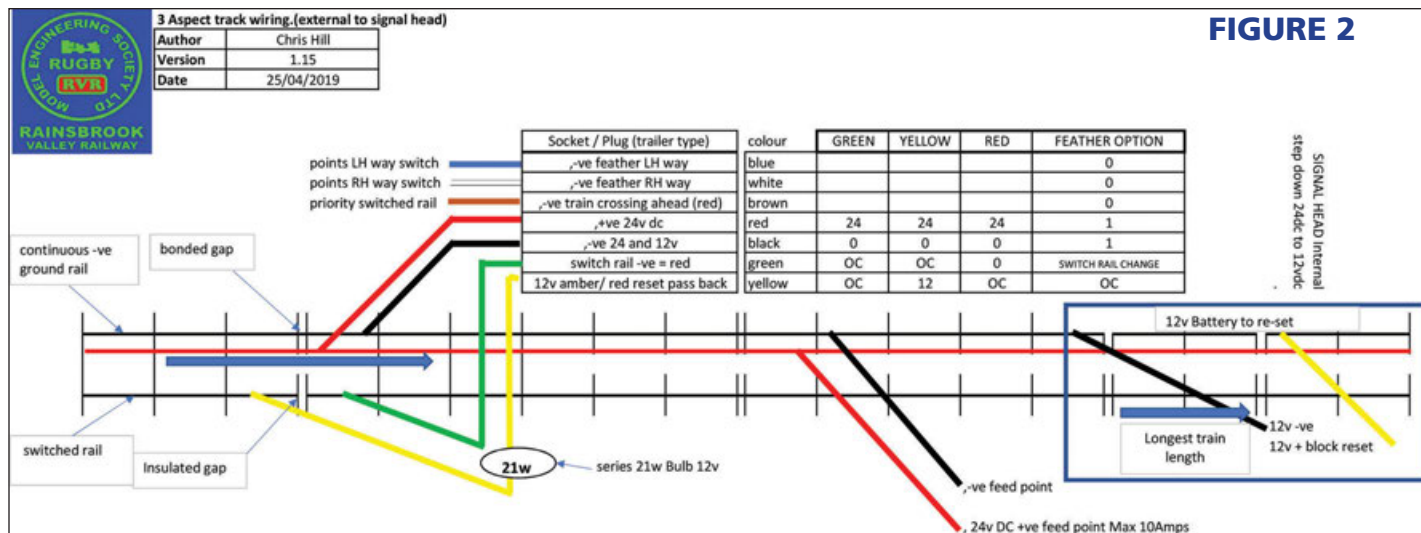
So how do you get a yellow and latch logic? Roll on a year of development and testing... hey presto.

Only joking, I will reveal all! Just remember my vanity asks if you repeat this it was my idea first, to my knowledge... As with all things someone has probably thought of it before but has applied it to a different solution. Referring to **Figure 1**, an unconventional diagram (I was asked to make it look as simple as possible)...

It’s a simple state logic – for the signal to have red on and off yellow on and off and green on and off you need six-state control. Three dual-state relays give you this six states (some clever dude will no doubt harp up that actually you get eight... 2x2x2 does equal 8. This is true but all on, all off and the disco combinations are not good signal states I am told so I will ignore them! The logic of eight states is still required as the redundant combinations are required for latching the circuit. In fact to get it working correctly I needed more logic gates in the form of diodes.

Back to the yellow question... (see **Figure 2**) To get red I simply use the right-hand rail as a switch to the left-hand grounded rail and run this as a ground to a changeover relay coil, the output of which goes to a supply to either a red or green lamp. But this would flicker as a train goes over and would not latch, so the red state once gained also has a feedback to latch itself on. This will now stay at red all day until the supply to the relay is cut to allow it to reset – in comes the next relay, this controls the feed to the first and is energised to break the supply of the first.

How do you reset? The feedback rail has three states; **floating** = no train in block, **0V(ground)** = train in



block, and 12V which comes on when the train passes the next signal which is now at red which feeding back 12V along the switch rail to the preceding signal. This 12V feed comes from the third relay that is energised by a red state and has a 21W bulb restricting the current to 2A, so if a train enters the now yellow state the rail is again grounded by the left-hand rail and axle, and the voltage then drops to 0 and the red kicks in again. Or when the next block the train is traveling too goes yellow, the one behind goes green if no train is present in it.

The power

So how do we power the system for a mile and get connections to work over that distance?

We used five 24V isolated power supplies (which we can turn up to 28V) DC at 8A and a conductor down the centre of the rail sharing a common ground with the head which has a step-down regulator to 12V. This allows 24V to drop down to 18V over distance and to still give us 12V at the head. Coupled with the low

consumption of the LEDs the volt drop is manageable.

In a worst case where all blocks are at yellow bar one, the system is rated and tested to cope. This will limit the railway to 21 trains for the time being, but as it is modular we can add some more if we fancy it.

The centre conductor was again a 'make it simple' exercise as we did need a mile of it and we were keen to avoid 'attractive' copper that might attract light fingers. We found that quality galvanised fence wire was quite adequate and cost-effective, and we used fence clamp screws to join to the heads without breaking the continuous line.

The insulated fishplates that we employ are made from nylon and are used to denote blocks, and isolate cross-welded points and crossings. We had these laser cut by an outside company and they are designed to fit the 6lb/yd rail that we use, along with the standard bolts to suit the normal fishplates.

I take my hat off to the guys who went round putting loop bonds on

FIGURE 2:

External track wiring – for full description see text.

BELOW:

Adding copper bonding wire across fishplate joint maintains the electrical continuity around track

BELOW

RIGHT: Typical signal post. To ensure posts are 'mower resistant' they combine a scaffold pole with a cast concrete foot.

every rail joint around the track using stainless-steel clamp screws and eyeleted link wires. These we found necessary to maintain a satisfactory electrical continuity around the track, as the fishplates weren't covering the distance. We found that they only maintained switching for about five rail lengths, each of six metres. Adding a copper bonding wire screwed into the rails across the joints has improved this to well beyond 20 rail lengths which is our current longest block.

Head wiring

A standard block head has four connections to the track, 24V, switched rail, Negative rail, and previous block switched rail. We used 6-metre 7-pin trailer extensions which double up as a head mounting and socket.

The structure of the signal head is a commercial IP67-rated box big enough for the lamps and wires to all fit inside, as the system has no external relay cabinets to contain switching equipment. In a nod to railway



architecture to maintain appearances, and in order to add anti-glare hoods to an ordinary flat box, we fit a fabricated face on it which is made from laser-cut plastic sheet, and ordinary black domestic pipe.

In use the system is design to draw current at the following levels;

Green – 50mA

Red – 60mA to 1.8A when train is traversing block or has entered when on yellow

Yellow – 120mA to 1.8A when train is traversing or parked on the block.

This makes it quite a low power system and is reasonably energy efficient. A skeleton box is shown in the picture.

I hope this little article explains the process we went through to design the system. Once we are allowed to be back up and running as normal, feel free to come down to the next open event at Rainsbrook Park to see it in action. The first people to see the 'production version' were at the 2019 Narrow Gauge event where we had the first three of 20 planned signals in action on the new section of track. This was the first 'real world' test for the signals and each one worked perfectly. We've since rolled out more of the heads and we had the remaining sections of track wiring complete by the end of 2019. This involved mass producing signal heads and poles, and blitzing the installation of track wiring.

Finally I must add a big thank you to the Rugby team for having confidence in the concept, fitting a large quantity of link leads around the track and making poles and anchors. And massive thanks to my dad Peter for manufacturing most of the heads and fitting them to the rail. **EIM**



ABOVE:

An assembled signal box.

RIGHT:

First batch to be fitted out on the line.

BELOW:

Mass production of signals underway.



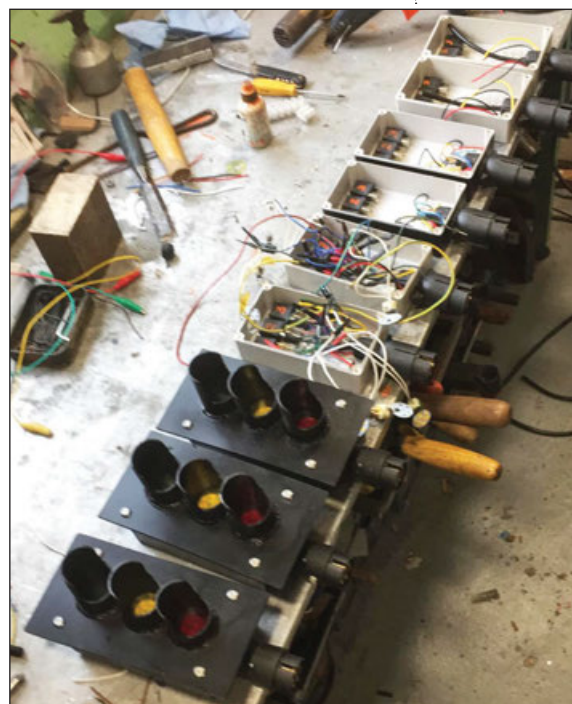
LOWER RIGHT:

Clear road ahead – installed signal in operation.



BOTTOM RIGHT:

Train passes and the signal resets to danger.



Copper plating for model engineers

Rich's journey through protective platings reaches the not universally known copper.

BY RICH WIGHTMAN Part three of four

Copper plating has some uses that may be of interest to model engineers. Model engineering covers a wide variety of subjects, not all of which I have tried as yet – copper plating can create a uniform colour over dissimilar metals and is widely used in the steampunk art world to good effect. It can be used as a base onto which other metals such as nickel can be plated. It can allow soldered connections to be made onto non solder-taking metals, to name a couple of potential applications.

For those that have just joined us and not read my previous scribbles (zinc-plating in the August issue, nickel in September – Ed) first and foremost let's get the 'elf n safety' bit out of the way. We will be using fairly safe chemicals but please let common sense prevail. Wear protective clothing, eye protection, rubber gloves and such. Definitely don't drink it, sniff it or eat it!

We will be making copper acetate which is poisonous but in the concentrations and small quantities described here is safe enough. But after use ensure that you clean down all surfaces and such like and wash your hands thoroughly, something we are all well used to these days...

A final health and safety thought – it would be wise to clearly label the contents of each container.

Materials

Right, let's get started. We need to gather a few materials, some of which you may already have if you have had a go at the zinc or nickel plating described previously.



ABOVE: Effect of copper plating clear on this coin...

PHOTO 1-5: The materials for copper plating – see text for details.

All photos in this feature by the author



- 1) Distilled white vinegar, five per cent acidity (Photo 1)
- 2) Hydrogen peroxide, three per cent or higher (Photo 2)
- 3) Electrical alligator leads (Photo 3)
- 4) A power supply (Photo 4)
- 5) A bit of scrap copper (Photo 5)
- 6) A Mason jar (also in Photo 5).

The only thing I need to point out from the above list is the hydrogen peroxide. It is used for bleaching hair but before you go raiding the bathroom cabinet the hair-bleaching type is not the one we want. The hair-bleaching type is not pure enough, often containing some sort of cream. A quick disclaimer here, I am no expert on bleaching hair! The type we need is food grade and can be easily purchased from that well-known online auction site. I'm sure there are other sources but I didn't bother to look any further.

To make the electrolyte which is copper acetate mix equal parts – in other words half and half of distilled vinegar and hydrogen peroxide. It doesn't need to be exactly 50/50, near enough will do.

Some sites I researched said that warming the mixture in a microwave or gently heating the glass jar over a low heat will speed up the chemical reaction but I didn't bother mainly because my Mason jar is too tall for the microwave and has a metal band around its neck – we also don't have a gas hob, ours is an induction hob which only works with pans containing iron. In any event it would be wise to consult the higher authority before taking over the kitchen!

Next put a piece of copper into the vinegar/peroxide solution (Photo 6). I used a scrap bit of thin copper sheet. Before dropping the copper in make sure it has been cleaned and scrubbed in water to remove any grease or dirt which may contaminate the solution.

Fasten the lid and give it a shake. After a while the solution will start to turn blue. The longer it is left the darker blue the solution will become. It doesn't need to be overly blue, too strong a solution will lead to uneven plating (Photo 7). Now we are ready to copper plate something.

Plating process

Connect the positive lead to the bit of scrap copper and put it to one side of the jar, this is the anode. Keep the alligator lead clear of the solution. Prepare the part to be plated by thoroughly cleaning to remove all dirt, grease, fingerprints and the like, and wash in clean water. I prepared a bit of scrap brass as a test piece (Photo 8).

Now attach another lead to your part and connect to the negative lead of the power supply. If there is a



PHOTO 6: Scrap copper in the plating solution.

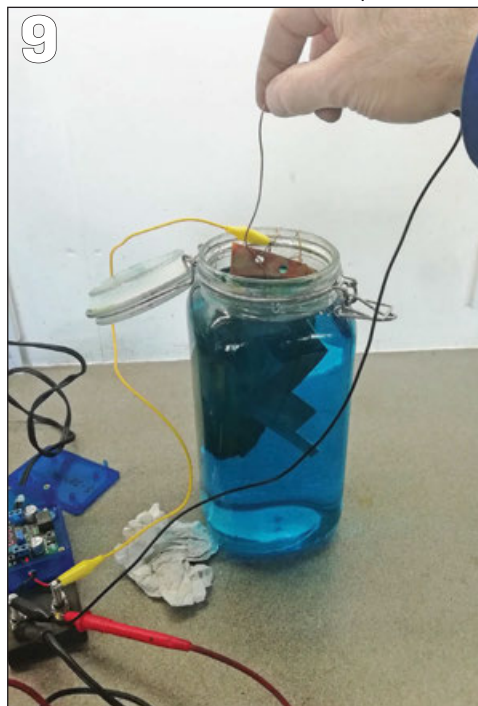
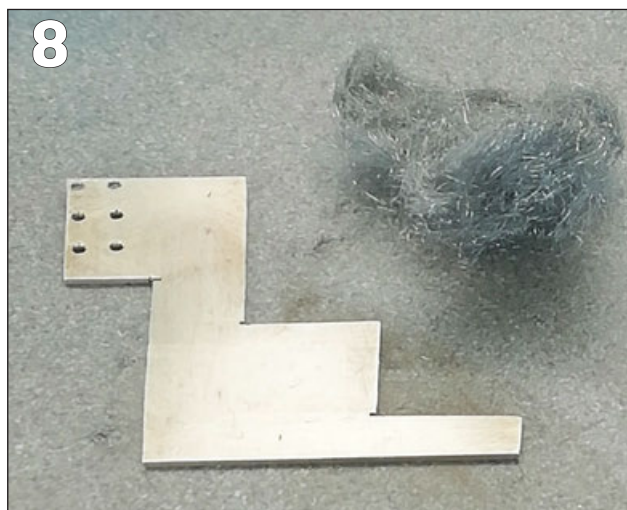


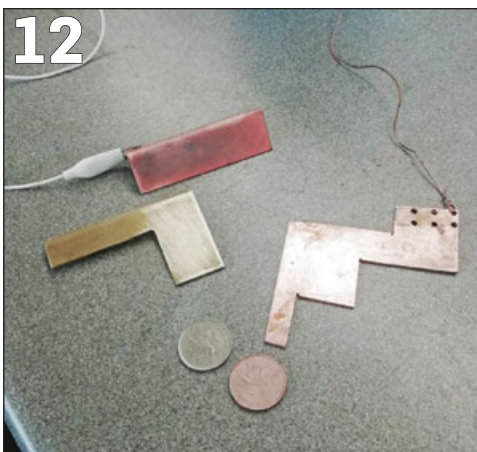
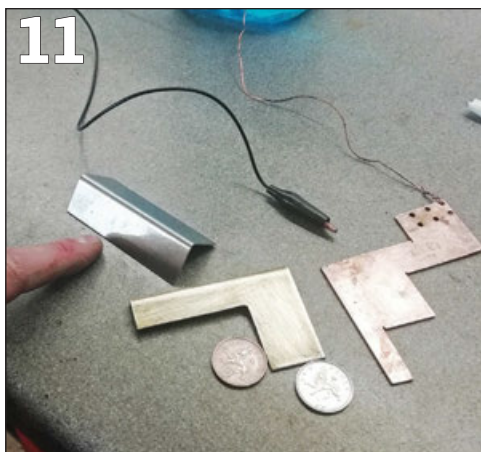
PHOTO 7: The solution has turned blue.

