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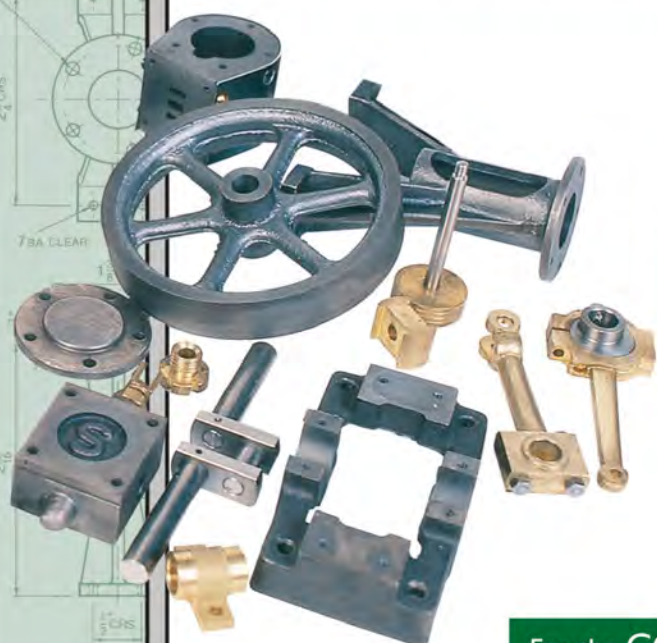
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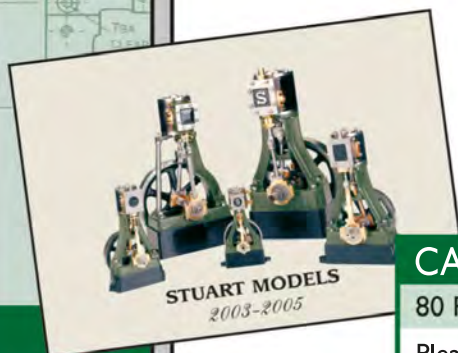
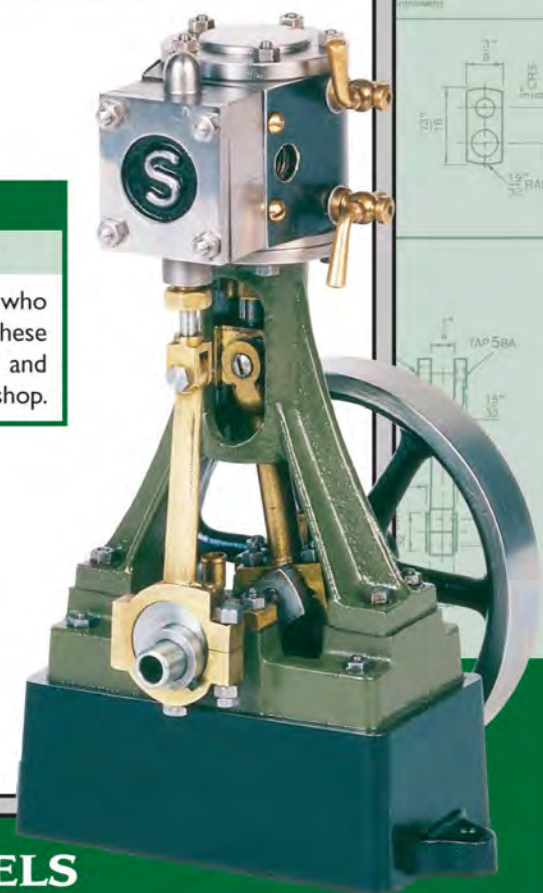
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CONTENTS

JUNE 2017 Volume 38 Number 12



EDITORIAL

7 THE SPALDING MODEL ENGINEERING EXHIBITION 2017

By DAG Brown

9 BUILDING THE LNWR COAL ENGINE IN 5" GAUGE

By Hotspur

13 THE KEMPTON STEAM MUSEUM

By Mark Smithers

16 A VISIT TO THE PIMLICO LIGHT RAILWAY

By Martin Evans

18 THE ATKINSON STEAM WAGON

By Graham Sadler

22 THE EIM STEAM PLANT – THE ENGINE – PART 7

By Martin Gearing

24 PRODUCT REVIEW

By Graham Sadler

25 HOLES AND MORE HOLES

By Don Ashton

26 HOME WORKSHOP LIGHTING

By Mike Haughton

29 MORE CONVERTIBLE ROLLING STOCK

By Jan-Eric Nyström

33 BUILDING A PANTHER TANK

By Chris Meyer

37 CLUB NEWSROUND

By John Arrowsmith

39 YOUNG ENGINEERS

By John Arrowsmith

40 DIARY OF EVENTS

By John Arrowsmith

41 INDEX FOR VOLUME 38

FRONT COVER

Jack Colby arrives at the Pimlico Light Railway station in charge of Chris Orchard's Simplex.
Photograph: Martin Evans

SPRING IS SPRUNG

As I write this, it is April and it seems that spring is well and truly sprung. Leaves and blossom have erupted from the trees and there are green shoots everywhere – which means that I need to go out and buy more weedkiller.

There's more heat and more light too, which means that my 5" gauge garden railway project – put to bed for the winter – can now be woken up and some serious progress made. The winter has been spent (whenever possible) making up track panels, points, signals, buffer stops and other paraphernalia and now the time has come to emerge from the nice warm workshop and install these onto the track bed which was laid down during the autumn.

As you read this, of course, it is May or June and the running season is well under way. The length of our diary page correlates directly with the seasons and it is now a full page long. This gives you a wonderful choice of rallies and steam-ups to go to.

SWEET PEA RALLY

This year's Sweet Pea rally will be held at the Rugby MES on the 10th/11th of June. Booking is required and more details are available at www.rugbymes.co.uk

GUILDFORD MODEL RALLY AND EXHIBITION

This popular steam rally will be held at Stoke Park, Guildford on the weekend of the 1st/2nd of July. The rally is open from 10am to 5pm each day and further details are available on the society's website at www.gmes.org.uk

MIDLANDS FEDERATION RALLY

This year the Midland Federation annual rally will be held at the Burton-on-Trent Model Engineering Society's track in Burton-on-Trent on Sunday June 11th. The address is Meadow Road, which is the only turning off the old Burton bridge (A511) and the postcode for satnav users is DE14 1TD. The last time this rally was held 21 locomotives attended. I am told that this simply proves what a friendly society they are and I am also informed that their catering is pretty good too.

The rally will start around 10am and run throughout the day. They have 3.5" and 5" rails on the raised level track and 5" and 7.25" on the ground level track.

For further information you can contact Keith Bloor (Chairman) on 01283 214542 or k.bloor2@btinternet.com, David Elliott (Secretary) on 01283 515526 or secretary.burtonmes@gmail.com or Barrie Wilkinson (Treasurer) on 01543 480340 or bwilkinson44@tiscali.co.uk. Please bring a copy of your club's insurance certificate.

Everyone is invited, so why not go along and get in some good running time!

Martin Evans
Editor

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The Spalding Model Engineering Exhibition 2017

DAG Brown pops over for a wander around the Spalding show

BY DAG BROWN

This year was the fourth consecutive occasion for the Webster family to stage the Spalding Model Engineering Exhibition at Springfields event centre in this fenland town; for those unfamiliar with Spalding, it is noted for bulb growing, in an area of fertile flat land where you can see for miles in all directions; you might be forgiven for thinking that English is the second language in the rich agricultural area; its flatness is perhaps epitomised by the name of a local high spot – Gedney Hill – which has a trig. point 13ft above sea level. Don't be put off, though; interesting things happen there and the exhibition was no exception.

Support for the show was noticeably greater this year with more club stands, more traders with real model making interest and some innovative initiatives, one of which will be highlighted in this article. Outside there was an excellent presence of steam road vehicles, as well as the ubiquitous portable track selling rides and some other activities especially tailored to appeal to the younger generation. So there was something for all ages, backed up by good parking facilities and catering provision.

ABOVE

The gauge 1 running track, which dominated the centre of the hall.

CLUB STANDS

Inevitably the location invites the attendance of relatively local societies and these included Lincoln, Peterborough, Saracen's Head (Boston), Melton Mowbray, North Norfolk, as well as the local area Gauge 1 group and the Model Wheelwrights. The SMEE was involved jointly with CNC4U, their digital group giving software support to a self-assembled CNC machining system, and there was a good presence of model boat clubs and aero modelling. So, all round a balanced exhibition presented the hobby in a good light. Keeping up with what we have learnt to expect in modern exhibitions there was a sub hall (in tented accommodation adjoining) devoted to radio controlled lorries performing impossible tasks which no doubt transfixed some younger people and provided a balanced interest. The list is not exhaustive but is considerably greater than in previous years.

A BROAD SCOPE OF INTERESTS

It was good to see a developing section of display models, not linked to the societies. These were varied in content and generally of good, traditional model engineering subjects.

As well as the display models there were some good trade stands; mercifully the candyfloss and rubbish merchants had not been lured to make up numbers. This year saw JB Tools for instance, CMD, MJ Engineering, Power Capacitors and the Craft Light Company sitting alongside Walker Midgley, whose presence at the major shows is always reassuring. These are the building blocks for future occasions and it is to be hoped that the trade base will be consolidated in future years. This year's contingent was significantly stronger than those in previous years.

A LINK WITH EDUCATION

The organisers promoted a link with schools to foster interest from the younger generation. This led to an ingenious competition which was promoted among a number of fairly local secondary schools, aimed at the design technology module of the curriculum. Seeding the idea within a radius of about twenty miles, in the event two establishments, both boys' grammar schools, rose to the challenge, the rest turning down the offer not through apathy but mainly because of other constraints within the tight time scale of three months. The project was executed during extra-

curricular time and by coincidence in both cases involved about a dozen boys, six or seven being the ones who really executed the task. Here was the challenge: 'Given the free provision of a bogie and a rigid wheelset, to build a velocipede which, under pupil power, would traverse a 50m length of 7¼" gauge level track in both directions without derailling'. By some quirk of chance I was asked to be the judge of the competition, a task which I found to be both interesting and challenging. The following words accord with my thoughts on the occasion and the good natured spirit of the contest.

The boys were all well engaged with the project and showed a level of interest and commitment which is not always attributed to people of their age, which is 11 to 14 years.

I was impressed by their attentiveness, articulate natures and their willingness to communicate with me in particular, as a complete stranger of a different generation.

The two schools had very different ranges of facilities: Boston Grammar School is aimed very much at design and consequently their realisation centres around wood and plastic materials. Consequently they were somewhat limited in metalworking equipment but, under their DT master, compensated well and executed the task making use of mainly wooden components to augment the free issue components.

Spalding Grammar School on the other hand have some quite good metalworking facilities and a DT master who is heavily into bicycles! They are into machining and welding.

Having examined the work and interviewed the teams my conclusion was that both were equally worthy of recognition and so, in a dead heat, each school received a year's subscription to *Engineering in Miniature* from the publishers, Messrs Warner Publications.

GENERAL DISPLAY MODELS

Not attributable to any of the clubs, the display models made a widely based collection which, although not of really outstanding class in the widest sense of the word, nevertheless well represented the work of competent model engineers. A hand shaper by Paul Arch perhaps reflects what is almost a forgotten art: these days we are so used to vertical milling machines and throw-away tooling that it is hard to remember that before the 1960s the shaping machine was de rigueur in a model engineer's workshop and the hand powered machine ruled the roost in the days before ready availability of electric motors. Never forget that such technology reminds you immediately how well the tool is sharpened and what is meant by a heavy cut!

A nicely finished Centaur gas engine by Frank Boyle was to a design once popular in many places, again echoing the days before the ready availability of electric power.

CLUB DISPLAYS

As mentioned above the club presence was good and came from as far away as Derby, Wolverhampton and Hull. It is difficult to select a typical representative cross section of the models, so I have picked one or two which illustrate the hobby.

On the Melton Mowbray stand Alan Boyle's 7¼" gauge model of a BR class 2 2-6-0 had been finished by the owner (no relation to the previous exhibitor of the same name I believe), from a former builder's work. Presented on a rolling road, it was easily the biggest exhibit on the Melton club's stand and was tastefully accessible for inspection.

Not that far away from Spalding the Saracen's Head Society is a little group who produced some interesting work, of which I have selected two notable examples: Hunslet locomotive 'Holy War' was the work of Julian Smith and is a typical example of the class, modelled as working on the lower galleries of the Dinorwig

quarries without any cab protection. From the general appearance I don't think it has yet been run.

The other Saracen's head offering is a masterpiece in miniature: a Cirrus V8 aero engine built by Paul Thompson, exhibiting some intricate machining in aluminium alloy and displayed with the sump separated to show off the intricate interior workings.

Peterborough Society had a varied content on their stand, from locomotives to traction engines, boats and tooling. As an example of the latter, Mike Pinnegar showed a varied selection of workshop tooling for doing all those awkward jobs you wish you had a thingummy jig for.

