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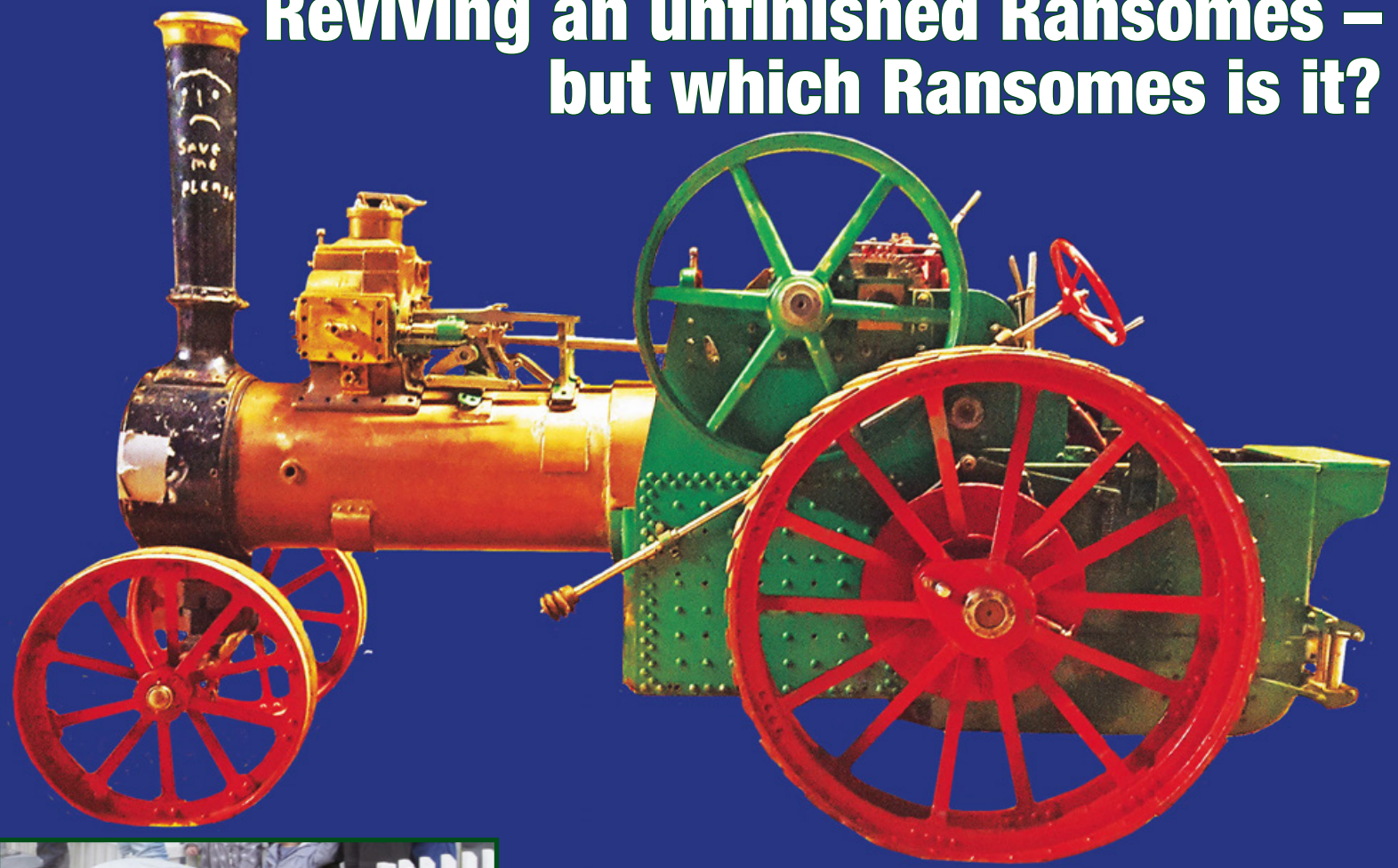

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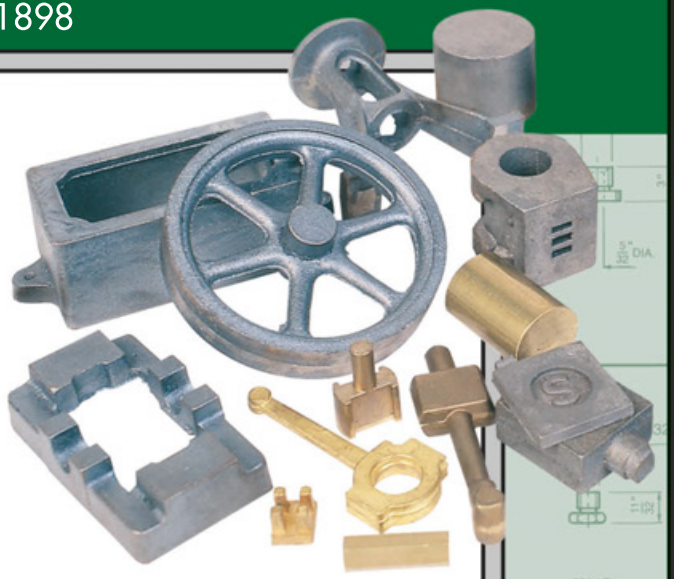

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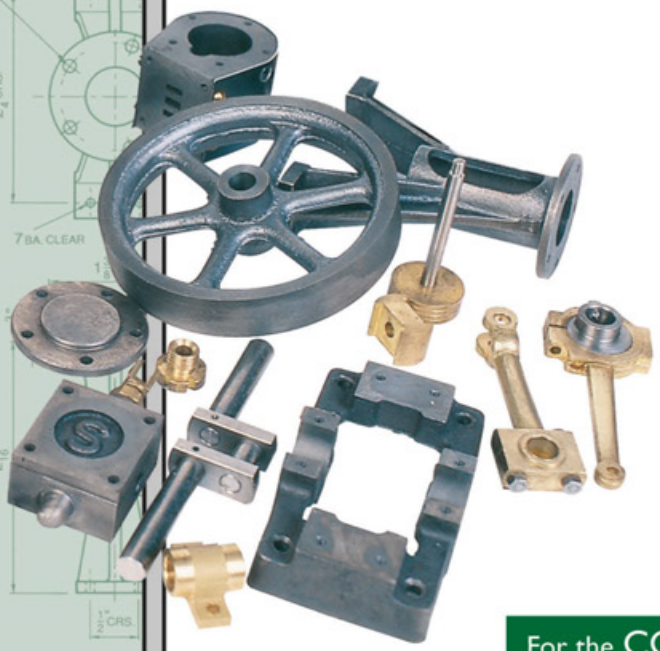

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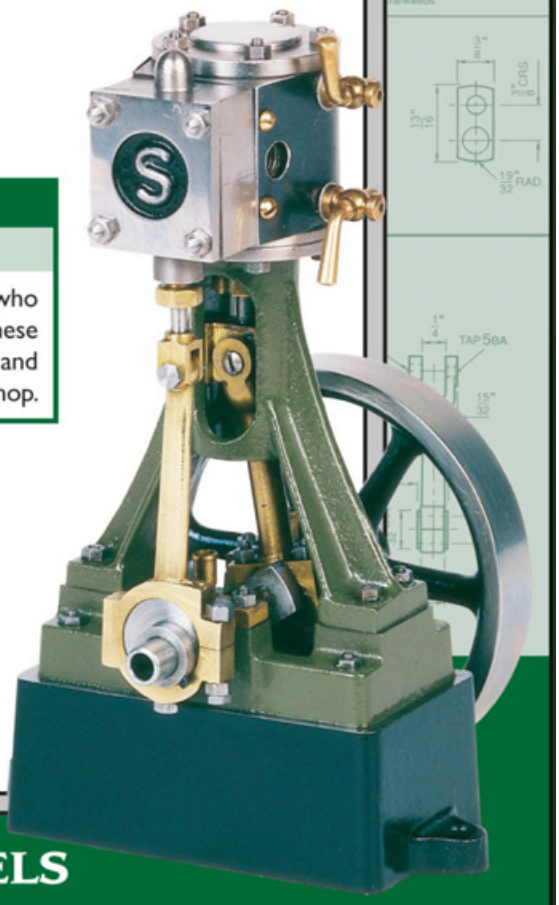

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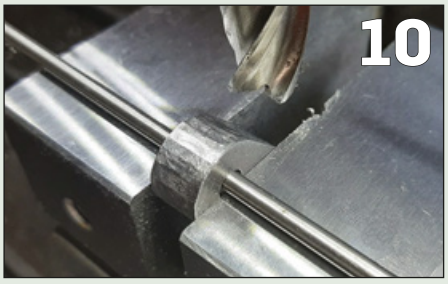

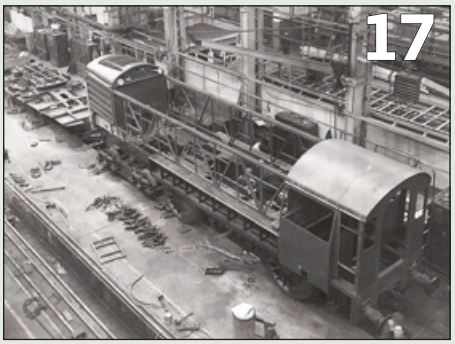

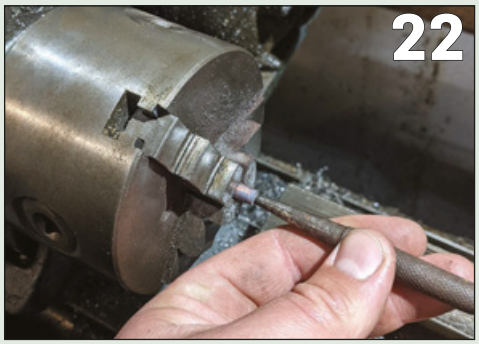

FRONT COVER

What Howard Trendell thought was an unfinished Ransomes steam tractor project in 2-inch scale proved to be a Ransomes, but not the one he'd expected. Howard and son Isaac begin their rebvuold in this issue..

EDITORIAL

Abandoned projects – a route in for newcomers

Welcome to the June EIM and I'm writing these words just a week or so after taking a brief break from another day swarf-making in the workshop of the Fairbourne Railway, to watch the first train of a new operating season pull out – it was a sight to gladden any enthusiast.

Now in my 'other' role as editor of EIM's sister magazine *Narrow Gauge World* I was also standing on the sea wall in Fairbourne when the line became one of the first in 2020 to restart services, which then was in July. As we know the hope for a return to normality was to be dashed, but this time there's a real feeling that we really are on the way out of a pretty dark period.

Fans of tech-ed Harry's 'Behind the shed door' column (there are fans, we've had letters!) will be interested to hear that he was a pretty busy Fairbourne Railway engineer in the weeks before reopening. His column this month focuses on a couple of specific techniques needed in 6-inch scale loco maintenance, instead of an overall round-up and to be honest he struggled to find time to write that. Have no fear, his column will be back in usual form next time.

As ever we have quite a mixed bag of material to offer you this month, including a new occasional series concerning the revival of a 2-inch scale Ransomes traction engine. Watch the online auction sites such as eBay or on social media model engineering for sale groups and such unfinished projects regularly come up – bringing another model engineer's abandoned dream to fruition is becoming an increasingly popular way for newcomers to get into the hobby, especially if they have an experienced mentor to guide them. And the successful completion of such a project often inspires the new model engineer to tackle something more challenging from scratch, which has to be a good thing.

Meanwhile, reading about such projects, such as the Ransomes and Sam Ridley's rebuild of a Winson kit, can encourage others to have a go themselves. So if you've turned an abandoned build into a finished model, why not write it up for your fellow readers?

Enjoy your EIM as we keep on that route back to some form of normal.

Andrew Charman – Editor

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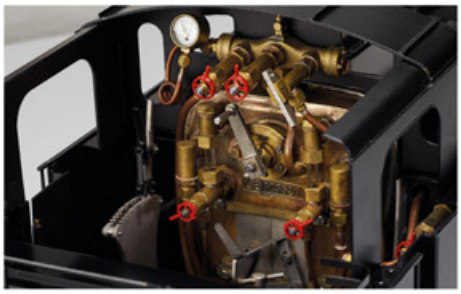

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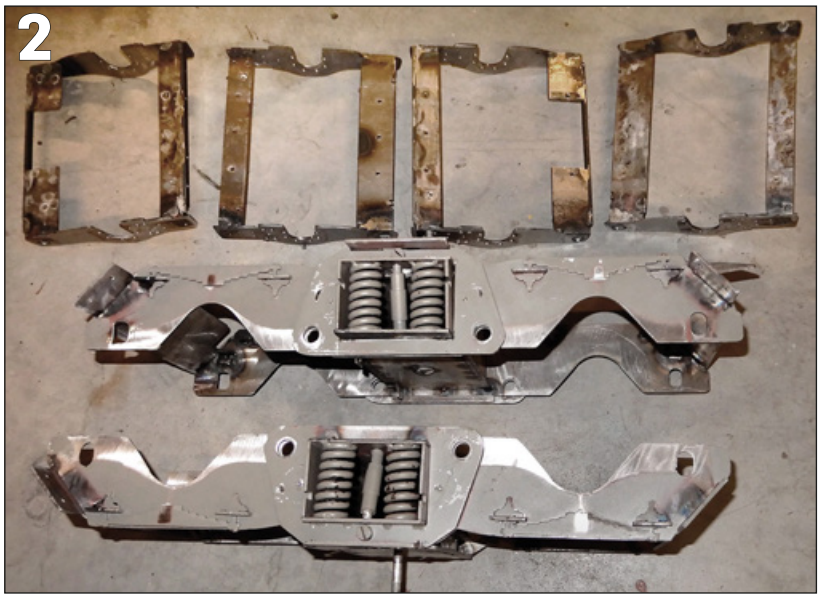
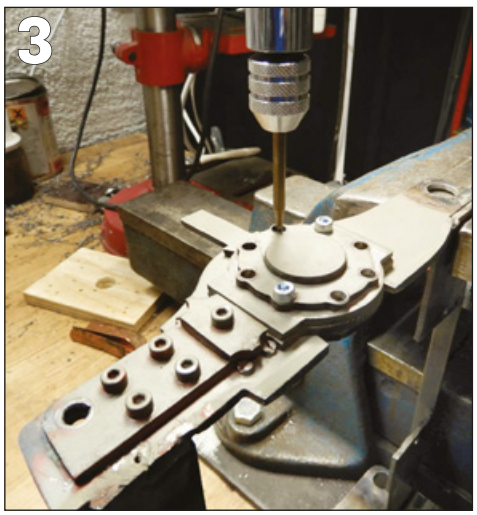
Improving the Dv12

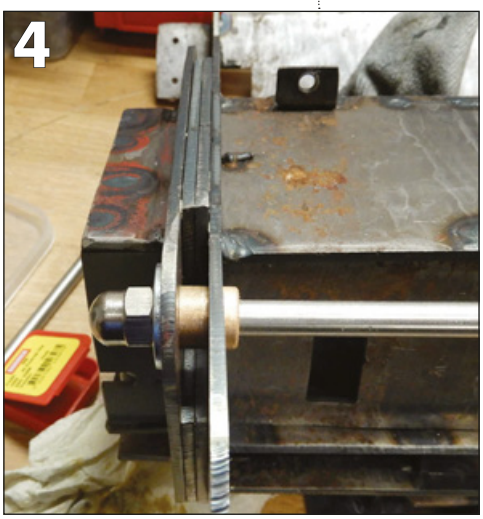
Jan-Eric describes how his battery-diesel, the build of which was serialised in EIM, has been improved to cope with a much heavier workload than anticipated...

BY **JAN-ERIC NYSTRÖM**



"The rather lightly-built battery engine has been in use at the museum for six years... it has run about one thousand kilometres each year..."





Readers may remember the four-part article about the 'Dv12', a 7¼-inch gauge, 1:8th scale, battery-powered diesel-outline engine, the construction of which I described in the June to October 2019 issues of EIM. Now, and in a response to Peter Kenington's *Current Affairs* series on batteries that started in the November 2020 issue, I'm going to describe electrical and mechanical improvements that were made to the Dv12 during the year of 2020.

I originally built the engine for my own use and enjoyment, but the people at our Railway Museum liked the looks of it (being a model of an original 1960s Finnish prototype, still in use today), so they offered to buy it.

I didn't get rich though, agreeing to sell it for almost the cost of the materials used — getting only a pound or so for every hour put into the project... After all, building miniature engines is my hobby, and I'm happy that more people can enjoy the fruits of the hobby in this way!

This of course meant that the engine was going to be in more or less constant, daily use during each two-and-a-half-month-long summer season, and not just for a few of my own runs at my home track as well as during special events at the museum — such as when I run my Ten-Wheeler there (**Photo 1**).

In fact, the rather lightly-built battery engine has been in use at the museum for six years as this is written; it has run about one thousand kilometres each year, in other words a total of 6,000 kilometres (around 4,000 miles), and it certainly shows!

For instance, due to the fact that the track is an oval, which is always run in the counter-clockwise direction (because of a steep incline that can only be run downhill), the flange of the front truck's right front wheel had worn very thin, to less than half its original thickness. Thus, we made new, digital drawings of the correct IBLS wheel profile, and new CNC-turned replacement wheels were ordered, this time in alloy CrMo steel, much harder than the original hot-rolled material.

Trucks and sub-trucks

The engine is of the Bo-Bo type, with a pair of two-axle trucks, each containing one 24-volt, 500-Watt

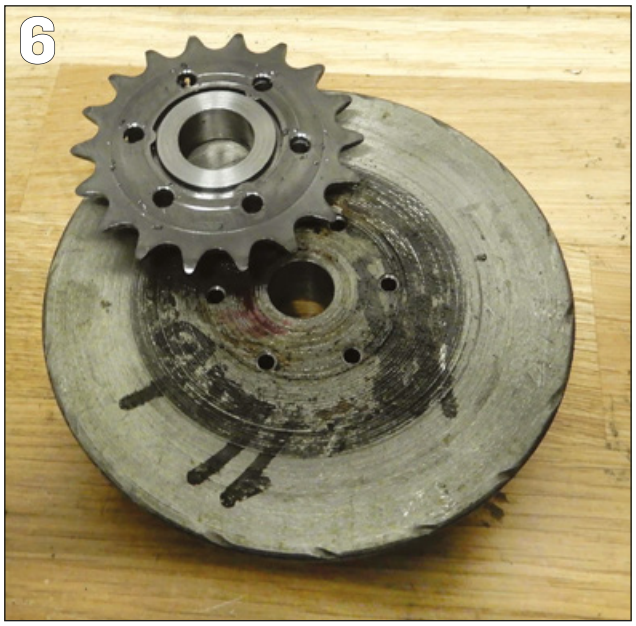


PHOTO 1: The author's Ten-Wheeler departs from the platform, while the Dv12 battery-powered diesel-outline engine awaits passengers.

PHOTO 2: Both two-axle trucks disassembled, with sub-trucks shown on top.

PHOTO 3: Re-tapping treads in axlebox 'pack', consisting of plasma-cut parts from 3mm cold-rolled steel.

PHOTO 4: Easily exchanged bronze bushing and spacer for sub-truck pivot.

PHOTO 5: Original axle with welded chain sprocket and brake disc.

PHOTO 6: New, sturdier sprocket with spacer. Note chafed edge on wheel flange!

PHOTO 7: Sub-truck with sprocket, motor and gears. Note brake cable and new oil pipes in copper.

PHOTO 8: Brake disc and sprocket now removable, not welded to axle.

Photos by Jaakko Tuominen

electric motor driving one axle via a pinion gear, and the other axle via a chain from the first. **Photo 2** shows the disassembled trucks, each consisting of two individually sprung 'sub-trucks'. The large coil springs in the photo are purely cosmetic, following the original look.

Jaakko Tuominen, who works at the museum, took the trucks apart and made substantial improvements. The axles' ball bearings are contained in a 'pack' of plasma-cut pieces forming an axlebox, held together with eight bolts. In **Photo 3** the threads in the holes have been re-tapped, the photo showing the side of one of the sub-trucks and the pieces forming the axlebox.

The sub-trucks are hinged to the main truck, originally this was only with a steel axle through drilled holes. During the heavy use, these holes became worn, so Jaakko drilled them to a larger diameter, and installed bronze sleeve bearings and spacers, (**Photo 4**). When these eventually wear out, it's a much smaller job to replace them! The spacers also prevent the sub-trucks chafing against the frame of the main truck.

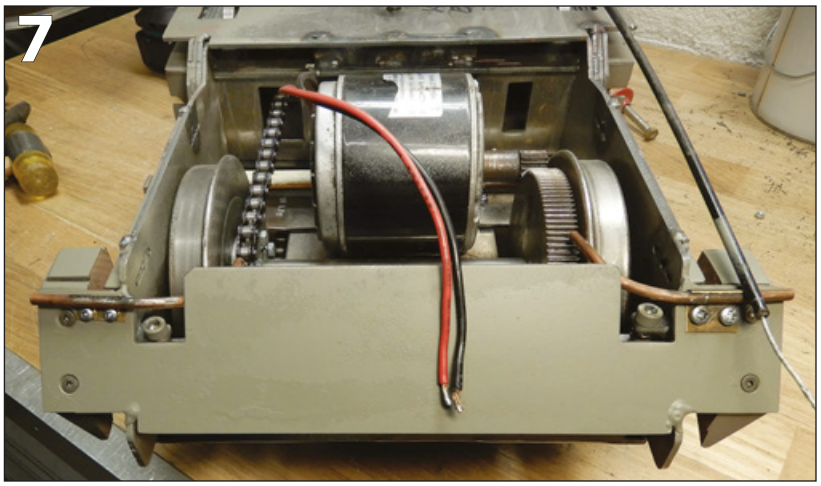
Wheels chains & brakes

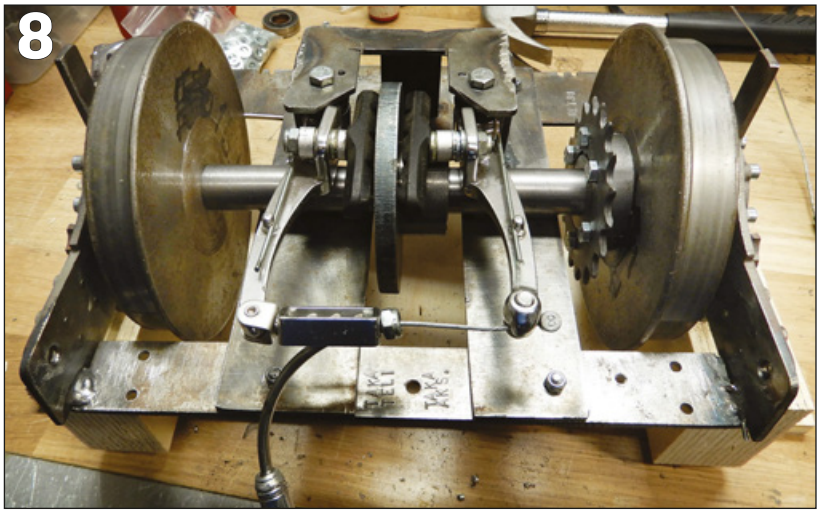
Not anticipating that the loco parts would wear out in my own, very limited use, I originally simply welded the chain sprockets and brake disc to the axles (**Photo 5**) – but with the heavy use at the museum, these parts needed replacement too. New axles were CNC-turned, and new sprockets were installed with turned spacers, thus bolting them to the wheels instead of welding to the axles. **Photo 6** shows one of these new, sturdier sprockets and a spacer, to be bolted to the new wheels.

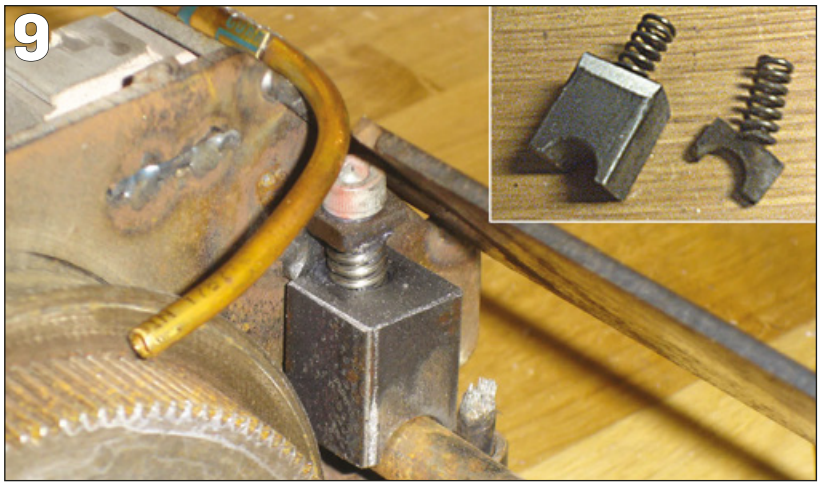
If you look closely at the edge of the flange of the old wheel in this photo (taken before the new wheels arrived), you can see small indentations – they are wear marks from the chain's splice link chafing against the flange, always at the same point on the perimeter... My original design didn't take the chain splice into account; I had placed the chain too close to the wheels!

This was partly due to the fact that the original motors were much wider – later replaced with shorter, but just as powerful motors, one in each truck. **Photo 7** shows that there now is plenty of room – the original motor was an extremely tight fit. Note the two copper tubes on each side of the truck; they allow oiling the chain and the gears easily, from the side of the loco – no crawling on the ground with a long-nosed oil can anymore!

The Bowden cable on the right side goes to the other sub-truck's cantilever, or V-brake, seen in **Photo 8.** ▶







By pressing on a foot pedal at the side of the loco, the brake shoes press against the brake disc, which is now also removable from the axle, instead of being welded as in Photo 5.

All in all, any future replacement of a single component in the locomotive will prove to be much easier than when I had everything welded together...