PHOTO 8: An offcut of scrap brass used as a test piece.

PHOTO 9: The test piece being dipped in the solution.

PHOTO 10: The test piece after plating compared to another piece of scrap brass.





convenient hole in the part copper wire can be used and the part can be fully immersed.

Turn on the power and dip the part partly into the solution keeping the lead clear (Photo 9). Keep the part moving and turn it around. Before long the part will start to turn red as it is copper plated. Remove the part and move the alligator clip around if necessary and dip again.

Repeat the process until an even colour is obtained. Photo 10 is the test piece alongside another bit of scrap brass for comparison. The heading photo on this feature is a 10 pence piece copper plated. As far as I can see it is not illegal to plate coins as long as you are not trying to defraud anyone. Not that you would want to pass off a 10p coin as 2p coin...

I experimented with bits of scrap

brass and steel and achieved quite good results. I found a scrap of chrome-plated steel sheet (Photo 11) and copper plated that (Photo 12). Then I quite easily soft soldered a wire to it (Photo 13).

Okay, that's as far as I went with plating. Zinc plating I have used many times and is a good way of protecting steel parts. It can be left as is or painted at a later date. Nickel plating is a great way to get a nice even shine on parts. Parts made of dissimilar metals silver soldered together also turn out nice with an even colour.

To conclude my experiments I had a go at etching (Photo 14), which is similar to the plating process but in reverse, in other words we want to remove metal from our part not add to it. I'll describe this process in the final part of the series next month. **EIM**

PHOTO 11: A scrap of chrome plated steel

PHOTO 12: The chrome steel after copper plating

PHOTO 13: A wire can easily be soft soldered to the chrome steel once it has been copper plated.

PHOTO 14: Coming next month, etching...



PHOTO EXTRA

A spare half-page gives us a chance to evoke memories of one favourite pastime Covid-19 has robbed us of in 2020 – steam rallies! Illustrated here is a taste of the miniature and the full-size content at the 2017 Shrewsbury Steam Rally, one of the top five such events in the UK. In this particular year it featured among other things a visiting loco from the Welshpool & Llanfair Light Railway and an impressive line-up of Sentinel steam wagons – no surprise really as they were built in the Shropshire town...

We need to be patient – Shrewsbury and all the other rallies have promised to be back in 2021, and to be better than ever...

Photos: Andrew Charman



Building a Ten-Wheeler

Having cast the wheels for his 7¼-inch gauge locomotive project in the last episode, this month Jan-Eric sets about machining them.

BY JAN-ERIC NYSTRÖM Part Nine of a series



Last month we saw how the patterns and moulds were prepared, and finally witnessed the actual casting of the wheels and the other parts for my 4-6-0 locomotive. Now it is time to machine all the castings to their final shape.

Starting with the smaller wheels for the tender and the front bogie of the engine, I contemplated a few different ways of holding the castings in the lathe. Unfortunately, my two chucks – one a self-centring three-jaw, the other an ‘independent’ four-jaw – were both too small for the job. However, I had earlier made a simple face plate, about 200mm in diameter, so this could be used for holding the castings. The only question was, how?

Clamping the castings to the face plate was one possibility, but that might be a bit of a hassle, because the clamps tend to get in the way during turning – you really need to get the tool bit to access all the surfaces to be machined, preferably without re-positioning the casting in the process. With a small wheel, there is also little room for clamps between the spokes.

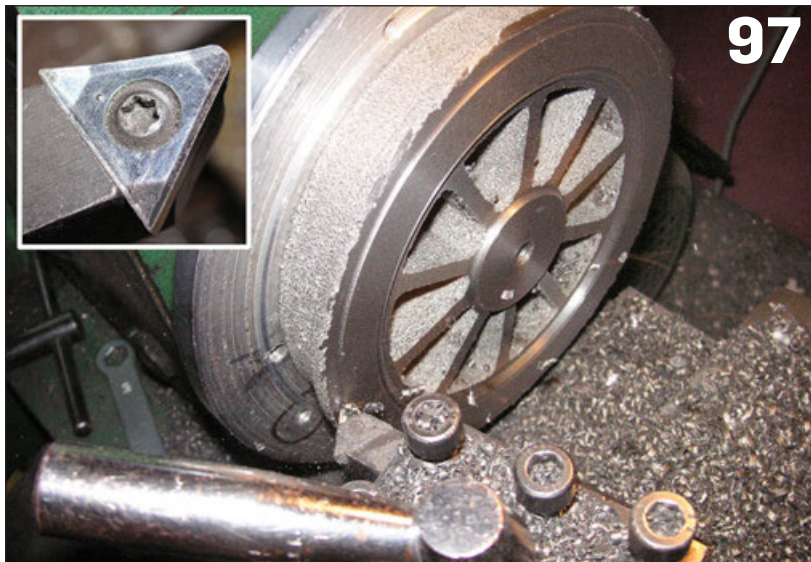
Tight grip

So, I decided to rely on friction instead! In **Photo 97**, I’m already machining a wheel, but the photo shows no visible clues to the method of holding the casting! What you do see is a threaded hole in the centre of the casting, and this is indeed the secret to the work holding.

I have a threaded rod passing through the spindle of the lathe; this rod is screwed into the casting, and is secured with a nut on the other end. A large washer rests against the left end of the spindle, so the nut can be tightened without causing any damage to the lathe.

The hole in the casting doesn’t even have to be in dead centre – in

“A casting is often slightly distorted – it may be oval, ‘dented’ or misshaped in some other way...”



fact, I drilled it just by eye, and threaded it M8. Since the bore of the spindle is much larger than the threaded rod, it was very easy to centre the casting by first only tightening the rod slightly, then using a small rubber mallet to ‘persuade’ the casting to run true on the face plate.

Since there were no sprues or other protrusions on the front rim of the wheel, it could be set flat against the face plate, and I could centre it with light mallet blows. When it finally was positioned satisfactorily, I tightened the nut; the threaded rod drew the casting tightly against the face plate, and all was set for turning.

Cast iron is relatively easy to

machine, unless it has inclusions of mould sand, or a hard skin of ‘white’ iron, which may be hard to penetrate. Fortunately, my castings proved to be proper ‘grey’ iron all through, and I also used a lathe tool with a carbide insert, which doesn’t dull as quickly as carbon or high-speed steel bits.

Carbide tools are brittle, however, so from the start I used inserts that had their tips broken off earlier – mea culpa... I did of course re-sharpen the tips before use, but not to an acute angle – instead, I rounded the tips slightly, as seen in the photo insert. This proved a good idea, preventing further damage to the inserts.

Note that carbide tools need a

PHOTO 97:

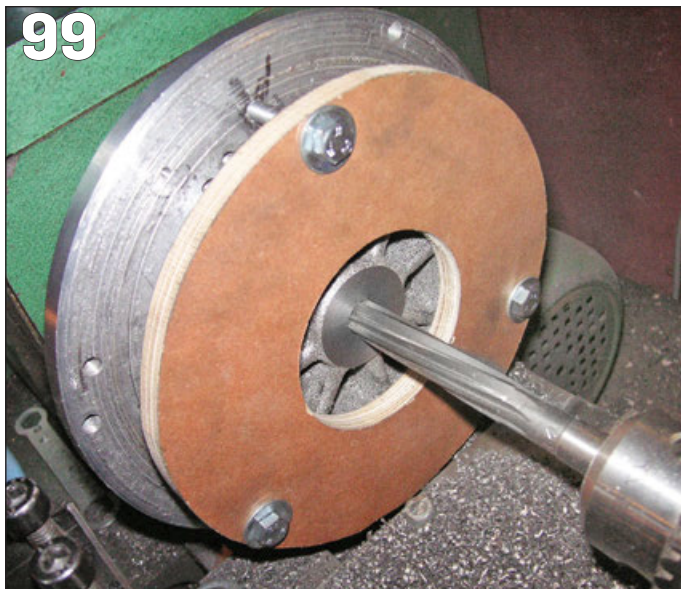
The back of a tender wheel being turned flat. The inset shows how a damaged carbide tool tip can be re-ground.

PHOTO 98:

A wheel for the front bogie, already machined flat on the back.

All photos in this feature by the author





special 'green' grinding wheel (made of silicon carbide or carborundum). Ordinary 'grey', 'red' or 'white' wheels (corundum or alumina) are too soft and will not properly sharpen carbide tools – instead, the tool will gouge the wheel!

I turned the back of the casting flat, and also slightly turned down the inside of the spokes. This got rid of any 'flash' caused by a slight leakage between the cope and drag halves of the sand mould during casting. Commercial castings are sometimes made from 'split' patterns, with spokes that are oval in shape. These castings thus have their flash, if any, on the centre line of the spokes. This type of flash can only be removed by filing, or with a burr in a hand-held mini-drill.

Having made my own patterns in one piece, I was not able to generate oval spokes. With patterns that are

PHOTO 99: A circle of sturdy plywood holds the casting to the face plate.

PHOTO 100: A finished tender wheel.

PHOTO 101: A simple cardboard-and-tape mould for a larger counterweight.



100



not split, less precision is needed in making and assembling the sand moulds, and, from a few feet away, you cannot really see if the spokes are oval or not, so I felt that the simplification was permissible.

Before flipping the wheel casting around, I also roughly turned the outside of the flange, leaving a generous allowance for later, more precise machining. In **Photo 98**, the casting has been flipped, and is also now held only by the tension of the threaded rod through the spindle. Here, I did a very precise centring, using the inner rim of the wheel as a 'datum', checking that it ran truly.

Imperfections...

A casting is often slightly distorted – it may be oval, 'dented' or misshaped in some other way. This can be due to many factors – most often, the sand mould was slightly disturbed during pattern removal. Centring the casting so that the surfaces that will not be machined run as true as possible will ensure that the visual appearance of the wheel will be optimal.

If you were to centre the casting using, say, a distorted outer rim as the datum, the inner rim and the spokes would not be centred. Since there is (or should be) a significant machining allowance on all the surfaces that are to be machined, it really doesn't matter if they are a bit distorted.

With the casting centred, I turned all front surfaces to their nominal dimensions, except for leaving the tread a little oversize.

One thing is very important; the spokes should retain their rounded bevel where they meet the rim and the hub. Never machine the inner rim or the hub of the wheel so close to the spokes that the bevels, or even the spokes themselves are touched by the tool! If you go just a little a bit too far, the result will be very ugly indeed. I

have seen examples of wheels that were turned too deep, and they look nothing like their prototypes!

Now, with everything turned to the right dimensions, except for the final tread and flange diameters, it was time to enlarge the centre hole to the exact size, matching the axle. But how? That threaded rod was in the way!

Photo 99 shows the trick: While the casting was still firmly held against the face plate, I attached a circle of 9mm thick plywood to the faceplate, using holes that were previously drilled and tapped in the plate. Tightening the three bolts, the piece of plywood held the casting to the face plate just as firmly as the threaded rod, so I could remove the latter.

The enlarging of the centre hole must not be performed by drilling! Since the hole is threaded, it would cause a drill to wander off-centre, and, in my case, the original hole may not even be exactly in the middle of the casting as it was drilled by eye only.

Since all the turned surfaces are currently perfectly concentric, it is important to get the axle hole accurately centred, too. This means the hole has to be enlarged by boring only. To ensure a perfectly sized hole, it is a good idea to ream it as a last step.

The only thing left to do after this operation is to machine the tread and flange to exact dimensions. I did this by mounting the wheels, one at a time, on an arbor. The end of the arbor had a M6 threaded hole, and was turned down to the exact size of the reamed hole for a slightly shorter distance than the thickness of the wheel. I could then attach the casting firmly to this stub using only an M6 bolt and a large washer. Turning on an arbor ensures that all wheels are truly centred.

The final result of the turning work can be seen in **Photo 100**. If necessary, a final skim can be given to all machined surfaces once the wheels

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are mounted on their axles, providing that the axles have been centre drilled and turned properly, of course.

The big wheels

A 4-6-0 locomotive has two different types of 'big' wheels, in other words the 'drivers', to which the main rods from the cylinders are attached, and the 'coupled' wheels, which receive their power via the coupling rods. Since the reciprocating mass attached to the drivers (main rods + coupling rods) is significantly heavier than the mass attached to the coupled wheels (coupling rods only), the counterweights on the drivers need to be much larger – at least in full size. In our miniatures, the mass and inertia is much smaller, so we copy the prototype more for the looks than for the physics...

I fabricated only one pattern for both types of wheels, and this pattern was made to the shape of the coupled wheels. Thus, I had to enlarge the counterweights on two of the cast-iron wheels, in order to make them look

PHOTO 102:

The large counterweights are 'cast' using polyester filler.

PHOTO 103:

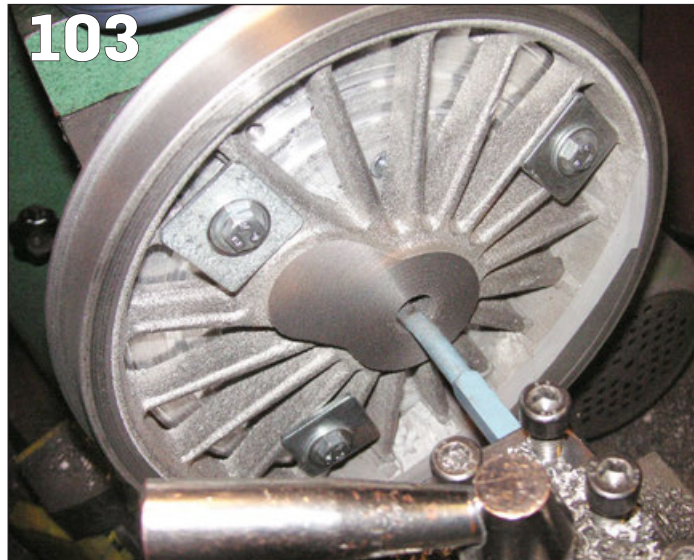
Boring the axle hole in a driving wheel.

PHOTO 104:

Forming the correct outline of counterweight using a burr mounted in an electric mini-drill.

PHOTO 105: A finished coupled wheel. The hole for the crank pin has not yet been machined.

103



like the prototype's driving wheels.

Photo 101 shows the method.