The centre of the main hall was dominated by the gauge 1 running track. I always enjoy watching the teamwork in assembling this track from its lay-flat state. It is always a crowd pulling attraction and this time I have no hesitation in illustrating a view of the yard, rather than one of the trains going round. Since most of them are steam driven, considerable attention goes into their preparation and it looks here as though Flying Scotsman is just getting steam up, while an engine is being coaxed off its train by an out-of-scale human.

The overall impression was that the show was a success, well worth repeating next year. ■



ABOVE

Frank Boyle's rather handsome Centaur gas engine.



LEFT

Spalding Grammar School demonstrated their competition velocipede at the show.

RIGHT

Boston Grammar School approached the velocipede challenge from quite a different direction. Both entries were considered worthy of the prize and so a draw was declared.



Building the LNWR Coal Engine in 5" Gauge

Hotspur describes the linkage between the brake cylinder and the hanger pull rods.

PART 16 – CONTINUED FROM PAGE 37 MAY 2017

MORE ON THE SPECIFICATION

I had always expected that the opening under the dragbox assembly would house the brake cylinder but, in arranging the support brackets, I had to take account of how the lubricator would be installed and where any mountings would be placed to take the pipework connections from the tender. It will be realised that the length of the chassis beyond the rear coupled axle is very short so I did not want any of these additions to be very obvious from a side view at the rear of the engine. When readers see what I have done, some builders may not agree with my layout as it is unconventional.

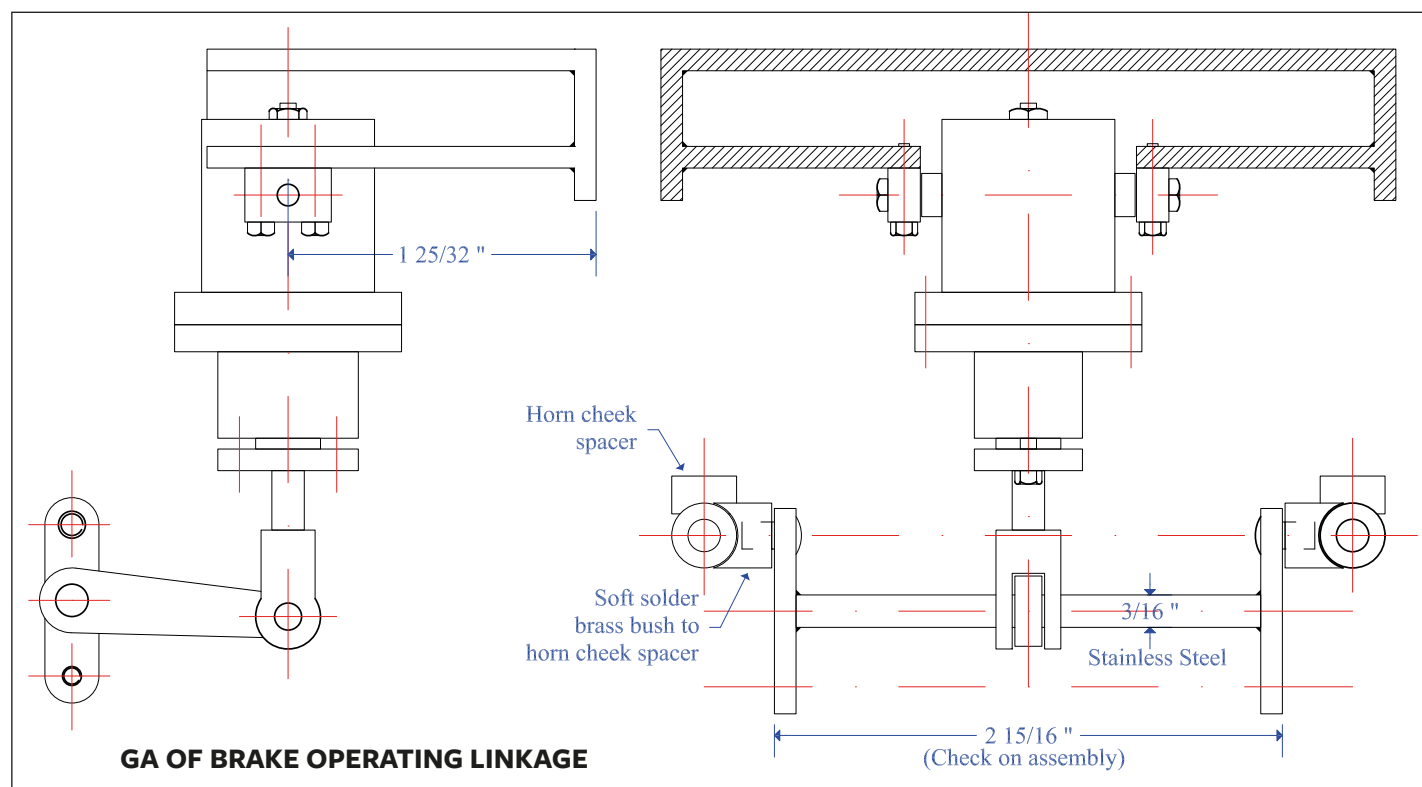
I had toyed with the idea of extending the rear hornblock tie bolts to hold a bracket rather than adopting the addition of the two pivot bosses on the sides of the hornblock spacers. The former is an option, if preferred, but I wanted the pivot itself to be more directly under the axle. The Coal Engine has the same two pairs of brake pull rods as used for the Coal Tank and I shall be supplying them ready cut in stainless steel. However, at the rear, instead of the pair of adjusters used on the CT, an extension will be arranged for the brake rods each side but inset behind the wheels to make sure the firebox grate and ashpan can be released easily either in an emergency, or at the end of the running session.

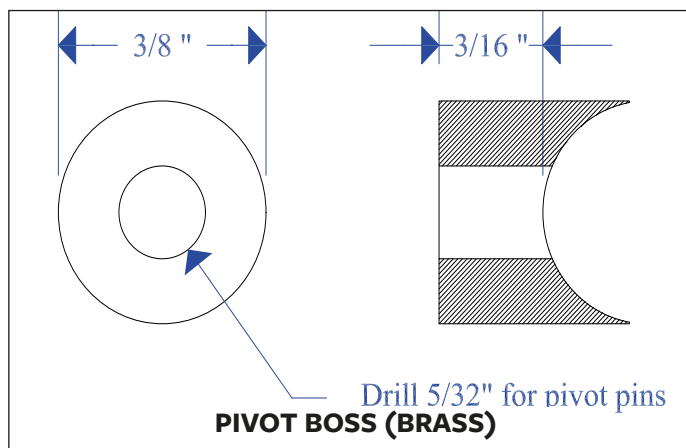
The brakeshaft is between the pivot bosses on a pair of cranks that allow the cross-shaft itself to be below the bosses to give clearance for the lubricating oil eccentric. It is made quite stoutly to cope with any twisting movement when the force from the



ABOVE – PHOTOGRAPH 1

The pivot boss for the brakeshaft crank pin soft soldered to the side of the horn stay for the rear coupled axle.





LEFT – PHOTOGRAPH 2
The fabricated brakeshaft assembly cleaned up and ready to fit between the pivot bosses.

cylinder is transferred out to the brake pull rods. The extensions to the pull rods are deliberately made larger than an expected scale section as there will be only one element of rod to do the pulling on each side. These extensions are thankfully hidden behind the wheels and will also have multiple diagonal holes to allow some lengthwise adjustment on assembly.

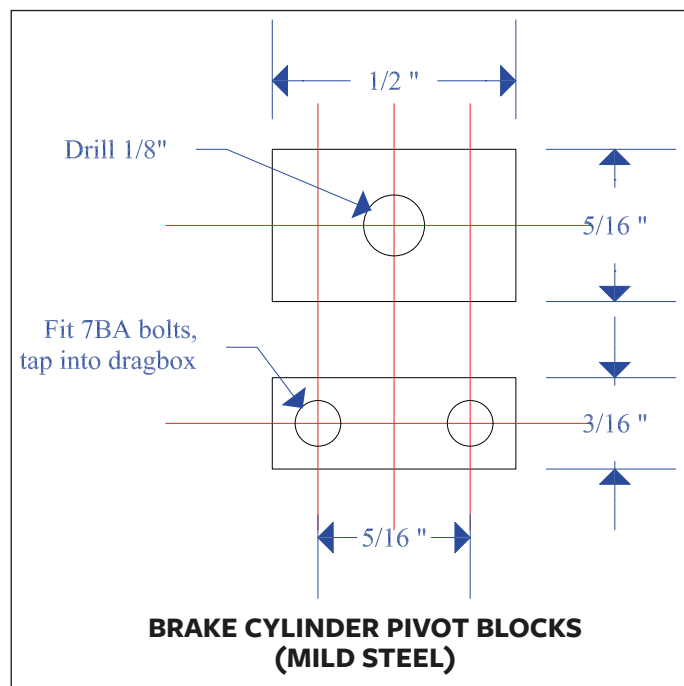
The position of the lubricator/tank is such that a conventional filler neck has not been arranged. Instead, checking the level of oil and topping up will be carried out from the rear using a simple level/filler plug. I was particularly looking to ensure that coal dust or ash would not gain entry to the tank. My general arrangement drawing will show that I have placed the oil tank on the left side of the dragbox to leave space on the right side for the pipework as I am expecting the fireman's side to be the water control zone.

The current design of the Webb tender I have available for this locomotive (as per the 'Lady of the Lake' or 'Problem' design) has water feeds to an injector and an axle pump but no provision has been made for either an axle pump or a crosshead pump on the Coal Engine. So there will just be a water feed to the injector and an emergency water pressure feed to the boiler. This will leave another spare water feed if the current tender design is adopted as drawn and a second injector could be arranged if there is room!

PIVOT BOSSES AND OPERATING RODS

Let us start with the two bosses for the horizontal brakeshaft pivots. They should be made from brass or bronze as we really do not want any issue with the brake gear seizing up. A short length of $\frac{3}{8}$ " diameter rod is needed which should be drilled $\frac{5}{32}$ " and the end has to be milled across with a $\frac{3}{8}$ " diameter cutter which will provide the concave form to match the sides of the hornblock spacer stays. I make my parts of this shape by holding the stock bar under the tool post, square to the lathe axis and with its centre at the usual tool cutting position. Part-off the formed end to leave the $\frac{5}{32}$ " hole length a full $\frac{3}{16}$ " long and take off the burrs.

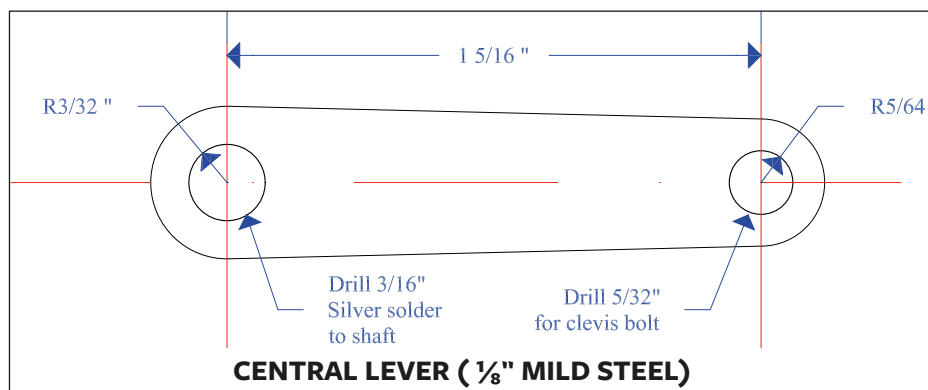
Then do the same for the second item and clean the side of the steel parts before