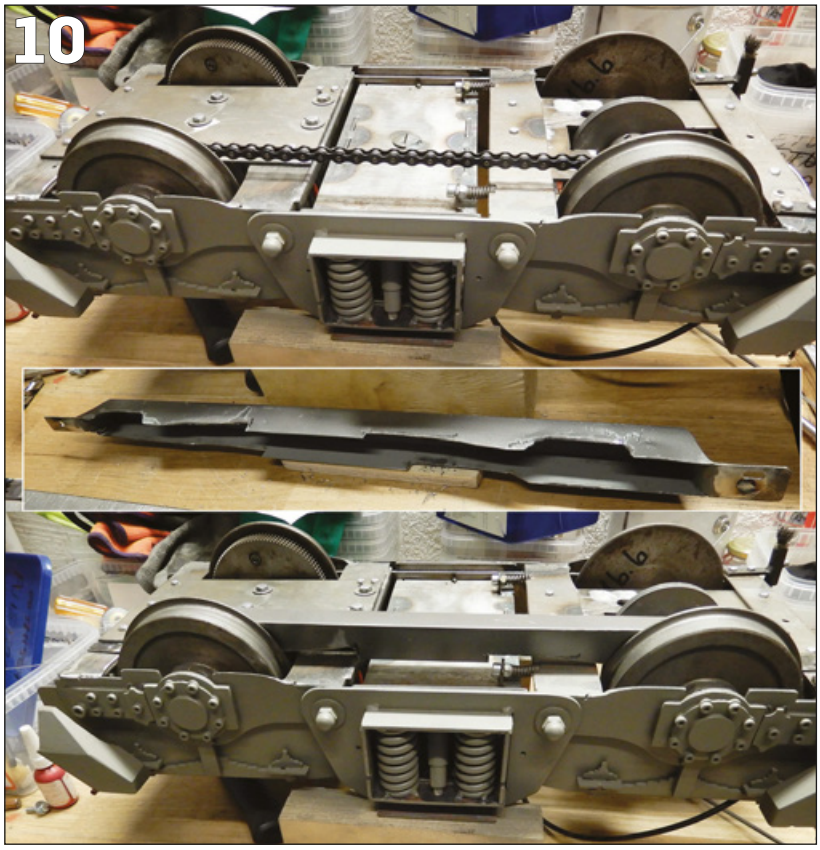


PHOTO 9: Sturdier 'saddle' for coil spring — inset shows old, flimsy saddle at right, allowing spring to 'jump off' during a derailment.

PHOTO 10: Top: Chain between truck axles held in tension with two springs on sub-truck at right. Middle: New chain guard. Bottom: Guard in place, protecting chain in case of derailment.

PHOTO 11: Original 'crow's nest' of cables, connected with crimped plugs and sockets.

PHOTO 12: New and more reliable design of cables and sturdy screwed connectors.

PHOTO 13: Bo-Bo type Dv12 engine on track, with driver's car and seat.

PHOTO 14: Grave design error — brake rigging almost cut axle in half!

Springs and guards

As mentioned earlier, the huge coil springs on the sides of the main frames are for looks only – the actual springing is by much smaller coil springs, at the outer ends of each of the sub-trucks. Photo 9 shows a 'saddle' containing a coil spring – now it certainly isn't displaced in case of a derailment, as my original, much smaller saddle often was. Compare the new and old saddles in the inset; the spring is recessed into the new saddle, ensuring it doesn't pop out...

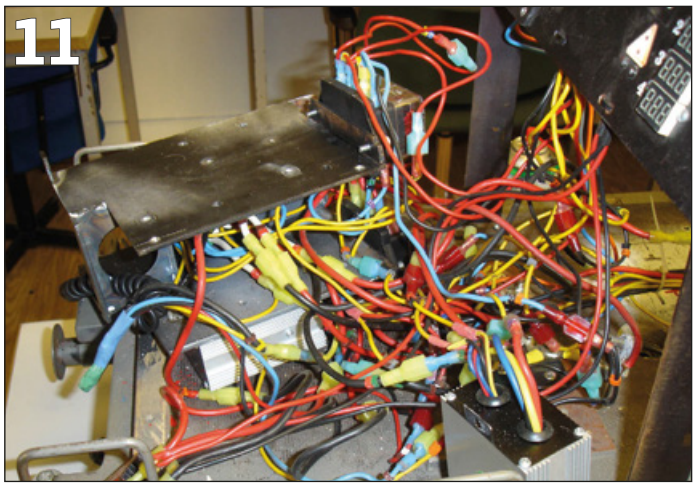
Derailments – yes, they do happen when kids are around; a little stone surreptitiously placed on the track can cause a derailment, and at one time a stone was placed between the rail and the point tongue of a switch, causing the loco neither to go right nor left, but straight out on the crushed granite ballast between the tracks...

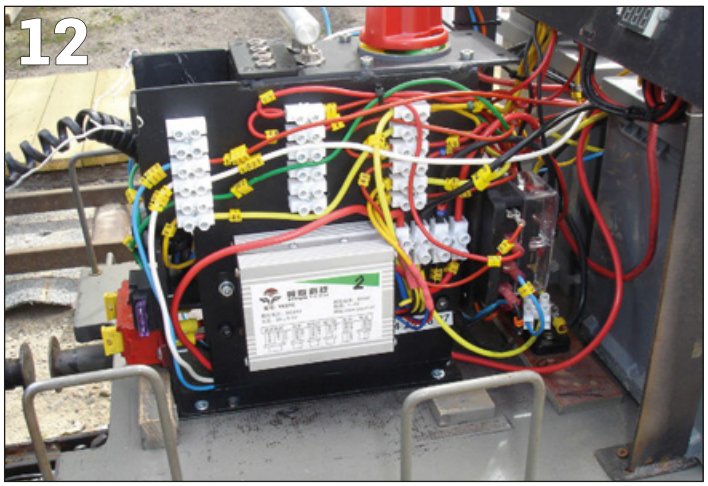
For this reason, the chains connecting the two axles in each truck are protected with a sturdy guard of steel (and not of aluminium, as my original guards were). Photo 10 shows the underside of an assembled truck, first without a guard on top, and on the bottom with the guard attached. The inset shows the shape of the guard. Note also the two chain-tensioning coil springs on the right side of the main truck bolster — these springs ensure that the chain doesn't lag, by pressing the sub-truck to the right.

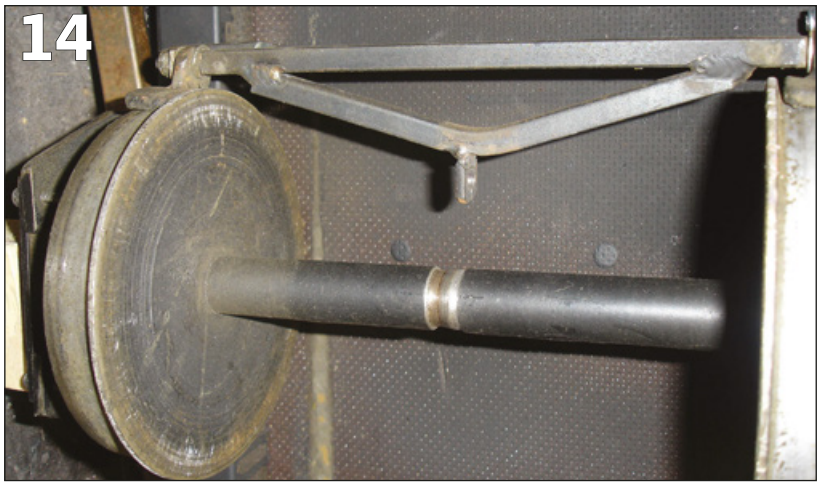
Electric & design errors

Originally, all the electric cables were connected with automotive crimped plug-and-socket 'spade' connectors, which tended to become loose over time, causing problems. My original electric connections, seen in Photo 11, have now been replaced by several strips of screwed connectors as in Photo 12. They are much more reliable, but still enable the disassembly of parts of the electric system.

The main motor fuses are now also accessible from outside the loco's hood — they blow ever so often if the







driver (often a youngster having a nice summer job) isn't experienced enough; except for the fuses, there is no overload protection in the inexpensive electronic motor driver boxes, one seen in the middle of the photo. Starting must be done very gently, and uphill running must be anticipated by increasing speed before the grade, when carrying up to a dozen passengers, otherwise the fuses will blow...

The thicker red and black cables (containing 4 square-millimetre copper) carry the motor current (up to 25 amps), while the thinner cables are for control signals, lights and the loud horn. The reversing of the motor current is now handled by sturdy relays instead of the original toggle switches, which were rated only for 16 amps. Much safer now!

Electrical components and connectors are indeed important; the original, cheap but swanky-looking, Chinese digital displays for motor temperature, voltage and current even caused a small fire in the cab, and were replaced by a single analogue ammeter. For a couple of ghastly pictures of the fire, see the October 2019 issue!

I made quite an error in designing the brake mechanism for the driver's car, visible behind the loco in **Photo 13** – the brake hanger connecting rod chafed on the car's axles. Had this not been noticed in time (**Photo 14**), the axle might have been cut in half! The insets in **Photo 15** show how the parts of the brake rigging were worn.

With all these improvements, this battery engine should now be good for many more years on the track at the museum — and if any replacements are needed, they are now much easier to implement.

Dv12 comes home

Having sold the engine, I did feel an 'empty spot in my heart', as the saying goes. What to do? Well, since I have also built an extensive HO layout (1:87 scale), I bought a newly launched, etched-brass kit of the Dv12, assembled the myriad small brass parts for the frame, and painted the resin-moulded hood and the brass cab with my tiny airbrush.

The result can be seen in **Photo 16**, in front of a exact-scale model of the Hanko railway station (Hangö in Swedish; Finland is bi-lingual, as seen on the LED-lit 'neon' sign). I built the station model from cardboard, the parts accurately measured and cut to size, with laser-printed actual colour photos pasted on the walls — yes, I took photos from all sides of the building in order to make this model!

The conductor's carriage in the foreground is also built from a brass kit, while the cargo wagons behind it are just wood blocks with laser prints glued on, as is the bus in the far background at left.

Thus, now again I have a Dv12 loco of my own, albeit almost 11 times smaller than the first one... EIM

PHOTO 15: Brake rigging chafed on axles, causing deep grooves in the steel.

PHOTO 16: Another Dv12 loco – this time in 1:87 scale.

Making Muncaster's Entablature Engine

Geoff completes the description of his latest Muncaster construction project, producing a highly attractive but not difficult to build engine.

BY **GEOFF WALKER** Part two of two

This second and final part of my construction feature describes and details all the moving parts required plus the assembly, painting, finishing, valve timing and running of the engine.

First the cross head guides will need to be made, these can be seen in **Photo 7** and detailed in **Figure 6**. They are made from 6mm bright mild steel strip and should be cut and milled as accurately as possible to the sizes shown. Only the holes in the base of the guides have been shown in the drawing. These can be used to spot-drill the position of the threaded holes in the upper cylinder cap. The holes in the top of the guide can be spot-drilled from the holes in the entablature plate.

To help align and then fix the guides in place I found it desirable to have the piston and crosshead assembly present. The 6mm channels in the crosshead can be used to align the guides in a vertical position while the fixing points are spot-drilled.

With the completed parts assembled use a small toolmaker's clamp or similar and clamp the two guides in the channels on either side of the crosshead. This will hold the guides vertically and while held in this position the bolt holes in the cylinder cap and the upper holes in the guides can be spot-drilled from the lower holes in the guide and the upper holes in the entablature respectively.

Remove the cylinder cap and drill and tap the holes for 8BA screws and drill the upper holes in the guides 8BA clearance.

With the guides fixed in place the crosshead should slide freely although minor adjustments may be needed to make this possible. This could be achieved by marginally enlarging the clearance holes in the guides.

Piston and motion

The piston should be turned oversize and then attached to the piston rod as shown. Hold the rod preferably in a collet chuck and turn the piston to a close sliding fit in the cylinder. The piston groove shown in the drawing is for a 19mm diameter viton O-ring. Alternatives to an O-ring are the graphite yarn packing as supplied by Stuart Models or simple oil retaining V-grooves as detailed in Stuart Models drawings.

The milled channels in the crosshead for the connecting rod fork and for the crosshead guides must be equally spaced either side of the piston rod centre line. The 52mm dimension can be adjusted to ensure the piston head finishes its stroke in the correct position at top dead-centre (TDC) and bottom dead-centre (BDC). In both cases this is 2 mm from the end of the cylinder.

The connecting rod is made from a short section of bright drawn mild steel (BDMS) bar 60 x 9.5 x 9.5mm (⅜ x ⅜-inch). Made from one piece it is much the same as in the Muncaster drawings. I have added a slight taper to the rod which I feel improves the overall appearance.

Start making by marking out and drilling the big and small-end holes. Next set the big end of the bar centrally in a four-jaw chuck and then face off and drill with a small centre drill. Slacken jaws one and two and slide the bar out, re-tighten the jaws and support the bar with a lathe centre. Machine the taper and radius the square section at the small end. (**Photo 8a**).

Proceed by milling the slot for the small end. This is 6mm wide which matches the centre width of the cross head. (**Photo 8b**). Then relief mill the sides of the small end and reduce the face width of the big end to 8mm (**Photo 8c**).

The top of the big end can be radiused by passing a round steel bar through the big-end hole and resting the bar on top of a machine vice ▶

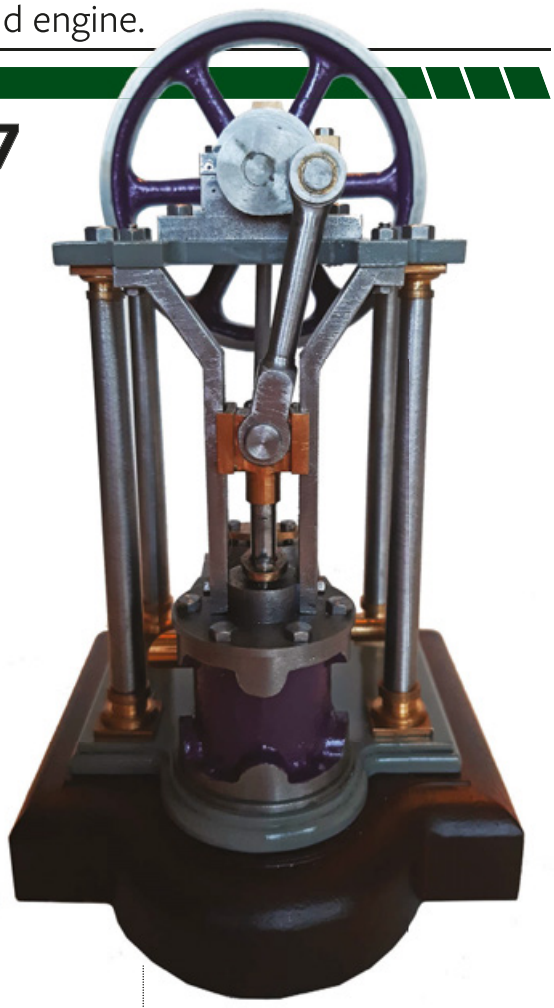
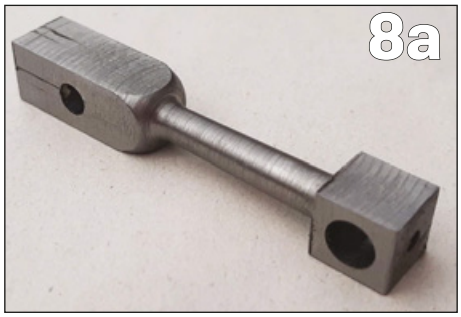
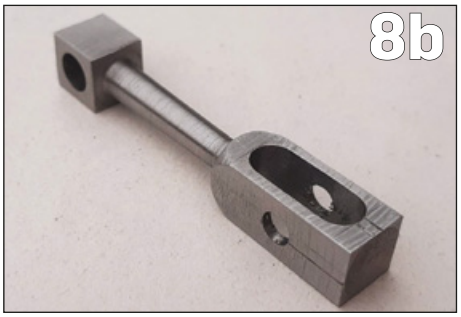


PHOTO 7: Front view of engine showing crosshead guides.

PHOTO 8A-C: Three stages in development of connecting rod.

All photos and diagrams by the author





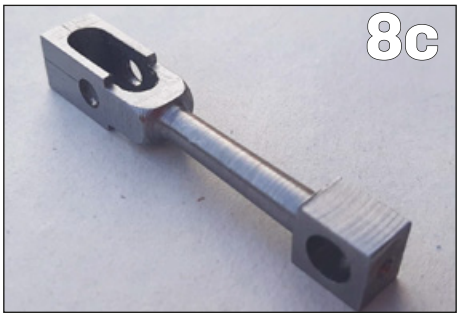
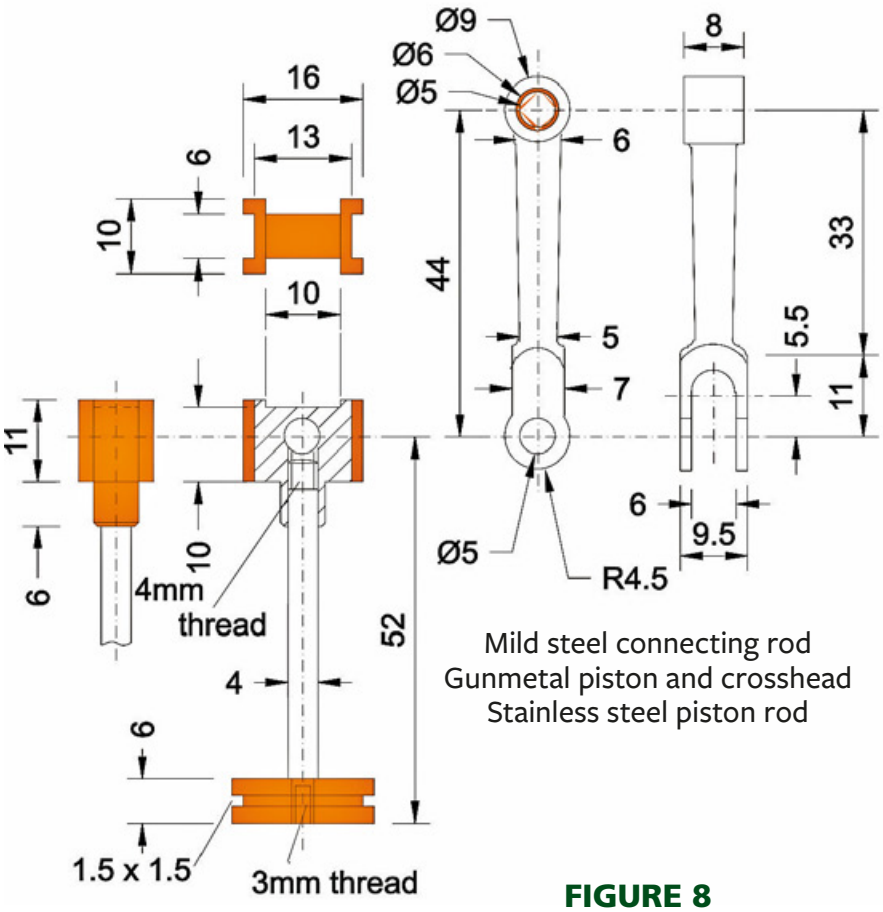
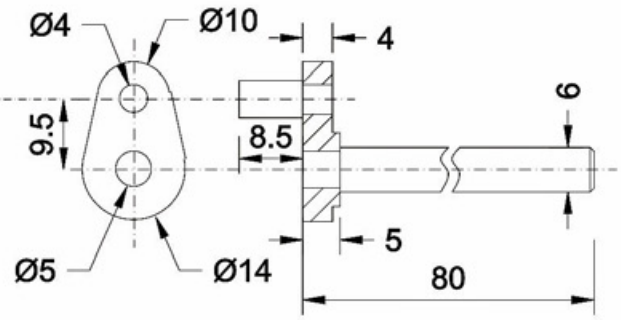


FIGURE 7
Piston, connecting rod and crank
All drawings to approx full-size



Mild steel connecting rod
Gunmetal piston and crosshead
Stainless steel piston rod



Mild steel crankshaft
Stainless steel crank pin

FIGURE 6
Crosshead guides
Mild steel

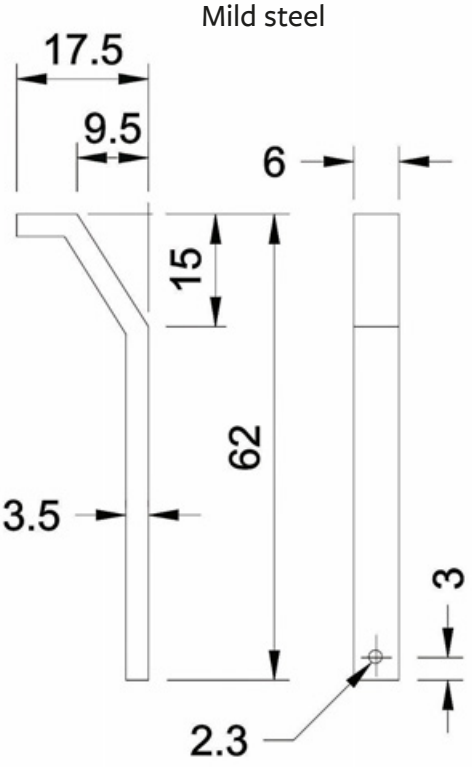
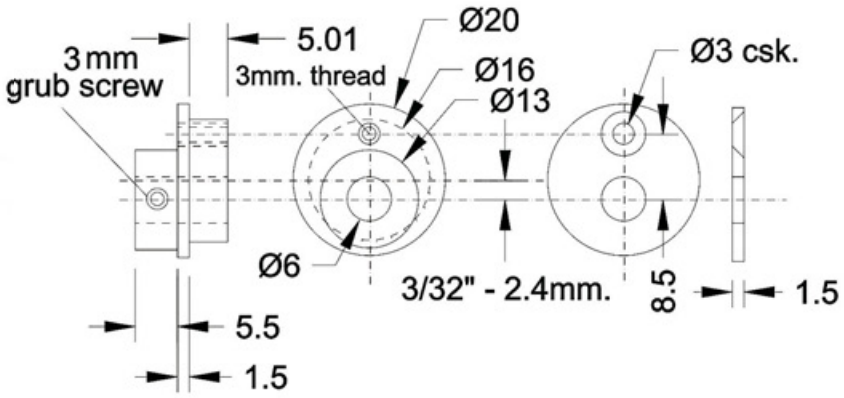
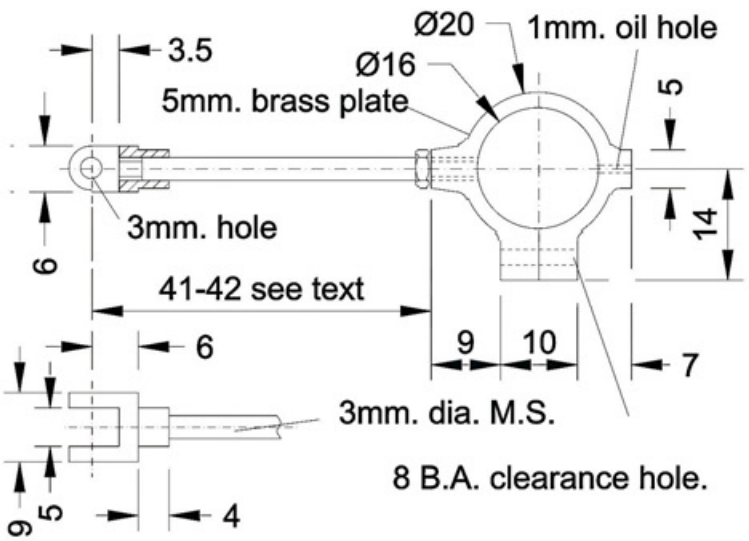


FIGURE 8
Valve gear

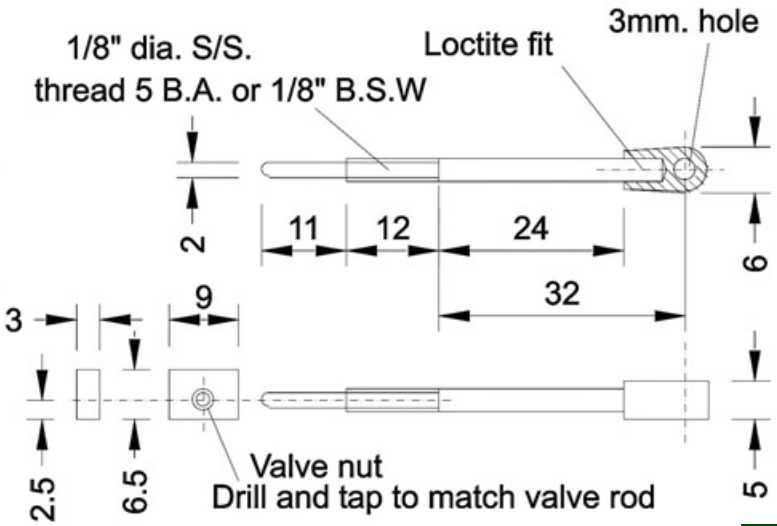
Eccentric and retaining plate – mild steel



Eccentric strap, push rod and fork



Valve rod and nut



(**Photo 9**). Press the work down on the bar and then rotate the work and tighten the vice through numerous positions, gradually milling away the material until the radius is formed. The milling height will remain constant for each pass of the cutter.

A small flat file can be used to smooth out any irregularities in the curve. Needle filing, or if you have one skilful use of a Dremel tool, will need to be employed to blend the rod into the big end. This of course requires patience, however the result, the head blending smoothly into the rod, is certainly worth the time spent (as in Photo 7 and **Photo 10**). Finally, the big-end bush is made from gunmetal and is held in place with Loctite.

"The result, the head blending smoothly into the rod, is certainly worth the time spent..."

To help form the small end turn up a small spacer 6mm wide and 9mm diameter. Slide this into the slot and locate with a 5mm screw and nut. Form the radii with small files using the spacer as a guide. Leave the spacer loose so it will 'roll' with the file as the radii are formed (Photo 10).

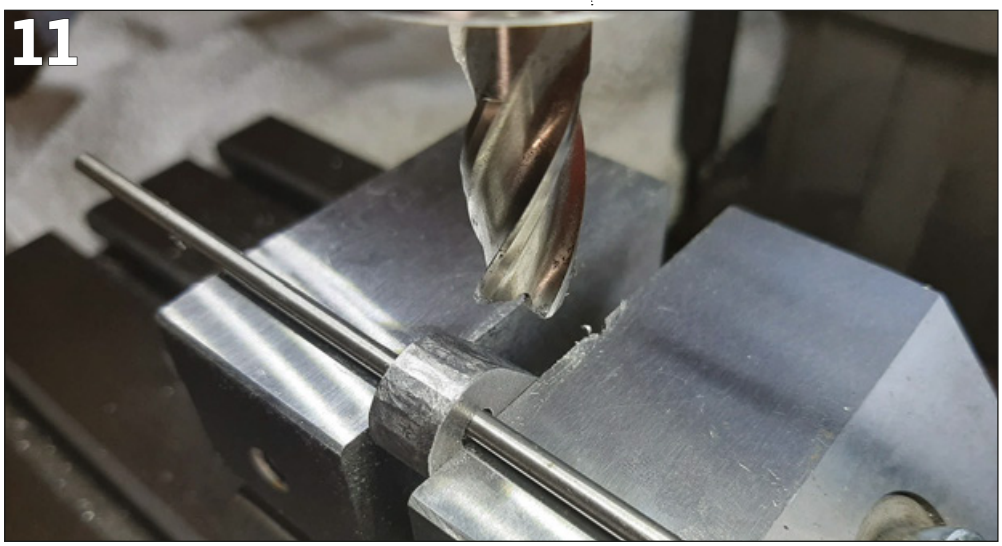
The small end clevis pin is not detailed in the drawing but can be seen in **Photo 13**. It is a simple plain-shouldered pin cross drilled at the end for a split retaining pin.