First, I drilled and tapped a few holes in the inner rim, between the spokes, and screwed in short bolts. The heads of these bolts will securely hold the added, larger counterweight in place. Cutting slits to accommodate the spokes of the wheel in a piece of cardboard, and attaching it with strips of adhesive tape, I could form a 'moulding cavity' into which I poured polyester filler.

Taking care to avoid air pockets by using a nail to pierce any bubbles, I soon had two rough castings with even rougher counterweights (**Photo 102**) ready for machining.

The turning of the full dozen small wheels (four for the front bogie, eight for the tender) had not taken me long – a couple of evenings in the workshop took care of them. The large wheels posed a bit of a problem, though. From the previous article you may remember that my lathe has a nominal swing of only 228mm (9 inches), while the diameter of these wheels in their

finished form is a little less than 220mm over the treads – add the flanges, and you get 228mm sharp!

However, the patterns, and thus also the castings, must be made with a machining allowance, and my castings, as they came out of the sand moulds, were around 232mm. Then there was quite a bit of flash on some of the castings – some of them were actually well over 240mm in overall diameter (visible in photo 101), and they would not fit in the lathe! So, with the help of my trusty angle grinder, I had to remove all the extraneous material, taking care not to cut into the actual flange.

Dirty, dirty...

I can tell you one thing for sure: applying an angle grinder to cast iron is really dirty work, much worse than the mere turning of castings. Cast iron contains some 3.5 per cent carbon by weight. It is, however, in the form of graphite – which translates to almost 10 per cent by volume. Graphite is much lighter than iron, and the dust

104



105



106



107

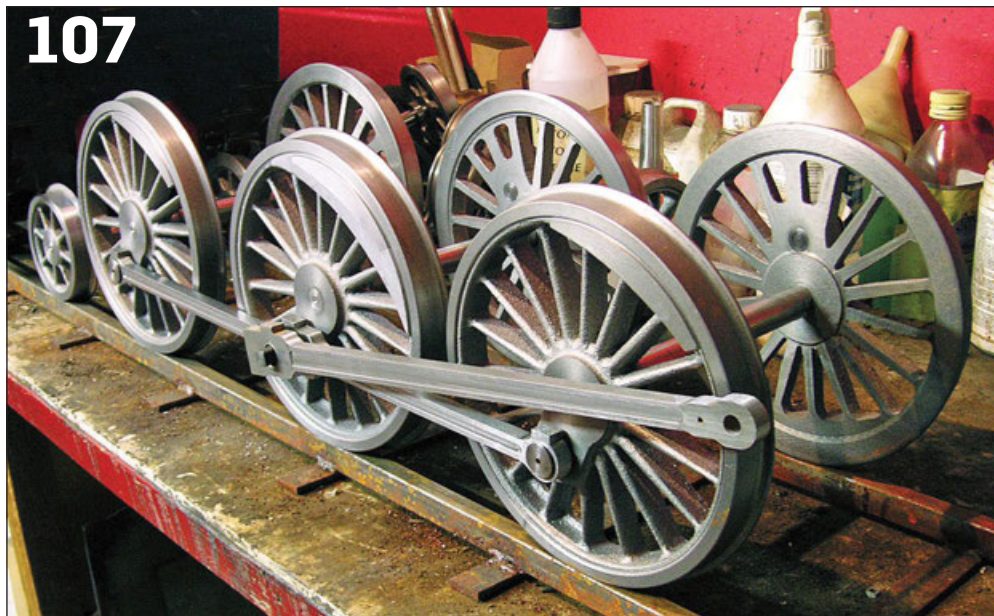


PHOTO 106: Stack of finished wheels for the 4-6-0 – all 18 of them!

PHOTO 107: A tentative assembly of the wheels, axles and rods provides inspiration for all the upcoming work.

PHOTO 108: Rough castings for tender bogies and passenger cars.

simple, but dusty task, performed with a largish burr in an electric mini-drill running at high speed, [Photo 104](#).

In order to get the right shape to the counterweight, I had made a cardboard pattern conforming to the original drawing, and used that to draw a line on the polyester filler with a felt-point marker.

[Photo 105](#) shows one of the finished coupled wheels. The texture of the cast iron is clearly seen on all unmachined surfaces. Using a finer moulding sand, that texture could be much smoother, but I had no choice but to use the rather coarse sand provided by the foundry – they had nothing finer, not being accustomed to miniature work! Painting the spokes with a filler primer will substantially reduce this texture.

With a whole stack of wheels

finish-turned, [Photo 106](#), I felt I had really got started on the project! As soon as I had machined the water-jet cut coupling rods, I could tentatively assemble the full set of driving and coupled wheels, [Photo 107](#). This was enormously inspiring, giving me full steam ahead to continue the project!

A boxful of castings

At this stage, I sure had a long way to go, still. As mentioned in the previous article, these were the very first steps in the construction of my new 4-6-0 engine – the instalments of this series are not always in chronological order!

In addition to the wheel castings, my visits to the foundry also resulted in dozens of other castings, seen in [Photo 108](#). They are of three kinds, clockwise from top left a heap of dummy leaf springs for the tender

will fly around and land on your tools and work surfaces.

For this reason, I did most of the grinding work outside my workshop, but that wasn't too good an idea, either – the grinding dust left in the yard rusted after the first rain, and made an unsightly brown stain on the asphalt. It took several months and many rain showers for it to finally disappear...

Having reduced the large castings to a size that would just barely fit my lathe, I was finally able to attach them to the face plate, just like I did with the small wheels, in other words with a threaded rod. This time, I used a slightly sturdier rod, 12mm, since these castings were much heavier.

After machining the rear side flat, I flipped the casting and could then turn the hub, counterweight, rim, tread and even the flange (which protruded well outside the face plate) without changing the setting.

In order to bore and ream the axle hole, I again needed to clamp the wheel to the face plate and remove the threaded rod. Thanks to all the holes in the face plate, I had no problem bolting the casting to the plate (this time, using just bolts and washers between the spokes) before removing the threaded rod, [Photo 103](#). In the photo, you can also see how the 'added' counterweight has been turned down so the surface of the polyester filler is flush with the cast counterweight.

Now, the driving wheel was almost finished. I only had to form the inner curve of the counterweight to the proper shape. This was a rather

108



bogies, then some axleboxes for the tender (made with a split pattern – note the ‘parting line’ of the mould, best seen in the two right-most castings), and finally, in the lower half of the box, axleboxes for a few passenger cars.

The tender for the ten-wheeler has two four-axle arch-bar bogies, and the axlebox design is rather characteristic for the prototype. For that reason, I wanted to simulate the look of these boxes, without actually building them from scratch. The castings provided a quick and easy way of doing this.

Originally, the axleboxes have hinged lids, covering the bearings inside the boxes. Since I was going to use fully sealed, factory-greased ball bearings in my miniature, there was no compelling reason to have such a lid – unless, of course, you prefer to build every detail on your model exactly as in the prototype, just as many other modellers actually do (for instance, see the late Juhani Saloranta’s meticulously crafted Decapod engine in the November 2017 issue of *EIM*). As you already know by now, I myself prefer to simplify wherever I can, so my axle



boxes are in one piece only, machined from solid castings. **Photo 109** shows all eight of them.

In order to facilitate machining, I first drilled each casting with successively larger drills, all the way up to 23mm (almost 1 inch), after which I bored the opening for the ball bearing to exact size with an adjustable boring head in the mill. In this way, only a small amount of metal had to be removed by slow and boring boring...

“After a couple of years, I still find graphite dust in the nooks and crannies of my workshop...”

It was necessary to machine all the surfaces showing the parting line of the sand mould. The top and bottom surfaces of the axleboxes have shallow grooves that accommodate the arch bars. In addition, I used a ball-end mill to form round grooves on the sides of the boxes – one such groove can clearly be seen in **Photo 110**. Each groove will accommodate a bolt, keeping the axle box firmly in place in the arch bar assembly, which is very simply made from strips of flat iron.

In **Photo 111** I have test-assembled one of the arch bars. The central bolster, to be made from rectangular steel tubing, is still missing. We’ll have a closer look at the tender (below), its frame and the bogies next time.

Metal recycling...

Now, I had finally machined all the castings for the locomotive. I collected the accumulated cast iron cut-offs, chips and swarf, almost 15kg in total, for a welcome gift to a friend of mine who has his own backyard foundry. I then swept and vacuumed away the black graphite dirt that had settled everywhere. Nevertheless, even after a couple of years, I still find graphite dust in the nooks and crannies of my workshop...

EIM

■ Parts 1 to 7 of this series appeared in the February to September 2020 issues of *EIM*. 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.

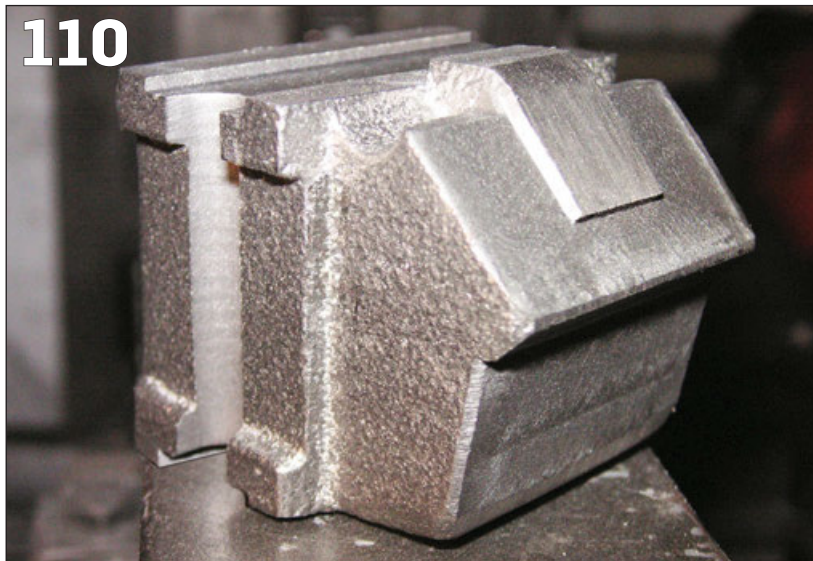


PHOTO 109:

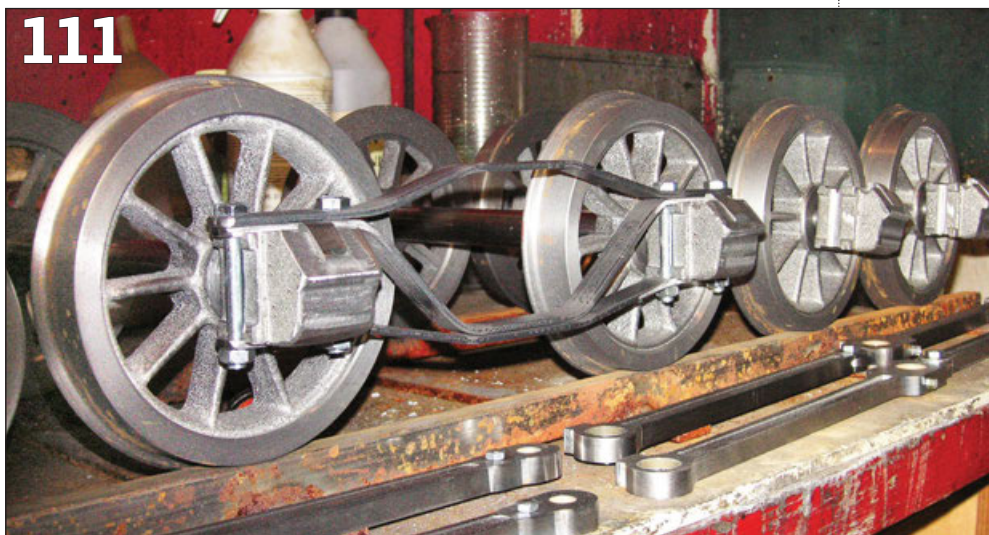
The eight machined axleboxes for the tender. There are no moving parts.

PHOTO 110:

A close-up of one axlebox, 35mm wide.

PHOTO 111:

A first test assembly of an arch bar frame for the tender bogie.



Mighty Miniatures

A post-lockdown day out on the Welsh coast finds our editor bridging a rather small gap between model and full-size engineering...

BY ANDREW CHARMAN

Picture the scene... It is mid July in Wales, which has been subject to even longer-lasting Covid-19 lockdown restrictions than the rest of the UK. For months we have been told not to travel more than five miles unless strictly necessary.

Now, however, we are allowed out again, and this magazine editor and model engineer is desperate to spend a day somewhere with steam. But the choice remains limited as across the country the club tracks are still closed to visitors and most of the heritage lines have yet to reopen – I can't even go down the road from **EIM** towers to the Welshpool & Llanfair Light Railway, where I am among other things a trustee, as it will not be running passenger trains again until the start of August.

Less than an hour away, however, on the Welsh coast, there is a solution which I actually believe neatly bridges the gap between model and full-size engineering, the Fairbourne Railway.

I have to admit that this little line, which back in 2011 then manager Chris Price told me firmly "is a Beach Railway, nothing more," has always been a bit of a guilty pleasure. I've long had a passion for the 15-inch gauge, the Ravenglass line in Cumbria and particularly the teachings of minimum gauge pioneer Sir Arthur Heywood, but I do find myself constantly popping back to this even narrower line in not exactly the busiest area of the Welsh coastal tourist industry.

Why this is I'm not sure – perhaps it has something to do with the fact that this line could almost be considered mutant model engineering. While many an **EIM** reader combines time in their own workshop with volunteering on the UK's heritage railway network, many on major standard-gauge lines, for me the Fairbourne, with its small, highly attractive locos, is more closely linked to the model engineering vocation. Well my friends have always described me as a short-axe freak...

Narrowing in gauge

The Fairbourne was not always quite as narrow, of course. In fact it started life as a 2ft gauge horse tramway, opened in 1895, taking visitors from Fairbourne village to the headland where a ferry carried them over the



ABOVE: 'Yeo' and 'Russell' share duties just after reopening in early August.

BELOW: The scene at the 2016 Gala, with the 7¼-inch gauge in operation framed by the Barmouth Bridge.

All photos in this feature by the author unless stated.

Mawddach estuary to the tourist hot spot of Barmouth. That role has remained ever since...

The year of 1915 brought big changes, when the route came to the attention of W J Bassett Lowke, another member of the minimum gauge royalty whose company was at the time producing steam locomotives from Gauge 1 models right up to 15-inch gauge. He wanted somewhere to exercise the latter and the whole line was converted to 15-inch gauge. Services were operated initially by 'Prince Edward of Wales' a Bassett Lowke class 10 4-4-2 designed by yet another icon of miniature railway engineering, Henry Greenly.

The 15-inch era was to last seven decades, though it briefly included an expansion into a third, less well-known gauge. In 1926 a motive power crisis saw the purchase of an 18-inch gauge Stirling Single locomotive, and an extra rail was laid along much of the two-mile long line in order to accommodate it. This diversion was to last only a decade.

Badly damaged during the Second World War, the railway was rescued by John Wilkins, a Midlands industrialist, and over much of the next 40 years he invested heavily in it with new locomotives, rebuilt track and various initiatives. But after gloriously busy days in the 1960s and





early '70s passenger numbers began a slow decline and the line became a heavy financial drain on the Wilkins family. Rumours of its closure abounded until in 1984 it was sold – a move that was to see a total transformation of the line.