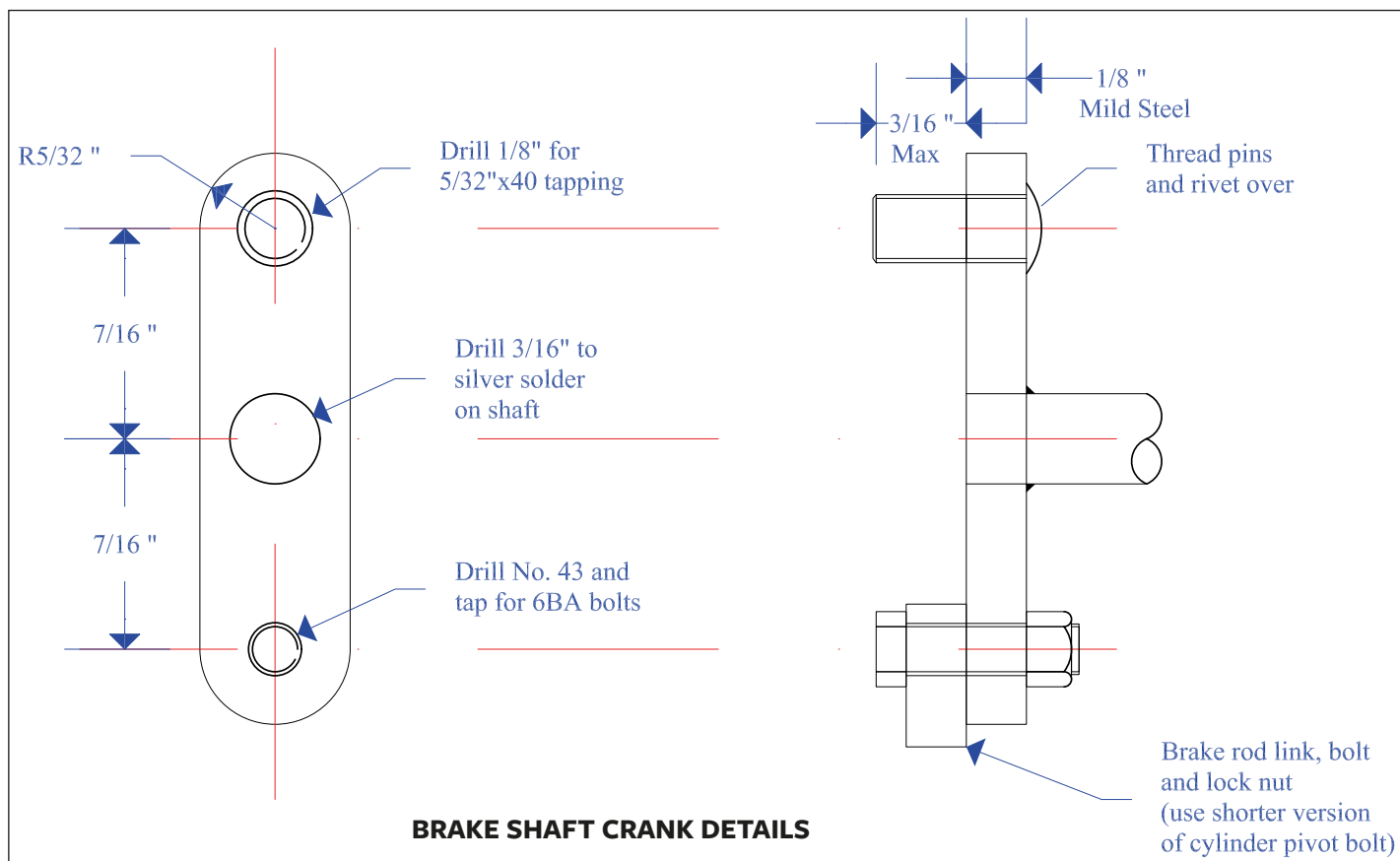


tinning each of them with soft solder and making the joint with the bosses placed centrally and at right angles on the insides of the stays. My picture with one in place should show what I mean. Do be sure to thoroughly clean off the soft solder flux otherwise it will be red rusty by the next day!

Continuing with the various fabrications; we should start with the horizontal compound crank arrangement for the brake linkage. Make the operating lever first as this has to be silver soldered to the centre of the crossbar operating rod. Mine is actually made in two halves with a joining sleeve but this was not my original intention! Unfortunately we all make mistakes from time to time and I was not going to waste what I had made. Some of my dimensions are on the GA of the installation but the links are detailed.

The operating lever is a simple piece of $\frac{1}{8}$ " mild steel plate drilled for the $\frac{3}{16}$ " diameter crossbar and the $\frac{5}{32}$ " pivot bolt hole for the clevis. On each end of the crossbar there are two $\frac{1}{8}$ " x $\frac{5}{16}$ " steel plates with radiused ends which I will call crank links. These pieces of mild steel have a central drilled hole for silver soldering to the cross-shaft at right angles





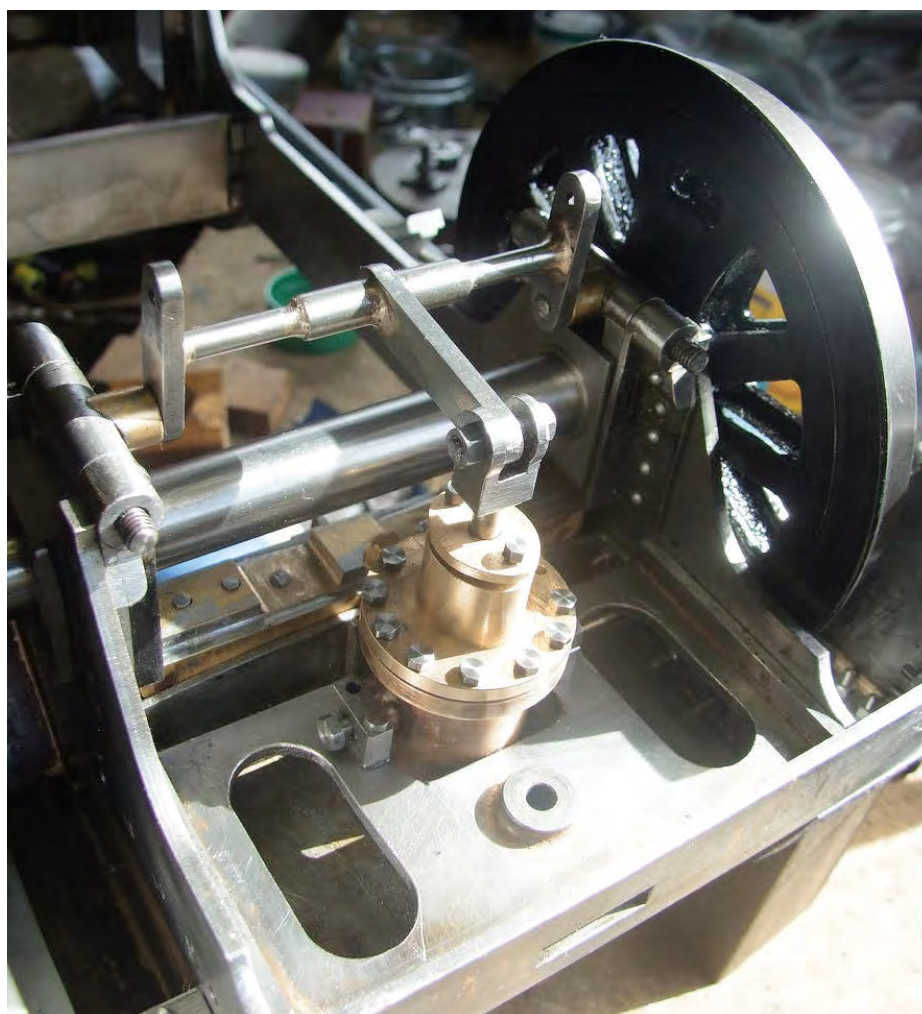
to the operating lever. There are also two threaded holes. The upper one is tapped $5/32$ " x 40 for short $5/32$ " stainless pivot pins which face outwards and provide the pivots which engage with the brass or bronze housings just added to the horn stays. The lower ones are threaded 6BA for the brake pull rod pivot bolts. None of these parts is complicated to make and they just require care to position the joints so all are at the correct spacing and are square and level when assembled for silver soldering. Cleaning the assembly afterwards is simple enough with strips of fine emery tape.

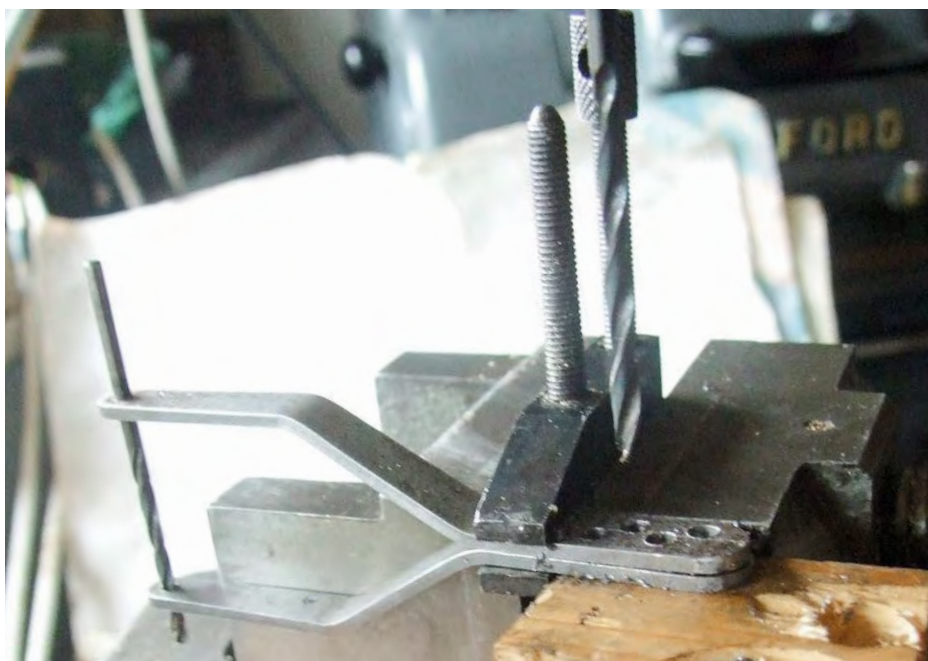
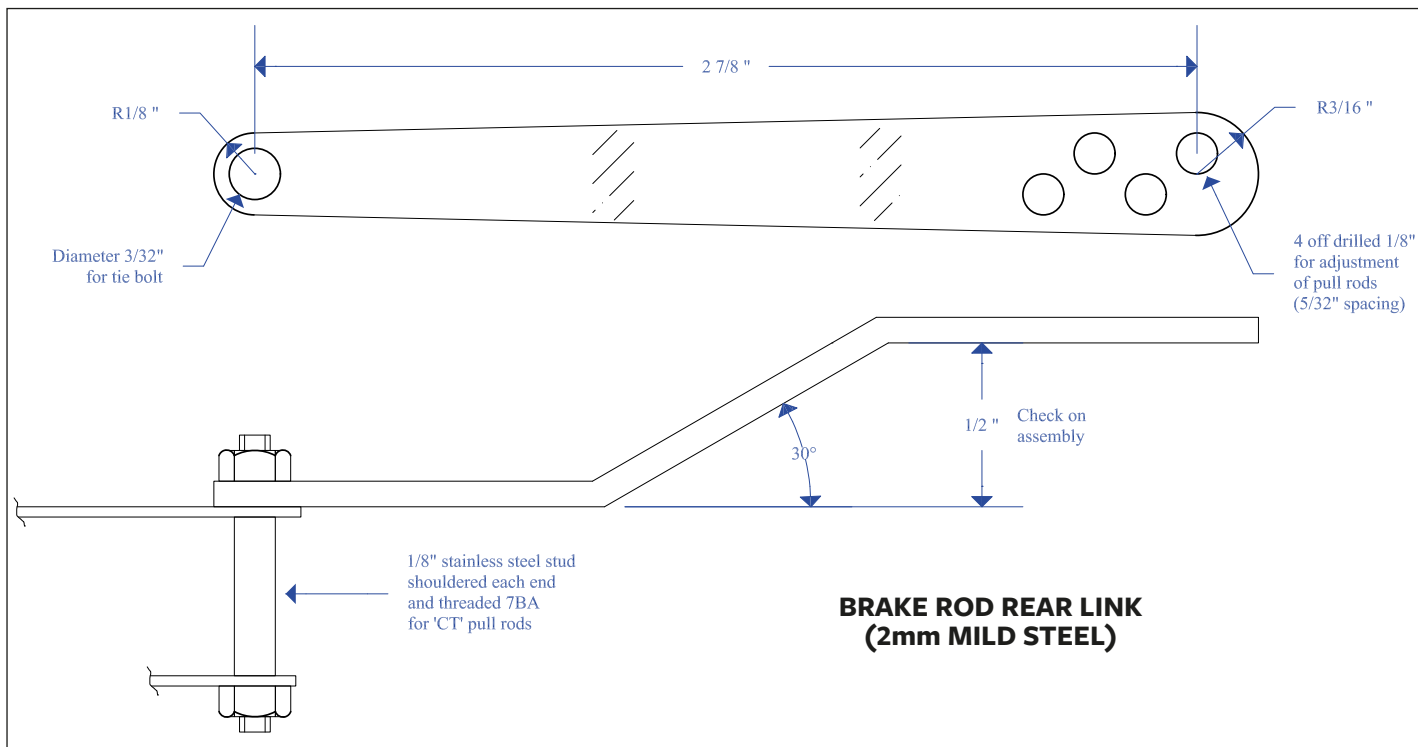
Make the two short $5/32$ " part threaded pins with enough thread to screw through the link plates and peen them over on the inside so they do not come adrift. As already stated, the links for the brakes themselves are on the inside of the rear wheels and have a zig-zag pattern of $1/8$ " holes to allow some adjustment of the brakes on final assembly. Again I hope my picture makes this clear. The holes are spaced at a nominal 45 degrees and although a bit larger than I would have liked, the bulk of this attachment is hidden behind the wheels.

The original Coal Tank pull rods were specified to have domed headed long bolts only $3/32$ " diameter but for the Coal Engine I have drilled the bottom holes on the brake hangers at $1/8$ " diameter. This means we need 6 studs from $1/8$ " stainless steel and the ends have to be turned down and threaded 7BA to keep the pull rods to a scale size. There will be some spacing tubes as per the Coal Tank and nuts to fit inside and out but if they are the small hexagon variety they will look fine.