The crank ends can be shaped in a similar fashion to the connecting rod as shown in **Photo 11**. The 9.5mm spacing between the holes is important and the crankpin and shaft should be dead square to the front face of the crank. The crankshaft is left a little longer than needed, the extra length being for an optional accessory drive pulley. As can be seen both the crankshaft and the crankpin have been shouldered and both are secured to the crank with Loctite.

Flywheel

As for the flywheel, I would recommend the standard Stuart 75mm pulley as used on the 10v engine. The size and the design are probably appropriate for this engine. **Photo 12** is an archive image of a machining setup suitable for a Stuart flywheel. A plywood disc is held in a three-jaw chuck and a shoulder turned to the inner rim diameter of the wheel. The wheel locates on the shoulder and is held in place using the three studs, three nuts/washers and mild-steel plates.

At this setting the outside diameter, the outer and inner rim, the hole for the crankshaft and the boss face can be machined. The outer and inner rim and the boss on the other side can also be machined by holding the wheel in the three-jaw chuck's reverse jaws.



The remaining parts to complete the engine are in **Figure 8**. The important size on the eccentric is the offset of 3/32-inch (2.4mm). All the other sizes are nominal but note the 5.1mm width which gives a small amount of clearance for the eccentric strap. I would suggest having two opposite 3mm grub screws in the boss and for neatness a 3mm countersunk screw for the retaining plate.

For the eccentric strap I used the brass section supplied by Stuart Models and as described in Part One of the feature. The strap can be made from 5mm brass plate and will need to be shaped as shown in figure 8 and bored to fit the eccentric. The 41-42 size is around the right length and can be adjusted if necessary.

The strap is designed to have a slit for adjustment. I was happy with the fit between eccentric and strap so decided to just mark a false slit with a scribed line. The 8BA bolt and nut are therefore just for appearance.

The fork, which is made from 6mm mild steel, requires some delicate milling and turning but nothing that will present too many problems. Thread the boss 3mm and counterbore as shown for the rod.

The clevis pin is not detailed but like the small-end clevis pin it is a simple plain-shouldered pin, cross drilled at one end for a small split retaining pin.

The valve rod is made from silver steel and will need to be turned down at the end to fit the 2mm hole in the valve chest. The thread is ideally 5BA as specified by Stuart, however I used 1/8-inch BSW which has been fine for adjustment and setting.

The brass valve nut is correct for the fully machined Stuart valve, the latter is not an essential buy, but is good value and as I mentioned in Part One, something I would recommend. My drawings do not include any details of the valve.

Secrets of setting

If you have never made a slide-valve engine and therefore not had any experience of setting the slide valve for correct timing, then please do some reading on the topic. The Muncaster articles by E T Westbury, which I mentioned last month, include a section on valve timing, explaining the basic criteria plus simple associated terms like such as TDC/BDC and lap and lead.

It remains now to set the slide valve to produce the correct timing and steam or air distribution. I have

summarised below the instructions in Andrew Smith's companion read.

A point to note when using the instructions is that with this **inverted** engine, TDC will be (when viewed from the front of the engine) with the crank at its lowest point and the piston at the bottom of its stroke. For BDC the crank will be at its highest point with the piston at the top of its stroke.

Okay here are the basic instructions taken from the book;

1) First remove the valve-chest cover plate and then reattach the chest to the cylinder. This is to allow the valve and push rod to be seen for adjustment purposes.

2) Fix the eccentric temporarily in any position on the shaft with the eccentric strap fitted and coupled to the valve rod which in turn is linked via the nut to the valve.

3) Now set the location of the valve in the steam chest so that for the extreme travel in either direction the opening of the top and bottom ports is equal. If the port openings are found to be unequal, the rod must be uncoupled and screwed in or out of the slide valve nut to the required extent.

4) The timing of the valve is now adjusted by setting the crank on TDC and after loosening the eccentric grub screw, turning the eccentric in the direction it is intended to rotate until the slide valve begins to open the top cylinder port just the least visible amount. Now fix the eccentric to the shaft and check the opposite end by turning the crank to BDC. The bottom cylinder port should show a similar amount of opening. Any discrepancy between the two indicates an error in the location adjustment and this should be corrected before altering the timing.

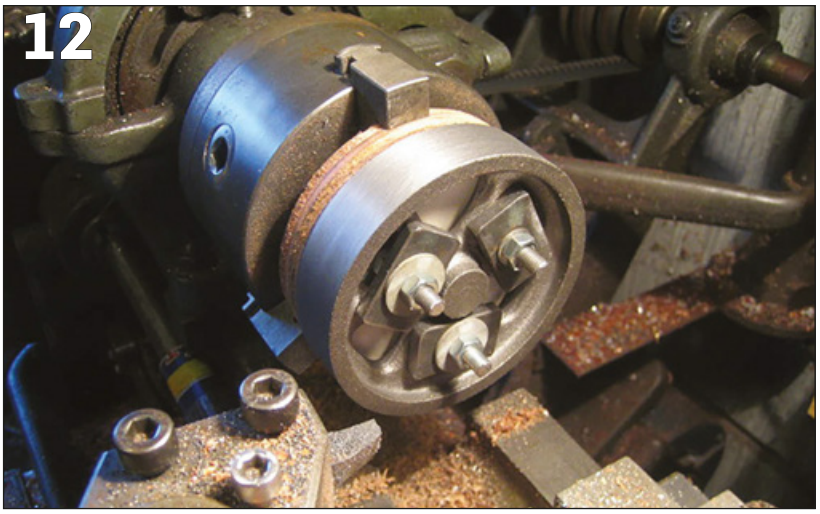
5) After some light lubrication of the moving parts the engine can now be test-run.

The test run is usually done using compressed air and without any gaskets, seals, piston ring and such. A small airbrush compressor is ideal for this purpose, running the engine on around 10psi. The test will also help to run-in the engine, easing out any minor tight spots.

Final assembly

Final assembly is the opportunity to add gaskets and seals. My choice for gaskets is PTFE plastic sheet film – only 0.1mm thick it is easy to cut and shape with a craft knife. As mentioned in Part One PTFE tape can be used in the glands. Rolled and twisted and wrapped around the rods it will compress and give a good seal. I like the viton O-ring used in the cylinder. They are not that easy to fit as you need to have a fine control over the width and depth of the piston groove.

"It is pleasing on the eye whether static or under power and when you have had your fun, you can put it on display for all to see..."



On assembly and prior to running in the ring should just lightly brush the cylinder wall.

The only parts painted on my engine are the base, entablature and the cast surfaces on the cylinder and flywheel. I like to keep painting to a minimum but do accept that some is necessary to finish the engine. The base and entablature have been spray primed and then spray finished with Halfords industry grey. The cast surfaces were hand painted with number 68 Humbrol purple gloss.

If you are making this engine, do have fun. It is not the easiest to set up and run and in doing so can test the patience of the most patient! I really like the engine, it is pleasing on the eye whether static or under power and when you have had your fun, you can put it on display for all to see! EIM

■ Part 1 of this series appeared in last month's issue of EIM – download a digital back issue or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.

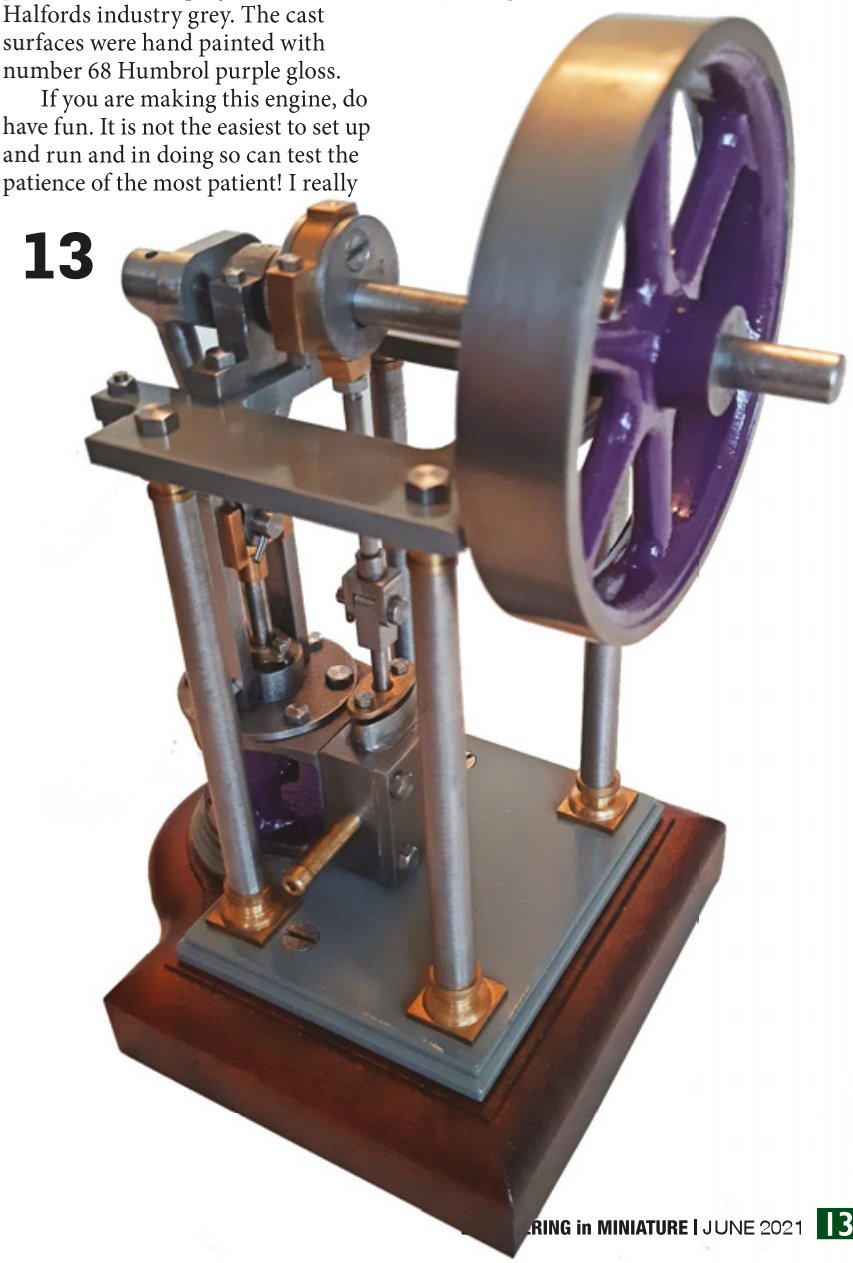


PHOTO 9: Forming radius on connecting rod end.

PHOTO 10: Finished rod end.

PHOTO 11: Radius process again, this time on crank end.

PHOTO 12: Lathe setup for machining the flywheel.

PHOTO 13: Further view of Muncaster engine after assembly.

Rebuilding a Winson

The debut locomotive build project for 16-year-old Sussex Miniature Locomotive Society member Sam makes more progress this month as he approaches the first coal-fired steaming of his 14xx loco, bought as an unfinished kit by a defunct manufacturer.

BY **SAM RIDLEY** Part Four of a short series

The premier steam test of my 14xx 0-4-2, a Winson Engineering kit which I obtained as an unfinished project, had proven successful. However, it had also added more boxes to the 'to do' list – the issues that were highlighted by the test described in last month's issue included a leaking and undersized ram on the crosshead pump which was not maintaining a sufficient water level; an injector that would start to become temperamental anywhere below 50psi running pressure and a blowdown valve that would not release a high enough volume of steam. Also there was still no in-line lubrication installed on the loco which would be needed before further testing.

Pump problems

Nonetheless, the loco had proved that it could turn over and work under its own steam! So, with the summer holidays about to begin we could start to get a good streak of working days in and hopefully solve these problems, starting with the crosshead pump.

To begin with, we decided to tackle the gland and only make a new ram if necessary, therefore the first job was to remove the pump from the loco. This would require disconnecting the inlet and outlet pipes, and removal from the frame stretcher – which was an interesting process with a boiler and motion work now in the way!

The pump body was then mounted in the trusty vertical slide on the Myford lathe to skim 1/16-inch from the gland face. This was done to allow a thicker 1/8-inch gland packing plate to replace the existing 1/16-inch plate which was not very strong and already out of shape.

Next, we found the centre of the original bore by using a drill blank held in the lathe chuck and very carefully adjusting the cross-slide and vertical slide until the drill blank would slot in. This was achieved by finding a drill blank which was closest to the bore of the hole to ensure a tight fit. If the drill blank went in we knew the bore of the pump body was properly centred with the chuck.

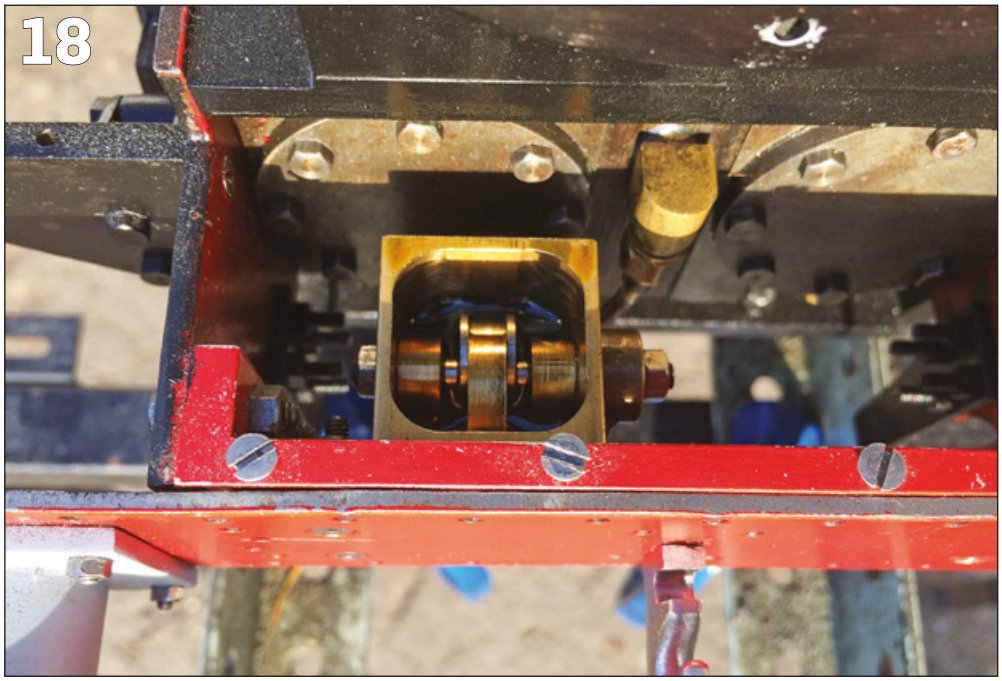
A new counterbore was cut to a depth of 1/4-inch using a 7/16-inch slot drill. The original counterbore for the O-ring was 3/8-inch and not perfectly round, which was why the gland would not seal.

With the new gland bored in the body, it was time to make a new gland cover. As noted prior, a 1/8-inch cover was going to replace the supplied 1/16-inch cover which would hopefully be able to hold its shape and properly support the gland packing. With the vertical slide still set on the Myford, an offcut of 1/8-inch thick brass plate was machined to the same size as the pump body and two 6BA clearance holes drilled through it to match the holes found in the pump body.

"This was my first time machining PTFE which was much softer than I was used to dealing with and required a very sharp tool..."

Finally, a PTFE insert was made to push into the 7/16-inch counterbore and protrude from the pump body by about 5 thou. The insert was drilled and reamed to suit the 1/4-inch ram. This was my first time machining PTFE which was much softer than I was used to dealing with and required a very sharp tool. I also learnt that once pushed into the counterbore, the PTFE would require the reamer to be run through again because being soft, the bore of the PTFE had closed up by a couple of thou.

With the machining finished, the crosshead pump was reassembled and fitted to the frame stretcher. A subsequent steam test proved the pump was now considerably more efficient – success!



If in doubt, replace

During this test, the injector was still being very temperamental, even after a nice bath in citric acid! So a brand new 12-ounce horizontal Gordon Chiverton injector was added and this was much more reliable from 40psi to 80psi which would be good enough for me.

The blowdown valve was still not performing up to standard, so after the boiler test it was removed for inspection, when we discovered a 'slug' of debris had become jammed in the valve outlet! This 'sludge' was presumably a hangover from the boiler manufacture and meant the valve did work, but nowhere near 100 per cent efficiency.

Next it was time to start work on the lubricator. We decided that for convenience and reliability the lubricator would be moved to behind the front buffer beam instead of the Winson design under the cab floor. Driving it from an eccentric on the rear axle could possibly be unreliable and the resulting pipe would have been 24 inches to the cylinders which a lightweight lubricator might not be able to feed enough oil through. Therefore, a new mounting position would be in order.

The tank was bolted onto two 4BA holes on the bottom of the front buffer beam using two of the four holes already drilled into the tank's baseplate. Thankfully, the gap between the back of the buffer beam and the cylinder block was just enough to fit the tank body (**Photo 18**).

A new drive arm was then fabricated from some ⅜-inch x ⅛-inch mild steel to drive the lubricator drop arm from the bottom of the expansion link. This would hopefully give a reliable and consistent throw for the oil pump.

The drive arm was a little challenging because it had to clear the leading axle while being the correct length to operate the clutch on the lubricator with the correct throw (**Photo 19**). After lots of 'fettling' the drive arm was near enough the correct length, however we still had to bend it, with heat!

More heat please

To bend the steel across its ⅜-inch width, we were going to need to use more propane to get it soft enough. This was achieved by heating the steel to cherry red, bending a set in it while hot using a couple of large adjustable spanners, letting it cool and then checking it on the locomotive. Ditto this procedure several times until we got it about right.

A slot also had to be cut into the bottom of the motion bracket when we found out the drive arm fouled it in reverse gear. The lubricator tank itself also required modifications with more silicone O-rings to seal the internal cross bar, a new 2.5mm stainless steel ram and a brass gland fabricated to replace the not up-to-scratch originals.

Finally, after a few false starts, the lubricator successfully pumped and held 150psi on test which should be more than enough to run at 80psi steam pressure. And now that it worked and fitted, a new copper pipe was fabricated to fit between the banjo on the bottom of the tank and a brass elbow mounted on the front of the steam chest.

With the lubricator now in place, it was time to start looking at the front end and adding the smokebox saddle, smokebox, chimney, blastpipe arrangement and blower. To begin with, the aluminium smokebox saddle was cleaned with emery cloth to remove any of the machining marks and it then fitted – helpfully – at the first attempt.

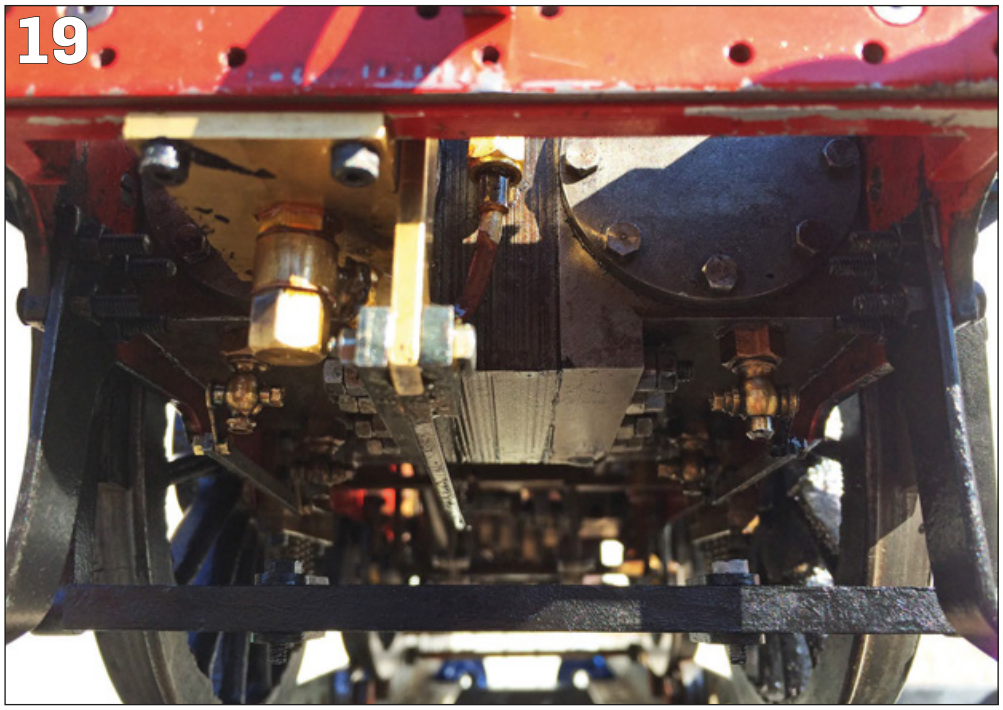


PHOTO 18: Just enough space to fit the relocated lubricator.

PHOTO 19: Lubricator drive arm required plenty of 'fettling' to fit.

PHOTO 20: Smokebox trial fitted – looking like a loco...

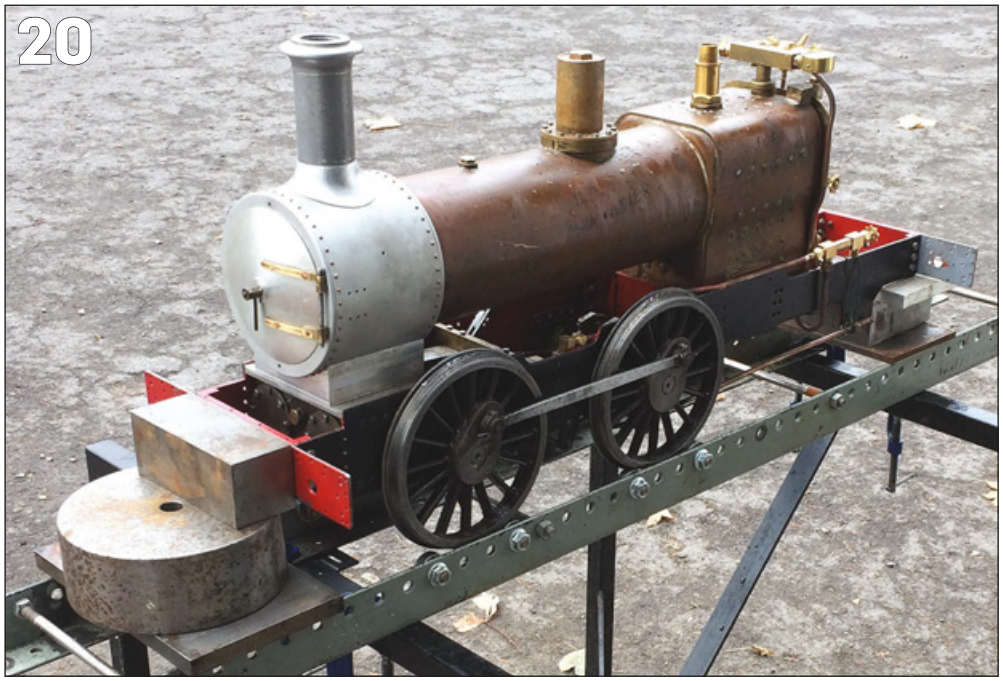
All photos by the author

Real rivets

Moving on to the smokebox itself, we felt that using glue to attach the decorative rivets would not be suitable, so we fitted them like standard rivets – with a hammer! First, the 76 holes in the smokebox rings had to be drilled through all the way as they were only at half the depth needed, and countersunk on the inside faces. Then, individually, all the rivets were pushed through the smokebox, cut to size and tapped over into the small countersink with a hammer, using a rivet snap on the outside to preserve the head of the rivet. This was my first-time knocking rivets over and it was a satisfying and successful operation, if a little annoying for the neighbours!

Finally, once all the rivets were hammered in, I used a file to remove any excess rivet material on the inside faces, so the smokebox ring would still fit onto the boiler. Also, whilst I was working on this, Andrew spent some time hand finishing the chimney, so the radii at the base looked pleasing to the eye – it was time consuming but worth it!

The final job on the smokebox was to screw the hinges to the front ring. We were puzzled by the intended way ▶



to install these, but we certainly were not going to use glue. Instead, two new hinges complete with 2BA threads were machined from some 3/16-inch square brass and these were screwed into the front ring. Trial fitting of the door, crossbar and dart proved to be successful and after several days of work, the smokebox assembly was ready to be trial fitted to the boiler and saddle (**Photo 20**). Following the successful trial fitting, the smokebox assembly was disassembled and given a coating of Bilt Hamber Etch Weld primer (**Photo 21**) and then brush painted with an unopened, but old, can of Reeves smokebox paint. It was now just the blastpipe arrangement, blower, and grate to be done before the loco could steam on coal for the first time!

PHOTO 21: Etch priming smokebox before final fitting on loco.

PHOTO 22: Blastpipe arrangement assembled in smokebox.

On the blower

The supplied blower pipe arrangement was discarded and subsequently replaced with a proper machined blower ring. This was fabricated from a short length of 1-inch diameter PB102 bronze and was also made in two halves. Each half was ¼-inch thick and bored out to ½-inch. A 1/16-inch deep groove was then machined into one face on each half using a round-nosed lathe tool; this was machined centrally between the outer edge of the material and the outer edge of the bore.

Next, the two halves were slid over a piece of bronze the same diameter as the bore and the outer seam was silver soldered using some high temperature C4 solder. The piece of bronze was then removed from the bore, revealing the inner seam which was silver soldered with some lower temperature Easy-Flo 2 solder.

So, with the two halves sealed, the dividing head was broken out once again to drill two no.70 holes, 180 degrees apart in one of the faces. This was again drilled centrally between the outer edge of the material and the outer edge of the bore – these holes would end up being the blower jets.

Using the vertical slide, flats were then machined on three sides of the ring to aid final assembly and another hole was drilled centrally into one of the machined faces. This hole was 5/32-inch, tapped 3/16-inch x 40tpi and would become the steam inlet.

With the blower ring made, a 3/8-inch length of 3/16-inch diameter PB102 bronze was externally threaded 3/16-inch x 40tpi, drilled 1/16-inch throughout and internally coned on one end to take a conventional pipe cone. This fitting was then screwed into the 3/16-inch x 40tpi hole previously described on the outside of the blower ring and carefully silver soldered in place with some more Easy-Flo 2. Finally a copper pipe was fabricated to run from the longitudinal fitting on the front tube plate of the boiler to the fitting on the side of the blower ring.

Out of the box

The blastpipe arrangement was essentially assembled straight from the packet with only a couple of small modifications needed. Small counterbores were added to hold more trusty silicone O-rings used to seal the fittings on to the steam chest and the block which joins the two steam pipes to the blastpipe.

With the blastpipe mounted, blower ring in place and lead cut to seal the base of the smokebox (**Photo 22**), all that was missing was the fire grate to be assembled. This was reasonably easy, only requiring alternating bars and spacers between two studs with four feet for each corner to be complete. This was another of those 'lucky' items that went together straight from the packet.