The new owners were music promoter John Ellerton and his father Dr Sydney Ellerton. John had already opened a 12¼-inch gauge line in France, but in the face of frenzied local opposition it closed after only a year. All of the stock from the French line remained in his ownership and after briefly trying to sell it on he decided to make use of it on a regauged Fairbourne Railway.

Transformation

The regauging was carried out in 1986 and the railway has been 12¼ inches wide ever since. But Ellerton's project went far deeper than a regauging, as Chris Price told your editor back in 2011. "John Ellerton turned the line into something very different. For example it had massive signal boxes, even though there were no signals – they have all gone now. He built a huge cafeteria at the Barmouth end, Penrhyn Point, whereas John Wilkins took a refreshment van down on the train each morning."

Ellerton had purchased a run-down 15-inch gauge railway and he too invested heavily, but after a while he lost interest in the project. The railway was run mainly by his father until in 1995 it was sold again to Roger Melton and Tony Atkinson. In 2008 they transferred the line to a charity, but Tony Atkinson provided significant subsidies and following his death in 2011 there were again brief fears for the line. Careful management and a return to a more simpler format have stabilised things, initially under the management of Chris Price and after his departure to manage first the Tallylyn and then the North Yorkshire Moors Railway, under today's GM Murray Dodds.

ABOVE: How it once was – 'Sian' and 'Katie' in 15-inch gauge days. Photo: FR

TOP RIGHT: Both locos have been back – 'Katie' here comparing profiles with 'Yeo' at the very wet 2013 Gala...

RIGHT: ...and 'Sian' in 2017.

LOWER RIGHT: Smaller 15-inch engines have also appeared – 'Mountaineer' lives at the Cleethorpes Coast line.

BELOW: 'Yeo' and 'Russell' are stalwarts of the line, here at a sunny Penrhyn Point in 2016.





ABOVE: The bespoke lines of Darjeeling Himalayan inspired 0-4-oST 'Sherpa', here at Penrhyn Point in 2019.

BELOW: In 2011 'Sherpa' was under overhaul in the Fairbourne workshops.

BOTTOM: 'Russell' rests in the running shed at Fairbourne.

BOTTOM RIGHT: While awaiting restoration, 'Beddgelert' played a role in the Ffestiniog Railway's Hunslet 125 festival in 2018, travelling to Beddgelert on the Welsh Highland line. Photo: Nick Wise



So this railway is a grand survivor – even the village it runs out of has made national headlines with suggestions that in around 25 years time the local council could begin relocating residents rather than continue to maintain the concrete walls that guard against rising sea levels, walls that the railway runs behind for much of its length...

The Fairbourne of today is one of a very small number of 12¼-inch lines in the UK – the other well-known ones being the Exbury Gardens Railway in the New Forest and the Littlehampton Miniature Railway on the south coast in Sussex. And the Fairbourne has now established its 12¼-inch gauge provenance, having been that way for some 34 years.

Motive power

Part of the appeal is without doubt the quartet of steam locomotives based on the line. They are all engines small enough that one could imagine a well-equipped large model engineering workshop putting them together in much the same way as many an EIM reader builds traction engines of up to 6-inch scale – these four locos are literally half-scale recreations of their full-size inspiration.

'Russell', a 2-6-4T in the style of the famed North Wales Narrow Gauge Railway 2ft gauge loco, was in charge of the first train to run following the Covid-19 pandemic, which I witnessed on a cold and damp 14th July as part of that first post-lockdown outing. The Fairbourne was one of the first lines to reopen, partly because like on the other 'narrow gauge' lines applying social distancing measures to rolling stock is easier when each carriage compartment is only big enough for one family at a time...

Russell has an interesting history – built in 1979 by Milner Engineering for Ellerton's French line, it originally had the visual appearance of a Leek & Manifold Railway 2-6-4T, before being converted to its present appearance in 1985 though retaining the extra rear axle of the L&M engine.

A second visit in rather better weather a week or so later (family insistence), found the other stalwart of the line sharing duties with Russell, Lynton & Barnstaple 2-6-2T 'Yeo'. This one was built by David Curwen in 1978 and with its newly repainted Southern livery looks glorious.

The third member of the fleet is perhaps the most interesting. Also a Milner product of 1978, 'Sherpa' is a representation of the iconic 0-4-0s of the Darjeeling Himalayan railway in India, though with the practical addition of a tender. The loco is about to undergo a 10-year overhaul, overseen by the Fairbourne's newest staff member, who also happens to be EIM's technical editor! We hope once Harry's feet are under the table to bring you a second feature, going behind the workshop door to describing the engineering aspects of maintaining 12¼-inch locos...

And the fourth loco? The 0-6-4ST 'Beddgelert', another North Wales Narrow Gauge inspired engine built by David Curwen in 1979, has been out of service for some time and the centrepiece of the Fairbourne's museum (this was opened in biblical





weather by your editor at the 2013 Gala). An appeal is currently underway to raise the funds to return the loco to steam.

There are those enthusiasts who still yearn for the 15-inch gauge days, and their pleas have been partly answered in recent years by history repeating itself – a third rail has been laid from Fairbourne along the first straight section almost to the level crossing where the line turns onto the sea front. This has enabled the line's former locos to revisit for Gala events, notably the two attractive Guest Engineering 2-4-2s 'Sian' and 'Katie', which today live on the Kirkstall Light Railway in Yorkshire.

Some would like to see the 15-inch go 'all the way' but that won't happen – a longer ride would only attract the odd enthusiast and would not be economically viable on a line which always has to keep a very close eye on its finances, and whose clientele is overwhelmingly based on tourists who know little or nothing about railways and just want the fun of a train ride.

Enjoyable ride

And the ride remains both as it was in 15-inch days and highly enjoyable, especially when running along the sea front, disturbing the local golfers and enjoying the impressive backdrop of the mid-Wales mountains, before plunging into a tunnel and emerging at Penrhyn Point. Here one can spot standard-gauge diesel multiple units traversing the oh-so long Barmouth Bridge, or look across the estuary to Barmouth itself, perhaps even braving the ferry to visit the tourist hotspot.

It's a relaxing place to be, amongst the sand dunes, while the inquisitive model engineer might also discover something rather more familiar, a short 7¼-inch gauge line which comes into its own at Gala events.

The Fairbourne Railway will always be a simple beach line serving almost entirely holidaymakers, but

your editor firmly believes that many a steam enthusiast may have dismissed it as not offering much of interest. If you are in the area you really should take a look, perhaps combining a visit with the Tallyllyn or Corris railways, both of which are not far from Fairbourne. You may be surprised at just how appealing this beach railway

is, especially those so attractive locomotives – mega model engineering they certainly are...

■ For more details of the Fairbourne Railway, including opening times and particularly travel restrictions in the current Covid-19 environment, go to the website at www.fairbournerrailway.com

ABOVE: More 7¼-inch action, this time in 2013.

ABOVE RIGHT: Fascinating the young, 'Sherpa' runs round at Penrhyn Point.

RIGHT: Heading for the tunnel, with Barmouth visible over the estuary.

BELOW: "It's a beach railway, nothing more..." 'Sherpa' and its train heads back to Fairbourne.



Dot – a micro engine

Stewart continues the build of his tiny stationary engine with reverse, a perfect project for those with very limited space, focusing this month on the motion.

BY STEWART HART Part two of a series



This short construction series launched last month describes the building of 'Dot', a stationary engine based on a design by noted US model engineer George Britnell and measuring just 2 inches (50mm) tall. Having built the base, cylinder stand and cylinder, we turn now to the motion.

Part 16: Crankshaft

You will need to make a couple of simple fixtures (**Fixture 1** and **2**) to make the one-piece crankshaft, the only size that you need to exactly duplicate in the fixtures is the 3.25mm off set to give the crankshaft its correct throw, the rest you can just work around.

The crankshaft is made from $\frac{3}{8}$ -inch free-cutting mild steel. The first operation is to chuck the bar true

in the lathe and turn down to 2.5mm diameter for 10mm. Assemble it into Fixture 1 and holding it firmly in place with the grub screw, and using a cranked parting-off tool so that you can get in close, form the crank shaft bearing journal 2.5mm diameter (**Photos 37 to 39**).

Re-chuck and part it off to a length of 26mm, then assemble the crank shaft into the split collet Fixture 2. Positioning the collet in the chuck so that the split is between two jaws, so that the jaws will pinch the collet up and grip the part securely, clock the bar up so that it is running true and turns down to 2.5mm (**Photos 40, 41**).

All that now remains is to machine the counterbalance in the crankshaft webs, this was done by mounting the shaft between two small vices with the part supported and



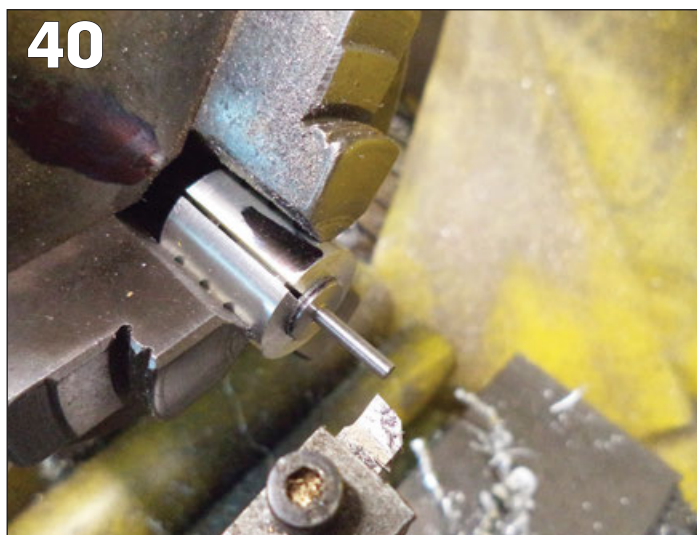
PHOTO 37: Turning the crankshaft down to 2.5mm.

PHOTO 38: Using cranked tool and Fixture 1 to turn the crankshaft throw.

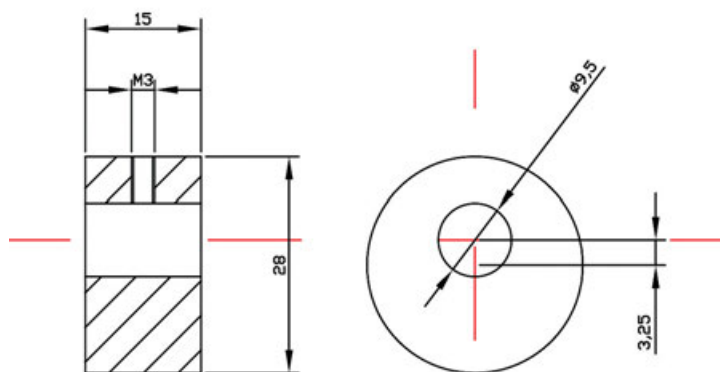
PHOTO 39: The turned throw.

PHOTO 40: Turning crank down to 2.5mm using fixture 2 split collet.

PHOTO 41: Turned one-piece crankshaft with both fixtures.

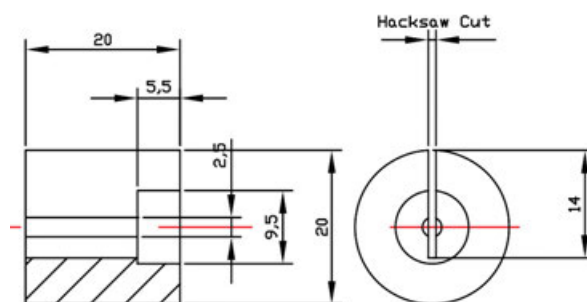


All component drawings reproduced approx full-size



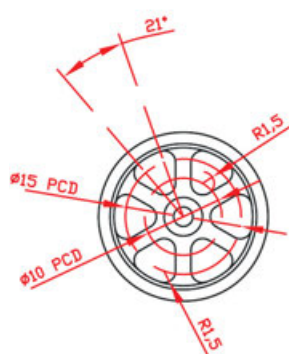
FIXTURE 1

Crankshaft throw big-end journal turning bush
1 off: Aluminium



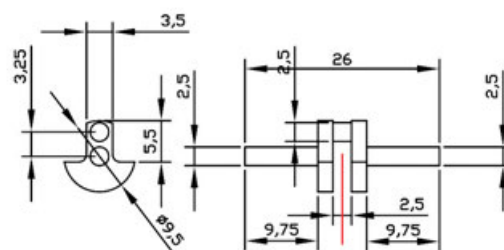
FIXTURE 2

Crankshaft main journal turning split collet
1 off: Aluminium



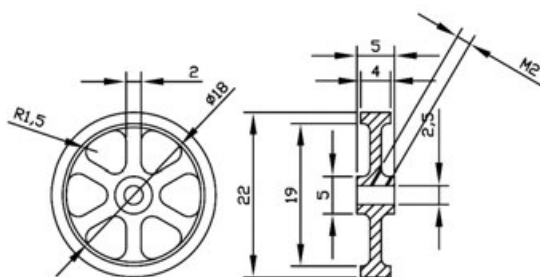
SKETCH 2

Flywheel (part 21)
spokes co-ordinates
- for use with rotary
table and DRO



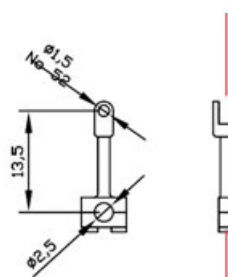
PART 16: CRANKSHAFT

1 off: Mild Steel



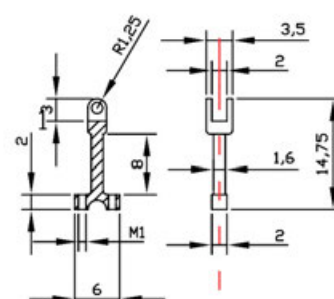
PART 21: FLYWHEEL

1 off: Brass (see sketch 2)



PART 12: CONNECTING ROD ASSEMBLY

1 off

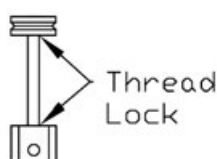
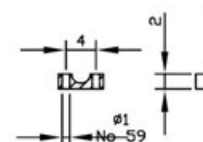