BELOW – PHOTOGRAPH 3

A general view of the underside of all the brake system components trial assembled to the chassis. I found one of my pivot bosses was off-centre and the fit of the lever in the clevis was poor!





ABOVE – PHOTOGRAPH 4

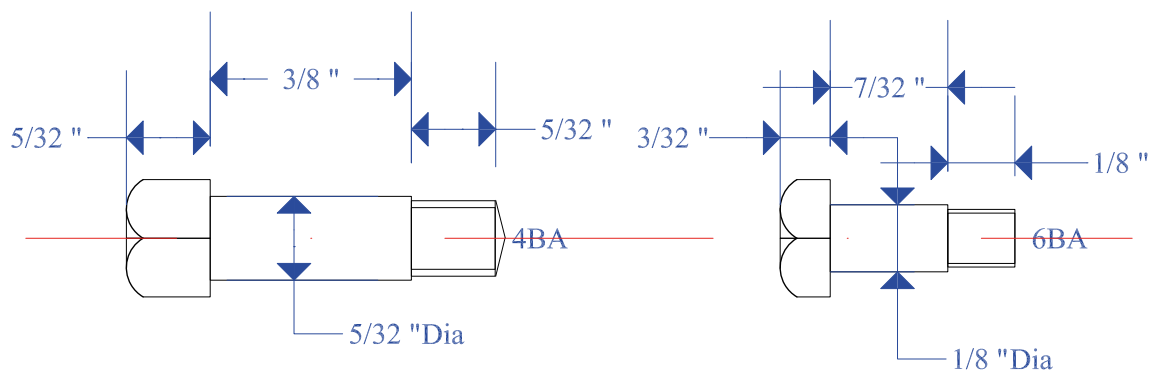
Drilling the zig-zag pattern of holes in two rear extensions for the brake pull-rods. These allow for some adjustment when assembling the brakes.

BRAKE COMPONENT ASSEMBLY

For the assembly of the parts we also need to make the mounting pivot blocks for the brake cylinder from $\frac{3}{16}$ " thick mild steel and the detailed drawing gives the dimensions. To mount them on the chassis I used $\frac{1}{2}$ " long 7BA bolts fitted into tapped holes in the lower plate of the dragbox. The dimension on the main GA shows that these need to be positioned slightly off-centre towards the rear axle to allow the brake cylinder to have some angular movement. The two pivot bolts for the cylinder and those for the brake pull rod extension are all $\frac{1}{8}$ " diameter with 6BA threads, but with longer plain lengths for the bearing surfaces. The shorter brake pull rod bolts need longer threads so locknuts can be added on the inside of the link plates. The single bolt for the clevis is $\frac{5}{32}$ " diameter with a 4BA thread.

Next time I will describe the lubricating oil pump and how it can be attached under the drag box.

« TO BE CONTINUED »



CLEVIS BOLT (7/32" HEX)

BRAKE CYLINDER CLEVIS BOLT (7/32" HEX)

Kempton Steam Museum

Mark takes us on a guided tour of the Kempton Steam Museum

BY MARK SMITHERS

In the January 2017 issue of EIM I featured the London Museum of Water and Steam at Kew Bridge and its unique collection of stationary engines. The subject of the present feature, Kempton Steam Museum, has four important similarities, namely its central theme of water supply; its important stationary steam heritage; its proximity to a 2ft gauge railway, and its West London area location, but it also has an important difference in its overwhelming 'star' attraction amongst the stationary engines.

Before discussing this item in detail, however, it will be constructive to outline the history of the Kempton Pumping Station site. One of the negative consequences of the population expansion of London caused by the Industrial Revolution was a significant increase in the quantity in the quantity of raw sewage discharged into the River Thames during the nineteenth century. The problem was highlighted by the infamous 'Great Stink' of 1858 when it was at last realised that a solution to the problem had to be found. As part of London's sewer network, two outfalls into the tidal part of the Thames to the east of the city, the northernmost at Beckton and the southernmost at Crossness, were constructed in the 1860's, but in order to reduce the propensity for the spread of contagious diseases, a water supply independent of the infected tidal part was needed. Following the 1852 Water Act, therefore, there grew up a network of pumping stations and reservoirs taking their water supply from above Teddington Lock in order to obtain cleaner water.

The Kempton Park Waterworks commenced operations under the auspices of the New River Company in 1897 and in its original form comprised two holding reservoirs and 12 sand filter beds. Initially the source of power for the pumping station was five triple-expansion engines, constructed by Lilleshall & Co. of Oakengates, Shropshire, two of which were used for abstraction and the remainder to pump the filtered water out of the reservoirs and on to Cricklewood, North London. These were housed in their own designated Engine House. The coal for the six manually-fed Lancashire boilers that supplied steam to the pumping engines was initially moved by cart from the LSWR's Kempton Park Station, but by 1915 this was effected mainly by means of a branch of a 2ft gauge railway linked to the River Thames at Hampton Wharf.



ABOVE

Parts of the parallel motion of an 1812 Boulton & Watt beam engine that was once used for water pumping purposes at Deptford are now used as supports for lamps on the walkway that surrounds the central well of the main part of the Museum Building. This is a commemorative plaque fitted on the one of the lamp supports.

By this stage, Kempton Park Waterworks had been under the umbrella of the Metropolitan Water Board for over a decade. Following the cessation of hostilities in 1918, and a return to normal peacetime activities, there was an increased demand for water in the London area and on January 25th 1924 an order costing £94,970 was placed for two large new triple expansion engines and associated pumping equipment with Worthington Simpson Ltd. of Newark, Nottinghamshire. These engines were designed to work in tandem with the Lilleshalls but, owing to their sheer size, required a separate Engine House, which was constructed during 1927-8.

The two engines were named after the then-Chairman of the Metropolitan Water Board, Sir William Prescott, and his wife, Lady Bessie, and were numbered 6 and 7 respectively (the Lilleshalls being Nos. 1-5), with the former officially entering service during the summer of 1929. These were each rated at 1008 pump horse power. In order to supply the requisite steam to the Lilleshalls and new engines, a new boiler house was added and equipped with six mechanically-fed coal-fired Babcock & Wilcox twin-drum superheated water tube boilers operating at 200psi, which were augmented in 1951 by a pair of additional water tube boilers constructed by John Thompson Ltd. In 1933 two steam turbines, Nos. 8 & 9, were

added to the pumping capability and these occupied a space originally intended for a third triple expansion engine that was never completed (perhaps not proceeded with in the light of the protracted completion of Nos. 6 & 7).

These were built by Frazer & Chalmers Ltd. of Erith, Kent and were each equipped to drive two Worthington Simpson centrifugal pumps via a David Brown reduction gearbox. By 1963 the site pumped 86 million gallons of water a day and kept 144 people in employment. Post-World War Two modernization and rationalization had by this stage reared its ugly head, however, and the 2ft gauge railway was closed in 1947. In 1968 there was a major reduction in pumping capacity and the Lilleshalls and their Lancashire boilers were broken up for scrap, with the latter's accommodation also being demolished. The reservoirs were also decommissioned at the same time.

The mighty Worthington Simpson engines carried on in service until 1980 when they were retired and their boilers scrapped. The pumping station carried on with electric power but nowadays operates on a reduced scale, now delivering 75 million gallons a day with only 14 employees. Thankfully, the triple-expansion engines, the turbines and their accommodation were not destroyed and in 1995 a new organization, the Kempton Great Engines Trust was formed, with the objective of preserving the site's important heritage and restoring one of the triple expansion engines, No. 6, to operational condition using a new steam supply.

This work took some 100,000 man-hours over a seven year period with the first steaming weekend for public benefit taking place some two years after the end of this period, namely October 2004. No. 6 'Triple' is today the largest engine of its kind in regular work in the world and can truly be called one of its engineering wonders. It was decided to keep No. 7 in non-operational display condition and in this state it is very useful for demonstrating the *modus operandi* of the engine during public tours. Both turbine-driven pumps have also been retained, with one being stripped-down, again for demonstration purposes, whilst it is envisaged as a longer term project that the other engine will eventually be returned to working condition.

**ABOVE**

The upper portion of Engine No. 6 showing, from left to right, the exhaust pipe to the condenser; the low pressure, medium and high-pressure cylinders and the steam supply pipe to the latter cylinder. On the uppermost level can be found the poppet valves for the upper parts of each cylinder, whilst on the level below can be seen the steam jackets for the cylinders and the distribution systems for lubrication: gravity fed for bearings and mechanically fed, using oil of suitably high viscosity, for steam-tight parts of the engine's anatomy. On the level below that can be seen the pipework connecting the cylinders to the receivers, and the spring shields for the lower level poppet valves. Immediately beneath this level are the connecting rods, crankshaft and rods connected to the pump rams.

BELOW

This view shows the oil pressure gauge for the low pressure crankshaft journal on No. 6. Although fed by gravity, the oil pressure within this bearing can rise to very high levels owing to the oleostatic forces generated by the action of the piston.

**BELOW**

The 'bottom end' bearing on the low pressure cylinder of No. 6 has proved prone to overheating on occasions and in order to monitor the situation, allowing the engine to be stopped if necessary, five thermocouples have been installed and linked to a meter. The associated wiring is seen to advantage in this view, attached to the main support framing for the cylinder.

**BELOW**

The lower part of the low pressure crosshead of Engine No. 6 is shown in this view, which also shows the bottom portions of the poppet valve spring assemblies and the rods connecting to the pump ram. This view emphasizes the fact that the pistons of this type of engine/pump arrangement act directly on the pump and not via the crankshaft.



**ABOVE**

The pipe leading from the high pressure receiver to the inlet valves for the medium pressure cylinder has been detached at the receiver end on Engine No. 7 to show the internal re-heating pipes, which are connected to the main steam supply.

LEFT

No. 7 Lady Bessie comes into its own when parts not easily accessible when the crankshaft is in motion need to be photographed. This is a 'level' view of the high pressure crosshead, lower valve spring assembly and upper pump ram rodding area of No. 7.

BELOW

This is the governor on Engine No. 7. This was latterly disconnected to prevent 'spurious' interruption of pumping operations.



In their design, the two 'Triples' closely resemble many marine engines with their vertically mounted cylinders driving a single crankshaft with cranks set at 120 degrees. Engines of this type had been routinely in use for water pumping purposes since 1886 when the practice commenced in the USA (the 1910 Hathorn Davy engine referred to in my EIM feature about the London Museum of Water and Steam is a classic example). Since the pumps are of the vertical reciprocating type, one for each cylinder with provision for either single or double ram operation depending on operational demands, the drive is taken directly from the crosshead of each cylinder to its associated pump by means of vertical rods. Had centrifugal pumps been used, drive from the crankshaft would obviously have been more appropriate.

The demands of the job that Nos. 6 and 7 were designed to do meant that, apart from necessary stoppages for maintenance or emergencies, they were in continuous operation throughout their revenue-earning careers, with each engine normally supplying around 19 million gallons of water to North London during a typical working day. As a guide to the proportions of the Kempton 'Triples', it should be remembered that each of them stands 62' 6" from the bases of the pumps to the top of their valve housings. Each has an overall width (this would appear to be

the appropriate term, given the orientation of their crankshafts) of 45ft. Each high pressure piston is 29" diameter, with the corresponding figures for the medium and low pressure pistons being 54" and 86".

The main mechanical difference in their design when compared with the classic nineteenth century reciprocating compound marine engine is inherent in the fact that whereas the latter normally used cuboidal steam chests and slide valves, the Kempton engines have camshaft-driven poppet valves, a feature more consistent with their date of construction. The two receivers that link the steam paths through each cylinder are each supplied with internal piping connected to the main steam supply to increase the temperature of the steam passing through them. In order to prevent the build-up of condensation in the cylinders when then engines were starting up, each was equipped with steam jacketing for the cylinders, again fed from the main steam supply. In order to obtain optimum results, this normally was activated some two days before the process of starting was undertaken. As with marine engine practice, the exhaust from the low pressure cylinder was directed into a condenser, in which the partial vacuum created provided assistance to the action of the cylinders.

« TO BE CONTINUED »

A Visit to the Pimlico Light Railway

The editor packed his passport to visit John Roberts's railway near Towcester

BY MARTIN EVANS

In Bicester, Brackley and Buckingham, boredom barely beckons. Especially if you visit the nearby Pimlico Light Railway.

Regular readers will remember our feature about the railway (EIM, September 2015) and your editor felt it was time he paid a personal visit, so he went along to the first public open day of the year, late in April.



Visitors enjoying the spring sunshine at the Pimlico Light Railway.

LEFT

Silas Frost at the seat of custom, ready to relieve me of my cash as soon as I arrive.

The railway is the base for a very popular, active and thriving model engineering club for youngsters. The club started over ten years ago and currently has about 35 members. The membership is a mix of ages, with a strong junior section. The emphasis is on getting the juniors fully involved in the running of the railway, with a system of bronze, silver and gold awards, which the juniors acquire as they work their way through the 'syllabus'. At 16, provided they make the grade, they are awarded their own Greasetop and a signed certificate which they can brandish at interviews to prove their model engineering credentials. Full driver training is part of the course and, provided they have demonstrated their competence, and

have reached the age of 16, they can drive for the public.