The week leading up to the maiden voyage on coal also had its fair share of tasks to complete – these included removing and brush-painting the trailing axle in top coat in black, also brush-priming the driving and coupled axles using more Bilt Hamber Etch Weld where bare metal was still on display on the outside faces. Another propane test was also conducted to make sure that everything still worked sufficiently enough for the loco to hit the rails and the rear axle was also placed back into the loco for stability on the rails.

This work came at the end of the summer break so it was back to working on the weekends for me which meant the maiden coal steaming would have to wait until the next weekend... EIM

■ Parts 1 to 3 of this series appeared in the March to May 2021 issues of EIM – download a digital back issue or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.

■ Are you building a loco project? Have you thought about having it featured in our pages? Contact the editor, details on page 3, for more details.

Gas turbine engines on the railway

Rodger tells the story of three phases of experiments carried out with new propulsion technology on the UK rail network, all ultimately in vain.

BY **RODGER BRADLEY**

Why did Britain's railways opt to pursue the route of gas turbine engines in the later 1940s, when electric traction had already been proved so successful, together with rapidly growing numbers of diesel locomotives? Gas turbines had been theoretically possible for many years, but the technology needed to create a high-velocity jet of air, together with a suitable fuel and combustion chamber was not practical until Sir Frank Whittle's work was so brilliantly successful in the 1940s.

Other forms of turbine had been tried before, from the Reid-Ramsay-McLeod locomotive, to the Beyer Ljungstrom prototype. These were unconventional, ultimately based on coal as fuel, and were steam turbines. That was perhaps no surprise, since Britain was very much harnessed to the coal industry, which made economic sense, and steam turbines were used in marine engineering.

In contrast to the work under way in the 1940s, and after the Great Western Railway (GWR) had placed its order with Brown, Boveri for an oil-fuelled gas turbine, the Ministry of Fuel and Power was being pressed by the British Coal Utilisation Research Association to develop a coal-fired gas turbine. As a consequence, the Ministry provided a £350,000 grant for the first two years of a coal-burning gas-turbine research programme.

Even before these adventurous projects, the various railway companies had been looking at ways of improving the operational and thermal efficiency of the steam locomotive, including use of pulverised fuels.

During the mid 1940s, railway engineers were considering alternatives to steam, but Hawksworth on the GWR did not see a future for diesel in main-line use. By this period, the war had propelled the jet engine – which is an open-cycle gas turbine (I know it's more complicated than that) – into the headlines. The higher temperatures, pressures and velocities generated in the gas turbine design demanded a different arrangement in order to utilise the energy on a railway. The obvious method was to harness that power by coupling the turbine to a generator, to drive electric traction motors.

PHOTO 1: Side view of No. 18000 passing Paddington goods depot, heading towards Old Oak. In BR protocol 'lion and wheel' totem faced forward, suggesting here loco being driven from No. 2 end. Livery is early BR colour of plain black with the aluminium band at waist height.

PHOTO 2: No. 18000 inside Swindon Works, possibly in 1956 when the loco spent most of the year out of service on general overhaul and replacement of damaged components By October 1956 it was back in service, but repainted green, with the new BR crest on the body sides.

Photos: RPB Collection/ Lens of Sutton

The GWR opted for this form of traction after the Second World War, following a visit made by F W Hawksworth and A W J Dymond to Basle, Switzerland in 1946, to see at first hand the Swiss Federal Railway's 2,200hp locomotive. Earlier that year, the GWR had announced it was looking at gas turbines for main-line use and had already been in contact with Metropolitan-Vickers. Both Brown, Boveri and Metro-Vick had some previous experience with gas turbines as power plants, and whilst Metro-Vick was still at the early design stage, Brown, Boveri had built a working locomotive.

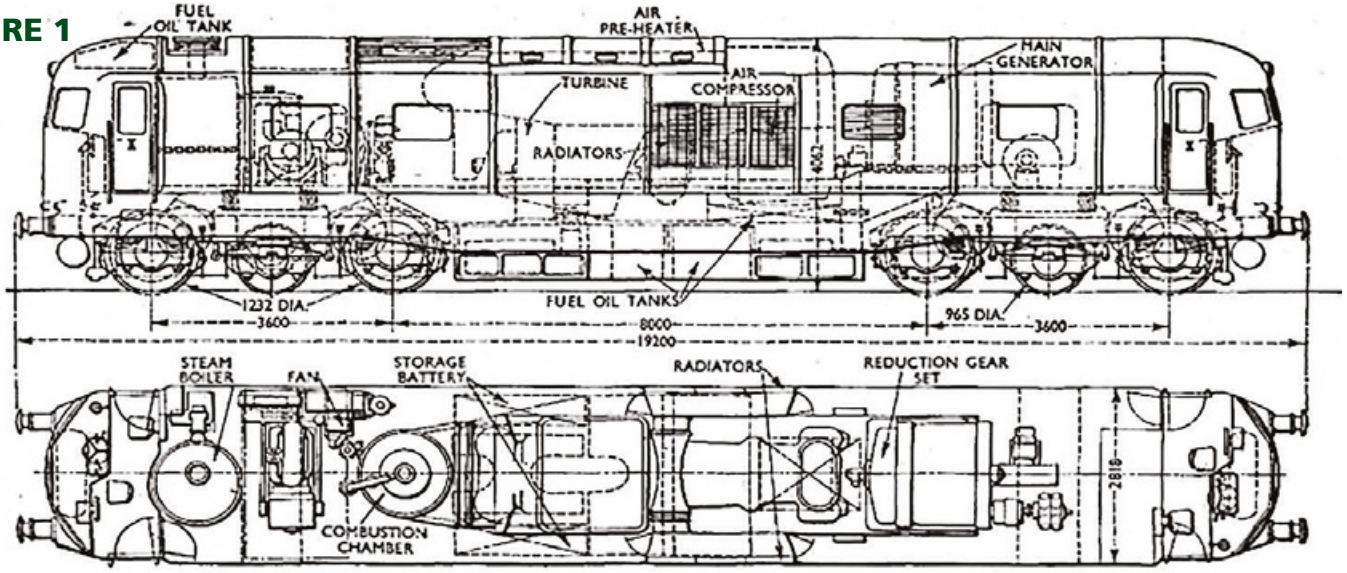
The GWR also had a plan to convert steam locomotives from coal to oil burning, which, with the addition of new oil-fired gas turbines offered an exciting prospect for the post-war era. So, following the trip to Basle, Hawksworth and Milne advised that an order be placed with Brown, Boveri, and similarly, a comparable loco from Metro-Vick in Manchester.

Post war economics allowed both the Transport and Fuel & Power ministries the scope to support and fund some of the work towards alternative fuel and power sources on the railway. The orders were placed, with not a little of the GWR's old-style marketing – "we are leading the way in technology and ideas", before nationalisation in 1948.

Basic Operation

The gas-turbine process takes in air from the outside world, passing it through a compressor and on into a ▶

FIGURE 1



heater stage before entering the combustion chamber, where it is mixed and burnt with oil fuel. The burning fuel raises the temperature of the compressed air and before passing this hot gas to the turbine, secondary air is introduced to lower the temperature. The gases are then passed to the turbine, where they expand very rapidly before being exhausted through the heater stage to atmosphere.

The rotating turbine drives a generator through reduction gearing, where the output is used to power the locomotive's bogie-mounted traction motors. In other examples the turbine is used directly to drive an aircraft through the air, a ship's propeller or other fixed machinery.

Brown, Boveri 18000

This 2,500hp locomotive was intended to be used between London and Plymouth, over the legendary South Devon banks, and like the Metro-Vickers design was planned to take 17 and 18-carriage trains unaided. Carrying enough heavy fuel-oil for a 250-mile trip, the locomotive was capable of 90mph, with a maximum tractive effort of 31,500 lbs and an all-up weight of no less than 115 tons.

FIGURE 1: Line diagram of Brown, Boveri locomotive, showing position of turbine and key components.

FIGURE 2: Line diagram of Metro-Vick locomotive, which, like the Brown Boveri shows location of key components.

The Brown, Boveri gas turbine was carried on two six-wheel bogies, with only the outer axles on each driven, making the wheel arrangement A1A-A1A in an overall length of 63ft.

The mechanical part of the loco was built by SLM (Swiss Locomotive Works) at Winterthur, with the two bogies constructed of welded steel box section. This technique was also used for a fabricated platform to carry the body and mounting positions for the power unit, water tanks, lubricating oil and fuel tanks.

A separate, auxiliary frame carried the power unit proper, with its three-point suspension, and attached to the fabricated platform. Notably, although the underframe girders and bogie bolsters were all welded, the cross bracing was riveted.

Powering this locomotive was a single stage open-cycle gas turbine driving a direct current generator through reduction gearing, just like a conventional diesel-electric locomotive. The generator in turn supplied power to four axle hung traction motors, rated at 397kW at 720V, 1500rpm.

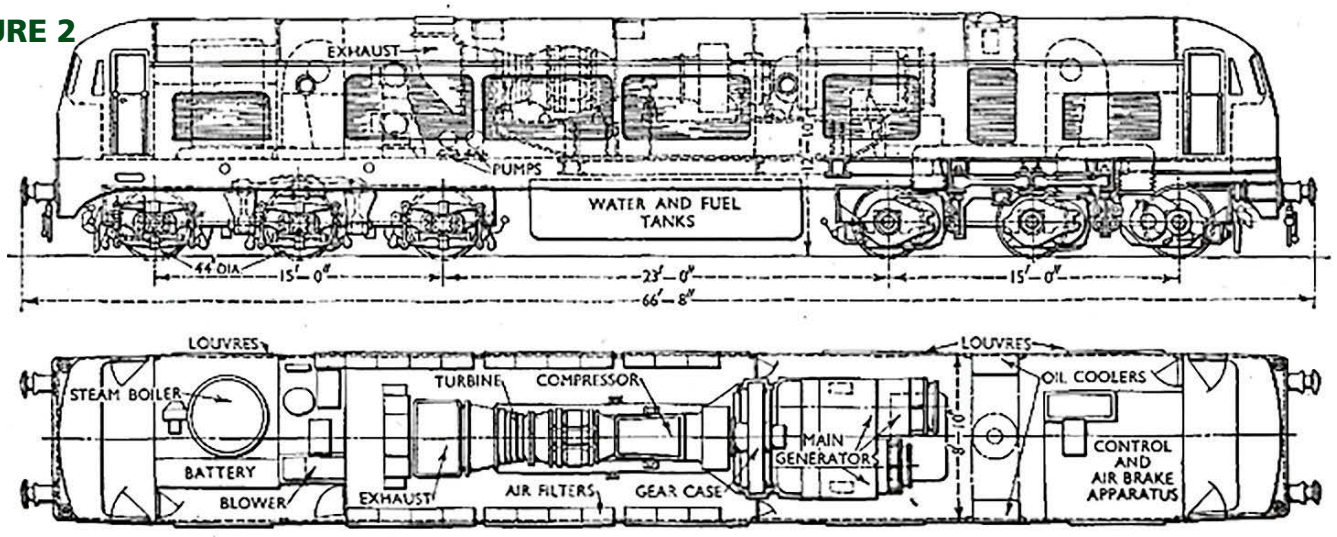
The final drive to the wheels was by means of a gear wheel driven by the motor pinion through a quill shaft, in turn linking with eight coil springs connected to a final carrier disc attached to the axle. This disc pressed onto the spring cups, forming the coupling between the driving gear and the axle, and the whole assembly was protected by a casing, to prevent ingress of dust whilst providing effective lubrication.

The gas turbine power unit consisted of a compressor, heat exchanger, combustion chamber and the turbine. Air sucked in through the compressor passed through the heat exchanger at a pressure of around 2.5 bar, where the temperature was raised to about 150 degrees C (around 500 degrees F), before finally reaching the combustion chamber.

Here, the oil fuel was mixed with a proportion of the air passing through the heat exchanger, burned and routed to the gas turbine itself. Most of the air bypassed the combustion chamber and was used to reduce the gas temperature entering the turbine from 930 degrees C (3,300 degrees F) to a mere 310 degrees C (1,100 degrees F).

In this stage, the expanding gases drove the blades of the turbine and finally were exhausted through the roof grilles, after passing through the heat exchanger. The turbine and

FIGURE 2



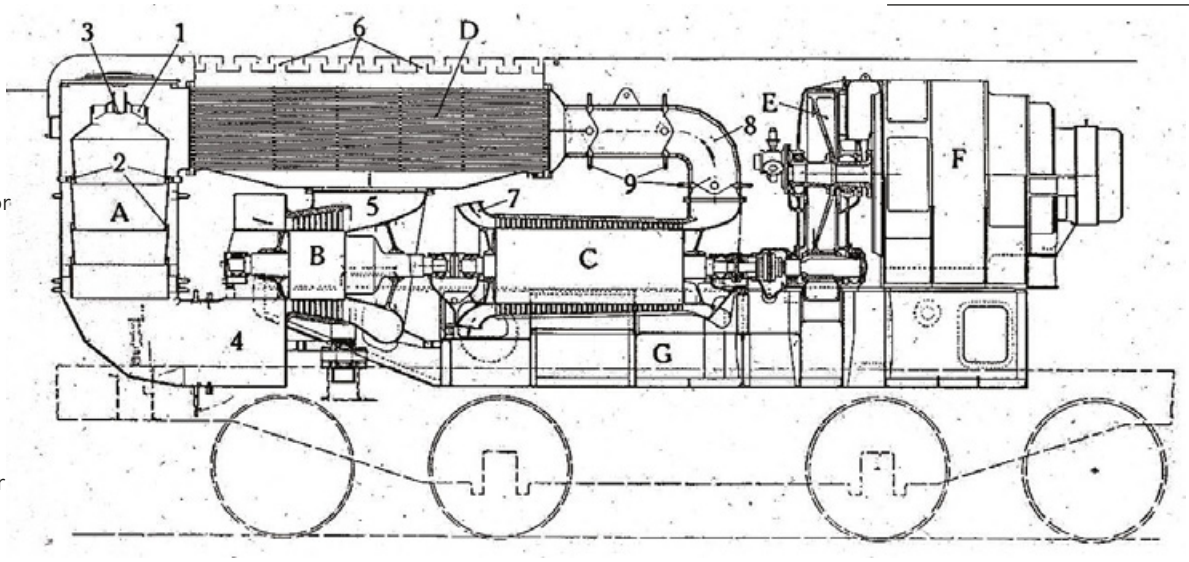


FIGURE 3

A: combustion chamber
B: gas turbine
C: compressor
D: air heater
E: gear drive to generator
F: main generator
G: power unit sub-assembly frame
1: air inlet swirl vanes
2: secondary air inlets
3: burner nozzle
4: turbine inlet
5: exhaust passage
6: exhaust vents
7: air inlet to compressor
8: air outlet pipe
: expansion joints

compressor were mounted on a single shaft, the free end of which provided the output through reduction gearing to drive the generator.

In addition to the main turbine, a separate 150hp Saurer diesel engine was used during start-up, driving a smaller auxiliary generator, which could also be used to power the four traction motors at low speeds, useful for shunting operations.

Metro-Vic 18100

This locomotive was ordered at the same time as the Brown, Boveri loco, in order to design and test a British-built version, capitalising on the reputation of the Manchester-based company in the electrical, railway and more recently jet-aircraft engineering field. Like its sister locomotive, No. 18100 was required to haul the heaviest GWR trains on the London to Plymouth route without the usual assistance being needed over the South Devon banks.

The Metro-Vick design was quite different from No. 18000, producing some 3,500hp and driving six axle-hung, nose-suspended traction motors. The final drive, unlike the Brown, Boveri design, was a relatively simple spur gear arrangement.

The main body of the locomotive was all welded and the underframe unit provided with solebars from deep-section steel, with a reinforcing plate welded to the top and bottom of each. The body assembly supported the weight of the power plant, fuel tanks and auxiliary equipment and was fitted with mounting points for the six-wheel bogies.

An innovative method was used to attach the body to the bogies by way of 'Metalastik' rubber-bonded swing links. Metro-Vick had used this arrangement on locomotives built for the Rede Mineira Railway in Brazil at about the same time. Although use of swing links was not new, the choice of rubber as the material to provide a resilient joint was, and later adopted for many other rail applications. The bogies themselves were fabricated by the Yorkshire Engine Co, together with a sub-assembly fitted to the underside of the locomotive, forming the mounting points for the bogies.

FIGURE 3: Diagram of gas turbine general arrangement, originally published in Volume II of *Locomotives and Their Working*, Simpson & Roberts, 1952. *Diagram: RPB Collection*

PHOTO 3: No. 18000 at Didcot Railway Centre and in green livery, showing signs of wear and tear. *Photo: Rosser1954, Wikipedia Commons*

The gas turbine was the same open-cycle type as the Swiss design, although in this example, no heat exchanger was used and the compressor, combustion chamber and turbine stages drove three generators through reduction gears. The design followed the same principles used by the company for the jet aircraft it had been building, with its nominal output of 3,500hp restricted to just 3,000hp on delivery.

The 15-stage compressor fed gas at a temperature of about 475 degrees C (1300 degrees F) into six combustion chambers lying parallel to the turbine itself, where the compressed air was mixed with fuel injected into the chamber and burned. The expanding gas then passed into the turbine, comprising five rows of moving and five rows of fixed blades, before being exhausted to the outside world.

The end of the turbine shaft was meshed with a reduction gear ratio of 4.375 to 1, to reduce the maximum speed of the turbine (7,000rpm) and deliver a lower speed of around 1,600rpm to the generator shafts.

Two of the three main generators were in tandem on the same shaft, whilst the third and a smaller auxiliary power generator were arranged on a second shaft. These generators, each of which fed two traction motors, were connected permanently in parallel and not only provided power for traction but, as with the Brown, Boveri design, charged the main batteries. However, unlike the rival design, no separate diesel engine and auxiliary motor generator set was used to start the locomotive – the main battery was the only source of power for starting. Like the Brown, Boveri loco, a separate oil-fired boiler was provided to supply steam heating, and the Metro-Vick design weighed in at a sprightly 129 tons 10 cwt.

Operational Challenges

Difficulties over the role that railway technical staff and others played in the development of the British design from Metro-Vick meant that the locomotive appeared a few months later than the Brown, Boveri version. Some of these difficulties were with the gas turbine department and surrounded the translation of an aircraft engine design into one suitable for railway use. As it turned out, the Brown, Boveri locomotive took to the rails in February 1950, whilst the Metropolitan-Vickers ▶

version appeared in December 1951.

The main problem for No. 18000 was its heavy fuel consumption, and coming at a time when the UK economy was struggling, this was clearly not going to bode well for any further developments. On one occasion a fire in the combustion chamber at Bristol Temple Meads station took it out of service for some time, and the arrival of more successful diesel power really put paid to any future for the loco – it was just too expensive to operate.

At the end of 1960, 18000 was withdrawn and later returned to mainland Europe, where for more than ten years it was used by the UIC (International Union of Railways) to study wheel-rail interaction. It was returned to the UK in the early 1990s, before being transferred to its present home at the Didcot Railway Centre under the ownership of the Pete Waterman Trust.

Metro-Vick's 18100 suffered the same fate in the end. With its emphasis on power, clearly targeting high-speed trains, fuel consumption was very high. In contrast to the Brown, Boveri loco, Metro-Vick's design used aviation kerosene, which was lighter but even more expensive fuel. 18100 was taken out of service in 1958 and stored at Swindon.

The loco was not disposed of immediately, however, and provided the test bed for a new generation of 25kV AC electric locos for the new British Railways electrification schemes. It was renumbered E1000, and provided valuable experience and knowledge about operating AC electric types as the first main lines were electrified. Officially withdrawn in 1968, it was scrapped in around 1971.

PHOTO 4: Second gas turbine loco by Metropolitan-Vickers, seen on the Western Region. *Photo: unknown source*

PHOTO 5: Metro-Vick in its final guise as a 25kV AC electric. *Photo: digitally-coloured by Garry Luck from original unknown source*

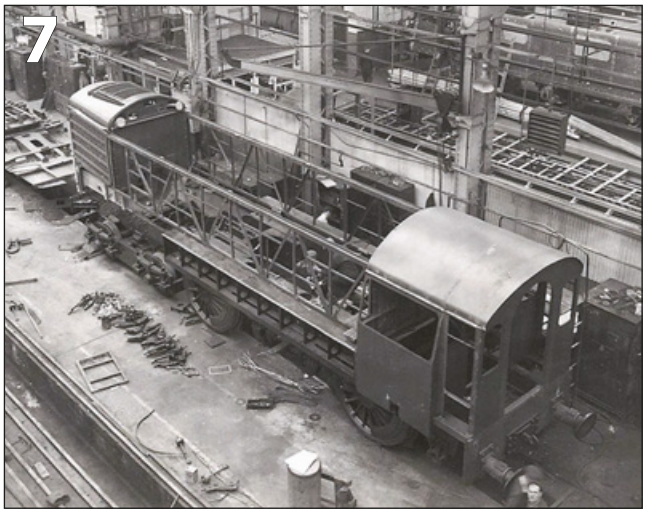
PHOTO 6: E2001 after withdrawal as an electric loco, stored on a disused section of the former Great Central line, not far from today's Buckinghamshire Railway Centre. A sad end for an innovative loco. *Photo: Gordon Edgar*

English Electric GT3

The third and final experiment with gas turbine traction appeared in 1961, although it did not actually enter revenue-earning service until 1962. In addition to the marked visual differences between the first gas turbines of 1950/1 the locomotive built in 1961 was a private venture by English Electric Ltd, to offer a competitive alternative to diesel and electric traction.

English Electric's GT3 was intended once again for express passenger use, with a range of design features aimed at economy of operation. The power equipment was an English Electric type EM27L recuperative gas turbine, developing a maximum of 2,750hp. GT3 was built at the Vulcan Foundry Works for trials on the London Midland Region and in marked contrast to the earlier designs was a locomotive and tender, the engine constructed on the chassis of a conventional steam 4-6-0. The loco unit had a cab at one end, behind the coupled wheels, with a 'hood' section over the turbine unit, in similar style to the Vulcan Foundry type 1 (Class 20) diesels, whilst the tender provided accommodation for the train-heating boiler and fuel tanks.

The two-stage gas turbine was arranged with one stage driving the compressor and the other driving a specially designed gearbox located on the centre driving axle. The unit was put together at English Electric's Whetstone Works in Leicestershire, based on similar installations for stationary use in industry. Both power



and compressor turbines were arranged 'in-line', with the initial startup using high power batteries. A feature of the power turbine's operation was that it could be shut down when the engine was stationary, with the compressor turbine still operating at a speed of 9000 rpm.

GT3 was owned by English Electric and achieved the same degree of success as its predecessors, running experimentally on various LMR routes, from the West Coast Main Line, to the Great Central section. Despite improvements made in this design, they were not sufficient to meet the challenge of the diesel locomotive. As with 18000 and 18100, ultimately it was suggested that this type of motive power would always remain unsuitable as experience had shown them to be ill matched to both climate and traffic conditions. GT3 was scrapped in 1966 at Thos Wards yard in Salford, Manchester.

British Railways APT-E

In the mid 1960s, and with the experience of these three prototypes still fresh in the memory, BR was not done with experimenting with gas turbines. Next out of the blocks was a gas turbine powered Advanced Passenger Train (APT) for non-electrified routes. The APT-E unit also provided the test bed for tilting technology and a number of other BR Research innovations.

The APT-E's power unit had an interesting history, since it was originally considered for use in road transport and the Rover Company had carried out development work during the war years. After the war the first example the company built was the JET1, which was followed by the Rover-BRM, driven in the Le Mans 24-hour race in 1963 to 1965.

In the 1960s, BR turned to British Leyland Motor Corporation (BLMC) for a gas-turbine power unit which would drive BR Research's experimental unit aimed at trialling a number of technical advances – including the tilting mechanisms. By that time Rover was part of the British Leyland Motor Corporation, and in 1969 the firm won a contract to supply the power units for APT-E, in the year it had exhibited a 350/400hp gas turbine powered lorry, fitted with the same 2S/350 turbines.

The aerodynamically styled APT-E was delivered to BR Research Division in 1972 and consisted of two 21-metre (69ft) long power cars, with two unpowered trailer cars between. The test unit was never intended for carrying passengers.

Each power car was fitted with five of the Leyland gas turbines, four of which were for driving the alternator-rectifier sets, while the fifth provided power through an alternator for auxiliary, on-board supplies for train heating, lighting, traction control and other services. Each of the traction alternators provided power to the traction motors carried on both axles of the leading bogies.

The three bogies supporting the non-powered cars provided articulation, and were also intended to provide steering through curves, in order to reduce wear and dynamic stresses – and of course to improve ride quality. APT-E was largely fabricated from aluminium, with the bogies including an electro-hydraulic/pneumatic tilting mechanism to provide banking of the vehicle body through curves, with that important objective of allowing increased speeds over existing tracks.

APT-E was to be the precursor of wider use of the technology on electrified routes, with gas turbine versions for non-electrified lines. In trials and testing, the four-car articulated set was sent out on the Western Region main line, and on the Midland main line out of St Pancras. Running on the Western Region, APT-E set a new British railway speed record on 10th August 1975, reaching 152.3 mph (245.1 km/h) between Swindon and Reading.

In the year following the speed record, APT-E was taken out of service. The four-car set of two power and two trailer cars was sent to the National Railway Museum for preservation, and is now based at the NRM's Locomotion museum in Shildon, where restoration work has been progressing.