PART 13: CONNECTING ROD

1 off: Brass

PART 14: CONNECTING ROD CAP

1 off: Brass

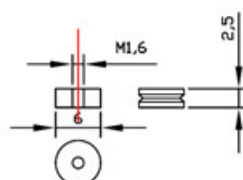


PART 17: PISTON ROD ASSEMBLY

1 off

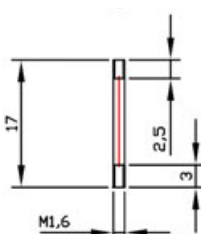
PART 18: PISTON

1 off: Brass



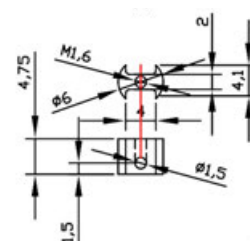
PART 19: PISTON ROD

1 off:
Stainless Steel



PART 20: CROSSHEAD

1 off: Brass



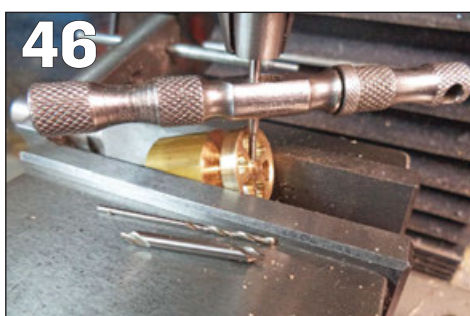
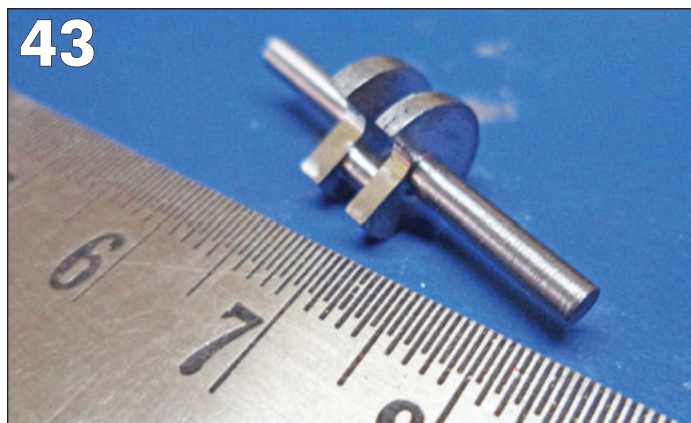
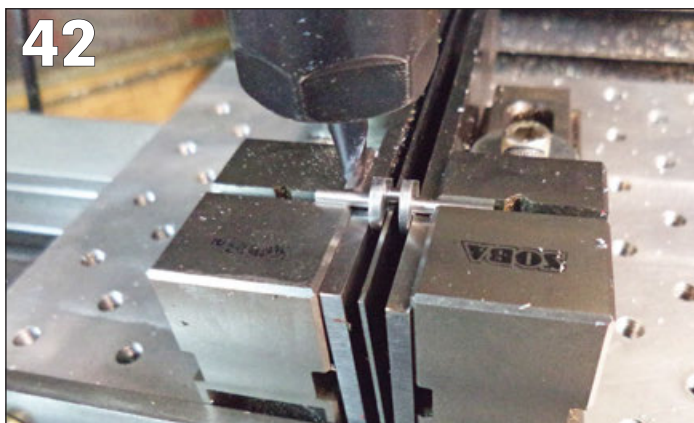


PHOTO 42: Machining crankshaft webs counterbalance, the part held between two small vices and parallels.

PHOTO 43: The completed crankshaft.

PHOTO 44: Flywheel spokes rough-drilled out.

PHOTO 45: Spokes milled out with 3mm end mill.

PHOTO 46: Drilling and tapping the flywheel.

PHOTO 47: Finishing off flywheel back face.

PHOTO 48: Trial assembly of the parts.

PHOTO 49: Milling connecting rod to shape.



orientated on parallels (**Photo 42**). I bought the two small vices at the same time hoping that they would be a matching pair, unfortunately they were far from matching – if they had been this setup would have been greatly simplified (**Photo 43**).

Part 21: Flywheel

I made this from 32mm diameter brass bar. Turn down the diameter to 22mm, centre drill and form the front face, then with a parting tool put a deep groove into the back face, this will reduce the amount of work for the small milling cutter when you cut out the spokes.

Keeping the work in place remove the chuck from the lathe, mount it on the rotary table and centre the table on the mill.

To generate the spokes I used the co-ordinates shown on **Sketch 2** using the Pitch Circle Diameter (PCD) function of the Digital Read-Out (DRO) to index round to each segment, and using the rotary table to do the 21-degree angular movement, this saves a great deal of calculation of angles and avoids lots of opportunities for error (**Photos 44, 45**).

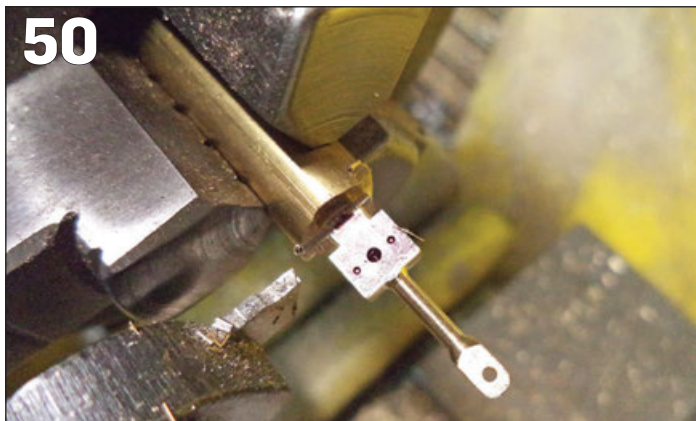
Return the chuck to the lathe and drill through 2.5mm, before parting off remove from the chuck and using the chucking length to grip onto in the vice, drill and tap M2 for a retaining screw (**Photo 46**). Then return to the lathe and part off.

Set up true in the chuck and finish off the back face (**Photo 47**). All that's required now is a little bit of tidying work with some Swiss files and that's it – job done (**Photo 48**).

Part 12: Connecting Rod Assembly, comprising **Part 13 Connecting Rod**, **Part 14 Connecting Rod Cap**

The rod is manufactured from $\frac{3}{8}$ -inch brass bar. Start by turning a length of bar down to 6mm diameter, transfer the whole lot over to the Spin Indexer and mill down to 3.5mm by 2.5mm for the forked end. Then reduce the back end to 2mm thickness for the crank bearing (**Photo 49**).

Using a 2mm slot drill mill the



slot and drill through 1.5mm. At a distance of 13.5mm from this hole mark with a small spotting drill the position for the crank bearing and its centre line. Transfer the chuck back to the lathe, and with a radius tool reduce the waist down to 1.6mm and part off to length (Photo 50).

In a small vice grip square and centre the mill up on the parting-off pip using a cantering point, and drill and tap M1 for the bearing cap (Photo 51). Line a thin slitting saw on the bearing centre line and cut the bearing cap off (Photo 52). It is now a simple operation to open the two holes in the bearing cap to 1mm.

Clamp the cap back onto the connecting rod tapping the two parts level, place the assembly onto a flat surface, place the small vice over the top and clamp it up. You can now line up on the split line and the mark and drill 2.5mm to form the big-end bearing (Photo 53), that's it another job done (Photo 54).

Part 17: Piston Assembly
comprising **Part 18: Piston, Part 19: Piston rod, Part 20: Crosshead**

The piston is just a simple brass disc made to a nice running fit in the cylinder, with an oil groove and tapped M1.6. It should pose no problems in construction.

The piston rod is made from 1/16-inch stainless steel rod threaded M1.6 at both ends (Photo 55).

I made the crosshead from brass, start by turning a length of bar down to 6mm diameter for a nice running fit in the Cylinder Stand (Part 1).

Drill and tap M1.6, transferring the chuck over to the Spin Indexer: centre and zero the DRO and mill to shape and drill the cross hole, transfer the chuck back over to the lathe and part off (Photo 56-57). **EIM**

■ Next month Stewart builds the reversing mechanism. To download digital back issues or order printed versions of the September issue containing the first part of this series, go to www.world-of-railways.co.uk/engineering-in-miniature/store/back-

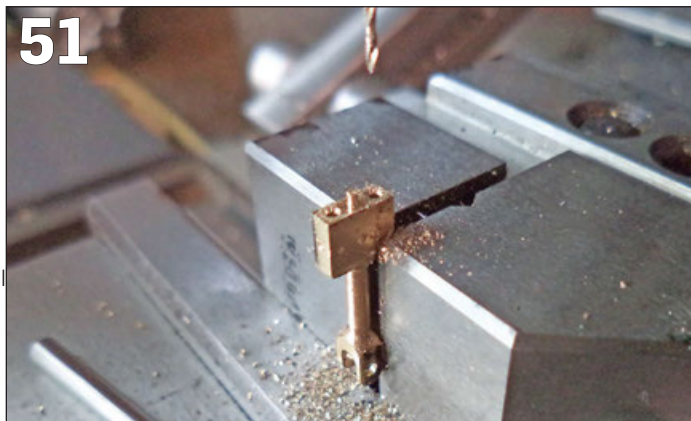


PHOTO 50: Turning down and parting off.

PHOTO 51: Drilling and tapping for bearing cap.

PHOTO 52: Cutting off cap with slitting saw.

PHOTO 53: Drilling for big-end bearing.

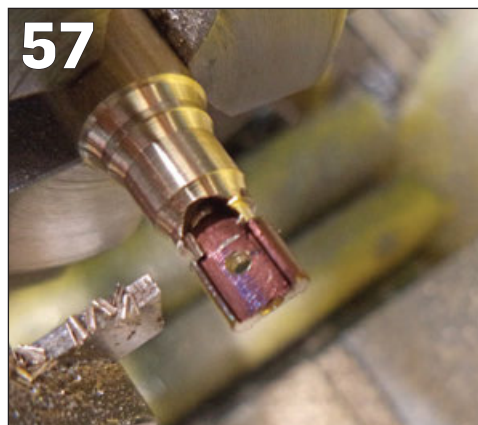
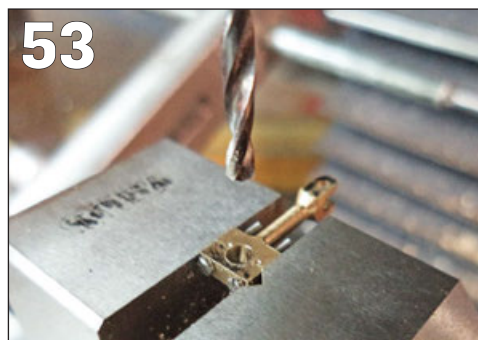
PHOTO 54: Completed connecting rod.

PHOTO 55: Threading piston rod to M1.6.

PHOTO 56: Crosshead milled to shape.

PHOTO 57: Parting off crosshead.

All photos and drawings in this feature produced by the author



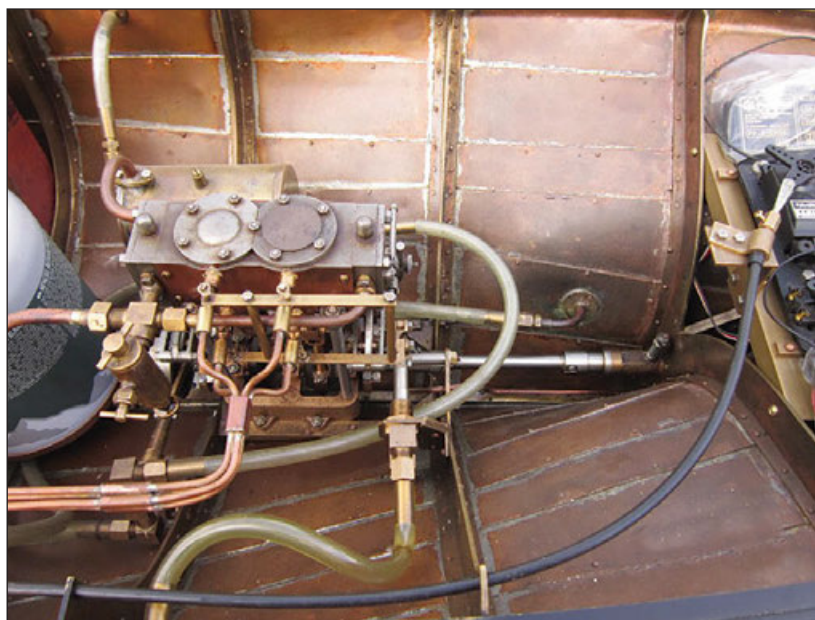
A steam-powered Tug

A mere 30 years after he launched this project, lockdown provides Stuart with the time to design out earlier issues and complete his maritime build.

BY STUART ROTHWELL



"It was the first boiler of any size that I had made and although it taught me many lessons I did not consider it a great success..."



TOP: Stuart's completed steam-powered tug 'St. Cruiser'.

UPPER LEFT:

The boiler designed by Stuart with its water pumps.

LEFT: The Stuart Turner twin marine engine was the second propulsion source tried.

All photos by the author

I have for as long as I can remember, wanted to construct a steam-driven tug and so the chosen model had to be of a boat that was originally steam powered but with modern lines.

Searching through numerous books I came across 'St. Cruiser', one of the last tugs to be built with steam power and in a book by P. N. Thomas I found the general arrangement works drawing complete with a nest of stations for the hull lines.

St. Cruiser was built in 1953 by Alexander Hall in Aberdeen so I approached the maritime museum for any information they had, they did not have much but were able to send me a much larger copy of the drawing I had found.

The boat was first owned by Steel and Bennie Ltd and worked out of Glasgow and in 1963 was re-engined by Crossley Bros Ltd in Manchester – in 1969 it was renamed 'Mt. Ardneil' and reregistered in Ardrrossan. After several owners I next found the boat working out of Liverpool operated by Carmet Tug Co. This firm sent me some photographs but by then the tug had undergone many modifications and so could these not be used for my model. Carmet owned the boat for 17 years it still exists, after 67 years in service, but is with Aquatec Diving Services off the coast of Ghana.

Engine issues

When considering the size of my model, I had just made a Stuart Turner Sirius engine and intended to fit that, driving through a reversing gearbox. I arrived at the size by drawing the engine compartment to suit this engine.

It soon became apparent, however, that this was not a suitable engine for this type of vessel and so I constructed a Stuart Turner Twin Marine engine to replace it. The scale worked out at 1/25th making the model 54 inches long and 14 inches over the beam, the original being 122 feet and 31 feet.

The hull was constructed by manufacturing sheet brass frames and the keel from the drawing of the hull lines. The keel and frames were held upside down in a jig and then skinned with 5-inch by 2-inch

copper plates formed to shape, tack riveted and soft soldered.

Having already made the engine, I turned my attention to the boiler and designed a centre-flue gas-fired version based on a much smaller model designed by Edgar Westbury. It was the first boiler of any size that I had made and although it taught me many lessons I did not consider it a great success.

I continued to fit out the hull with all the ancillary equipment required. Apart from the hand-operated boiler feed pump I made and fitted a Stuart Turner stream-driven feed pump which is based on the Weir water pumps, it is a very interesting little engine to make and run, and does the job well.

I wanted to have the model as self-sufficient as possible so fitted a simple exhaust condenser with cold water being pumped from the lake and the exhaust being fed back into the onboard water tanks.

The gas burner is controlled by an attenuator which was made to a design found in an American magazine using a car tyre valve with reverse flow, I also fitted a pilot light just to ensure safety. All of this was set up on the bench many times to test run but the boiler always let the system down, which resulted in my loss of interest.

Put aside

Abandoning the tug, I went on to build a Princess Royal locomotive in 3½-inch gauge but not before building a Rob Roy 0-6-0 for experience and I am very grateful for the help and guidance provided by the members of Southport MEC of which I am a member.

These projects finished, I decided to have another attempt at St. Cruiser, the only model I had never completed. Over the winter of 2018-2019, I designed and built a completely different type of boiler.

It is 7½ inches in diameter and 6½ inches long, approximately scale size, fitted with twin fire tubes and fired by two ceramic burners. Gas is supplied from a commercial bottle. During steam trials on the bench it proved far more efficient than the original, and so once Covid-19 arrived my lockdown project became to finish the model which had started life some 30 years earlier.