The track follows a basic figure of eight route with a couple of passing loops and a station, conveniently situated near the cake tent. A slightly unconventional signalling system protects the diamond crossing at the centre of the figure of eight, and also the exit from the station. A willow tunnel provides some extra interest. This was a bit of a compromise as a 'real' tunnel would have involved the shifting of a very large quantity of soil!

As well as helping to run the railway the youngsters are encouraged to get involved in building locomotives, rolling stock for the railway and small stationary steam engines. James, on the cake stall, told me all about Wednesday and Friday evenings during the winter, which present an opportunity to get into the well equipped workshop and develop some very useful model engineering skills. These skills will prove to be very useful in the future, not only because the ability to understand how things work and how to fix things is so important, but also as the basis of a very satisfying hobby and, in many cases, a highly rewarding career.



LEFT

Mike Barnes is ready for the off with his Sweet Pea. Note the water tower in the background painted in the proper colours – we'll have to excuse the locomotive just this once.

PIMLICO LIGHT RAILWAY Open Days 2017

April 23rd
May 28th
June 25th
July 23rd
August 27th
September 24th

For more details, Google 'Pimlico Light Railway'.

**ABOVE**

Paul Parsons, Will and James man the highly popular and profitable cake stall, which makes even more money than the train rides. Half the takings go to the 'Send a Cow' charity.

BELOW

Jack Colby, winner of the recent EIM lathe competition, arrives at the station in charge of Chris Orchard's Simplex, which is painted in the proper colour, I'm glad to say.

**ABOVE**

Chris Orchard's correctly liveried Simplex makes a further appearance as it emerges from the hole in the hedge and negotiates the diamond crossing.

The workshop itself is a hive of activity and there is a strong GWR flavour to the entire enterprise. There appears to be a great deal of locomotive and rolling stock manufacture going on. Several engines fill the benches, and the spaces under the benches, at various stages of construction. There is a Manor and a GWR 2-8-0 ('Swindon', designed by the 'original' Martin Evans) both reasonably well advanced, being built, at least up to now, in tandem by John Roberts. The latter was particularly interesting to me as it is not a model that I have seen very often. It appeared to require only plumbing and plating to reach completion. The Manor was in roughly the same state. It will be good to visit again before too long and see them both in steam!

I gather there are four fairly well advanced GWR 1400s. These are being built as a batch and it will be nice to see those finished too, as they are really very pretty locomotives - at least in the eyes of GWR fans. Within the club there is a completed GWR Pannier, two 1500 'Speedy's, a Warship and a Simplex. Jack Colby and John Roberts are starting to build a couple of GWR Small Prairies. John's workshop does have a 'mini-Swindon' atmosphere about it and has also turned out several driving trolleys and riding cars for passengers, in the form of (amongst others) a Travelling Post Office, a Parcels Van and an Autocoach.

At the end of the afternoon, the clearing up operations were carried out with impressive efficiency, mainly, one suspects, because tea and coffee awaited the volunteers, as well as the opportunity to consume any cakes that remained unsold. Your editor was privileged to be included in this activity, despite having done absolutely no work at all.

This was a great way to spend a sunny Sunday afternoon - well worth the journey (93 miles, in my case). And don't worry, no passport was required. ■

**ABOVE**

Tickets, of course, must be properly clipped before the journey can begin.

BELOW

John Roberts demonstrates that although this fork lift's fork lifting days may well be over it can, all the same, enjoy a new lease of life lifting locomotives.



The Atkinson Steam Wagon

Graham continues his description of the water tank on his Atkinson wagon by discussing the various fixtures and fittings

BY GRAHAM SADLER – CONTINUED FROM PAGE 33 MAY 2017

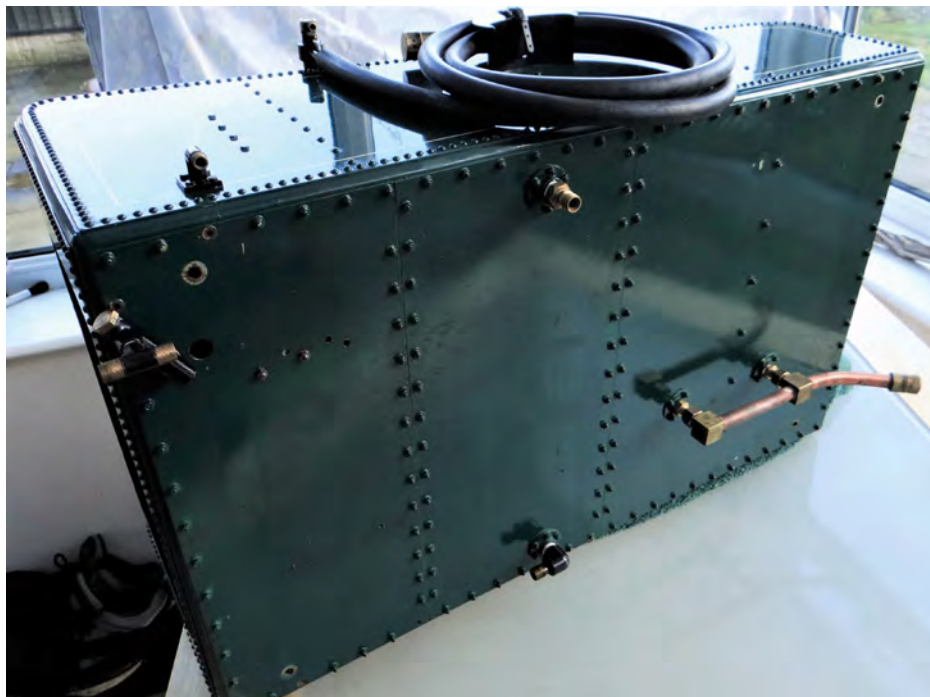
FITTINGS

The fittings are simple turning tasks. Five flanges are needed, which are all the same size (except for the thread size), one or two drain points, an engine pump and injector outlets (which have fitted filters) and a dipstick. In the tool box area, additional fittings are through the side and inner wall which also has the fitting for the hand pump. Don't forget to add a tube on the inlet, bent downwards so it is almost on the floor of the tank, well before it is finally sealed.

The pump is mounted on a piece of bent 1.5mm steel – it needs a lot of force in operation so don't go thinner. No dimensions for this are given as it will have to be made to fit your chosen pump – I used a ¾" ram and it fills the boiler fast. The handle is stored on a bit of bent 5 x 15mm strip fixed to the base. Feed to the engine is through a set of special tee pieces and eventually finds its way into the boiler through the same clack as the engine pump but there is a non-return valve in the line to stop engine pumped water being fed back to the tank through the hand pump. Belt and braces perhaps but one can't mess about with water feed. One thing to watch here though – the hand pump is useless if the engine pump bypass is open. We found this error at our first rally as we couldn't fill the boiler when both the water and pressure were low... See photographs 1 to 3. Note the internal pipe work for the engine pump bypass.

Water goes into the tank through a filler and down an angled scoop made from 26g brass (make a card template first) through a notch 100mm wide and 50mm deep in the back wall of the tool space, seen in photograph 3. It's riveted in place and sealed with the GRP on the inside. The filler is a pleasing bit of turning, or fabrication using a bit of tube – modify the sizes to suit. I made press tools for the lid and hinge to get the curve right (photograph 4). In addition, on mine is a catch system. It's fiddly to make and it gets in the way. Furthermore, it's under your crutch when you're sitting on the machine – not good!

The dipstick is simple. Take the centre tube from a household hand spray bottle. Drill a close fitting hole most of the way through the top screw and put a 1.5mm hole all the way through. Set it up so that



ABOVE – PHOTOGRAPH 1
Base of tank showing fittings.

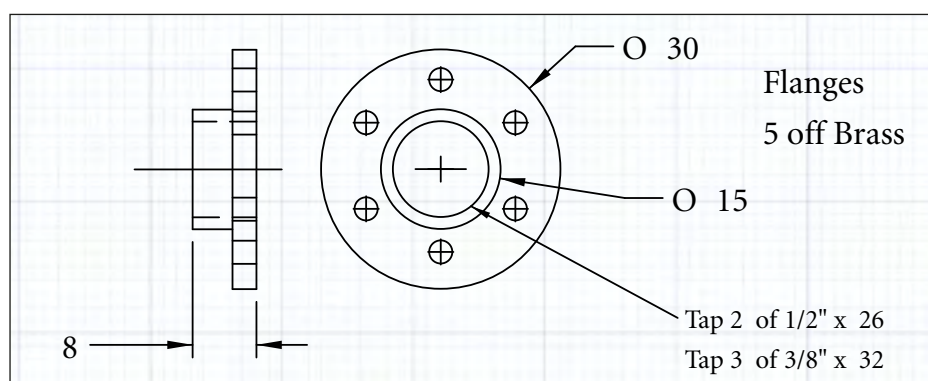
the tube clears the bottom of the tank by 25mm or so, so that when it shows empty you still have a few litres of emergency water left. Just put a finger over the hole in the top nut and lift it out – easy!

Do not drill any of the fitting holes until the position of the tank has been established on your chassis.

WATER DRAIN

This was added very soon after the first rallies. The drain plugs mounted under the tank were difficult to get at, and one drained straight onto the differential –

not the best position! So the fixings shown in photograph 5 were produced and consist of a threaded nipple ¾" x 32 screwed with a ¾" AF hex brass nut into the female coned block. The tube is screwed into the tank and locked in place with a locknut. The block is drilled for 12mm copper tube brazed in place, the end having a knurled drain plug positioned just under the back of the chassis. I used the double arrangement to speed things up because the central angle in the tank tends to stop it emptying completely.





**ABOVE
PHOTOGRAPH 2**

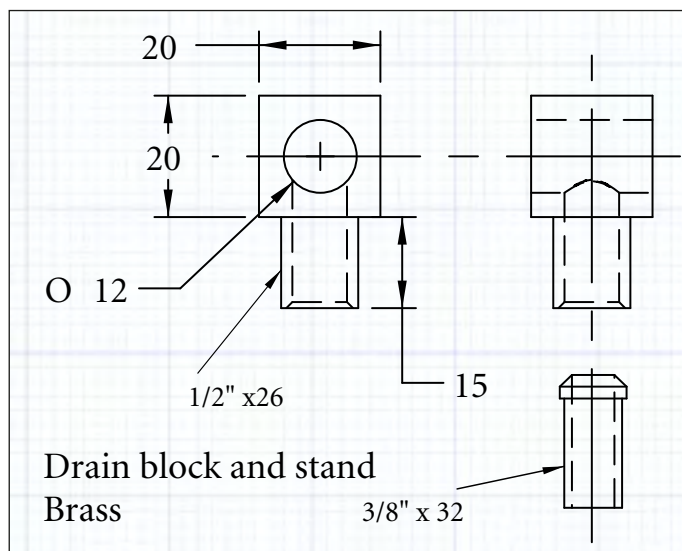
Bypass and handpump outlet containing a non-return valve.

**RIGHT
PHOTOGRAPH 3**

Hand pump, water scoop and bypass pipework.

**BELOW
PHOTOGRAPH 4**

Parts of the filler.



LIFTING EYES

These support the seat assembly, which avoids the possibility of damage or the need for ugly fixings on the tank. They are scaled from standard lifting eyes. The 5mm rod is heated red hot and bent round a 12mm former to form a spiral. This is then cut, heated again to flatten the ring, then brazed onto the base using a simple jig (photographs 6 and 7). These are screwed into the top angles in the tank. The thick mounting washer thickness has to be adjusted to get them all in the correct orientation.