The gas turbine period on Britain's railways had never been successful, but the work involved in developing the technology for the APT showed what could be possible. The involvement of the British locomotive and engineering industry was a success, but the commitment of that same industry to diesel and electric traction and its ensuing success was also the final nail in the coffin for gas turbine technology. EIM

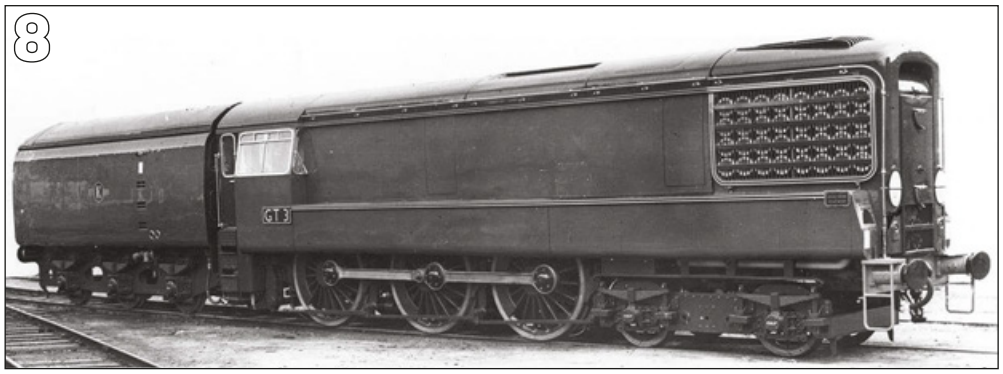
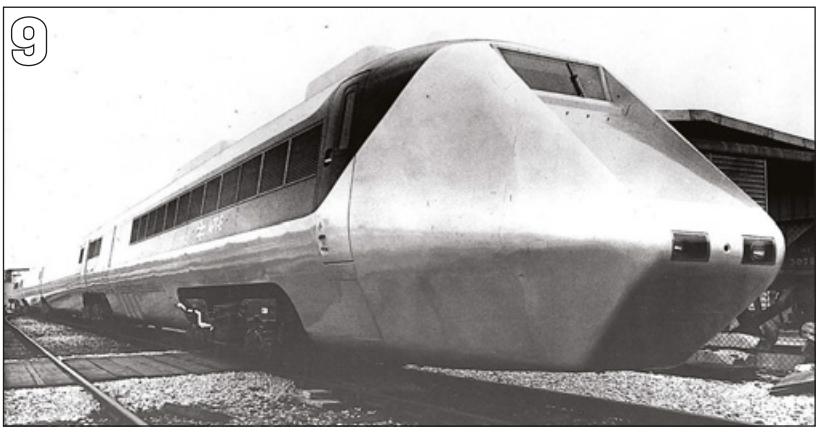


PHOTO 7: GT3 in build at Vulcan Foundry, showing simple fabrication of upperworks. Framing for casing, with cab at end nearest camera is a clear nod to design of Class 20 diesels. Just in view at leading end is outside frame four-wheeled bogie – you could fit a boiler and hey presto, you have a new steam loco... *Photo: RPB/ GEC Traction Collection*

PHOTO 8: Official shot of English Electric's unique GT3. One wonders why – why? It was built on what was essentially a steam loco chassis. A 5-inch gauge model has been built of this one-off project.

PHOTO 9: Official shot of APT-E soon after completion. *Photo: RPB/ GEC Traction Collection*

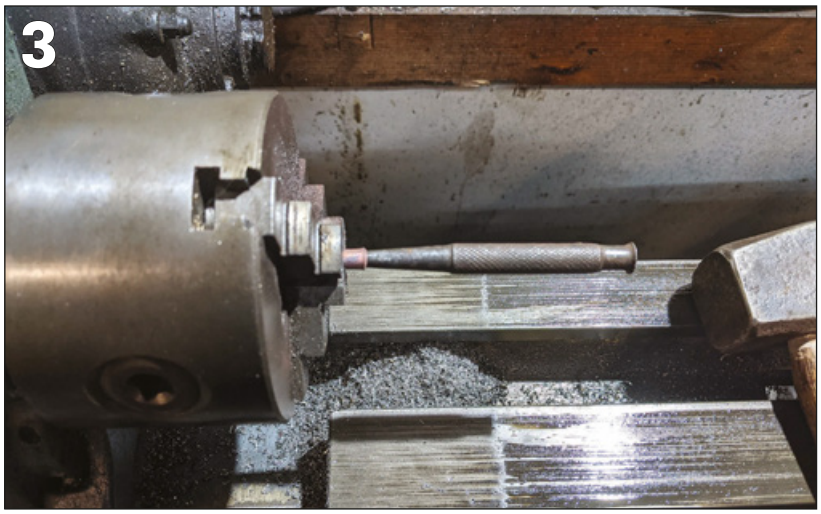
PHOTO 10: British Rail APT-E in the Rail Technical Centre sidings between tests in 1972. *Photo: Dave Coxon/Wikipedia Commons*



A flare for copper

Our tech ed's activities with 6-inch scale locos on the Fairbourne Railway in recent weeks saw him employing two techniques useful to model engineers no matter what scale they work in...

BY **HARRY BILLMORE**



"Ensure that the drift is tapped in square to the tube, as it is very easy to end up with a lopsided flare..."

Readers who follow these features will know that much of my activity since arriving at the 12¼-inch gauge Fairbourne Railway on the Welsh coast last Autumn has been concerned with the 10-year overhaul of half-sized Darjeeling B Class 0-4-0 'Sherpa'. We are at the stage of putting the loco back together with lots of additional refinements, and fitting a new axlebox lubrication system gave me an excuse to try out flaring copper tubing using a lathe.

You can buy kits to put flares on tubing that are designed for brake lines, however I didn't see the point for just four flares so I came up with this method instead.

The process

I first annealed the copper before setting it into the jaws of the Myford Super 7 lathe, tightening down firmly but not so hard as to deform the now soft copper (**Photo 1**).

To seat the tube in the chuck firmly and allow me to form the wider head I first tapped a slender long tapered drift into the tube, expanding it gently against the chuck jaws and starting to bell-mouth the end (**Photo 2-4**).

I then chose a thicker centre punch (**Photo 5**), ground to a steep point for the final forming – a couple of gentle taps led to a nice flare on the end of the pipe (**Photo 6**) that fitted the oil cups very nicely, both sealing the pipe to the cup and, with some careful

PHOTO 1: Step 1 – annealed copper tube gripped gently in chuck.

PHOTO 2: First expansion to seat tube into jaws and start the flare.

PHOTO 3: Gentle wiggle allows drift to be removed.

PHOTO 4: After first drift, showing initial expansion and flare.

PHOTO 5: Comparison of two drifts used, first one on right and finish one on left with a freshly ground end.

Photos by the author unless stated

PHOTO 6: Second drift being gently tapped home, care needed to ensure this goes in square.

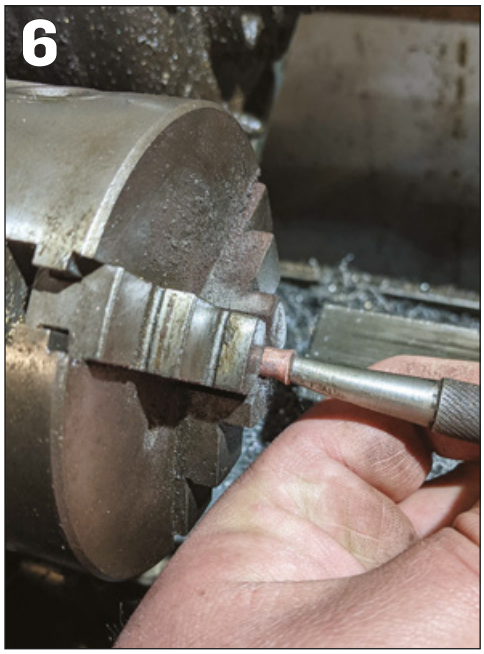
PHOTO 7: When care isn't taken – slightly wonky miss-hit with final drift produces both chuck jaw marks and a wonky end.

PHOTO 8: Finished item with its corresponding nut.

PHOTO 9: View into top of fixing nut showing flare doing its job.

PHOTO 10: And finally attached to oil cup – careful machining of length of nut followed to be able to use it to clamp fixing bracket as well.

PHOTO 11: Sherpa's bottom end, back together and awaiting the boiler. *Photo: Andrew Charman*



machining of the length of the nuts, helping to clamp the oil cup to the bracket on the frames (Photo 8-10).

Keep it straight

Care must be taken at this stage to ensure that the drift is tapped in square to the tube, as it is very easy to end up with a lopsided flare as shown in the picture (Photo 7).

The bottom of these tubes will eventually have some silicone tubing connecting the oil cup to a hollow bolt on the axlebox top that both holds the bronzes up and allows the oil to feed into an oil way in the top of the bronzes.

All this contributes to the progress of the rebuild, which as Editor Charman's final shot shows (Photo 11), is making good progress, with hopes of the loco returning to service in not too many weeks' time. ▶

Wire and weight – slide bar setting

When setting up slide bars on locomotives, my favoured method where there is space to do it on larger models is to set up a centre wire down the centre of the cylinder bore, leading all the way past the driving axle. I have seen several different setups for doing this, some complex and some much more basic, this one is very much on the basic side of things!

The first thing to do is to fit the rear cylinder cover as the slide bars almost always attach to this and it is quite difficult to set them up with one end floating in space.

Following this, thread some fine flexible wire through the piston rod hole and back towards the driving axle – use this to locate a suitable bit of framework to use as a point to clamp a hanging bracket to (**Photo 1**).

My hanging bracket is simply a piece of reasonably stout angle iron with a V-notch cut into it, coming to a very sharp point. This means that the wire is going to be held in the bottom of the V and cannot move unless the bracket is moved.

I then make up a bracket for the front of the cylinder, again made out of stout angle iron with a V-notch in it, roughly in the middle of two holes that are oversize for the bolts or studs on the cylinder (**Photo 2**). Hang the wire over the notches having roughly lined them up and stretch the wire out with weights hanging from each end.

What follows is a lot of careful measurement and patience. Starting at the front end of the cylinder, measure using bore gauges from the cylinder wall to the wire, as close to the bracket as you can both vertically and horizontally.

Adjust the bracket with gentle taps from a hammer until the wire at the front end of the cylinder is precisely in the centre of the bore. Fully tighten down the bolts holding the bracket in place then double check the position of the wire at eight points around the bore of the cylinder.

Once the front end of the cylinder is set in the centre of the bore, you can then set the rear end of the cylinder, measuring from where the piston rod will sit in the rear cylinder cover to the wire and moving the bracket that is clamped past the driving axle. A large movement of this bracket will result in a small change in the measurement at the cylinder cover so it is important to take some time and check everything repeatedly.

Once this is complete (**Photo 3**) you can take numerous measurements from the wire to determine aspects such as the correct ride height for the driving axle, how parallel the cylinder bore and the frames are and of course the correct position of the slide bar to ensure it is parallel and true with the cylinder bore. Job done! EIM

PHOTO 1: Cylinder lining rear bracket, showing V-notch and clamp holding it in place on framework. Note also the tensioning weight.

PHOTO 2: Cylinder lining front bracket showing V-notch, weight and two oversize holes for clamping and adjustment.

PHOTO 3: Cylinder lining showing taut wire passing through rear cylinder cover, extreme care needed to ensure this is absolutely true to bore.

Kenny's engine

Originally written for his club newsletter in 2004, Granville continues his evocative tale started last month of model engineering trials and tribulations in the late 1940s...

BY **GRANVILLE ASKHAM** Part Two of three

There she sat, all forlorn. A beautiful 5-inch gauge Midland Compound chassis complete with all her motion work and reversing gear but, she would **not** turn over. No amount of assistance, turning the wheels over centre, shifting the reversing gear a tad, nothing had the slightest effect. The valve gear looked good and so there was nothing for it but some serious dismantling.

Down came the motion, out came the outside pistons to reveal the cylinder bores beautifully honed in the colliery workshops and previously unseen. Remember, dad had bought the engine as a bare chassis with the cylinders already in place.

Then he noticed something else. These cylinders were huge lumps of cast iron and, unusually, the ports were cast in using cores. A quick poke with a piece of wire showed the ports in the outside cylinders were clear of the hard core sand, but what about the inner cylinder, an even bigger lump?

In the Midland Compound, the middle cylinder is the high-pressure unit and steam exhausts into the two outer cylinders to complete the cycle. Thus, any problem with this cylinder will prevent the engine working.

The block to progress

More dismantling and out came the offending cylinder. Sure enough, both port cores were still in situ. Cores are quite hard and in these restricted passages the sand took some shifting, but eventually, it was all removed and the job of rebuilding began.

Soon all was back together and a second connection to the garage air line produced satisfactory results with the Compound turning over slowly and sweetly – great sighs of relief all round.

The steam pals gathered – more talk, tea and ginger cake. "What about t'boiler, Kenny?" Good question – where could sufficient sheet copper be found to build a boiler in these post-war times of shortages?

There were no centrally heated homes in those days except the grand houses where they had large cast-iron radiators heated by antiquated coke-fired boilers. All our houses had coke fires and some, not all, did have a hot-water system. Very simple, a small tank behind the fire back was piped to an upstairs hot-water cistern and a cold tank in the loft. The hot gases from the fire were directed through a damper around the tank, so heating the water. Convection did the rest.

"He didn't sell many of these boilers, they lasted a long time when installed so the chance to sell three at once was not to be missed..."

These tanks and cisterns were made from **copper**. And one of the cronies remembered that a neighbour of his had just had her back boiler replaced. "What a job, took best part of a week because t' fireplace 'ad to come out...".

He would go and see that lady. When he returned it was with a heavy, newspaper-wrapped parcel which when untied revealed a very dirty, soot-encrusted, battered-looking old back boiler. It was worn out, but it was a start. Much wire brushing, sawing and hammering produced a sheet of copper, badly pitted but bits of it were usable. Now if this boiler had been replaced, the new one must have come from somewhere...

A visit to a local hardware shop (i.e., goldmine), provided the answer. Yes he had recently sold one but they were made pre-war and yes, he had another two or perhaps three. He didn't sell many, they lasted a long time when installed so the chance to sell three at once was not to be missed.

So we had enough copper to make a boiler. Not like the ones we make these days, this one was riveted throughout. You couldn't buy ⅛-inch copper rivets – shortages again – but you could get ⅛-inch copper wire. Guess who learnt the art of heading short pieces of annealed ⅛-inch copper wire to turn them into rivets? I must have headed a thousand.

There was no requirement for boiler insurance on model locos in those days, but if there had been that boiler would have passed. All the seams riveted and caulked, all the tubes properly expanded in place and only a little plumber's solder used on the screwed and nutted stay heads. Every year it was pressure tested and never failed.

Now, construction proceeded quickly. One of the boxes which came with the chassis contained Bassett-Lowke water and pressure gauges, these really finished off the backhead.

First steam

Then, at the end of summer, a special Saturday event. Word had got round that Kenny had finished t' boiler and there was going to be a steam-up. And steam-up there was. Outside the shed on a fine afternoon, loco on chocks. Water in the boiler, kindling in the firebox, then coal.

Boiler warming through, drain cocks open, final oil round. Needle off the peg of the pressure gauge, open the blower, watch the pressure rise. Shift reverser to full forward, crack the regulator and hold your breath.

Lots of water and steam from the drain cocks, chimney and a few unexpected places, but slowly the wheels turn and, as the cylinders warm through, the regular beat becomes apparent. Close the cocks and the engine settles down. Not a long run, just enough to note a few small jobs that need attention. And here comes mum with the tea – and fruit cake. It really is a special day. EIM

■ Next month in the final part – where to run the monster? No local model engineering society track, and no transport to get it there if there was...

RIGHT: Kenny and his Midland Compound – a real example of practical ways to beat post-war shortages. *Photo: Askham family collection*

Ensuring oil's well...

Our occasional series unlocking the mysteries of steam locomotives for those new to model engineering this month focuses on the essential subject of lubrication.

BY **ANDREW CHARMAN**

Effective lubrication is essential to all steam locomotives – in fact every steam engine whether road, rail, marine, stationary... Whatever the type of engine, its mechanical makeup involves a great many metal parts moving in contact with other metal parts, so it is vital to maintain slipperiness between those surfaces to ensure they do not overheat and eventually seize.

In the case of components such as axles, rods and the like, which make their movements in an environment not affected by steam or extreme heat, lubrication by drip-feed is the norm. The rubbing surface is lubricated either through a pad or directly, fed from an oil reservoir mounted above it and feeding by means of gravity. The actual lubricant usually runs down to the part by means of wicks on wires known as **worsted trimmings** – looking after these and regularly topping up the reservoirs are among the duties of the driver, as we will describe shortly.

Lubricator types

Where internal surfaces affected by steam or hot water must be lubricated, such as the inside of valve chests or cylinders for example, there are two popular forms – the **hydrostatic** or '**sight feed**' lubricator and the **mechanical** lubricator. Both can be employed to lubricate cylinders, valves and pistons – in other words areas under pressure – and they are filled with a very thick oil to cope with the presence of steam.

"A major advantage of the mechanical lubricator is that it only starts working when the loco starts moving..."

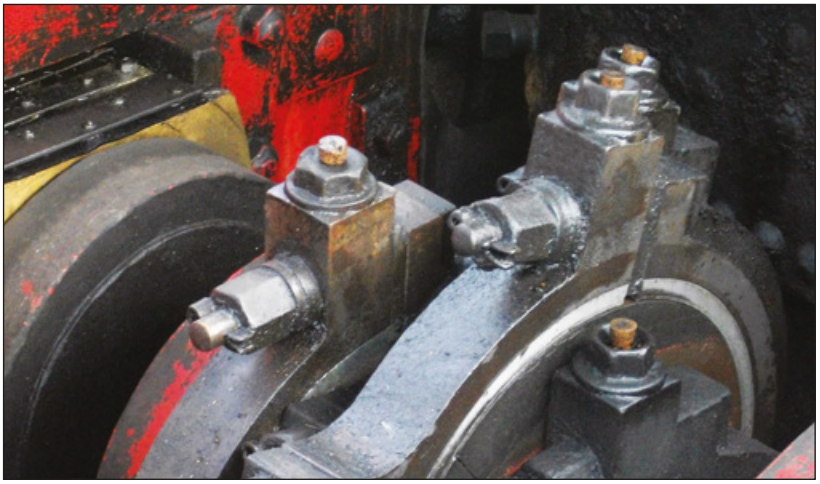
The sight feed lubricator was developed from earlier displacement lubricators introduced by John Ramsbottom in 1860 and most often found on locomotives of the Great Western Railway. In the displacement design steam enters a container of oil, condenses to water and falls to the bottom of the chamber, pushing up the oil into the delivery and then steam pipes, where it is atomized and passed to the cylinders.

The sight feed added a glass to the delivery pipe, mounted in the cab so that the driver could observe the flow rate. Later the design was developed to more sophisticated lubricators, though still using the same basic principle, and most popularly manufactured by C C Wakefield & Co.

In such lubricators steam pressure propels the oil, whereas the mechanical lubricator is directly driven by the locomotives motion, and can also be as effectively used to lubricate axleboxes and the like as it can components under steam or hot water pressure.

A major advantage of the mechanical lubricator is that it only starts working when the loco starts moving, so it does not waste oil. It then continues to work at all times the loco is moving, including when it is coasting and none of the steam required to power a hydrostatic lubricator is going to the cylinders.

Mechanical lubricators are easy to



spot, comprising a box often mounted on the running plate, with a rachet on the side joined by a rod to part of the motion, often the crosshead. This drives a pumps inside the lubricator itself, immersed in the oil, forcing lubricant along the delivery pipe.

Lubrication procedure

Lubrication tends to be a job of the loco driver though the conscientious fireman assists in many areas. The oil cans normally live on a flat 'warming plate' directly above the firehole door, which as its title suggests, warms the thick oil to lessen its viscosity and make it flow more easily into the various oiling points on the loco.

There are two distinct types of oil used on a locomotive. The '**cylinder**' or '**steam**' oil used to lubricate pressure surfaces such as cylinders and the steam brake is much thicker than that for various bearing surfaces, such as in the motion.

As part of the start-of-day checks before taking a loco out the driver adds lubricant, and will normally fill the lubricators requiring cylinder/steam oil first, giving the thicker liquid the most time to warm through and lessen its viscosity for easier flow.

A mechanical lubricator is filled to its sight glass and then manually operated or primed by turning its handle to ensure the oil is pumping through correctly, the moving oil visible through the sight glass.

A locomotive fitted with a hydrostatic lubricator is traditionally replenished by the fireman. Water is drained from the lubricator by opening a cock on the bottom of the body and removing a hexagon-shaped filler nut on the top of the body. Steam oil is poured in until its level reaches the base of the filler nut thread, the nut is replaced and the steam valve reopened. There is another cock which allows steam to flow through the lubricator body, warming the oil before it is used.

Oiling round

The driver undertakes 'oiling round' of the various moving parts as part of pre-run visual checks of the motion. Parts needing lubrication fall into three basic types, **rotating**, such as axlebox bearings or rod ends; **sliding** as in crossheads, valves and the like, and **rocking**, such as the little end of a connecting rod.

Sliding parts are normally fed from a cup or pot located above the part in question, with a worsted fitting in the bottom. The yarn draws out the oil from the pot by a syphon action, and then feeds it to the moving component, a drop at a time.

Worsted trimmings come in three forms – the **Plug**, which simply fits directly into the feed hole to restrict the flow of oil, **Plug Tail**, drawing the oil out of the pot or cup to produce a more consistent flow; and **Tail**, used where a greater flow of oil is required.

Oil for rocking parts of the motion usually lies in a well which has a pad made from worsted yarn in it. The pad regulates the flow of oil.

Rotating parts typically need more oil and have their own individual and larger cups mounted directly on the part itself. The holes for these are sealed on the top with a cork – why ▶

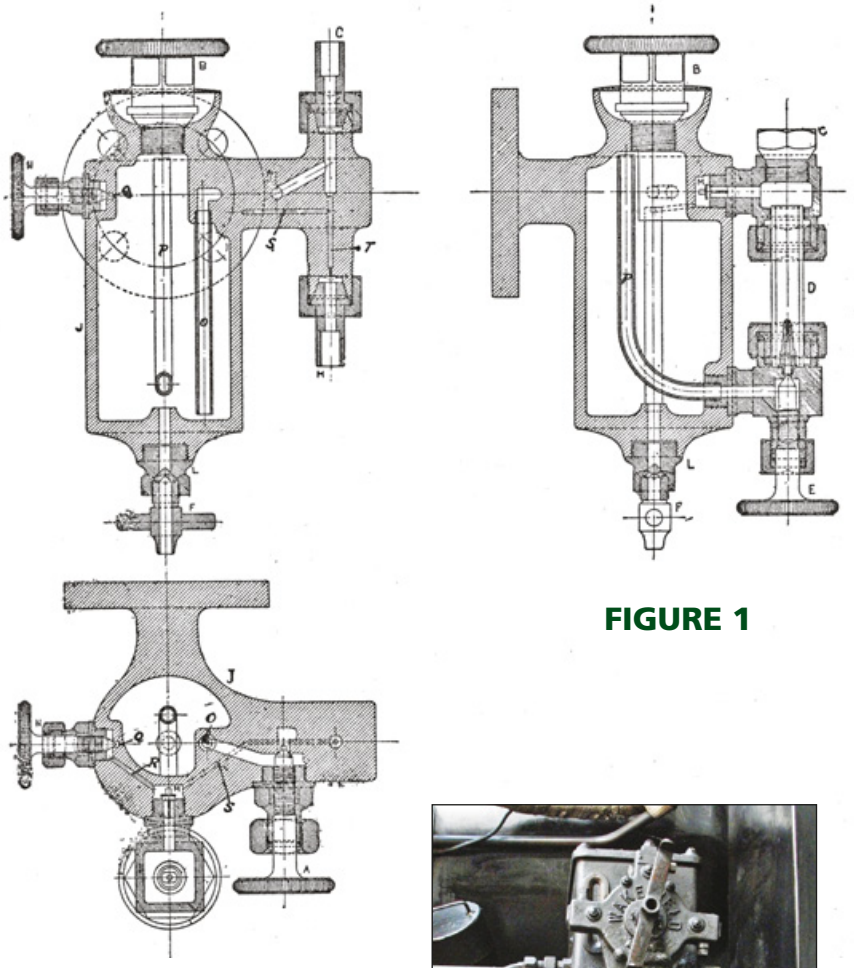
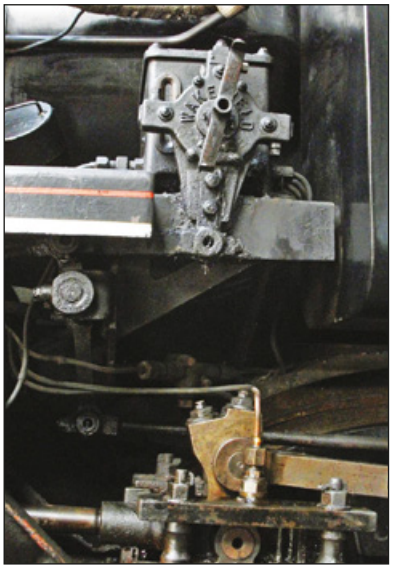


FIGURE 1



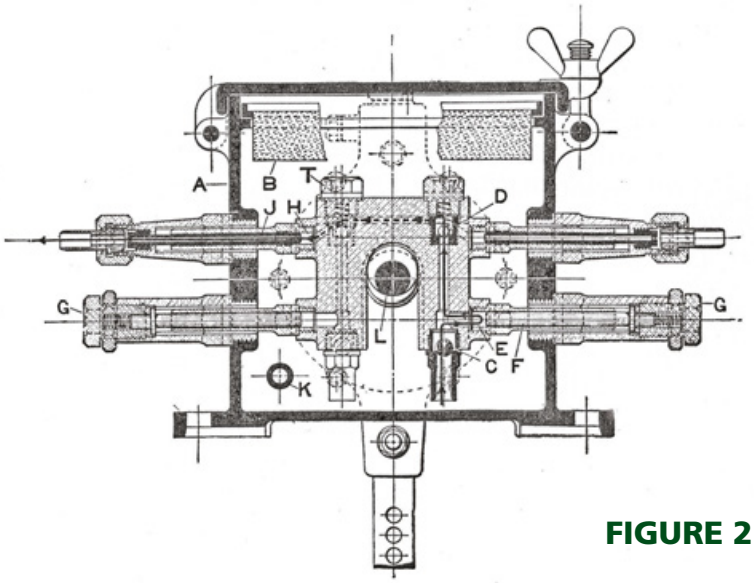


FIGURE 2

HEADING: Oiling round Hall class 'Olton Hall' at Crewe, in the days when the loco was playing a starring role in the 'Harry Potter' movies. *Photo: the late Eddie Bellass*

LOWER FAR LEFT: A typical oil reservoir with a worsted trimming within.

LOWER LEFT: On the inside motion of this locomotive the oil reservoirs can be seen topped by corks.

FIGURE 1: Diagram of a Wakefield sight feed lubricator.

ABOVE RIGHT: A mechanical lubricator on a standard-gauge engine, driven by the motion.

FIGURE 2: Diagram of a typical Wakefield mechanical lubricator.

Photos by the author unless stated

cork? Simply because if it falls out and lands in the motion it won't cause damage in the way a metal cap could. Trimming these corks to size with a penknife is another of the lesser-known entries in the driver's skill set... Some large locomotives have a more complex system, with a spring-loaded ball sealing the hole.

Inside an oil cup is a restrictor plug which is either threaded or tapered, with flutes in the sides. Below the oil hole is at least one felt pad – as the part rotates the oil is thrown around the cup and a certain amount pushed through the flutes and on to the felt pad, maintaining constant lubrication, but only when it is needed, on the move.

Checking oil reservoirs are not filled with water is an essential job – any water must be syphoned out before oil pots are refilled. This water can be picked up on the road in wet weather, but can also be the result of a careless fireman overfilling the water tanks on a tank locomotive.