The model is now complete though I had not realised how long it would take to make all the details, fit it out and paint it. Bench testing completed the tug is now ready for the launch which will hopefully take place on the boating lake at the side of the Southport MEC club track in the near future. **EIM**



"My lockdown project became to finish the model which had started life some 30 years earlier..."



TOP: With the superstructure off the layout of the mechanics becomes clear.

UPPER RIGHT: The finished tug is an attractive model...

RIGHT: ...which boasts a great deal of well-modelled detail.

We welcome readers' projects for inclusion in *Engineering in Miniature*, and we pay for submissions used. Subject matter can be rail, road, maritime, stationary, workshop or of any subject that will interest our readers! Simply write down some details of your project and send with suitable pictures to the address below.

Do not be too concerned about grammatical excellence in your words – that's the editor's job! But please ensure photos are of a suitable size for reproduction – they should at least allow 200dpi reproduction over 14cm, and preferably 300dpi.

Send your submissions to andrew.charman@warnersgroup.co.uk or to The Editor,

EIM, 12 Maes Gwyn, Llanfair Caereinion, Powys SY21 0BD

Why not show off your new project in our pages for fellow readers to enjoy?

Creating a Stirling engine

16-year-old Hereford SME member Daniel goes the hot-air route for a design-and-build project, and makes best use of errors that occur along the way.

BY DANIEL BELL

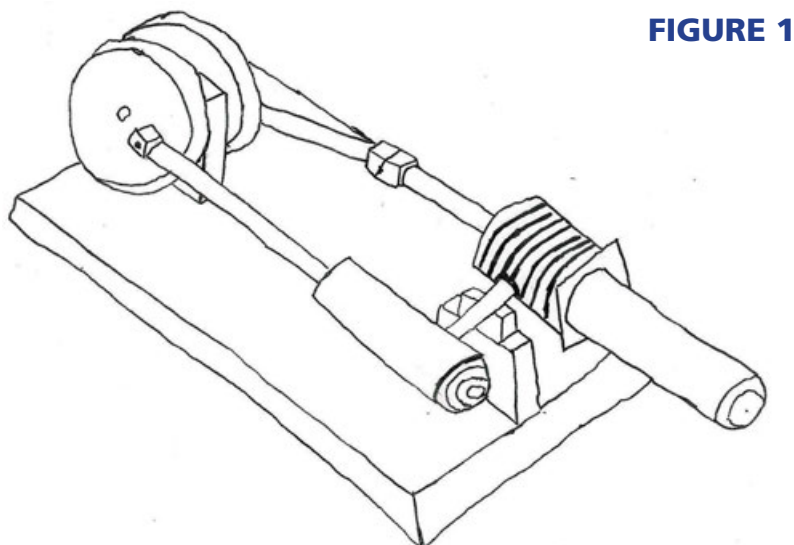


FIGURE 1

FIGURE 1:

Daniel's sketch of his proposed engine. Making detailed plans is not necessary so long as you have a concept of what you are trying to achieve.



PHOTO 1:

Turning a brass hemisphere before adding cooling fins to make an end cap for the power cylinder.

PHOTO 2:

Turning a round end to the displacer cylinder – Daniel concentrating on his work!

PHOTO 3:

The Stirling engine after Daniel had silver-soldered it together.

PHOTO 4:

Brass hex bar for creating the small-end hinge.

PHOTO 5:

Drilling holes in the centre of the hex pieces using a lathe.

PHOTO 6:

Turning the new flywheel.

All photos via the author

I have always had an interest in Stirling engines and before I joined the Hereford Society of Model Engineers I built a Stirling engine out of Coke cans with my dad which I have run at the Much Marcle steam rally a few times.

After finishing my battery-electric steam wagon build I decided to make a Stirling engine as it was a bit smaller and it didn't have any issues with needing to make a boiler, unlike a steam engine.

Unsure how we were going to go about the design, Dad bought me a kit of a Stirling engine so I could measure up the parts and then make a larger model.

I wanted to ensure that my design was based on an actual working model so we built the kit to test whether we had all of the parts we needed. We discovered that the built-in methylated-spirits burner was insufficient to power the engine, however it worked very well when we tested it with a blowlamp.

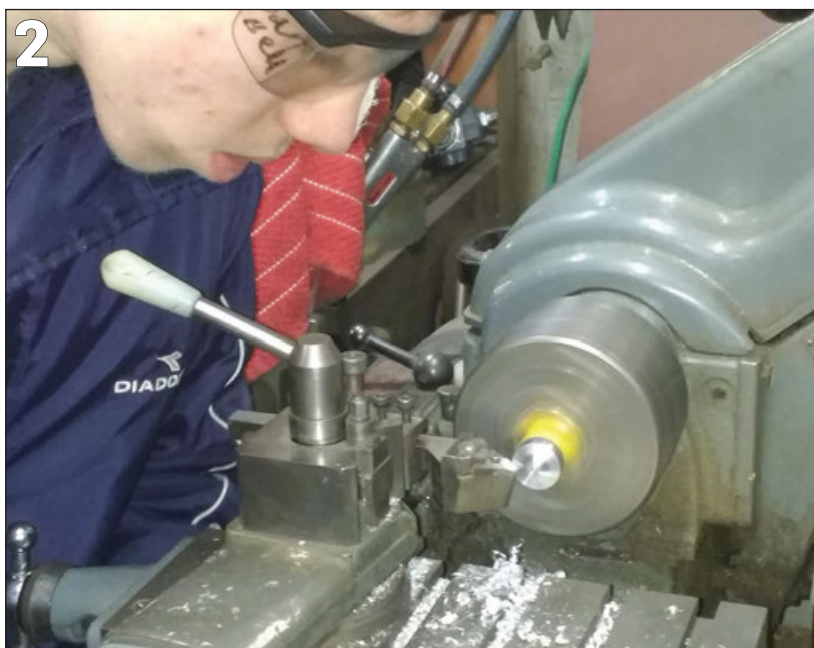
Scrap scavenge

Satisfied that it now worked (though not as well as I had hoped) I had a look for pipes from the scrap and offcuts that were around the club. What I was able to find would help me decide a scale for the other components. While I was at it, I found an ideal size section of wood to form the base.

I found some brass pipes that I thought would be suitable for making the power and displacer cylinders as well as a discarded brass whistle housing that was suitable to fit inside one of the pipes and to be used as the power piston. My first task was to turn down the power piston to remove the rough edges on it, as well as cutting down the power cylinder to size.

I removed the tarnish and previous flux markings from the displacer cylinder using emery cloth. I then faced off and deburred the ends of the cylinder with a deburring tool in the lathe.

To create an airtight plug on the end of the power cylinder we used some offcuts of a brass bar. I turned a hemisphere on the end and used a parting-off tool to add cooling fins. (Photo 1). This was then silver soldered on to the cylinder.



In order to make the displacer piston, we heat-shrunk an aluminium tube over an aluminium bar as we could not find a block that was of suitable diameter. When it had cooled down I turned a round end to the piston and then smoothed it off using emery cloth (**Photo 2**). We then drilled a 6mm hole in the flat end so we could attach it to the piston to its rod.

For the power cylinder I turned a heat sink out of a solid section of brass with a section to allow for the displacer cylinder to be attached. I then bored out a hole in two brass plates to clamp the displacer cylinder to its heat sink.

In order to silver solder the heat sink to the rest of the model, we used an angle grinder to grind off a section so I could drill a hole large enough to connect both cylinders with a pipe. These were then silver soldered together (**Photo 3**).

To make the connecting rod for the power piston, I ground two parallel flats onto a stainless-steel rod, then cut a slot in some brass hex bar for the rod to fit into (**Photo 4**). Then I turned down the hex to add a $\frac{3}{16}$ -inch thread on the other end to fit the existing thread on the power piston, and drilled a hole in both the hex and rod to allow for a small end hinge to be created between.

To create the crosshead for the displacer piston rod I drilled a 6mm hole in the centre of two sections of brass hex (**Photo 5**). I milled the two sections in order to make a joint for the crank. As I planned to use grub screws I drilled and tapped threads which enabled me to attach the sections to the rods. I used a spring pin to create the pivot. I employed a similar method to create the crank blocks for the big ends.

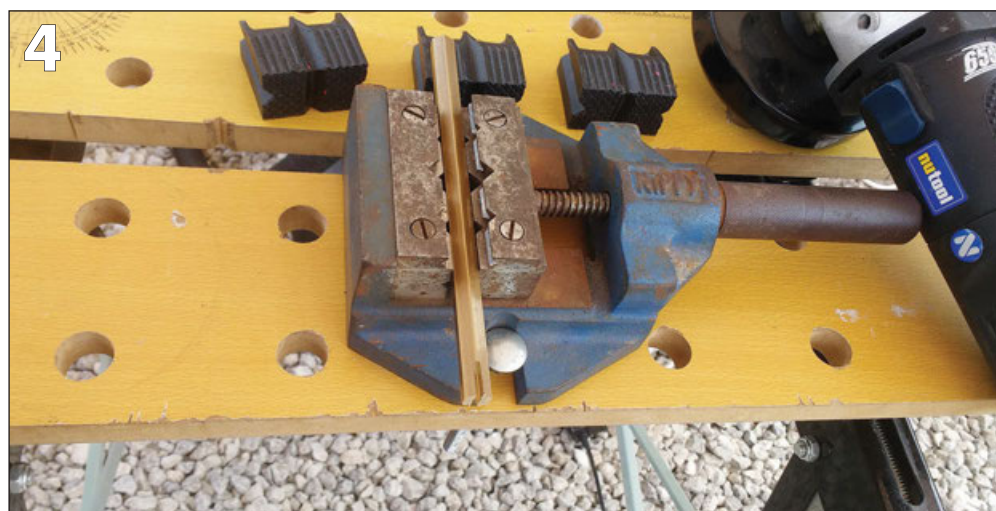
I cut a section of brass to create a support for the cylinders, then marked, drilled and tapped a set of holes in order to attach the cylinders to the wooden base. Then I made a block to take the axle which holds the flywheels.

I drilled the hole in a brass block that could hold the axle, and I had to enlarge the hole for the axle up to 10mm to allow for the fitting of two bearings. I also drilled and tapped some holes in the bottom of the block to attach it to the wooden base with countersunk screws.

Brass flywheel

I made one of the two flywheels from a section of brass that I turned and cut (**Photo 6**). I then drilled and tapped a pair of holes at opposite ends in order to attach it to the axle (**Photo 7**).

I decided to recycle a flywheel



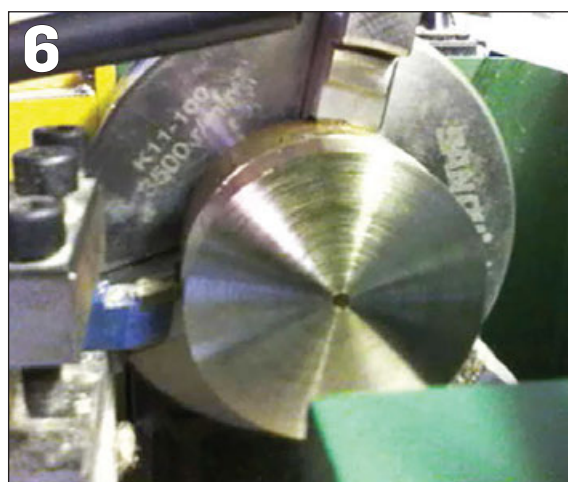
from a model boat for my second flywheel so I had to make an adapter for it, through drilling a 3mm hole in a shaft to create a sleeve for the flywheel to sit on.

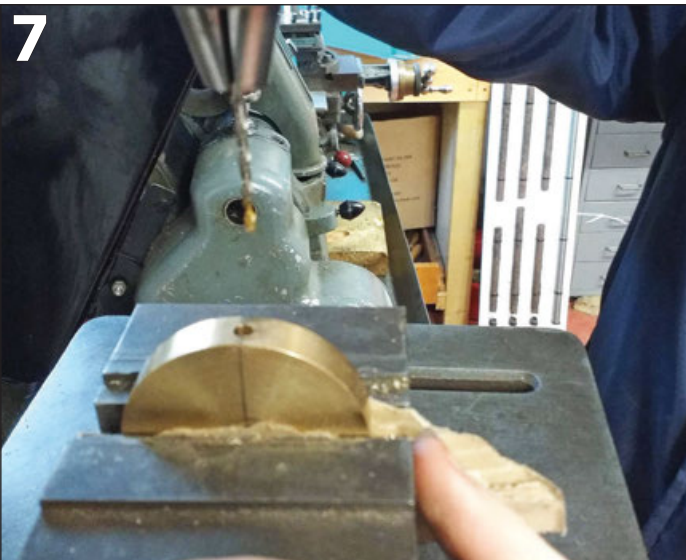
Switching to plan B

My project then suffered a slight setback when, discussing my design with members of the Stirling Engine Society, I discovered that brass is an unsuitable material to use for the displacer cylinder as it conducts heat too efficiently.

To replace it I found a stainless-steel tube for the new displacer cylinder, but the wall was too thick so I turned the inside using a boring bar (**Photo 8**) and a carbide-tipped tool for turning the outside (**Photo 9**). I then cut it off with the parting-off tool. I then turned the end for the displacer cylinder from a stainless-steel bar.

I was going to solder the end onto the displacer cylinder, however we then discovered (using a test piece) that we had one of the grades of stainless steel that cannot be soldered. Therefore I had to make a new displacer cylinder end from the stainless steel bar so it would hold fast to the cylinder when I heat shrunk it on. Once it had cooled



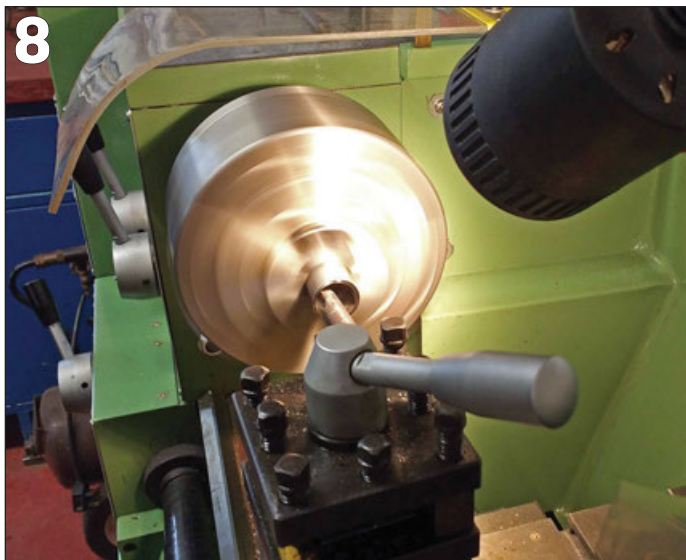


down, I parted off and tidied up the end of my displacer cylinder so there wasn't too much material sticking out (Photo 10).

This is the point to which my

build project has progressed so far and I'm currently at the stage of working out the travel of the pistons.

In order to figure out where to drill the holes on the flywheels to



"I have 3D-printed attachments to enable me to connect the pistons to the flywheels and test the running of the engine..."

obtain the optimum stroke on the engine I have 3D-printed attachments to enable me to connect the pistons to the flywheels and test the running of the engine. I have also filled some of the dead space with wire wool to reduce the volume of air inside the cylinders.