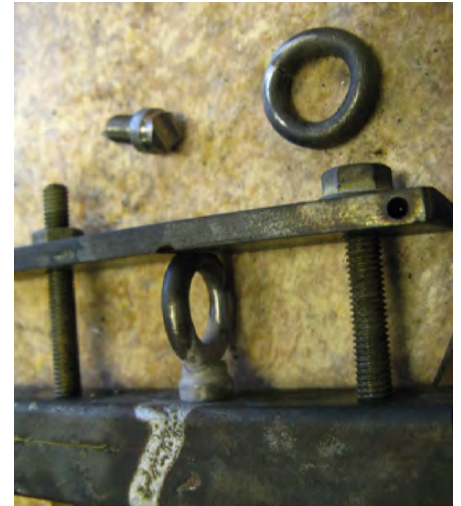
FOOT RESTS

I wanted solid footrests and an assurance that my feet couldn't bang into the front wheels or mudguards, damaging the paintwork (see the front cover of the September 2016 issue). They slide into a heavy mounting plate which forms the cover over the front of the engine unit. It is produced from a sandwich of 20g steel spaced with 12 x 10mm bar which forms the slots for the footrests to slide into. The plate is locked onto the chassis with two captive 2BA screws and two loose ones to give access to the top of the engine for maintenance. There is a hole for access to



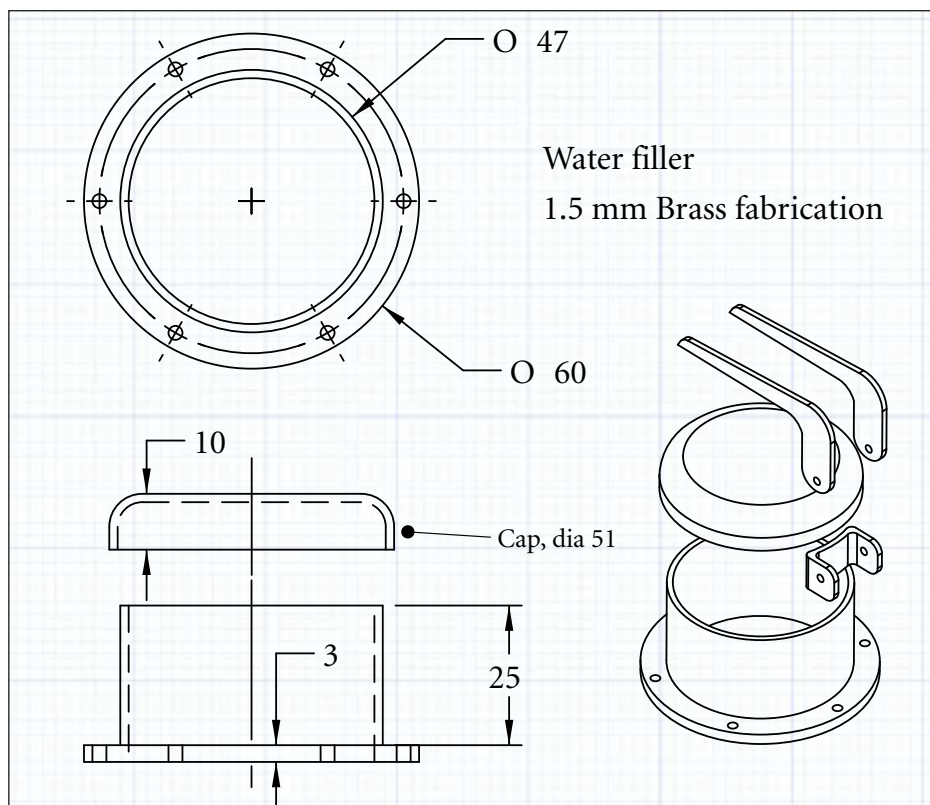
ABOVE – PHOTOGRAPH 5
Drain arrangement.

BELOW – PHOTOGRAPH 6
Tank top.

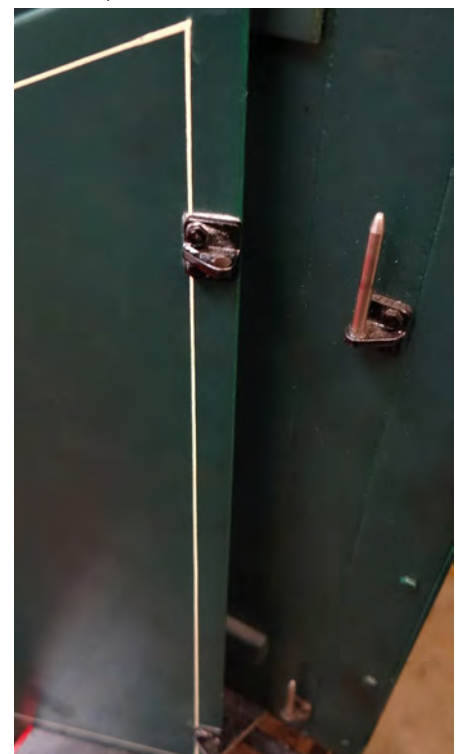


ABOVE – PHOTOGRAPH 7
Brazing jig for the lifting eyes and components.

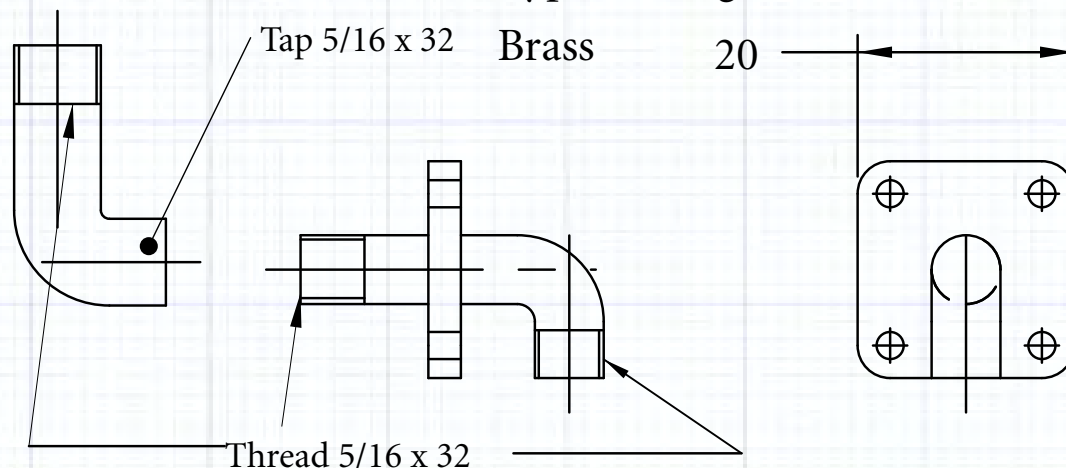
BELOW – PHOTOGRAPH 8
Foot rest plate, tank mounting and side sheets.



BELOW – PHOTOGRAPH 9
Side sheet pintails.



Bypass Flanges



the lubricator. The 'legs' of the footrests are hot bent to shape from the same 12 x 10mm strip. It was interesting getting them all the same to say the least! The horizontal base is welded on and a bit of 3mm plate keeps them spaced in the vertical direction (photograph 8).

SIDE SPLASHES

These are from 6mm plywood and fill the space between the tank and cab. They represent the coke storage space on the prototype and hide the coal box and firing tools. They are fitted on pintails fixed onto the cab for instant removal and drop down over a pin fixed at the back of the foot rest mounting plate to stop them opening. The pintails are long enough so that the splashes drop over the edge of the plate, hiding it from view when the foot rests are removed (photograph 9).

SEAT

This gave me a lot of headaches. Far too many really nice miniatures are spoiled by ugly utilitarian seats on an otherwise brilliantly engineered and finished engine. I was thinking about this for a long time but the problem was solved with a tractor seat found very cheap (£10) in the autojumble section of a rally. It is held in place by a single bolt through the centre and sits on a hinged (100mm brass door hinge) aluminium plate which is sprung at the back onto a 10mm ply base. There is almost zero flexibility in the wagon leaf springs and some comfort is desired! It is mounted on the four lifting eyes, dropping in firstly at the back, which has stops making sure it won't drop onto the tank and damage it, and then onto pegs under the plywood base. At the front I made dedicated shoot bolts with spring detents in them to stop the possibility of opening from vibration on the rally field. The seat assembly can be removed in seconds. There are no dimensions, as it built itself, but photographs 11 and 12 show it clearly.

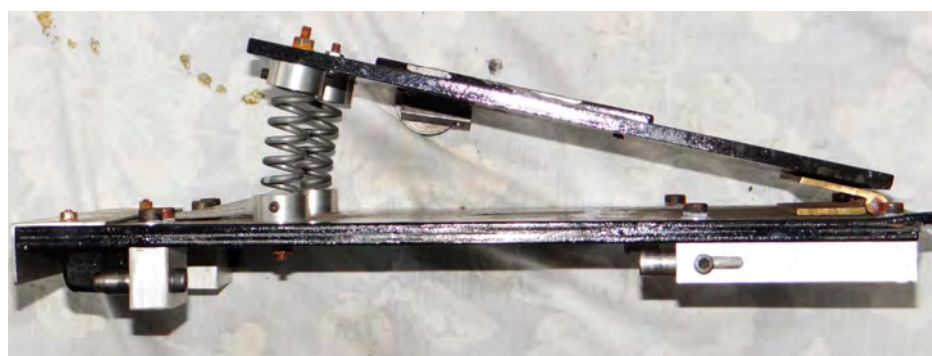
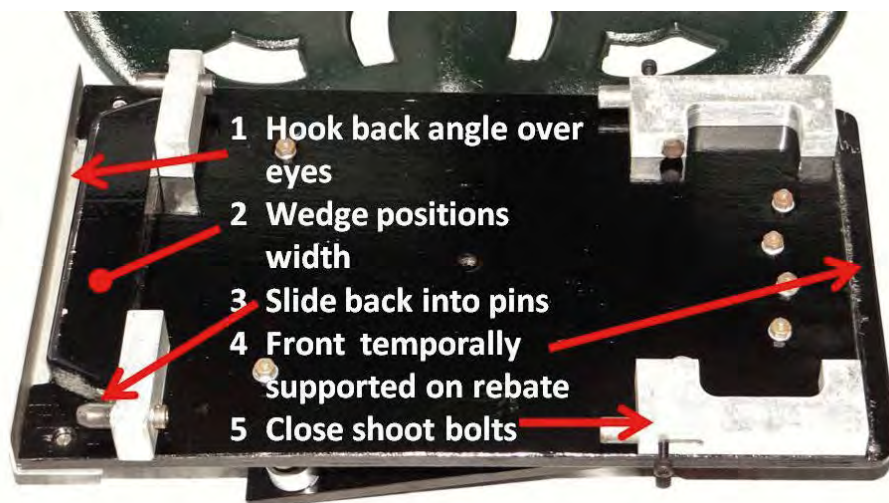
« TO BE CONTINUED »

RIGHT PHOTOGRAPH 10
Components for the non working water lifter.



BELOW PHOTOGRAPH 11
Seat mount, bottom view.

BOTTOM PHOTOGRAPH 12
Seat mount, side view.



The EIM Steam Plant – The Engine

Martin Gearing uses the fixtures we made last time to make the cylinder covers

BY MARTIN GEARING – PART 7 – CONTINUED FROM PAGE 27 MAY 2017

CYL. COVER - HEAD – ITEM E14

Cast Iron – 20 x 24 x 3.5

Refer to – Drawing E14

STAGE ONE – MILL, HOLDING IN VICE

Make sure you use the correct thickness blank!

Secure in the vice on parallels sufficient to bring flush or just above the vice jaws, with the long EDGE datum against the fixed jaw. After tightening remove the parallels. Set the spindle to zero, with the vice jaws on the Y-axis and the datum indicated on the X-axis.

Centre drill. Drill Ø3.2mm at the four locations indicated.

Centre drill. Drill and tap M4 at the position indicated. See photograph E37.



ABOVE
PHOTOGRAPH E37

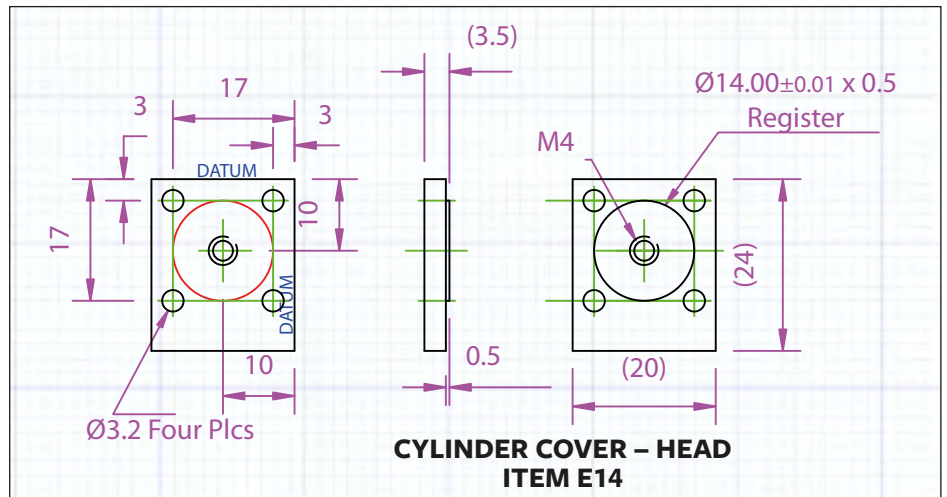
Cylinder head cover – 1st stage: drilling/tapping.

BUILD NOTES

Tolerances for all parts in the article – unless stated otherwise:

- Non-functional (ie parts not a fit or a match): $\pm 0.1\text{mm}$
- Functional (ie parts having to match): $\pm 0.02\text{mm}$

All drawing labels start with the reference letter E.



STAGE TWO – LATHE, USING TURNING FIXTURE

Hold the cover to the cover machining fixture with four M3 bolts, but stop short of tightening.

Pass the securing bolt from the plain end through the reamed hole into the M4 thread in the cover and tighten securely. Remove the four M3 bolts which were used to ensure alignment.

Hold the assembled fixture in a self-centring chuck and check that it runs true by checking with a dial gauge against the reference diameter. Should the total run out exceed 0.04 then transfer to a 4-jaw chuck and set to run true to within this tolerance.