How difficult 'oiling round' a locomotive is depends on its design. Generally, a two-cylinder loco with Walschaerts motion is the easiest because all 'the bits' are on the outside. Three-cylinder variants, Stephenson Link-equipped engines and others have much of the motion inside, which usually entails crawling amongst it while the locomotive is over an inspection pit.

On narrow-gauge engines the job tends to be easier as oiling points can be accessed by reaching between the frames, once you have ensured there is no chance of movement in either the locomotive or the motion – operating the reverser in the cab, for example, changes the geometry of the motion.

Methodical process

The driver learns to treat lubrication as a methodical task, ensuring none of the various and many oiling points are missed. Again the length of time taken depends on design – your editor has been assured that oiling round a British Railways Standard class locomotive, for example, takes less than half the time it takes to do the same job on a Southern or Great Western Railway locomotive of similar size.

"There is a particular point where the motion can be stopped to expose the most lubrication points in one go..."

ABOVE LEFT: Checking an oil-soaked worsted trimming by removing it from its oil cup. The oil runs down the trimming into the feeder hole.

ABOVE: Here the driver is rotating the handle of the mechanical lubricator to 'prime' it.

LEFT: Oiling round the loco, a methodical task carried out many times during a typical operating day.

One aspect that greatly helps or hinders lubrication is exactly in what position the loco has been halted. There is a particular point where the motion can be stopped to expose the most lubrication points in one go, and this too varies with the design of loco – on standard-gauge locomotives with the two most popular forms of motion – two-cylinder Walschaerts and Stephenson's Link – the 'right' position is with the big end of the leading connecting rod in the top back quarter of the wheel i.e. 'ten past', on the clock. This is, however, by no means universal on Walschaerts-fitted locomotives and loco crew on today's heritage railways learn the correct points on their particular engines as part of their training.

Keep it clean

Cleanliness in lubrication is essential. When filling the oil feeder cans and using them, they should be wiped to ensure no grit, ash or such like gets into the oil reservoir. Similarly, when a cork is removed, a wipe around its base first removes any dirt that might be sitting on its edge.

Cups should never be over filled – only to the base of the thread that secures the retaining cork, otherwise once on the move the pressure of the oil will force the cork out, with the oil following it.

If the loco is fitted with a spring-loaded ball retainer, a screwdriver or similar is needed to press down on the ball, exposing the hole for filling with oil. When the pressure is released the ball will spring back to its closed position. Again, any excess oil should be wiped away with a cloth.

Lubrication is a constant process whenever one is working with a steam loco – visit any heritage railway and you will notice that as soon as the engine is stopped for any period, perhaps at the terminus before a return trip, the driver will be off the footplate, walking round their engine carrying the oil cans... EIM

Toeing the line...

Parting-off tools need accurately setting up to ensure a correct cut and help prevent the likelihood of the delicate tool breaking. Harry has a simple method to ensure this.

BY **HARRY BILLMORE**

When using a parting-off tool it is vital to ensure it is correctly aligned, both to ensure a straight cut and to avoid putting stresses on these delicate, easily broken tools. And there is a quick method, as follows:

First mount the tool in the tool holder and unlock the tool post to allow it to rotate freely.

Then bring the carriage up to the chuck so that the tool holder is allowed to press against the chuck.

Continue to gently advance the carriage until the tool holder is pressed firmly against the chuck face.

Then tighten down the tool post. On any reputable lathe you can be sure the chuck face is at 90 degrees to the bed so pressing an accurate tool against it, you can be equally sure that tool will be correctly aligned.

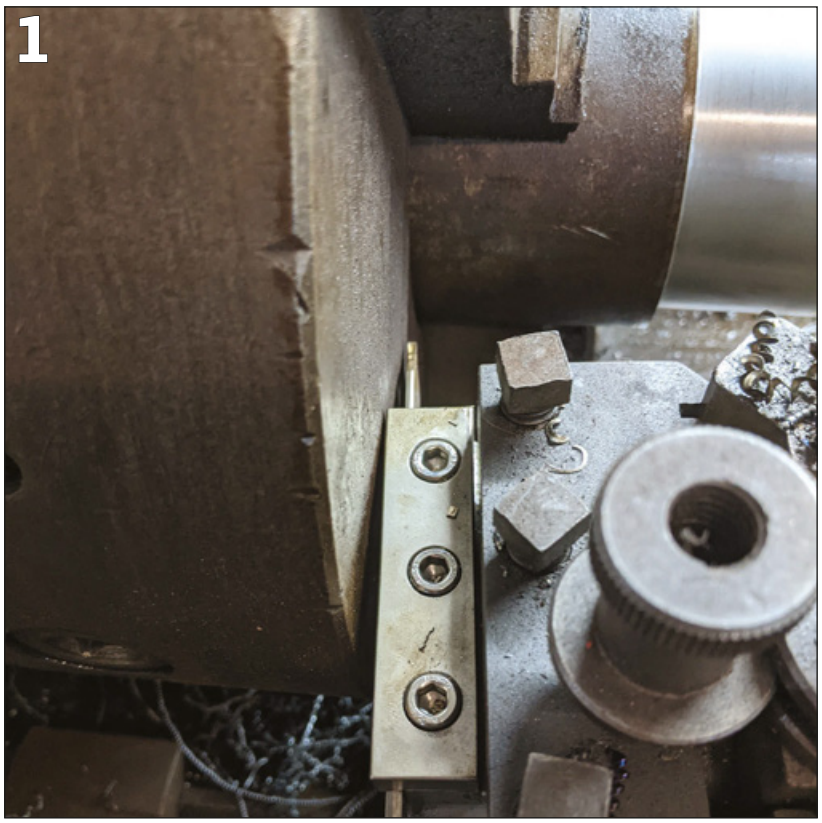
This method is especially useful on worn machines and those without an indexing tool post to provide quick and accurate tool alignment. And of course it is equally useful for correctly aligning any tool when mounting it in the tool post. EIM

PHOTO 1: Approaching chuck with toolpost free to turn.

PHOTO 2: Pressing tool holder against chuck gently and allowing tool post to turn and align itself correctly with face of chuck.

PHOTO 3: Tighten down toolpost and take the cut knowing tool correctly aligned.

Photos by the author



A first model engine for first-time model engineers

Matthew concludes his simple oscillating engine build for model engineering newcomers, describing the assembly and testing of the engine.

BY **MATTHEW KENINGTON** Part Five of five

The first step in preparing for the assembly of the engine is to smooth and polish the various components (if this hasn't been done already). This requires emery paper or cloth (better!), a polishing cream (such as Brasso or Autosol) and a good deal of elbow-grease. Start with a coarse grade of emery, commensurate with the depth of whatever scratches and such are present, and then move to gradually finer grades – I didn't get beyond 300 grit before moving on to Autosol, but more patient model engineers would go to 600 or even 1200 grit before being satisfied.

To maintain the finish on (at least some of) the components, a metal lacquer was used – this can also help to keep rust at bay on steel components, although I didn't use it for this purpose on this engine. The brand I used was Rustins Metal Lacquer – it was easy to apply by brush and leaves an almost invisible finish, letting the polish of the metal shine through.

If you plan to add a plaque with recessed lettering, as I did, then a simple method of painting the lettering is to generously fill the recessed letters with your chosen paint colour (black in my case), such that the paint level stays well below the surface level of the metal of the remainder of the plaque. You will struggle to do this well without some of the paint falling outside of the characters; don't worry about this and concentrate on covering the base and sides of the recessed characters.

Leave the paint to dry thoroughly (24 hours plus for most paints, but check the tin) and then, using a piece of fresh emery paper placed grit-side uppermost on a solid, very flat, surface, rub the surface of the plaque. This should remove the extraneous paint, leaving the characters beautifully filled with paint. Use something like 80 or even 120 grit emery paper to start with – something that won't clog too quickly with the excess paint, but also won't unduly score the surface. You can then repeat with ever finer grades (and ultimately a polishing cream, as discussed above) until the desired finish is achieved.

"The engine is a fun thing to watch and very rewarding to see how something so simple can run so well, if care is taken in the machining operations..."

■ *The first four parts of this series were published in the February to May 2021 issues of EIM – you can download a digital back issue or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.*

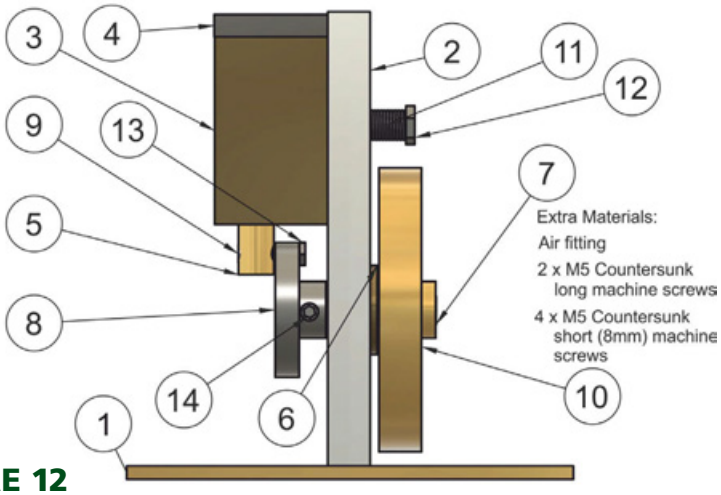


FIGURE 12

Parts List				
Item	Qty	Part Number	Description	Material
1	1	Base		Brass
2	1	Upright		Aluminum
3	1	Cylinder		Bronze
4	1	Cylinder Cover		Aluminum
5	1	Piston		Brass
6	1	Bush		Bronze
7	1	Flywheel Shaft		Steel
8	1	Crank		Steel
9	1	Crank Pin		Steel
10	1	Flywheel		Brass/Bronze
11	1	Spring		Steel
12	1	Bolt	M5 Bolt	Steel
13	1	Nut	M4 Nut	Steel
14	1	Grub Screw	M4 Grub Screw	Steel

Assembly

Now for the exciting part! Whilst it may seem like you have a depressingly small number of parts in return for so many hours of labour, it is now time to fit them all together and test the engine – for clarity the general arrangement and a full list of components is provided in **Figure 12**.

The first step is to insert the flywheel-shaft bush into the upright support (see Photo 22 in the April issue for the intended result). This should be a press-fit, ideally, and should not need any further mechanical attachment. A bench press is ideal for this job, however as we didn't have access to one at the time, we found that a woodworking vice served just as well. Take care to ensure that all surfaces are clean, so as not to press any swarf into the upright or bush during this process. The use of a couple of pieces of sacrificial soft metal (such as aluminium sheet) to line the vice jaws, can help to prevent any unevenness on their surfaces from being imprinted on the workpiece.

If the fit is a little loose, such that the bush may vibrate or rotate in use, then some Loctite 603 will restrict any errant behaviour. Its flange should fit snugly up against the upright, if the outer has been machined parallel – don't forget to maintain the pressure, if using glue, until it is fully dry.

Once the bush has been inserted (and the glue has been left to dry, if

relevant), the flywheel shaft and flywheel can be installed. There are three possible outcomes here:

1) The shaft is loose in the bush and there is play in the resulting bearing. The only option here is to machine a new flywheel shaft, to a very slightly larger diameter, using the bush/upright as a test-piece, to judge when the correct diameter has been achieved. You could, of course, try and drill out the bush and make a new one, but this is fraught with problems (particularly the drilling-out bit) and, compared to machining a new shaft, the time taken would be like using a bag of cement and a bottle of miracle-gro to build a skyscraper.

2) The shaft fits snugly, with no 'play' (vertical movement) and rotates freely. Congratulations – go to the top of the class, you're a shoo-in for the end-of-year Design and Technology (DT) prize – they don't refer to it as 'metalworking' these days.

3) The shaft needs some persuasion to fit into the bush. Depending upon how much 'persuasion' is required, there are a couple of courses of action:

a) It won't go in at all, despite fitting beautifully when tested on the bush alone. Don't despair, this is quite a common issue and arises because the bush has shrunk when press-fitted into the upright (brass, for example, is a soft-enough metal to do this).

The solution here is to remove a tiny amount of material from the shaft. The simplest way of doing this is to put the shaft back in the lathe and use a fairly fine emery paper along its length to remove a small amount of metal, checking with the bush/upright at regular intervals until the bush fits. Ideally this should be a tight-ish fit, ready for the next step.

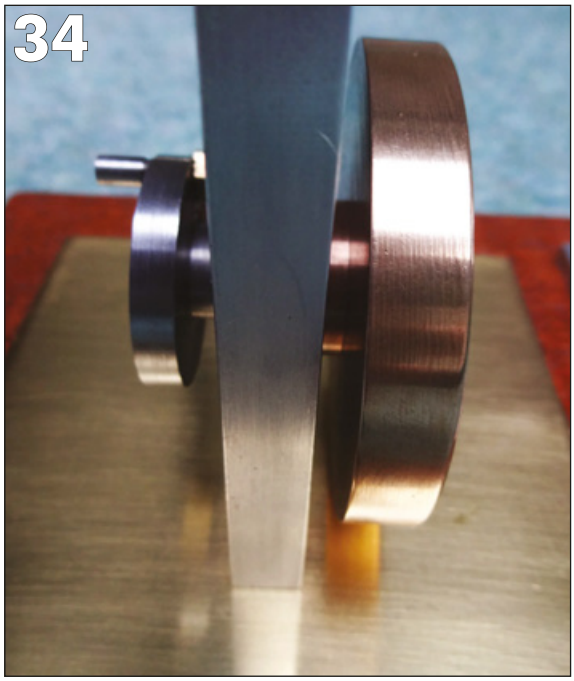
FIGURE 12: The general arrangement, with parts listed.

PHOTO 32: Step 1 – bolt upright to base using countersunk bolts (Allen bolts used here as they were to hand).

PHOTO 33: Step 2 – insert flywheel and shaft from bush-flange side of upright and attach crank using grubscrew.

PHOTO 34: Flywheel and crank attached.

All photos and diagrams by the author



b) The shaft is a tight-ish fit and would need a small industrial steam plant in order to get it to turn freely (in other words not the tiny little cylinder it will have to work with). This is the situation I encountered with my prototype (no DT prize for me then!).

This is actually, however, not a bad position to be in, as it allows a really close-fitting bearing to be achieved. The secret is to slowly and patiently rotate the (stiff) bearing, using plenty of lubricating oil (3-in-1 is a good starting place as it is thin and penetrates well), until it gradually frees. Initially, this might require the services of a vice, but gradually a (slowly-rotating) electric drill can be used (keep being generous with the oil – think of it as 'bearing cleaning fluid'), until eventually the bearing should be silky smooth, rotatable easily between finger and thumb and with a glorious lack of any play whatsoever.

Once achieved, it is a thing of wonder and you will play with it for hours. The oil will turn black during the process – this is a good sign, as it shows than the bush is wearing (in a good way) and the particles are being washed away by the oil.

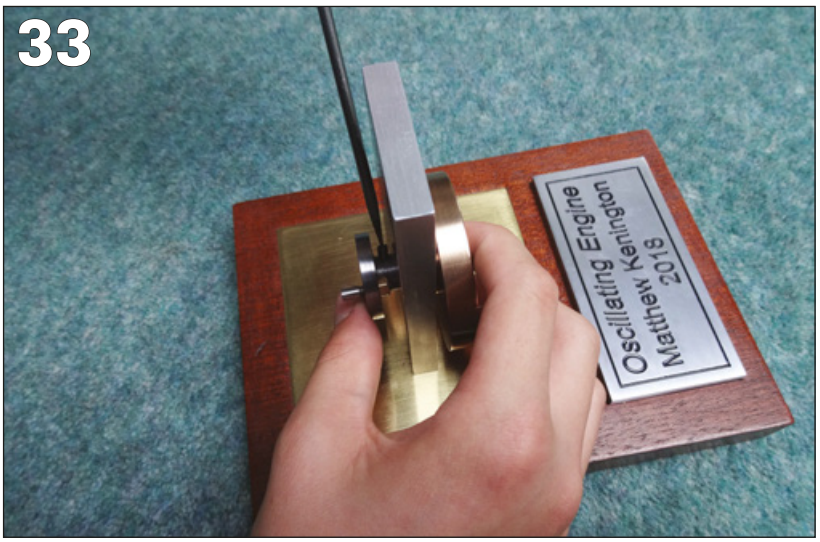
Further assembly

The remaining assembly tasks are now straightforward, although an assistant is quite handy when fitting the cylinder, as will be discussed. Step 1 is to bolt the upright to the base (**Photo 32**); this gives the model some stability when adding the other parts.

The next step is to insert the flywheel and shaft into the (now precision-fitted) bush and to add the crank and crank-pin, attaching these with an M4 grubscrew (**Photo 33**). The flywheel should rest against the flange of the bush.

The crank should be held as close as possible to the upright when tightening the grubscrew, as shown in the photo, to minimise any lateral play in the flywheel shaft (although it still needs to rotate freely, of course). Once complete, it should look like **Photo 34**. There should be essentially no gap between the flywheel boss and the bush-flange, nor between the crank-boss and the upright. The flywheel shaft should also not protrude beyond the crank, if all has been made accurately.

Assuming that you have a piston and cylinder which are close friends (**Photo 35**), these can now be attached using a suitable length of M5 bolt, two ▶



washers and a spring. Photo 36 and 37 show the component parts and assembled pivot for the cylinder.

Note the use of a cut-down bolt for the pivot itself (as opposed to a machine screw) – the plain shaft of the bolt makes for a lower-friction pivot and will cause less wear to the aluminium upright, in use (although this will still wear relatively quickly!). A better approach would have been to bush this hole as well, but I was an impatient 12 year-old at the time...

The spring uses six turns of 0.6mm (23 swg) spring-steel wire and, like everything else in this project, was found 'lying around' (ready-made) in a bits box.

Brass washers are shown, but are not strictly necessary and any thin M5 washers will suffice. This is the point where an assistant can come in quite handy (thanks dad). Press the assembled pivot through the pivot hole (Photo 38) and into the tapped hole in the side of the cylinder, then twist to hand-tight before lightly tightening with a spanner or socket. Getting a friend to help at this point is handy as it is tricky to push against the spring pressure and align with the cylinder at the same time.

I didn't find it necessary to thread-lock this part with glue, but you may wish to do so. Don't forget to ensure that the hole in the piston shaft is placed over the crank pin during this process (hence the benefit of an assistant for this step). I said it was tricky...

PHOTO 35: Step 3 – insert piston into the cylinder, ensuring crank-pin hole aligns with port and pivot holes.

PHOTO 36: Component parts of pivot.

PHOTO 37: Assembled pivot.

PHOTO 38: Step 4 – push assembled pivot through upright (see Photo 37).

PHOTO 39: Finished engine. Air-line fitting and regulator attached for testing has M5 thread.

Once complete, the engine should look like Photo 39 – note the addition of an air-line connector: M5-threaded, for 4mm pipe.

The tension in the spring is quite critical to the operation of the engine. If the spring is too strong, then the engine will take a lot of pressure to start and run. If it is too loose, then steam (or compressed-air) will leak between the cylinder and the upright and the engine will rattle in operation. The spring chosen was the result of a little experimentation. As an added bonus, the correct strength of spring yields a satisfyingly-genuine 'chuff' from the exhaust!

Testing

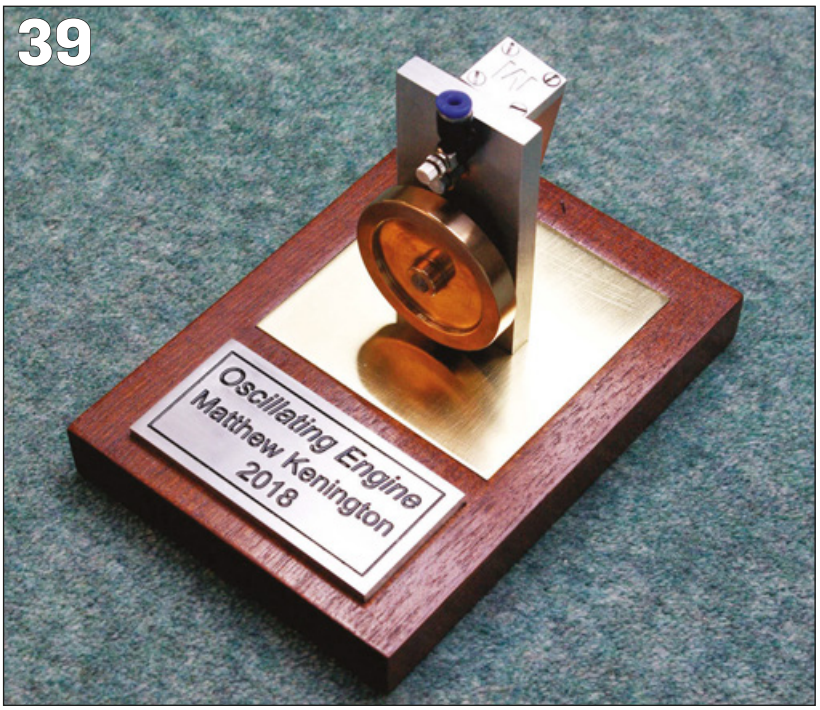
The engine was connected to an air compressor using 4mm pneumatic pipe and worked first-time. It will self-start if the inlet port is aligned correctly, otherwise a flick of the flywheel is required.

The engine should run smoothly on about 4 psi (although it will take a little more than this to start it off) and it may well need some 'running in' to achieve its best performance – don't forget to add lots of thin lubricating oil to all rubbing surfaces.

The engine is a fun thing to watch and very rewarding to see how something so simple can run so well, if care is taken in the machining operations. It is an excellent 'practice piece' before moving on to more challenging projects.

As indicated at the start of this series, this was my first model engineering project and I learnt a huge amount from it, while also gaining enormous respect for the achievements of model engineers with far more complex models of all shapes and sizes. The model looks simple, but was very challenging. I've since built a Stuart S50 from castings and a reconfigurable ground and raised-level riding truck of my own design. My current project is a 5-inch gauge Great Western Manor 4-6-0 – a little scary, but very exciting!

I would love to know if anyone embarks on building this engine and am happy to offer what help and advice I can. If you would like to get in touch, please do so via the editor. EIM



A Ransomes revival

Howard and his son Isaac have taken on the project of an unfinished Ransomes, Sims & Jefferies 2-inch scale General Purpose Traction Engine, and will be sharing updates in our pages as the build progresses.

BY **HOWARD AND ISAAC TRENDELL** Part one of an occasional series

I am one of many from an era when commercial steam traction had finally been superseded by diesel power and the only places to see steam in action, much as it is now, were the heritage railways and steam rallies. As a child growing up in the 1970s, my mother, father and I would visit the steam railway attractions and attend local steam rallies and it was here that I dreamt of owning my own engine, road engines seemingly so much more practical than a railway locomotive!

I was brought up on a smallholding and I developed a love of all things agricultural and mechanical but, as owning a traction engine was beyond practical in every respect, I settled for vintage tractors to keep me entertained. So, 30 years later, enter my youngest son Isaac.

Steam rallies continued to be a regular event for our family of three girls and one son and Isaac developed my love of things agricultural and mechanical but once he was 11 he took it one step further than me by becoming an active NTET (National Traction Engine Trust) Steam Apprentice, and the steam bug really bit hard... After every weekend playing with traction engines all I heard in the car on the way home (and still do) was "How much are traction engines Dad?", "When can we get our own traction engine Dad?" and so on.

Our own engine

My father's health began to deteriorate but he was determined that Isaac should realise his dream of owning an engine and so a search began for a suitable machine. The criteria for purchasing an engine were that it had to be of a manageable size and as, by my own admission I fix things rather than make them, a renovation project of an older scale model as opposed to building an engine from scratch would be the way to go. In due course a certain well-known online auction site turned up a very interesting item that we considered presented an achievable challenge and a deal was struck.

We had bought what appeared to be on first impressions a Ransomes, Sims and Jefferies Steam Tractor scale model which was about 85 per cent complete but dismantled and in several cardboard boxes. The plans that came with it were of the well known John Haining designed 2-inch scale RSJ Steam Tractor of which there are a number of examples around – some videos of these can be found on the internet.

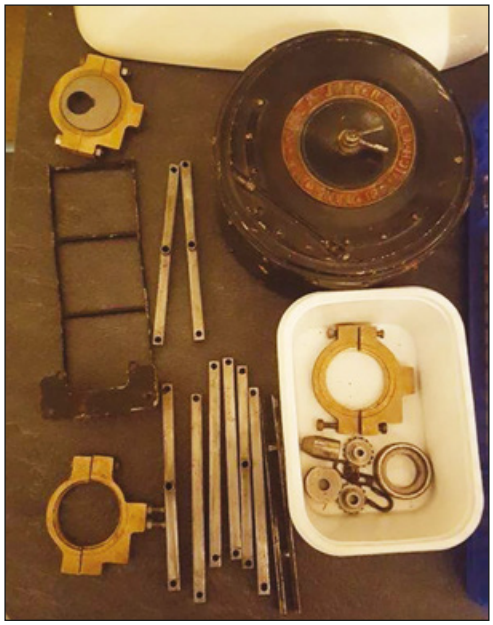
ABOVE: Putting the bits together revealed to Howard and Isaac that they didn't have quite what they thought...

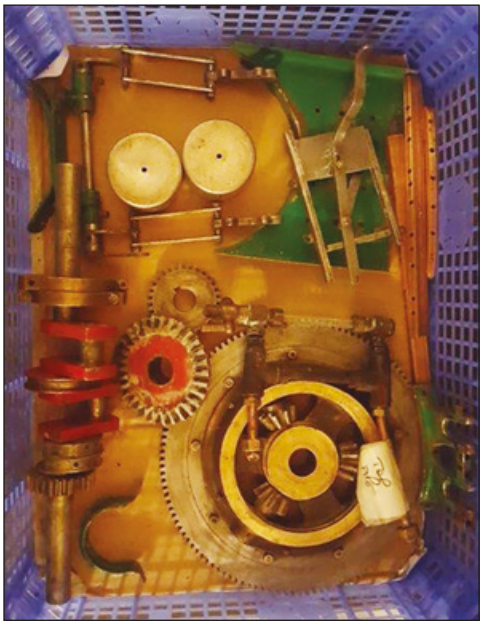
BELOW: Some of the many parts purchased.