Sealing issues

Unfortunately there was too much of an air gap around the shaft of the displacer piston so I 3D-printed a seal to stop the air from leaking. However the PLA filament is not self-lubricating so the seal is quite stiff. By moving the displacer by hand I discovered that the travel of the power piston was insufficient to power a full revolution of the flywheel. So the next move is to create phosphor bronze seals in order to free up the engine and to reduce the size of the power piston head so that it travels further per stroke.

This is the stage I have currently got to, unfortunately my project has been delayed by current social-distancing restrictions. With the editor's permission I'll update progress in a forthcoming issue.

■ **The Editor replies:** Absolutely – we will look forward to further updates from Daniel, another enterprising young model engineer that the Hereford club in particular seems to produce so many of!

Other clubs – do you have talented youngsters? Get them to send in something to appear on our Young engineer pages! We welcome submissions from young engineers (well engineers of any age), and we pay for a fee for features used which might just help fund the next project! See page 33 for details of how to make submissions.

■ So how do Stirling engines work? All is explained on page 11.

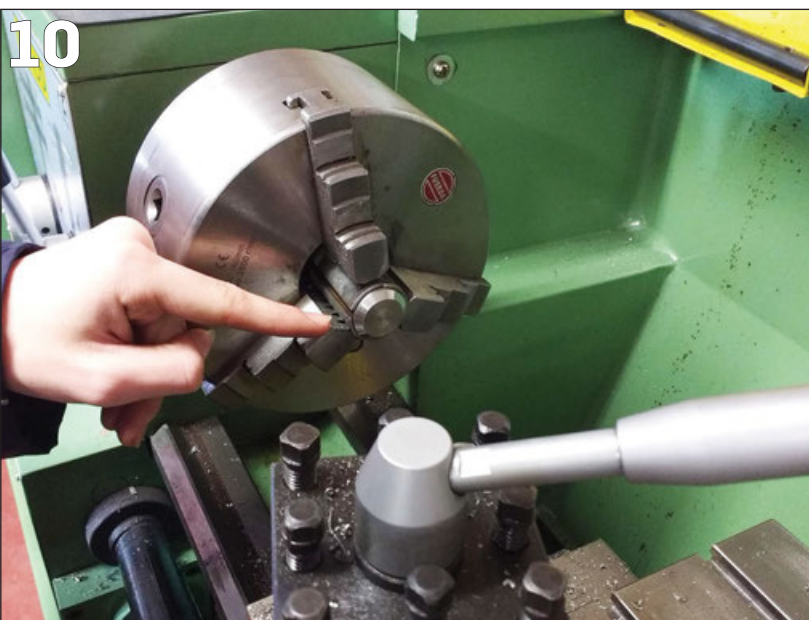


PHOTO 7: Drilling the opposing holes in the new brass flywheel.

PHOTO 8: Boring out the stainless-steel displacer cylinder.

PHOTO 9: Turning the outside of the stainless-steel displacer cylinder with a carbide-tipped tool.

PHOTO 10: Turning the end of the displacer cylinder after parting off the end.



Jack Buckler – 1926-2020

The creator of 'Sweet Pea', one of the most popular locomotives in model engineering and first serialised in **EIM**, has sadly passed away. Rest in peace Jack Buckler...



"Many hundreds of Sweet Pea locos have been built and it is rare to see two that look exactly the same..."



It is our sad duty to report that Jack Buckler passed away on 8th August aged 94 following a stroke.

Jack will be known to many as the designer and builder of his very famous 5-inch gauge 'Sweet Pea' locomotive. He approached Blackgates Engineering in the mid 1970s to enquire whether castings could be obtained for a model he was building for his friend Dr Roger Jackson. This started the long association between Jack and Blackgates, and subsequently Sweet Pea was born as a commercially available design.

It used to irritate Jack when people said this was a model of the Reverend Teddy Boston's 'Pixie' locomotive, which it was not. Jack followed this design with a 3½-inch gauge version 'Sweet Violet' and the 'Sweet William' in 7¼-inch gauge.

Hundreds built

Many hundreds of Sweet Pea locos have been built and it is rare to see two that look exactly the same. An annual rally is hosted by clubs around the country, starting with the first held by the Leeds club at its Eggborough site in 1993. Jack was often in attendance at these rallies and was extremely proud to see his offspring performing on the track, and there can hardly be a track anywhere that hasn't had an example of the Sweet Pea run on it.

The design was published as a series of construction articles in **EIM**, starting in the October 1981 edition, and this series was followed by a book published a few years later.

Jack was an electronics engineer by profession, but a steam man by

inclination. For many years he operated his own electronics company with his younger brother Peter.

Full-size narrow gauge

We first met Jack when an invitation was extended to interested parties to visit a 2ft gauge line near Leeds. This turned out to be about 230 yards of single-track line running from the rear of Jack's house and along the top edge of a valley, that had been designed and built by Jack and Roger, his GP.

They frequently steamed a quarry Hunslet loco called 'Allan George', that they successfully bid for in 1965 when the Penrhyn quarry railway in Wales was dismantled. Together they rebuilt the loco (it took five years) and ran the Howden Clough Light Railway with a small band of helpers until it all got a bit too much for them. Railway helpers were often rewarded with a

glass of Jack's (potent!) home brew.

The railway's equipment was sold to the Teifi Valley Railway in Wales in 1983. Today the only trace remaining of the Howden Clough line is a girder bridge built by Jack and Roger.

Jack intended to lay a 5-inch/7¼-inch gauge track in place of the 2ft gauge but this never happened. A Garratt type of Sweet Pea was on his drawing board for some time, and he even had the two chassis well on the way. He took great delight in solving technical problems and spent a great of time designing an articulated joint for the steam pipe to the cylinders. Typically, Dr Jackson (Roger to his friends) was not impressed and commented that a flexible pipe connection would have been easier.

Jack will be sadly missed by all who knew him.

*Phil and Jacquie Owen
Blackgates Engineering*

ABOVE: Jack Buckler, pictured by Brian Holland of the City of Oxford SMEE at the 2013 Sweet Pea Rally.

ABOVE RIGHT: The original Sweet Pea loco built by Jack.

RIGHT: A rare event, all three gauges of the Sweet Pea concept pictured together at the 2018 rally. Both photos: John Arrowsmith



No Midlands show in 2020



The somewhat inevitable, but no less sad news has emerged that there will be no Midlands Model Engineering Exhibition in 2020.

Traditionally held in mid October, the Midlands show is of course one of the largest and most important gatherings of the model engineering year and normally this issue of *EIM* would include the four-page pull-out guide detailing what to expect at the show.

On 3rd August, however, show organisers Meridienne Exhibitions announced that the 2020 exhibition has been cancelled as a result of the impact of Covid-19.

A statement from Meridienne added that the decision to cancel the event until October 2021 ensures safety and will enable the team to deliver the highly popular event without compromise next year.

"Like many other organisers we have been watching the criteria for events unfold," said Chris Deith, exhibition director of Meridienne Exhibitions and also the founder of *EIM* magazine in 1979.

"Venues are only currently planned to reopen from 1st October subject to successful outcomes of the mass-gathering pilot studies. There are also ongoing government restrictions in place for the continuing management of this pandemic which are subject to change at any time," Chris added.

"We are positive that considerable social-distancing measures will need to be in place regardless. We feel these would have a significant impact on our ability to present the event to the normal size and format for everyone's enjoyment.

"Therefore, we have come to the sensible and responsible decision to cancel the event until October 2021."

Chris added that all at Meridienne are aware that loyal supporters of the show will be disappointed with this decision. "But it would not be right to organise an event that does not meet the high expectations that have been set over the last 42 years".

Meridienne has confirmed that the 2021 show dates will be 14th-17th October, again



As these views from previous shows illustrate, inside or out the Midlands exhibition is one of the most important on the model engineering calendar and will be missed this year. Photos: Andrew Charman

at the Warwickshire Event Centre near Leamington Spa.

Any visitors who have purchased an advance ticket for this year's event will be refunded directly.

Updates on the show and the sister London event, traditionally held at Alexandra Palace in January, will be posted on the Meridienne Exhibitions Ltd Facebook page and Twitter feed, @MeridienneEx.

16mm show delayed to 2021

The 2020 National Garden Railway Show has also fallen victim to the covid-19 pandemic.

Organised by the Association of 16mm Narrow Gauge Modellers and a hugely popular event for those model engineers working in the smaller scales, the 2020 show was originally due to be held in April at the Peterborough Arena.

Due to the onset of coronavirus and the resultant lockdown the show was put back to November, and has now been rescheduled to 26th June 2021.

"(The show) will take place later in the year than normal so if restrictions on indoor events are tightened over winter, which could happen if there is a resurgence in the virus, there is time for the restrictions to return to levels which permit the staging of indoor events," 16mm Association chairman Alan

Regan said in a message to members

"We will continue working with the Arena and the local authority to make sure that our show is compliant with prevailing protocols for indoor events," he added.

Tickets bought for the 2020 show will be valid for the 2021 event – full details of the exhibition, which usually includes at least a dozen layouts and 80-plus traders, will be at www.nationalgardenrailwayshow.co.uk





Live-steam sale makes £132K

Mid-Wales heritage line the Welshpool & Llanfair Light Railway has benefited by close to £120,000 from the auction sale of mainly model railway items from the estate of Leicester-based enthusiast the late Mike Abbott (pictured above).

The sale conducted by Gildings auctioneers in Market Harborough on 18th August saw all 229 lots sold, with the final sale total topping £132,000 against a pre-sale bottom estimate of £70,000.

After sale costs and fees are deducted, the W&LLR will receive a welcome boost to its funds of almost £120,000. Mike was not a volunteer on the railway but apparently wanted the proceeds to be donated to the line because he had visited it "and liked it."

Most of the models sold consisted of live-steam items in 16mm and G scale, along with a great deal of OO-gauge indoor railway stock, but there were also three larger-scale steam locomotives, two in 5-inch gauge and a 7¼-inch gauge Orenstein & Koppel, two 7¼-inch gauge diesels, rolling stock and a 3-inch scale Maxitrak road roller.

The 7¼-inch gauge Metropolitan line 'Sherlock Holmes' sold for £3,600 plus charges, and the Maxitrak Aveling & Porter road roller £5,500 plus charges. "We are thrilled with the success of this sale, not least because the proceeds will benefit a much-loved light railway that relies on public support and has faced increased financial challenges due to its closure during the pandemic," said Andrew Smith, Gildings' in-house railway expert.

"It is rare for a collection of this size and scope to come up at auction, so although we knew there was a lot of interest in the sale, even we were surprised by the high levels of bidding we saw on the day."



Kerr's faces end of the line

Scotland's oldest miniature railway appeared set to close at the end of its 2020 season in September.

The 10¼-inch gauge Kerr's Miniature Railway, located right next to the main line railway in Arbroath, is blaming continually falling visitor numbers rather than specifically Covid-19 for its demise after 85 years of operation by the same family.

Opened in 1935 by Matthew Bullock senior, the ¼-mile long line reached its peak in 1955, when a staggering 60,000 passengers were carried. Matthew Kerr Junior succeeded his father in running the line and when he died in 2006 his widow continued to operate the railway with her son John and volunteer support.

The motive-power roster has included two 1930s Bullock steam locos and four i/c locos, while the railway has also operated miniature road vehicles giving rides to Arbroath sea front.

John Kerr announced the impending closure in an emotional video message on Facebook. While he admitted that the Covid-19 pandemic had left the line without revenue for more than four months, the decision had resulted from a consistent

decline in visitors in recent years. "In 2019 the line carried 3,500 people but that was operating 97 days, five hours a day, so it's not very many people at all," he said.

"Ten years ago the railway was carrying 13-14,000, so we've lost 10,000 people and on those numbers we just can't continue – 20 years ago it was closer to 20,000."

John added that a council decision in 2015 to move a play park away from the line had caused a drop in passenger numbers. "With the numbers we are at now we can't keep the railway going, it's costing me money but more importantly, emotionally it's too much to keep the enthusiasm going."

"There are other options with other locations and councils who would love to have the railway, but if these changes were to take place it would be a new railway using the equipment, not the Kerr's Miniature Railway. As of the end of this year, Kerr's Miniature Railway will cease."

He added that he had wanted to see the line celebrate its centenary in 2025. "But speaking as a volunteer myself it's becoming more and more difficult to keep the motivation and enthusiasm to keep the railway going."

LETTERS

336 the magic number for wheels

Further to your article regarding locomotive wheels in the August issue of *EIM* (Start Here, page 25) I feel that there is a lot more to this subject than meets the eye.

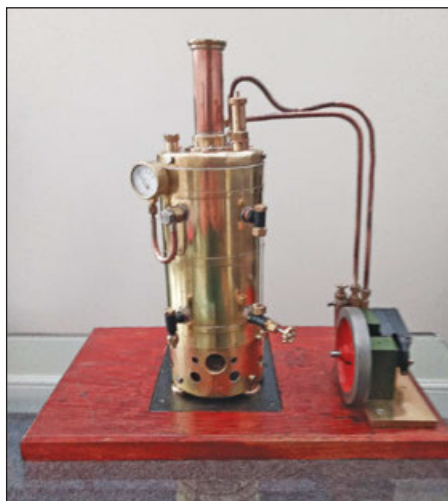
In the early part of the 20th century the rule of thumb regarding the diameter of locomotive driving wheels was that the diameter of the wheel in inches was equal to

its normal maximum speed in miles per hour. For example on an express passenger locomotive with 6ft 8-inch (80-inch) diameter driving wheels, the normal maximum speed would be 80 miles per hour, while for a freight locomotive with 4ft 8-inch (56-inch) diameter wheels, the normal maximum speed was 56 miles per hour!

This is known as the 'wheel diameter speed' which in all cases is 336 revolutions per minute. But like all rules, these speeds were often exceeded in practice! It wasn't until around the 1920s when cross balancing of the locomotive wheels and motion was perfected that the maximum speeds could be increased by about 20 per cent.

The wheel diameter speed applies equally to models as it does to full-size locomotives, for example a 5-inch gauge pacific with 7-inch diameter driving wheels will be doing seven miles per hour when the rpm of the wheels is 336 – assuming no wheel slip is occurring!

Malcolm Young



■ Another successful *EIM* Steam Plant and boiler build from another newcomer to model engineering, in this case Lincoln-based Tony Cass, who is justifiably pleased with his first-ever build. He is now progressing to a Rob Roy 3½-inch gauge loco – just the kind of progress that makes us very pleased in the *EIM* office!

The editor replies: Fascinating stuff Malcolm – I wasn't aware of that particular formula, you learn something new every day!

We welcome letters on any model engineering subject. Write to the editor at andrew.charman@warnersgroup.co.uk or at *EIM* Letters, 12 Maes Gwyn, Llanfair Caereinion, Powys SY21 0BD

Catching up fast...

The clubs are busy again and making the best of things as our latest round-up demonstrates.

COMPILED BY ANDREW CHARMAN



Welcome to this month's *Club News* round-up and the delightful picture above is indicative of the theme staring out from the various journals and newsletters received at EIM Towers, a theme of clubs getting back up and running again. Members are at the tracks and getting on with their hobby, while of course maintaining the various measures, such as social distancing, to protect themselves from the lingering effects of the Covid-19 pandemic.