Using a sharp RH knife tool with only the slightest discernible tip radius, machine the $\text{Ø}14 \pm 0.01 \times 0.5\text{mm}$ register. See photograph E38.

After removing the fixture from the chuck remove the cylinder cover, deburr and put to one side.

CYL. COVER – ROD – ITEM E15

Cast Iron – 20 x 24 x 4.5

Refer to – Drawing E15

STAGE ONE – MILL, HOLDING IN VICE

Check you have the 4.5mm thickness blank!

EXCEPT that the operation of drilling and tapping for a M4 thread is replaced by drilling a Ø3.8mm hole, followed by reaming Ø4, all stages are a repeat of those used to produce item E13.

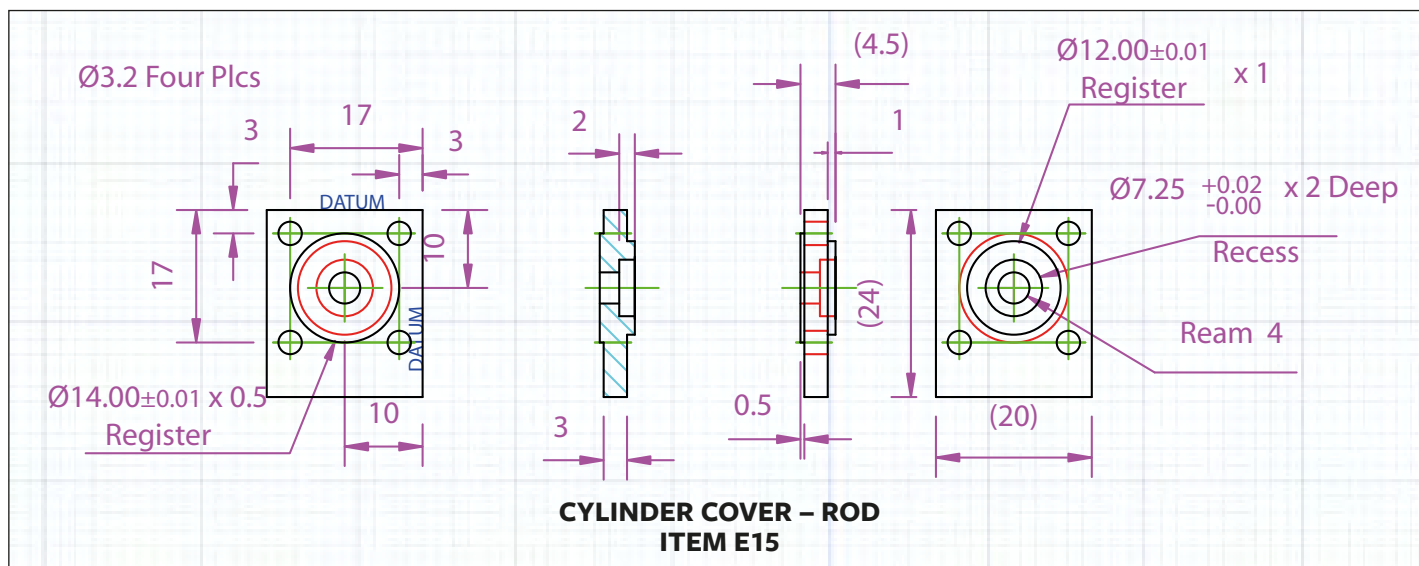


ABOVE
PHOTOGRAPH E38

Cylinder head cover – 2nd stage: turning Ø14 register using fixture.

STAGE TWO – LATHE, USING TURNING FIXTURE

The cover turning fixture now requires the captive nut to be fitted. From the end with the locating recesses pass the securing bolt through the Ø4mm reamed hole into the M4 thread of the captive nut, and before tightening the M3 bolt in the captive nut. Tighten the M4 securing bolt followed by the M3 bolt that holds the captive nut.



Unscrew the M4 securing bolt and check that it is free and picks up the thread in the captive nut easily. If not go through the installation again until this is achieved.

Hold the fixture in a self-centring chuck and check that it runs true by checking with a dial gauge against the reference diameter. Should the total runout exceed 0.02mm then transfer to a 4-jaw chuck and set to run true to within this tolerance.

Hold the rod end cover to the cover machining fixture with four M3 bolts but stop short of tightening.

Pass the securing bolt through the reamed hole in the cover and fixture into the M4 thread in the captive nut and tighten securely. Remove the four M3 bolts which were used to ensure alignment.

Using a sharp RH knife tool with only the slightest discernible tip radius, machine the $\text{Ø}14 \pm 0.01 \times 0.5\text{mm}$ register.

Remove the cover from the fixture and reverse, locating the $\text{Ø}14$ cover register into the fixture recess. Hold the cover to the machining fixture with four M3 bolts but stop short of tightening.



ABOVE – PHOTOGRAPH E46

Cylinder rod end cover – Holding with 4 x M3 bolts before removing M4 central bolt.

BELOW – PHOTOGRAPH E40

Cylinder rod end cover – 1st stage: boring $\text{Ø}7.25$ 'O' ring recess.



Pass the securing bolt through the reamed hole in the cover and fixture into the M4 thread in the captive nut and tighten securely. Remove the four M3 bolts which were used to ensure alignment.

Machine the $\text{Ø}12 \times 1$ register.

Replace the four M3 bolts and secure. See photograph E39.

Remove the M4 securing bolt.

Machine the $\text{Ø}7.25 \times 2$ recess for the 'O' ring seal, checking frequently with the plug gauge produced earlier. See photograph E40

Leaving the fixture secured in the chuck, remove the four bolts freeing the cover which should be deburred and put to one side.

CYL. COVER – GLAND – ITEM E16

Cast Iron – $20 \times 20 \times 4.5$

Refer to – Drawing E16

STAGE ONE – MILL, HOLDING IN VICE

Simply repeat the steps used to produce item E14.

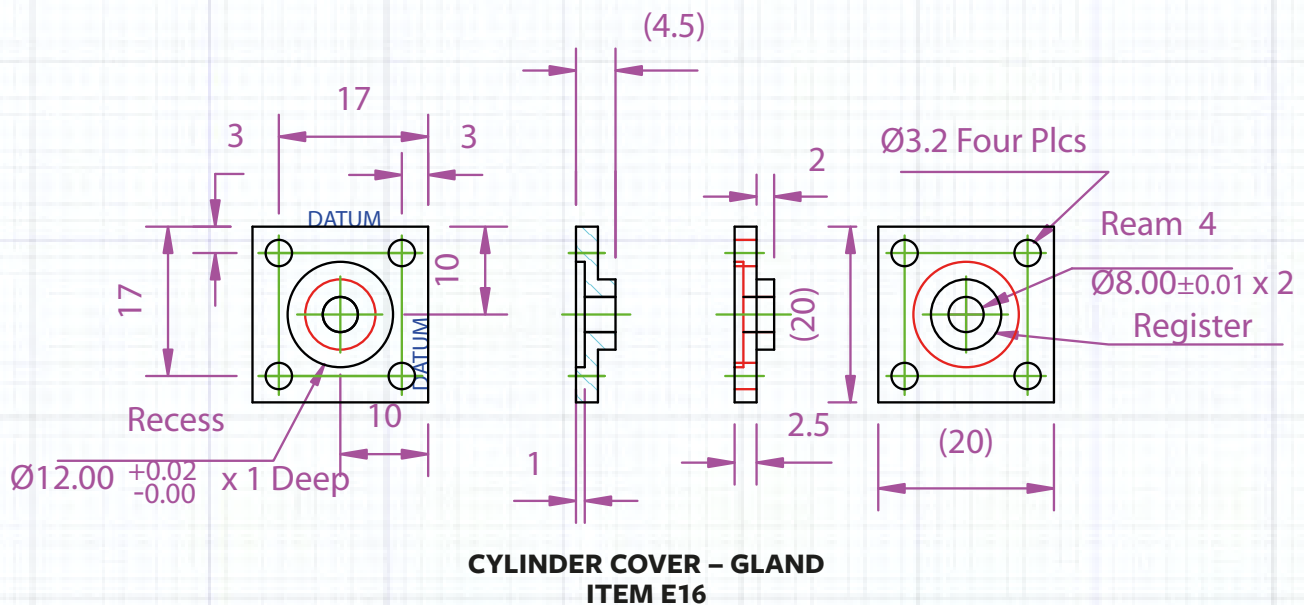
STAGE TWO – LATHE, USING TURNING FIXTURE

Hold the cover to the cover machining fixture with four M3 bolts but stop short of tightening.

Pass the securing bolt through the reamed hole in the cover and fixture into the M4 thread in the captive nut and tighten securely. Remove the four M3 bolts which were used to ensure alignment.

Using a sharp RH knife tool with only the slightest discernible tip radius, machine the $\text{Ø}8 \pm 0.01 \times 2\text{mm}$ register.

Remove the cover from the fixture and reverse, locating the $\text{Ø}8\text{mm}$ register into the fixture recess. Hold the cover to the fixture with four M3 bolts and M4 securing bolt but stop



short of tightening. Carefully tighten the four M3 bolts and whilst doing so check that the M4 securing bolt remains free in the reamed holes. When this is achieved, remove the M4 securing bolt and machine the Ø12 x 1mm recess, checking with the Gland Cover Register gauge. See photograph E41.

Next time we will turn to the flywheel.

« TO BE CONTINUED »

RIGHT – PHOTOGRAPH E41

Gland cover – 3rd stage: turning Ø12 recess to locate on cylinder rod end cover.



PRODUCT REVIEW

EXPO HARD WIRE CUTTERS

Code 755-80

£17.95 RRP

As we get older, due to loss of strength, mobility and perhaps arthritis, undertaking simple tasks becomes more difficult. One such task is the cutting of wire or rivets with cutters. The normal heavy duty type have a force ratio of about 1:8 when the end of the handle and a cutting position in the centre of the jaws are compared (slightly variable due to the positions of the work being cut and the hand on the levers). This means some cuts have to be done twice, turning the wire or cutters through right angles, sometimes making the need for careful positioning of the second cut, or we force the cutters down onto our

thigh to push down in an undignified way in order to increase the applied force.

Expo has a superb pair of cutters which will vastly reduce this problem. They have a 'unique' double lever system so now we are working at a ratio of about 1:16 yet little more movement is required in use. Cutting 1/8" rivets is now a very simple task. What is nice is that the cutting position on rivets with the jaws almost on the work is perfect for hammering into a small countersink without any further trimming. The cutting is further aided by the handles having soft feel grips and cleverly shaped ergonomic contours, making the action comfortable, easy and a pleasure rather than a real grunt! Expo claim 60% less effort is required during applications. The spring back is positive and, to keep the cutters to a convenient size when not in use, there is a convenient jaw lock.

Graham Sadler



Holes and More Holes

Don describes the vagaries of the front frame extensions employed in many Great Western designs and the difficulties encountered because of this in the GWR 4709 'Night Owl' project

BY **DON ASHTON**

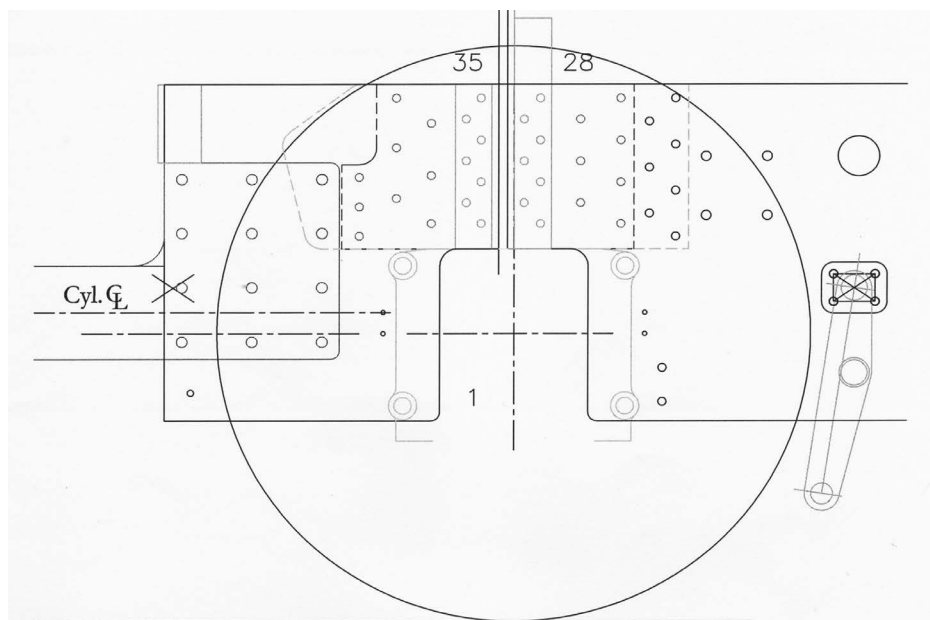
At the front end of the mainframes it was standard Churchward practice to carry the cylinder block on forged extension bar frames some 10 feet in length. On engines using a pony truck the substantial joint with the mainframes, just behind the cylinders, coincides with the heavy motion plate right across the locomotive. Just to complicate matters the leading driving wheel and its axle box slot also reside in this area. Oh – and the leading brake arrangement also wants room to function!