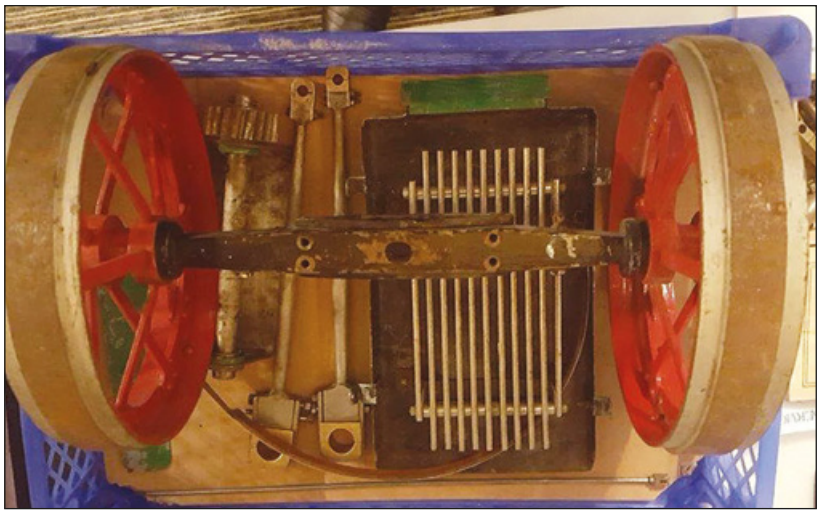
Not what it seems

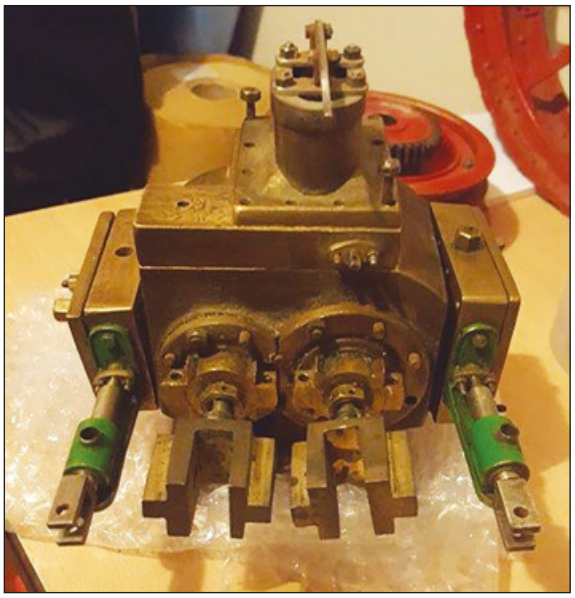
An account of the building of the RSJ steam tractor appeared in *Model Engineer* magazine in 1976 and 1977 and I located back copies of all the instalments of the articles to assist in the rebuild. But once we had got the engine home and started studying the plans against the model something just didn't ring true. Firstly, the 2-inch scale plans of the tractor didn't fit the measurements of large key components such as the flywheel and road wheels and we calculated that it was a very odd 2⅞ths scale. Why would anybody upscale a model from 2 inches to 2⅞ths? An engineering masochist maybe, just trying to tax their brain and test their maths skills?

No, the answer was much simpler. One evening we loosely assembled the whole machine on the bench and laid ▶



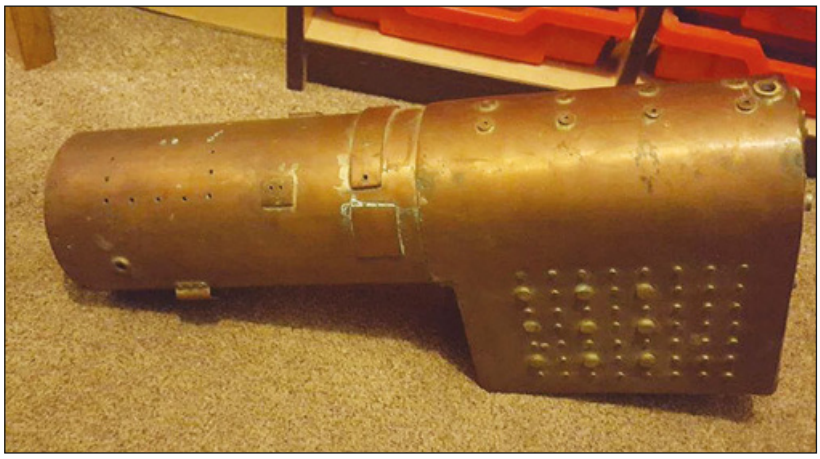


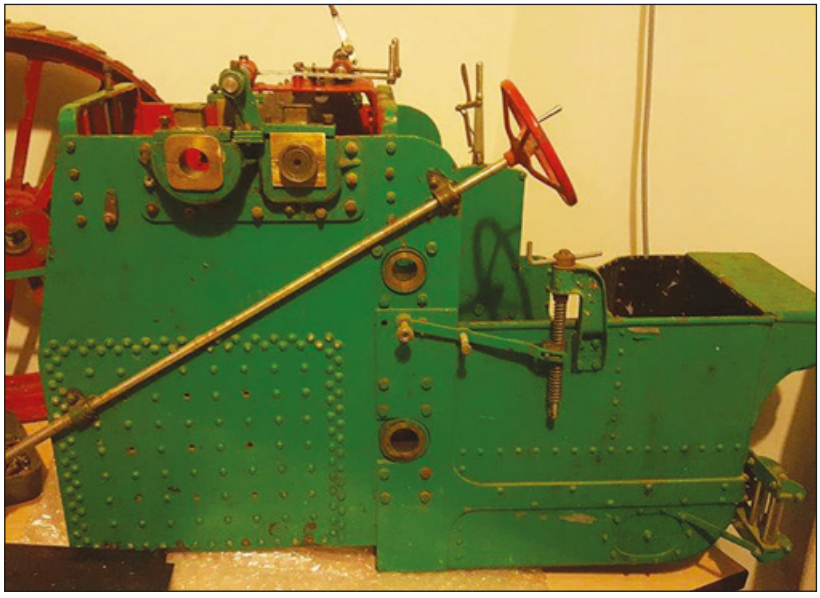




the plans alongside and compared them with some images of Ramsones engines on the laptop. We realized that what we had was actually a RSJ General Purpose Traction Engine manufactured in 2-inch scale – the only resemblance to the 2-inch steam tractor plans are the compound cylinder block design, which some Ramsomes general purpose engines share with the steam tractor, and the general common styling of Ransomes steam engines.

Now, there are very many examples of fine-scale model traction engines regularly exhibited at steam rallies and model engineering events across the country every year. They are invariably of common designs by Burrell, Foster, Fowler, Marshall and such, but less common are makers such as Mclaren, Aveling and Ransomes and a lot of these models are built from commercially produced plans or kits. We have been unable to locate any commercial plans for our model and have so far concluded that the original builder drew their own plans from a full-size engine in their locality and built it from scratch. It therefore appears to be a one-of-a-kind model of a relatively uncommon make. If anyone knows of another then we would be very interested to hear about it.





TOP LEFT: Front axle assembled, below the grate, ashpan and motion parts.

TOP: Engine's compound cylinder block amongst the finished sub-assemblies in need of dismantling and refurbishment.

CENTRE LEFT: Boiler appears much newer than rest of engine and ready drilled for cylinder block.

LOWER LEFT: Careful work will be needed to accurately mount the boiler within already made hornplates.

All photos by the authors

As this is a renovation of an almost complete working model it presents several challenges, but also opportunities, in developing our knowledge and skills in machining, fabrication and reassembly. Our goal is to get the Ransomes in steam and so the first job on the list was to appraise the task ahead.

Old engine, new boiler?

As this model came to us in a dismantled state, we are not sure if it has ever been steamed before except that the boiler is brand new and has never been fitted while the motion and tender are certainly much older, dirty and a little oily. One possibility is that the engine is quite old, has been steamed to the point of boiler failure and dismantled a long time ago with a view to rebuild with a new boiler but never completed.

The new boiler is silver-soldered copper, drilled for the cylinder block and bushed for the steam outlets and water gauges and cocks. Because the barrel has been drilled to accept the cylinder block this will need to be the first datum point from which we must take the initial assembly measurements to mount the boiler between the horn plates.

The correct mating of boiler to hornplates is critical to the connecting rod and motion travel and will be something that we will spend a lot of time getting right. If this is wrong, then the engine will never run properly as there is a danger of the pistons bottoming out in the cylinders if the boiler is not in the correct place.

Model traction engine convention

dictates that the boiler is mounted in the horn plates with screws passing through the plates into threaded holes in several solid stays soldered into the sides of the firebox. The screws are disguised as rivets to give the correct appearance of a full-size engine. The problem that we face is that the positions of the firebox stays do not match the pre-drilled holes in the horn plates, presumably the old boiler was slightly different.

While we are pondering the critical issue of correct boiler mounting, the remaining parts of the engine have been completely disassembled ready for cleaning and stripping of the old paint prior to repair and reassembly.

Key to reliability

The majority of the motion is present with only a minimal number of components requiring fabrication such as the Stephenson expansion link guides, regulator and its control rod. Most of the gearing, and the flywheel, is secured on the shafting with grub screws instead of keyways, something which we will look to improve on to ensure reliability and correct convention. A new perch bracket and axle trunnion is required along with a boiler-mounted water pump and firehole door and a fair few minor but important parts such as hub caps and boiler cladding not to mention quite a bit of piping.

Initially we may only prime the bare metal of the model during the rebuild and once we know that we have a runner will then disassemble for a full repaint in the correct Ransomes livery and lining. As already mentioned no commercial plans appear to exist of this model (*unless EIM readers know different? – Ed*) and so for the fabrication of components, we have contacted the Museum of English Rural Life at Reading University which holds the surviving Ransomes archive containing many full-size engineering drawings of the firm's products. Currently we are trawling through lists of drawings to identify the pages we need to make the missing parts.

Full-size inspiration

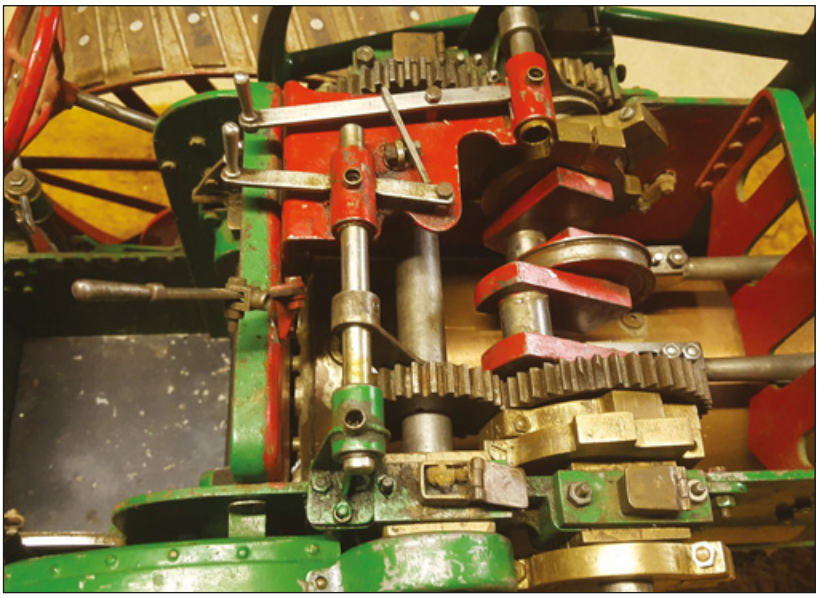
We also need to view a full-size version of the engine to see first-hand exactly how things look and measure up parts on the real thing. As we believe the engine to be a one-off our aim is to get it as accurate as possible and achieve as high quality a finish as we can while learning a lot of things along the way.

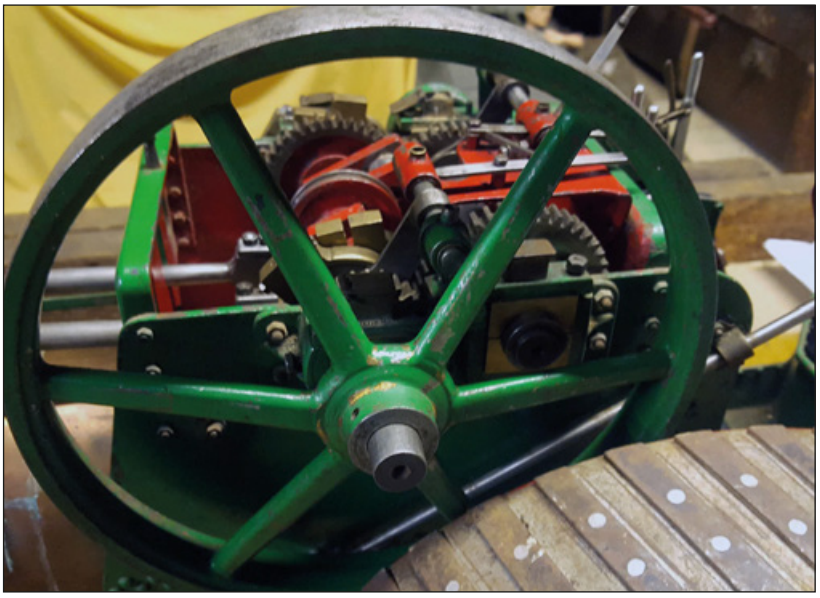
So, a lot of work awaits and if it all goes to plan, we hope to have a fine but unusual working engine at the end of this project. In the next instalment of this series we should have solved the boiler mounting issues and located the drawings needed for fabrication to begin…

Should you wish to follow our real-time progress, please visit our Facebook page: https://www.facebook.com/ransomestractionengine EIM

■ Further instalments of this rebuild will appear in EIM as Howard and Isaac make progress.

"The boiler is brand new and has never been fitted while the motion and tender are certainly much older, dirty and a little oily…"

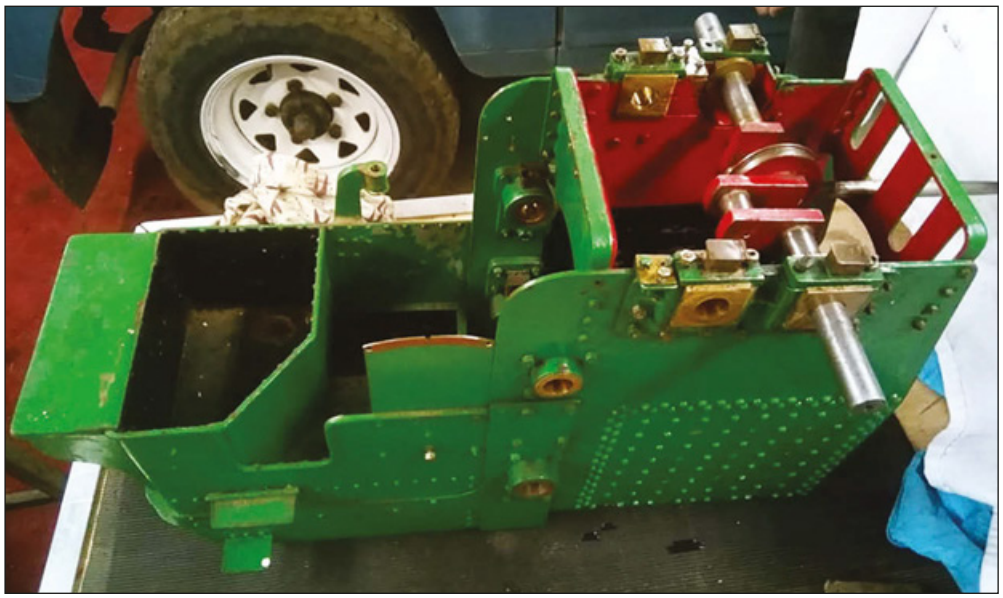




TOP RIGHT: Motion assembly in as-purchased state before work started.

RIGHT: Motion and flywheel will have grub-screw securing replaced by proper keyways.

BELOW: Off we go – motion stripped for the revival project to begin.



Result – all square...

Main frames that are precisely square to one another are crucial to ensuring trouble-free running of any locomotive and Alex has a way to ensure this happens.

BY **DR ALEX ELLIN**

Over the past few years, I have read in EIM about people rebuilding locomotives where the mainframes have been found to be out of true, or of those building new locomotives where this has been an issue. As having a sound set of mainframes is an important feature of any well-built engine and I have never seen anyone talk about how they hold the frames square to each other during initial assembly, I thought I would share my method with you.

A cut above

The first step on the way is to have a pair of mainframes that are identical to each other. We are all now used to paying many hundreds if not thousands of pounds for the castings to build our engines so I believe it is false economy not to make use of modern technology by buying a pair of laser-cut or water-jet cut frames to provide the best foundation for the rest of the engine.

I have to admit to using water-jet cutting as it is kinder to the material. Depending on the type of steel used, laser cutting can give rise to brittleness and sources of cracking in the heat-affected zone. Please note that I am not saying that laser-cut frames will crack but I have had experience of a coil of laser-cut steel strip that shattered (quite explosively!) and nearly took my nose off when I picked it up – the same thing never happened again once we changed the process and used water-jet cutting instead. As I am able to do my own CAD work and can get my frames water-jet cut, I do, but I happily accept very many model engineers have used laser-cut components without issue.

"It is amazing how rigid the frames feel with the stretchers in place and checking on a surface table I have not experienced any rocking..."

PHOTO 1: Alex's set of oversized frame stretchers await use on their next project.

FIGURE 1: The general arrangement of the stretchers.

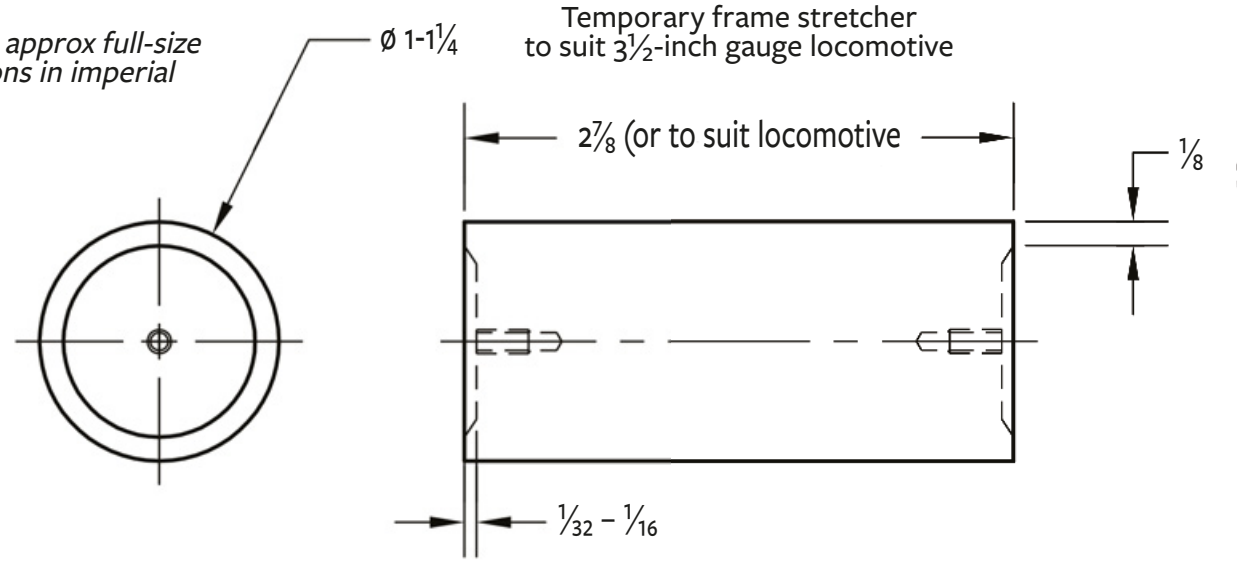
The next step is to make a couple of over-size frame stretchers that are as long as the space between the frames, but at least an inch in diameter – I find this to be big enough for the 2½-inch, 3½-inch and smaller 5-inch gauge engines I have built to date. For bigger ones where you have space, increasing the diameter to 2 inches could only be an advantage but the 1-inch bar fits nicely down the centre of my three-jaw chuck.

For longer engines you might consider making three stretchers rather than two but I have always used just two. Photo 1 shows a pair of stretchers for 2½-inch gauge made from 1¼-inch diameter aluminium, the pair for 3½-inch gauge were made from 1-inch diameter steel; both proved perfectly adequate in service.

The accompanying drawing shows a temporary stretcher to suit a typical 3½-inch gauge engine; you would obviously change the dimensions to suit yours.

FIGURE 1
Temporary frame stretcher to suit 3½-inch gauge locomotive

Drawing to approx full-size
Dimensions in imperial



When facing off the ends of the bar in the lathe, I undercut the ends by about 1/32-inch leaving a 1/8-inch wide land on the outside. I know most lathes have their cross-slides set up so they leave a square or very slightly concave surface on a faced end but the aim of this undercutting is to ensure that this stretcher bears squarely on the frame without any rocking.

The centre of the stretcher is drilled and tapped to suit convenient holes in the frames; for 2½-inch gauge, I have used 6BA and for 3½-inch gauge, 4BA is fine. Care is taken when facing to length to get this as accurate as practicable.

It is then a case of placing the two stretchers between two suitable pairs of holes in the frames. These could usefully be left close tolerance on the outside diameter of the bolt used but I have not found this to be necessary.

Photo 2 shows the stretchers fitted on the frames of the 3½-inch gauge GWR 43xx I am building at the moment to Don Young's design. It is amazing how rigid the frames feel with them in place and, when checking on a surface table, the lathe bed (if big enough!) or a sheet of thick plate glass, I have not experienced any rocking, even when first fitted. If you do, it can only be due to either a lack of concentricity of the drilled and tapped holes in the end of the bar (use a four-jaw chuck instead if you are worried) or slop in the fit of the bolts in the holes in the frames. In either case, slackening off the bolts and retightening them on the surface plate will cure the issue.

You can then fit the first of the locomotive's own frame stretchers or buffer beams. By fitting the first one in close proximity to one of the temporary stretchers, you can then move the latter down a long set of frames to provide support elsewhere. In this case, the first component I chose to fit was the rear drag box – this was fabricated from parts water-jet cut at the same time as the frames (**Photo 3**).

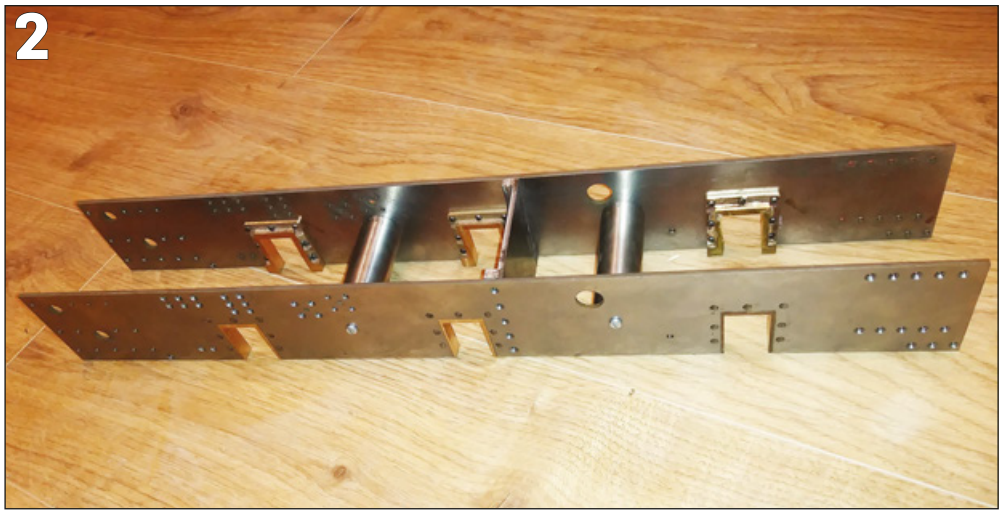
Multi-use tool

Although not originally intended, I have found the temporary stretchers to have another use. If you want to fabricate a component that fits across the frames, such as a plate frame stretcher with riveted on and then brazed flanges, you can place the temporary stretchers between two small pieces of plate (those shown in **Photo 4** are 3/16-inch thick) and then use this to ensure the correct positioning of these when drilling for the rivet holes.

You will notice that I fitted a couple of small clamping plates to mine to make it easier to hold everything in place whilst drilling. This saves having to use the frames for this purpose and, as you used the same stretchers when assembling the frames, these sub-components will end up the right width.

Once the mainframes are fully assembled, you can put the temporary stretchers in a drawer and forget about them. If you are anything like me – when you spot them in there at a later date when looking for something else, you just may be tempted to make a set of frames for another engine so they don't go to waste! **EIM**

■ Have you come up with a method or dodge that has saved you times in the workshop or added to the accuracy of your build project? Why not share it with your fellow readers? Contact **EIM** at the editorial address



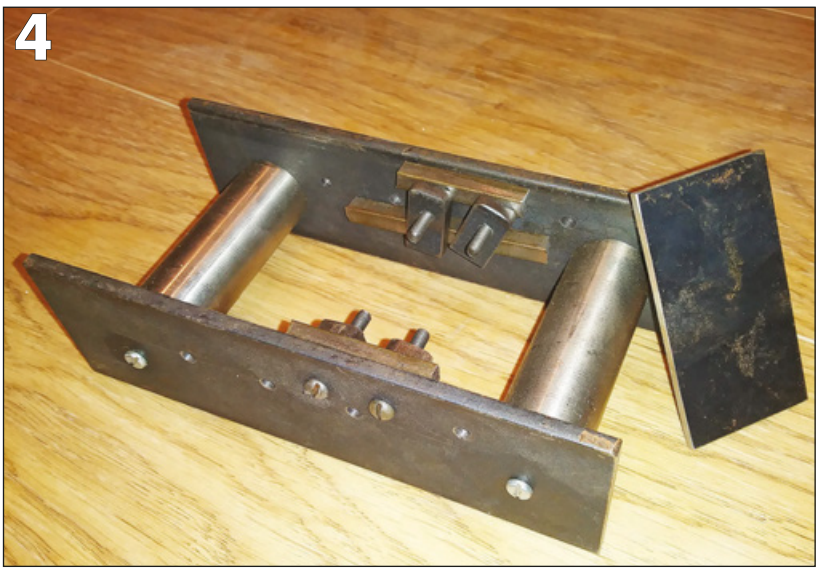


PHOTO 2: Two stretchers fitted to a 3½-inch gauge 43XX chassis.

PHOTO 3: Fitting parts with stretchers in place ensures squareness.

PHOTO 4: Stretchers also useful for fabricating components.

All photos and diagrams by the author

9-inch Foden lorry in build at North Bay

The ranks of large-scale road engine builders has a new entrant in the form of Darlington-based North Bay Railway Engineering, which is launching a 9-inch scale Foden steam lorry.

NBR was created in 2013 as a separate enterprise to the 20-inch gauge North Bay Railway at Scarborough. In 2017, the firm moved to Darlington to be at the centre of the town's rail heritage and until now has concentrated on new-build narrow gauge locomotives, new boilers for narrow gauge locos and large scale miniatures.

NBR is well-known for the variety of builds undertaken, including a 2ft gauge Decauville 0-4-0, a run of 'Sipat' Bagnall 0-4-0STs and new boilers for the 15-inch gauge Bure Valley Railway. Current projects include a 3ft gauge Sharp Stewart new-build loco for the Southwold Railway Trust.

The Foden is being built for sale in conjunction with large-scale model traction engine manufacturer AN Engineering – NBR is the recommended boiler manufacturer for AN's engines.