The heading picture comes from

the **Grimsby & Cleethorpes ME**, and was taken at a day instigated by member Graham Dumbleton on 9th August, as he was keen to steam his recently-completed 7¼-inch 'Britannia' 4-6-2. According to club newsletter *The Blower*, the members day was "By invitation only, but everyone was invited." The 'Brit' apparently performed very well, especially on the newly completed extension to the club's ground-level track which members grabbed an opportunity to run test trains on.

Also in the picture, which to your

"We had some very complimentary comments from our passengers who were very pleased to see us back..."

editor really sums up model engineering enjoyment, is 'Henrietta', another loco new to the Grimsby club and of which more details are promised soon, while in the background member Brian Chatburn tackles the 1 in 70 bank with his 5-inch gauge electric loco.

Public return

The Grimsby club has not reopened for public rides yet but some clubs have, not least the **Chingford & District ME**, which held its first public running day on 9th August and which according to the club's newsletter proved highly successful despite a last-minute issue when the rostered loco 'Captain Howey' failed. This forced the abandonment of a planned afternoon of double-heading with i/c loco 'Demoiselle' having to maintain services by itself.

Newsletter editor Chris Manning paid tribute to the efforts of members who made the reopening possible, a lot of work needed as the track had been out of service for eight months. Covid-19 measures worked well, Chris adds, with young members especially ensuring trains were cleaned between each trip. "We had some very complimentary comments from our passengers who were very pleased to see us back." In total 120 paying passengers were carried on the day and the club now hopes to

ABOVE: A superb shot from the Grimsby ME, showing a range of club members enjoying their hobby. Photo: Neil Chamberlain/Grimsby ME

LEFT: An important event at the Chingford ME, 'Demoiselle' in action at the club's first 2020 public running day on 9th August. Photo: Chingford ME



run public trains every Sunday until at least the end of September.

Elsewhere in its pages the Chingford newsletter reflects another theme of recent weeks, model engineers taking the opportunity of the spare time released by lockdown to complete projects! In this case it is member Bryan Alderslade, who has "at last" finished his 2-inch scale Durham and Yorkshire traction engine, only hydraulic and steam tests still needed. You can see from the photos on this page that it is a very fine model.

A sagging issue

Also of great interest in a very full Chingford newsletter is the continuing history of the club, in this issue documenting the years 1944 to '49. At this time, it is described, the raised track was supported on pillars with nothing but the metal bar of the rail between them, and a consistent issue was the rail sagging between the pillars, especially at joints!

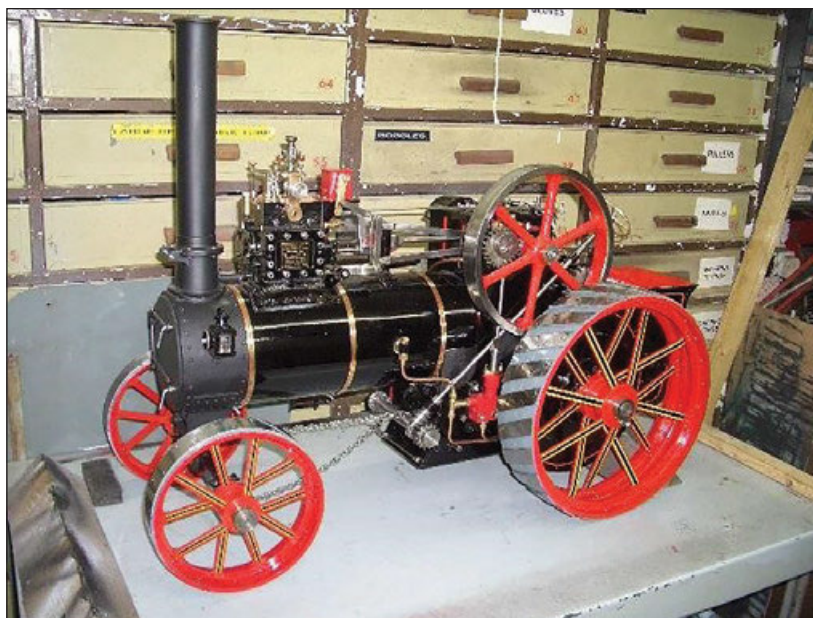
The latest edition of the **Bradford ME Bulletin** is another to report a hive of activity at the club's Northcliffe track as members get back to having fun. Newsletter editor Graham Astbury is another deciding to publish more frequently. Recognising that the newsletter is for some members their only way of keeping in touch with the club, particularly in recent times when some have had to self-isolate, Graham has decided to produce a September edition for the first time – usually summer holidays dictate against, but not this year!

Graham also issues an appeal to members who have specialist knowledge of engineering subjects to share them with fellow members, quoting the example of a short but highly useful contribution from

"A consistent issue was the rail sagging between the pillars, especially at joints..."

THIS PAGE:

Chingford member Bryan Alderslade has completed this superb 2-inch scale Durham & Yorkshire traction engine during lockdown. Photos: Bryan Alderslade/Chingford ME



R Finch in the latest edition on firebricks – essential for all those who need to do any silver soldering. It's a message we can only repeat in **EIM** – if you have some specialist knowledge that would benefit your fellow model engineers, why not write it up for our pages? It's the essential but perhaps less obvious subjects that tend to get overlooked...

Simulated steaming

Notable in the latest edition of *The Workbench*, newsletter of the **Durban SME** in South Africa, is a computer simulation of the club's track site that even includes a drone view that lets one fly around the grounds! Quite handy when current restrictions may prevent a real visit to the track...

Subject to similar restrictions are fellow South African club the **Pietermaritzburg ME**, though they have managed to clear some damaged trees that were threatening

the track, a job which apparently "has shown up some limitations brought on by advancing age!"

Away from the club members have been continuing their own build projects and perusing the latest *Maritzburg Matters* newsletter we particularly like the picture of a newly completed model by Colin Healey, a marine steam engine from the 'Great Western' paddle steamer that was built by Isambard Kingdom Brunel. This model is truly magnificent, even mounted in a section of the ship's hull. We reckon **EIM** readers would love to learn more about it Colin...

The problems caused by Covid-19 continue to afflict many clubs, not least the **Bournemouth SME**, the latest newsletter revealing that with great regret the 2020 Santa Run at the club's Littledown track will have to be cancelled as the committee feels adequate social distancing will be impossible. "The planning and





preparation would have to start shortly and as no-one knows how Covid-19 is going to react to the colder weather and recent relaxing of restrictions, the Society could lose out if we invest time and money into the event, only to have to cancel it nearer the time," club chairman Peter Burton states in the newsletter *B&DSME News*.

Boiler tickets

Newsletter editor Dick Ganderton also highlights another very real consideration resulting from the pandemic, that of steam locomotive boiler tickets.

"By the end of October there will be no member with a steam loco 'in ticket' – at present it is not possible under the present social-distancing rules to conduct boiler tests at Littledown," Dick writes, adding that "it is unlikely that we will be able to use the Littledown facilities until the end of the year at the earliest." He points out that members taking their locos to other tracks must ensure the

ABOVE: The new train shed at the Lincoln ME will be an impressive structure when it is completed. Photo: Neil Grayston/ Lincoln ME

BELOW: This newly complete 'Ellie' loco by Bournemouth member Jim Cunningham demonstrates the success of the club's novice build project. Photo: Bournemouth ME

validity of their boiler certificates.

Better news in the same issue is a picture of a completed 'Ellie' tram-like steam loco to run on 16mm scale track. This attractive gas-fired model has been made by Jim Cunningham and is his first loco build. It again demonstrates the success of the Bournemouth club's Project Ellie which was created to encourage novice model engineers to complete an engine of their own and in the process hopefully spur them on to greater things in future. In fact Jim joined the Bournemouth Society specifically so he could participate in the Ellie project.

Solid progress on improved facilities is evident in the latest newsletter from the *Lincoln & District ME*, a new train shed progressing rapidly to completion with its roof on and the posts set in concrete. Lincoln newsletter editor Neil Grayston tells *EIM* that new member Tony Cass has been busy on this project, a name well known to your editor as he has in the past many times shared a Welshpool & Llanfair Light Railway footplate with Tony! A recent convert to model engineering, Tony has already completed an *EIM* project as pictured on page 39.

Busy times too at the *Ryedale SME* – like at so many clubs members have been kept busy in recent weeks catching up on maintenance and improving the facilities at their track site after far too long away. New track panels have been made for the diesel depot and concreting of the extension track bed in the down yard completed.

Members were also delighted to hear of some planned track activity, the club's committee deciding to turn the usual August bank holiday open days into two days of running for members, subject to the latest rulings and conducted under social distancing regulations, which

included no overnight stays and no catering available. "Basically it's bring your loco and your own food and drink and come and run a train," the newsletter stated. Can't say fairer than that...

A return to activity at the *Isle of Wight ME* too, the latest edition of its *Vectimod* newsletter reporting the restarting of members' running days from 1st August. Meanwhile the newsletter highlights yet another example of a member making the most of lockdown, Ian Gordon building a superbly detailed 1-inch scale model of a 47ft Watson Class lifeboat. This was a project Ian had clearly planned for some time, as he bought the hull, a plan "and a motley collection of whitmetal fittings that bore little relation to the plan," many years ago while living in New Zealand!

In fact marine models appear to be a theme amongst Isle of White members, perhaps not a surprise, Clive Richards having finished an RAF fire and rescue launch and almost finished two more ships, including an impressive Tribal class destroyer, during lockdown!

Of course it wouldn't be an edition of *Club News* without an update from the perennially busy *Rugby ME*, even with the club's new signalling system starring in this issue of *EIM*. Leaping off the page in the latest edition of the club's newsletter is a picture of the AGM, which had been delayed from its planned date of 28th March by the arrival of Covid-19.

The meeting was held on 4th July in the open air at the track, members able to social distance accordingly, and the picture suggests a rather garden party-like atmosphere, though we understand like many summer events in the UK rain did conclude proceedings early...

Debuting on the same day was the club's new 'traversing' lift table, which appears already to be a highly useful bit of equipment, used on this occasion to unload some passenger carriages from a trailer.

The very next day saw Rugby club members on the track for their first members' running of 2020. It made your editor smile to see the very first locos let loose were a pair of 'Scamp' i/c models, one of them in the hands of Rolf Thomas who is yet another member of the Welshpool & Llanfair footplate department...

One long loco

A further members' day on 1st August not only saw the return to action of Romulus loco 'Dr John', the overhaul of which was recently described in detail in our pages by Edward Parrott, but also a real





highlight for all involved at Rugby, the first trial steaming of the enormous East African Garratt 'Mount Kilimanjaro'.

This loco, loaned to the Rugby club by its owner, the well-known supplier of components for miniature lines PNP Railways, has already undergone a great deal of work at the club, with Edward Parrott intimately involved in the operation.

The work carried out so far is to enable the loco's boiler to pass its hydraulic and steam tests, and the first steaming was held to set a benchmark ahead of a major

programme of improvements planned for the engine. It is a seriously impressive loco and we look forward to continuing updates.

Of course there is always a lot going on at Rugby and on the equally busy following day the first sleepers of a major extension to the raised track were screwed down by chairman Aubyn Mee.

We are out of space again. As ever keep your newsletters coming in, and if you have photos from your club that you think would look good on these pages, don't hesitate to send them in to the address on page 3. **EIM**

THIS PAGE, CLOCKWISE FROM ABOVE:

Scenes from yet another busy month for members of the Rugby club, including a socially-distanced open-air AGM, first use of the new lift table, members Conor and Rolf with their Scamp locos, and first test run of the very long Garratt 'Mount Kilimanjaro'.
Photos: Rugby ME



NOTICE BOARD

Notice Board offers readers the opportunity to post free of charge private for sale or wanted ads, queries and such like. If you have something for sale, are searching for that elusive casting or drawing, or just want to alert your fellow model engineers to something of interest, send in details to the address on page 3 and we'll put it in! (Don't forget your contact info...)

Yes we know we published the below last month! But the reader selling the loco managed to get his own phone number wrong, and not surprisingly got no enquiries, so we are happily publishing it again!

Draper lathe for sale

For Sale. Draper metal engineering lathe; it is surplus to my requirements. It is about 7 years old and has an 80mm 3-jaw chuck, 80mm 4-jaw chuck, an ER25 collet holder and 11 collets, metric and imperial, 4-way tool post, screwcutting gears and a tailstock chuck. Centre height is 3½", about 12" between centres. 3MT headstock and 2MT tailstock tapers. £400 collected from Broseley, Shropshire. It is fairly heavy and 28" long, 9" wide and 11" high. Contact me if you want to know more details. Nick Coppin, nicksue.coppin@gmail.com



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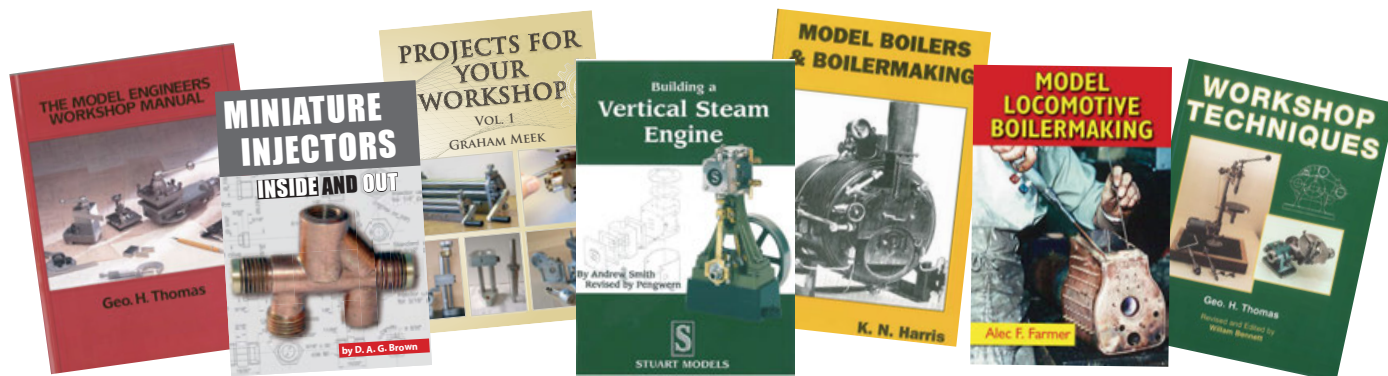


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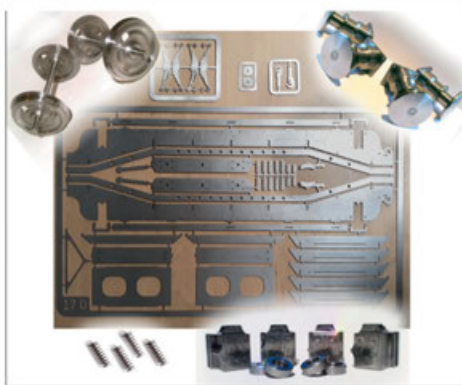


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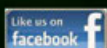
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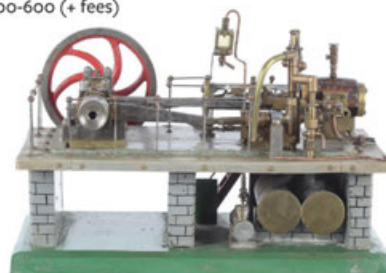
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