NBR's David Humphreys told **EIM** that between the two businesses, everything required for the steam wagon can be produced, from castings and a boiler through to completed engine units and gearing on the boiler ready to drop into a self-build chassis, or even a completed wagon.

Anyone interested in more details of the Foden wagon can contact David Humphreys at david@nbres.co.uk or by phone on 01325 778393

BELOW: Work is well underway on the chassis for the new wagon.

New owners take on historic Scarborough miniature line

As David Humphreys focuses on the continuing expansion of North Bay Railway Engineering Services (above) he has relinquished control of the 20-inch gauge miniature railway in Scarborough the engineering firm grew out of.

The new operators of the North Bay Railway are John Kerr and Peter Bryant, who already run the 15-inch gauge Cleethorpes Coast Light Railway.

The North Bay line opened in 1931 and had been run by Scarborough Council until 2006 when David Humphreys took it over.

The line operates a quartet of historic Hudswell Clarke steam-outline diesel hydraulic locos, all built in the early 1930s, and in recent years has added Bagnall 0-4-0ST 'Georgina' to its roster, one of the first locos built by NBR.

The new owners were in place for the opening of the line's 90th anniversary on 12th April. "The railway is an extremely important asset to the town and wider region," John Kerr commented.

"David has done a fantastic job of revitalising this attraction, we are looking forward to working with his dedicated team to further this – we can't wait to take the railway to its centenary and beyond".

While retiring from the line that he has extensively upgraded in recent years, David will remain at the helm, with business partner Mark Ashton, of NBR.

John Kerr and Peter Grant have taken over running the North Bay line from David Humphreys (right) *Photo: NBR*

Midlands show set to go ahead in October

The news we all hoped for has been announced – the Midlands Model Engineering Exhibition will be back in its traditional slot this October.

Cancelled like just about everything else in 2020 by the Covid pandemic, the show is set to be held between Thursday 14th and Sunday 17th October at its usual venue of the Warwickshire Exhibition Centre near Leamington Spa.

Now in its 44th year and sponsored by **Engineering in Miniature**, the show is described as one of the largest on the UK model engineering scene. Organiser Meridienne Exhibitions promises all of the traditional favourite aspects of the show, including more than 50 specialist model engineering suppliers in the hall.

Competition prizes

The model engineering competition is also a central part of the event and entries are being sought for the 16 competitive classes, in which prizes are awarded to the winners, and also for 16 display classes enabling builders to display their work to their fellow enthusiasts.

More details of the show will be released closer to the event and **EIM** will include the usual four-page pull-out guide to the show in our October issue – obviously the event going ahead depends on continuing improvements in the Covid situation but all the evidence suggests this time we won't be missing out.

With all of the major gatherings, including Merideienne's sister event in London and the Doncaster National having fallen victim over the past year, we reckon many readers will be counting the days to the opening of this exhibition.

Full details of the show, and advance ticket booking facilities, will be added to the official website in due course – www.midlandsmodelengineering.co.uk

Big traction engines played a role in the last Midlands show in 2019. *Photo: Andrew Charman*

Enthusiasts of all ages top the class

I have been reading the May issue of **EIM** with great interest, especially on the subject of breaking the age barrier and encouraging youngsters to take up our brilliant hobby. The Top Field Light Railway (*a 7¼-inch gauge line in Norfolk – Ed*) is a prime example of this.

We are by comparison a fairly new club, having been established in 2016. A majority of the group are all below the age of 30, myself included. We have a collective average age of around 25, with the oldest three members in their late '60s and early '70s.

We strive to be an active club, working hard to build our railway, learning many of the skills needed to carry out a wide variety of jobs. The older members are an invaluable source of knowledge and skill. I believe we are lucky with the members we have, as they have realised how important it is to pass on these skills to the younger generation and novice members.

The club's managing committee decided early on to use social media as a suitable platform to attract a wider audience, both those interested in model engineering and those who appreciate it but do not necessarily understand what it's all about. You can find us on Facebook and we also have a separate private page for members only. We also took the opportunity last year to launch our website www.tflrailway.co.uk. Please take a look.

We operate on the first Sunday of every month from April to October, plus we run additional special events throughout the year. Our most interesting event is the miniature mayhem gala, where we run every available steam, diesel and battery electric loco. It is truly mayhem on a grand scale.

To supplement our day-to-day site operations, we also have our own portable track. This can be taken to events all over the local Norfolk area. It's an income which greatly boosts the club's annual income and something we realised we needed early on.

Our club goes from strength to strength and it's something we wish to share with you and fellow readers of the magazine.

Rob Ewles, *Chairman, Top Field Light Railway*

The editor replies: Always delighted to receive letters like this – a successful operation made so by model engineers of all ages. Rob has invited Harry and myself to the Top Field Light Railway and we look forward to visiting as soon as we are able.

Model engineering subject to raise or question to ask? Send letters to 12 Maes Gwyn, Llanfair Caereinion, Powys, SY21 0BD or by email to andrew.charman@warnersgroup.co.uk

The Top Field Light Railway encourages enthusiasts of all ages. *Photo: TFLR*

Young engineers need protection too...

May I add a few thoughts to the age discussion? Over the years I have had the good fortune to meet with several youngsters who have shown promise in our hobby. The fact that with maturity the rival claims of career, education and romantic distractions led them away from the hobby is disappointing, but one can only live in hopes that in later life the old mechanical fascination returns and we can welcome them back into our ranks.

I feel that most recruits join via the club movement, and here lies a first possible stumbling block; that of the grumpy old man who wants nothing to do with kids around the facility. Unless they can be persuaded to accept the need for young blood then any recruiting drive could well end in failure and disillusionment from the would be recruit.

Yes some come via Dad, granddad or a friendly uncle, and often stay the course.

Many clubs have a cadre of members willing to accept and encourage youngsters, even to accept some responsibility for training in all aspects of the hobby. Others regard youngsters as an imposition!

I firmly believe, however, that there is a darker aspect of encouraging youngsters. We should be aware that this scenario is possible. In the course of my active time in the hobby, I held perhaps a unique position, an ex-copper with a second career as magazine editor. Over several years in that post I had on several occasions to reply to questions about the behaviour of a club member who showed too much interest in helping certain youngsters on and off trains during running sessions and in some cases wanted to develop a more than healthy interest in the training of a young member. Each time a tactful warning from an officer of the club involved, brought such practices to a conclusion, often with the member moving to other interests not connected with the hobby.

My worry is that if such individuals do not get noticed and eventually get in trouble with the authorities that our hobby could, by association, come in for criticism, maybe in knee jerk reaction form some local authorities losing their premises as a result of the act of one individual.

I am aware that such are isolated incidents, but would urge that clubs inviting junior membership or operating public services are aware of the dangers.

The other thing which increasingly worries me is that I do not recall any more than a handful of members of ethnic minorities as members of clubs. In the present climate maybe a small recruiting effort in this direction would prove fruitful, as a group we do not want any slur of racism levelled on the hobby.

I am not advocating witch hunts through the hobby, but as a rule of thumb I would regard any member who point blank refused a 'CRB' check or its modern equivalent as being worth more than casual attention.

My only wish is that the hobby continues in good heart for many years to come, giving joy to any who come in contact with the movement.

Ted Jolliffe

The editor replies: While many readers might not enjoy reading this letter, Ted does make some valid points. However they should be seen as sensible advice – and not as a reason for clubs not to bother making any efforts to recruit younger members. Such new blood, the next-generation model engineer, is essential to ensure the hobby we all enjoy will have a future.

Dates for the diary

Trains running again, tracks awakening, more events announced, we're getting there....

COMPILED BY **ANDREW CHARMAN**

Opening the *Club News* pages last month I reported a sense of growing optimism on the club scene and I get the impression that has accelerated over the past month – I'm delighted to post at the top of this first page a locomotive in steam on a club track, as caught by **EIM** correspondent Bill Edmondson on a visit to **Westland & Yeovil District ME** on 29th April.

Definitely adding greatly to the optimism is the announcement of more events that will happen this year, not least the Midlands Model Engineering Exhibition as detailed on page 38 – it seems so long since we last went to a show! We are still not quite at the stage which will see the diary page restored to **EIM** but hopefully we are not too far away. We did notice that the editor of the **Bradford ME**'s monthly *Bulletin* expects to resume the club's 'Dates for the Diary' in the July issue – hopefully by then we will be doing the same...

Rob Roy rides again

Another event that does look set to happen in 2021 is the Rob Roy Rally. Rex Hanman has been in touch to let us know that the event that he founded should be going ahead in September at the **Bromsgrove SME**.

"A decade ago, to celebrate the 50th anniversary of Martin Evan's Rob Roy design, I organised a rally of this delightful little locomotive at the Andover ME in Hampshire," Rex told **EIM**, adding that the rally turned into a pleasant annual event attracting a number of finished and part-built models, one even coming from as far away as New Zealand.

ABOVE: Bob Liddle enjoyed being back on his 3½-inch gauge LNER A2 'Blue Peter' at the Westland & Yeovil District ME on 29th April. *Photo: Bill Edmondson*

BELOW: Much variety at a past Rob Roy Rally – the event goes ahead this year. *Photo: Rex Hanman*

"A couple of years ago the Bromsgrove SME expressed a wish to hold the rally at their club but this was scuppered by the pandemic. I have now heard from my Bromsgrove contact that they plan to hold the rally on Saturday 11th September."

Anyone wanting to get involved in the event can contact Rex on 01980 846815 or at hanmanr@yahoo.com, Ian Horsfield on 01386 792628, meadowsend03@btinternet.com or Bromsgrove chairman Peter Maybury on 0121 453 3691 or at peter.maybury@outlook.com

The Bromsgrove track site is at the Avoncroft Museum of Historic Buildings (B60 4JR) – more details are on the website at bromsgrovesme.co.uk

Talking of dates – in the April issue we mentioned the Sweet Pea Rally being planned at the **Hereford SME**, and that it had been put back until August. Well the date of the gathering for fans of the popular narrow gauge design has now been confirmed as 21st-22nd August and **EIM** correspondent John Arrowsmith remains the contact for all those wanting to take part. However John is now on a new email address – johnarrowsmith678@gmail.com

An even more bumper selection of club newsletters and magazines than usual have arrived at **EIM** Towers this month and we are grateful for them

News from the Southern Fed

The Southern Federation of Model engineering Societies held its AGM on 13th March – the now ubiquitous Zoom application enabled a good attendance from members from all around the country. The Secretary, Peter Squire, masterminded the meeting processes to great effect and presentations, questions and polling went smoothly.

The meeting noted the recent retirement through ill health of the Federation's IT manager and Treasurer, Dr Martin Baker, and the subsequent election of Peter returning to the Secretary role, and of David Goyder adding the Treasurer role to his editorship of the newsletter. Martin is continuing to support the current web systems during a transition period for reasons highlighted below.

Also noted was the retirement of Mike Chrisp as Vice-Chairman, although he was asked to become Vice-President alongside Ivan Hurst! This he agreed to, and he will continue to support and mentor activities that he has 'fathered' such as the young engineers awards. The role of Vice-Chairman now falls to Paul Naylor to add to his role as Membership Secretary.

In addition to the usual reports on activities for the past year, the Board proposed a seconded resolution to change the name of the company to 'Federation of Model Engineering Societies' (*as briefly mentioned in last month's issue – Ed*), and this was accepted by the required number of votes in support.

The dropping of the word 'Southern' in the title is a response to the feedback from attendees at last year's AGM and strategy workshop and reflects the national spread of the affiliated member clubs. This will be implemented formally as soon as possible, and the paperwork (letter headings, name change on certificates and such) will catch up later.

Note that all commitments made by SFMES will be maintained by FMES, so, for example, a boiler certificate issued with the SFMES name will be valid after the name change. FMES looks forward to continuing to liaise with Northern Association of Model Engineers and the 7¼" Gauge Society and others as before in the support of our hobby.

This development of new web systems is also a response to the strategy workshop, and SFMES sees it as a key enabler to improve and enhance services for the future. Commercial contractors are working on this remit now and this ultimately will provide less reliance on volunteers to manage ICT systems and give them more time and the tools they need to do the things that they want to do to enhance our hobby.

Bob Polley, Hon Chairman

Mission control! This picture courtesy of the SFMES clearly shows the logistics of holding an AGM in the post Covid age of Zoom...

all. As I've said before please accept our apologies if your particular club doesn't get a mention – to adequately cover all the variety and quality of the club scene highlighted in the journals, we'd have to turn an entire issue over to club news, and I think I might get into trouble if I did that... Please keep sending them in, the journals provide us with a whole lot of information on the club scene helping us to produce a better magazine for you all.

One group which we have seldom mentioned before is the **Crowborough Locomotive Society**. Writing in the latest edition of the club journal editor John Wood expresses the thoughts of many when he says that he hopes this will be the last edition recording the absence of any CLS running.

Let's get to work

Judging by the comments of chairman Charles Marks the Sussex-based club has much to look forward to, Charles commenting that "thanks to the herculean efforts of members," the CLS now has an extended track of about 800 metres length with bridges and viaducts, five steaming bays, two carriage sheds, a signal box and signalling system and more. Charles adds that now the infrastructure is there it must be maintained, and looks forward to the work days that resumed on 7th April. I'm sure many other clubs are doing the same.

The Crowborough newsletter also includes some pictures recalling the club's early days from its formation in 1989, including the arrival of the clubhouse – this having formerly seen service as a British Railways closed goods wagon! Now that's what you call provenance...

One club never knowingly not busy is of course the **Rugby ME** and the latest newsletter is full of pictures showing a whole host of maintenance and improvement activities going on at the club's Onley Lane site, from building a new girder bridge to relaying the track in the old station, and working on several locomotives. Perhaps the best picture, however, is reproduced above, showing the first pre-season boiler tests underway in the newly pressure-cleaned steam-up area. Pre-season tests mean that we are set to have a season...

The latest edition of *Leeds Lines* from **Leeds SME** includes on its cover the somewhat blunt end of a Class 20 diesel, rather nicely modelled in Gauge 1 by member Steve Russell. Within the newsletter Leeds chairman Jack Salter reports how his GP called him in for a check-up and was surprised how much weight he had lost during lockdown – the opposite to most people. Jack writes this just above a picture of him digging an inspection pit in his workshop, just about the deepest pit for model engineering purposes this editor has seen! Model engineering, good for the health, and diets...

Online upgrade

Leeds SME is of course waiting to hear exactly when it can return to its former site at Eggborough power station – progress is steady, but is being made. Meanwhile member Peter Smith has created a new website for the club. Have a look at https://www.leedsmodelengineers.org.uk – it's impressive, including Youtube videos and an enjoyable photo gallery.

The latest edition of the **Chingford ME**'s highly frequent newsletter imparts some sad news with the passing of two of the club's honorary members. Councillor Chris ▶

"One in yellow, one in green, one in blue and one in red. No chance crewing the wrong train at this club..."

Robbins, the Mayor of Waltham Forest was made an honorary member in 2015 after helping to secure both a pavilion for the club's workshop and then a £60,000 grant to convert it into a workshop and public toilets. And Iris Phelps maintained the club's grounds for many years after first attending with her husband Norman, as well as being a regular guard and electric driver.

Better news from the Chingford newsletter is a reopening date, the club getting permission from the local council to start running trains from 2nd May, subject to all the usual Covid protocols being followed. Hopefully by the time you read these words not only Chingford but clubs up and down the country will be back into a usual routine.

Some clubs won't be restarting straight away of course – in the latest edition of the **Grimsby & Cleethorpes ME** newsletter *The Blower,* chairman Geoff Morgan predicts a likely public running resumption date in June, which will at least give the club an opportunity to observe how other railways and 'fairground-type' attractions operate in a Covid-safe manner, so the club can determine what level of safety measures it may need to introduce.

It's easy to forget that coming out of the pandemic many clubs are in very unknown territory, having to consider such matters as, for example, taking card payments only.

And of course as so many people celebrate increasing post-pandemic freedoms, it's equally easy to forget that many, including the Grimsby chairman, have been continuing to self-isolate to either protect vulnerable family members or due to underlying health concerns. For such people a return to normality might not seem quite so close...

Stylish sim

One of the pleasures of the various journals is the variety, coming in literally from across the globe. The latest *Workbench* from the **Durban SME** in South Africa features on its cover what at first appears to be a highly attractive three-dimensional map of the club's track and its surroundings, in a style guaranteed to attract visitors.

In fact, however, it's much more, a 'still' from a computer simulation program being created by Durban member Mike Thorne. Mike has been working for more than 50 years in illustration, cartoons and since 2000 in 3D animation and modelling.

He hit on the idea of a train simulator in early 2020 and has been working on the project ever since. The sim is based around fellow member Errol Koch's Avonside loco, centrepiece of a fully interactive program which will allow users to carry out all aspects of handling a model steam loco, right from unloading it from a pick-up truck!

Mike hopes the sim will help the Durban SME – like many others the club has suffered greatly from Covid, closed throughout 2020 and sadly losing one of its new members to the virus in February this year.

Mike thinks this might be a global first for a model engineering society and certainly we haven't heard of anything similar – it's without doubt an excellent modern way to promote clubs to today's audiences. He also sent us a short youtube video (https://youtu.be/r8NdCPIV_Ks) he's produced to promote the club's children's parties. Not for the purists but again an excellent bang up-to-date piece of promotion – an excellent

RIGHT AND BELOW: Mike Thorne's impressive artwork for the Durban SME is actually part of an extensive simulation program he's developing and which is doing much to promote the South African club.

example of a club making use of the skills amongst its membership.

Continuing the global reach of our club news, the latest edition of the newsletter from the **Model & Experimental Engineers Auckland** reports on a recent meeting, held at the home of one of the members, New Zealand unencumbered by general lockdowns. Apparently 13 members were present and judging by the selection of pictures in the newsletter, they are a busy group producing top-quality model engineering, from electric clocks to locomotive components and "queer electronic devices" (That's a direct quote from the newsletter!).

Clubs meeting at the homes of their members works very well, especially for smaller groups, once lockdowns are past us and we are allowed to again of course. The still young **Cambrian ME** met this way until Covid intervened, and members have since kept in touch by a round-robin email system with weekly updates. Now thoughts are turning again to resuming face-to-face meetings, which is a good thing. The club counts your editor among its membership though compiling this magazine and its sister *Narrow Gauge World* means I seldom can contribute much – hopefully that will change in due course!

Back in South Africa, they clearly go in for a lot of colour – a picture of bodies for new driving cars delivered to the **Centurion SME** and printed in the club's *Centurion Smokebox* newsletter, shows the quartet all neatly painted – one in yellow, one in green, one in blue and one in red! No chance crewing the wrong train at this club...

Award-winning Downs

Coming back closer to home, congratulations are definitely in order for the youngsters involved with the 9½-inch gauge **Downs Light Railway** at the Downs School in Malvern – in April they were named winners of the Small Groups category in the highly prestigious Heritage Railway Association annual awards.

Now while some readers might not consider this historic line, which we featured in the May 2019 issue shortly after its 90th anniversary, as a club, to all intents and purposes it is. The line is operated by a Trust with the pupils at the school playing central roles in maintaining and operating it just like any other club. The line does a great deal to interest youngsters in miniature railways and allied model engineering subjects, and any regular reader of **EIM** will know we are great advocates of anything encouraging the young into our vocation.

The most recent newsletter from the **Ryedale SME** includes an interesting piece from former **EIM** contributor Doug Hewson on 'working the pick-up goods' describing how when main line rallies are held at the club's Gilling track, long goods trains are run with rakes of finely made freight stock, 10 wagons and of course the brake van, all worked to the proper regulations. It sounds highly complex, including swapping wagons about at various halts along one's journey, but also a lot of involving fun...

Oh look, we've run out of pages again. That's your lot for this month – more from the rapidly reviving club scene next time. We thought we'd finish this month's selection with another of Bill Edmondson's pictures from Westland & Yeovil, of Mike Watson' 5-inch gauge 'Britannia' blowing down after a successful day.

We are very much on the way back to normal – and if your club is back in action, we'd really like to see some pictures to brighten up next month's *Club News* pages – send them to the address on page 3... **EIM**

ABOVE: The youngsters running the Downs Light Railway, seen here in 2019, are the very worthy recipients of the Heritage Railway Association Small Groups award. *Photo: Andrew Charman*

BELOW: More from Westland & Yeovil – Mike Watson's 5-inch gauge 'Britannia' blows down after its run. *Photo: Bill Edmondson*

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 (Don't forget your contact info...)

■ We've been contacted by a Mrs Ford, whose husband, a model engineer, sadly recently passed away. Mrs Ford tells us she has around 100 issues of **Engineering in Miniature** going back to 1994, and issues of *Model Engineer* stretching back to the 1950s. She is not looking to sell them but does want them to go to a good home where they will be of benefit to someone.

If any **EIM** reader is interested Mrs Ford can be contacted on 01453 825171. The magazines would need to be collected from Gloucestershire.

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SUBJECT INDEX

Index covers **EIM** volume 42 nos 1 to 12, July 2020 to June 2021. Feature listed with month of publication followed by page – for example Aug 33 means August 2020 issue, page 33. Digital copies of previous issues can be downloaded or printed versions ordered from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature/ or by telephoning 01778 392484.

AUTHOR INDEX

QUICK GUIDE

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**We keep a large, constantly-changing stock of second-hand engines in all scales and gauges.
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7 1/4 INCH GAUGE LNER A4 "SIR NIGEL GRESLEY"

A 7 1/4 inch gauge LNER B1; built to Martin Evans' "Roedeer" design the engine is in "ex-works" condition, unsteamed from new.

The work of a highly experienced engineer who built more than twenty locomotives over a forty year period - often working on two or more models at once, the B1 was one of the last on his bench, along with a fine 7 1/4 inch gauge Liverpool & Manchester "Lion" and well-advanced Britannia.

The engine has been built to a good standard throughout - fit and finish of the motionwork and valve gear is excellent, links are bronze-bushed and secured with pinned castellated nuts.

The copper boiler is a commercially built job by Kingswood, supplied new in 2001 and silver soldered throughout, complete with original manufacturer's test certificate. Since arriving with us the boiler has had a repeat hydraulic test at 150psi for 100psi working pressure, with new certification issued. **ref 9288 £24,500**

5 INCH GAUGE LIVERPOOL & MANCHESTER RAILWAY "LION"

A well-built 5 inch gauge Liverpool & Manchester Railway "Lion", to LBSC's "Titfield Thunderbolt" design.

The work of a highly experienced builder, with more than twenty locomotives to his credit over a forty year building career, he went on to build a 7 1/4 inch gauge version of the same design which we sold last year.

The engine steams freely and runs well, with recent boiler test. **ref 9289 £4,250**

5 INCH GAUGE GWR 57XX 0-6-0PT

GWR Pannier tank to LBSC's "Pansy" design, a well-built engine with commercial boiler by Morewood.

Built very much as a club running engine, we like the workmanlike layout of the backhead, clearly visible sight feeder for the cylinder lubricator and easy to use knurled "cool grip" valve handwheels.

It steams freely and runs well, with clear, well-defined exhaust beats (and a very nice whistle!). Crosshead and hand pumps draw water from the pannier tank, the injector is piped to take water from a tank on a driving truck. **ref 9473 £4,650**

5 INCH GAUGE MIDLAND 4-4-0

A particularly well-built 5 inch gauge model of a Midland 4-4-0, the work of a talented and highly prolific engineer—we've sold several of his engines in the past, including a superb La France steam fire engine and 5 inch gauge Caledonian 2-4-0.

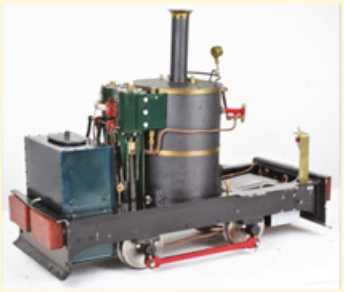
Completed in 1997, paintwork is on the bright side of "working clothes", however the engine remains in fine mechanical condition and runs beautifully, with sharply defined, square exhaust beats.

The copper silver soldered combustion chamber boiler is fitted with four superheaters, the chassis runs near silently, notching up close to mid gear in either direction **ref 9412 £6,950**

5 INCH GAUGE "POLLY II" PROJECT

The engine has been the subject of recent work and a repaint, the owner ran it on air in his workshop although the current lockdown prevented venturing out to the club.

We've hydraulic tested the boiler and issued new certification for same. In running order, however the engine needs a variety of jobs doing, including reseating a clack valve, regulator gland packing, drain cocks and tender water valves which don't shut off effectively. **ref 9444 £2,950**



5 INCH GAUGE "COFFEE POT" PROJECT

A 5 inch gauge vertical boiler locomotive, powered by a twin cylinder vertical engine with slide valves actuated by Stephenson's gear. The silver soldered copper boiler has had a crudely executed gas conversion, with the burner apparently held in with some fencing wire. Boiler feed is by hand pump and an electric pump powered by a small dry-fit battery - looks and sounds like the sort of thing you'd find in a coffee maker. **ref 9424 £2,350**

5 INCH GAUGE BR 9F "EVENING STAR" PROJECT

A 5 inch gauge kit-built BR 9F 2-10-0, largely complete although with some pipework dismantled and the pressure gauge missing.

Silver soldered copper boiler, 100psi working pressure, feed by twin injectors, axle pump and hand pump in tender. Rolls along freely, a previous owner has fitted some replacement parts including nice quality top feed clacks. **ref 9261 £5,950**

We are always interested in acquiring engines of the type that we sell. If you know of a steam engine for sale, in absolutely any condition, please let us know. Engines bought outright, or we are happy to take them on a commission sale basis, or pay you a finder's fee if you put us in touch with an engine which we later purchase. All engines listed are on our premises, available for inspection by appointment. Please do contact us, even if all you have is a rumour of an engine being available!

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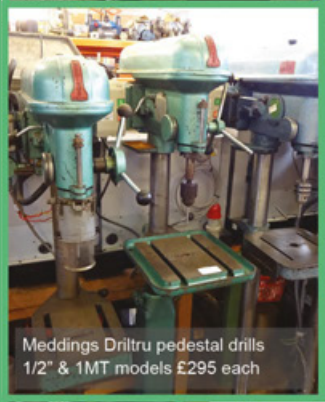
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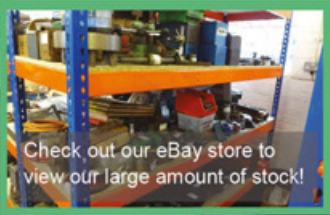
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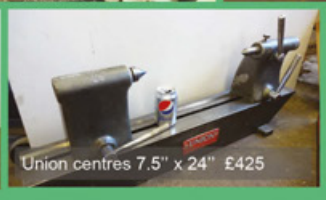
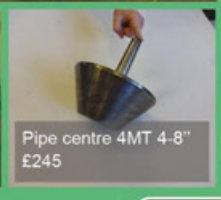

Union centres 7.5" x 24" £425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