The potential weakness in slotting out for the axle box is met head-on by sandwiching the joint with a 1¼" plate on the inside and another of ¾" squeezed between mainframe and wheel outside. In fact when the axleboxes wear this latter plate takes a hammering from the wheel rim. The motion plate's 5"x5" angle irons are right in the middle of all this.

My drawing of the area shows where the modeller may fear to tread. The main pattern of 12 joint holes serve for fitted bolts of 1¼", driven in with considerable force. For convenience during the dismantling of 4115 the whole front unit complete with the cylinder block was turned upside-down to give a rare view of the lower bolt holes between cylinders and frames. The joggled irons were saved for reuse on 4709.

Notice the unit displaying three scallops. Specified as case hardened, this forms the pivot for the heavy longitudinal compensating beam between the leading spring and the pony truck. Each class of engines uses a different scallop according to the required weight taken by the truck. 4709 uses the rearmost scallop, placing the pivot 1½" ahead of the cylinder centreline. The photograph depicts 4115 2-6-2, but as we are using cylinders from 2-8-0 2861, whose tapped holes for the bolting of the pivot casting are to 28xx pattern, there was some head scratching in order to find a neat solution.

The drawing also shows the second brake hanger, and how obtusely the cross marking the leading brake hanger cannot align with one of the fitted extension frame bolts. The pivot has to sit on a joggled bracket (not shown). At least we have 6" extra room here than the 2-6-2 tank engines, which only just managed a leading brake at all! The astute will notice



that the cylinder bore is 2½" above but parallel to the axle line in common with several GWR Classes.

The angle irons are 5" x 5" x ¾" and that numbered 35 is straightforward enough, but hands up those who fancy curving number 28 up and over the wheel, for that is what it does. The actual motion plates are heavy castings carrying the slide bars. Although the holes for the horns are not shown, the horn castings require 8 fitted bolts each side of the slot. Outside of

the horns there are pairs of ½" holes. These enable alignment of the axle centres and the cylinder centreline 2½" above. This affects the dead centres, and both differently; the front dead centre by almost 2 degrees and the rear a shade more. In order that the eccentric pairs may be universal a stepped key is employed in the axle.

The mainframe started off far from straight, but soon returned to the straight and narrow after the Llangollen people had waved their magic wand! ■

RIGHT

4115 frames upside down showing the lower bolt holes. The 'scallop' referred to may be seen just to the left of the centre of the picture.



Home Workshop Lighting

Mike Haughton concludes his discussion of the options available to us for lighting our workshops by shedding some light on LED technology

BY MIKE HAUGHTON – CONTINUED FROM PAGE 17 MAY 2017

TYPES OF LUMINAIRES: LIGHT EMITTING DIODES (LEDs)

These consist of a junction between two doped semiconductors which produces light when direct current passes. These first appeared as low power indicators from 1968. They were either infra-red or red emitters. Infra-red types are still used in TV remote controls and we cannot see the light emitted. Development of LEDs is still ongoing and prices have fallen dramatically.

LEDs were produced able to emit infra-red, then red, then green by manipulating the semiconductor materials used. Eventually ultraviolet (UV) emitting LEDs were developed for Blu-Ray DVD players, which allowed phosphors to be added. The phosphors absorb UV and re-emit it at a lower frequency in the visible range. By mixing phosphor types the colour of the visible light can be manipulated. Figure 5 shows the construction of a single junction low power indicator LED.

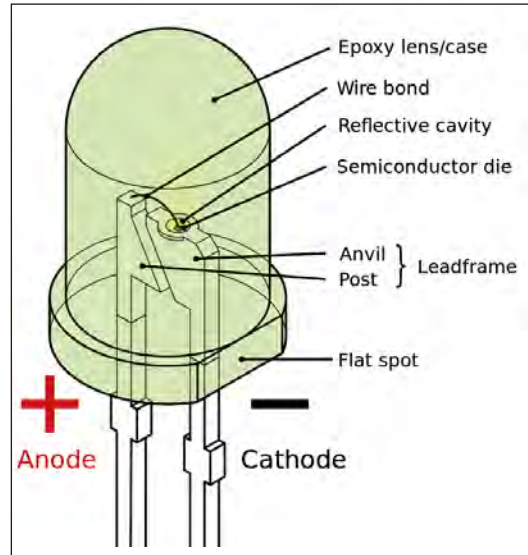
Higher power LEDs have large numbers of diodes 'integrated' onto a silicon wafer, sometimes described as COB (Chips On Board). Although energy efficient, higher power chips require backing heat sinks to stop them thermally running away. There can be several different colour diodes on one chip so colour variation is possible, but perhaps this is not useful in a workshop situation.

The LED technology is still developing and formats are still evolving. Many are surface mounted devices (SMD) these days.

LEDs are low voltage devices; they require constant current drivers for highest efficiency. Use the right driver – preferably buy a driver and LED together.

LEDs can have a very long life, over 20,000 hours or 20 years (I've never known one fail – Ed.). Although they are very efficient and physically robust their drivers may not be and may fail before the LED.

As to efficiency, expect at least 10 lumens per Watt. Read the specifications as some products are less efficient. These efficiencies include the driver.



**ABOVE
FIGURE 5**
Low power LED
indicator.

**ABOVE RIGHT
PHOTOGRAPH 10**
10W COB LED
weatherproof
flood light.

**BELOW
PHOTOGRAPH 11**
IKEA SMD LED
lighting strip.



High power LEDs are seriously bright and can damage your eyes! Position them where you don't look directly into them. There are some LED chips around that are several hundred watts input power. You don't need that amount of light in a workshop though. Roughly, a 10W LED equates to a 100W filament bulb.

It seems like there is a LED lamp for every occasion and every physical

format. There is more choice of colour temperatures and formats on line than in retail outlets – they are clearly having difficulty keeping up! I have used quite a number in my workshop and illustrate some types here.

Photograph 10 shows a 10Watt LED COB weather-proof flood light at 6000K, with the driver built into its case. It is IP65 rated – more on IP ratings later.





You should be able to see the postage stamp sized chip with its yellow phosphor coating. These lamps give a good light and make excellent machine lights.

Photograph 11 shows an IKEA sourced SMD lighting strip and driver that can be extended by plugging together units to give the desired length. The orange dots are the phosphor coated SMD's. These units are only available as Warm White 3000K units but they are good for display cabinets mounted below shelves.

Photograph 12 shows my Chester mill with two IKEA Jansjö LED lights added to a horizontal bar attached to the mill. These lights have flexible stalks that allow positioning close to the work and should they obstruct the movement of the table they just bend out of the way. These lights are low wattage, about 1.5watts, but do an excellent job when positioned close to the cutter. I have also

installed them on 2 drilling machines, a Warco and an Alpine. To attach them to the machine I have removed the supplied base and made simple modifications to fit them to a flat horizontal bar attached to the mill column. These £10 lights don't have IP ratings but the power supplies are 'wall warts' and mounted well out of the way.

INGRESS PROTECTION (IP) CODES

A workshop is not a particularly clean nor dry place - well mine certainly isn't. It's important to give some consideration to safe lighting as domestic stuff isn't usually IP rated. Ingress protection codes take the general form IPXY, where 'X' represents ingress of solid objects and 'Y' represents ingress of liquids. Table 2 is highly selective so consult the internet should you want to know more. I have not included codes above 6, although they do exist.

ABOVE PHOTOGRAPH 12

Chester 6x26 mill with 2 IKEA Jansjö lights.

BELOW TABLE 2

List of IP codes up to 6.

IP CODE	INGRESS OF SOLID OBJECTS 'X'	INGRESS OF LIQUIDS 'Y'
0	No protection	No protection
1	Solid objects (eg hands) > 50mm dia.	Drops of water falling vertically
2	Solid objects (eg fingers) > 12.5mm dia.	Drops of water, enclosure tilted up to 15°
3	> 2.5mm	Rain falling up to 60° from the vertical
4	> 1mm	Splashes of water, any direction
5	> 1mm and dustproof	Waterjets, any direction
6	> 1mm and dust-tight	Powerful water jets, any direction – watertight

A FEW MORE LED LIGHTS FROM MY WORKSHOP

Photograph 13 shows the end of a 1.5M LED batten, strip light, 45W, 6000K, 5200lm, 110lm/W. The photograph shows the cable cover open. The unit light cannot be replaced, nor is it dimmable; the cost is equivalent to a conventional protected electronic batten. I'm uncertain what the CRI is but the unit lights up instantly at full output and gives a very good light when mounted at ceiling height.

Photograph 14 shows a 600mmx600mm LED light panel being fitted to my workshop ceiling. These units are intended to be fixed into suspended ceilings, which I don't have. However, I found that aluminium frames are available. The photograph shows the panel being slid into the frame and shows the driver above the panel; 48W, 6500K, 3800lm, CRI=83 and 40,000 hours' life are claimed. This panel works really well and lights a 5mx5m room adequately but, in hindsight, two might have been better. These panels appear to be edge lit and give a rather satisfying diffuse light.

Photograph 15 shows it in action, from below, with the hatch to the attic open and a conventional protected T8 fluorescent lighting the upper storage area.

New LED lamp styles seem to be appearing almost every day now. Here are two styles that I have tried and find very useful in the house/workshop and in 'Anglepoise' type balanced arm desk lamps. They are available in warm white and daylight colours and with a variety of base fittings. The one shown in photograph 16 can be found by searching for 'LED retro filament bulb'; the one shown is 10W and is more than adequate for a reading or desk lamp. 7W versions are also available. The envelope appears to be glass.

Photograph 17 shows an LED 'corn cob' style 10W B22 base bulb. The individual surface mounted chips are obvious; the number present, 32 in this case, produce 900 lumens so apparently are not quite so efficient. The efficiency depends on the chips chosen by the manufacturer and the quality of the built-in driver. Notice that these corn cob bulbs will tolerate an input voltage range of 85 to 265 Volts AC. These bulbs are non-dimmable but come on instantly with very little heat produced. The corn cob envelope is clear plastic.

Both these lamps cost £3- £4 (delivered in the UK) and claim a life of 50,000 hours!



ABOVE – PHOTOGRAPH 13
1500mm LED batten.



ABOVE – PHOTOGRAPH 14
600x600mm LED light panel.

BELOW – PHOTOGRAPH 15
LED light panel in action.



IN SUMMARY:

MY WORKSHOP LIGHTING ADVICE

Don't accept cast off, second use, 'domestic' lighting for your workshop.

Go for LED panels or battens or fluorescent strip, with electronic ballast, for overhead lighting.

Go for LED lighting for spot lighting, machine and bench lights and work lights; you will save on energy costs and the LEDs will last a long time.

Try out whiter lights – 5000K or 6500K. (Fish tank lights can go to 16000K!) Very white lights annoy some and be careful not to look into the lamps.

Go for lighting with an IP6? rating. Bits fly around workshops and there is often dust and moisture about so plan for these eventualities.

Get the right LED driver for the LED panel/batten and avoid LED replacement tubes for fluorescent battens; they were a stop gap.

Should you have any comments, good or bad, you can contact me at mikehaughton@btinternet.com



ABOVE – PHOTOGRAPH 16
Retro LED filament bulb B22.

BELOW – PHOTOGRAPH 17
Corn cob style LED bulb B22.





More Convertible Rolling Stock

Jan-Eric describes how he extended the variety of the convertible rolling stock in his collection

BY **JAN-ERIC NYSTRÖM**

In a previous short series (December 2016 to February 2017) I described the making of the two dark brown coaches in photograph 1, coupled behind an ugly, utilitarian 'driver's wagon' containing a propane tank. By lifting off the detailed, prototype-like tops of the convertible coaches, seats are revealed, and the coaches double as passenger-carrying wagons.

Since I run my trains in two distinct locations – on my own track at our family's summer place in Hangö (Finland's southernmost town), as well as on the track at the Finnish Railway museum, some 90 miles away – I decided to build two more wagons to share between these locations, so that I wouldn't have to transport everything back and forth every time I decided to run on the other track...

This article describes the construction of the two new convertible wagons; the first is a prototype-like mail coach, similar in size to the previous two brown coaches. This mail coach can carry a propane tank as well as passengers. The second new wagon is a low-sided open goods wagon that can quickly be converted for carrying passengers, featuring a long, padded bench.

ABOVE PHOTOGRAPH 1

The author's multi-purpose wagons on the track at the Finnish Railway museum. In the background you can see a full-sized prisoner transport wagon (note the barred windows) and the original Hyvinge station building, dating from 1872.

A MULTI-PURPOSE COACH

The completed mail coach, painted bright orange, is already on the track at the museum in photograph 1, while photograph 2 shows the main components during construction – a process so similar to the making of the two previous, brown coaches that I won't repeat all the details in this article.

The frame of this mail/propane/passenger wagon had to be modified and widened to accommodate a propane tank of the standardized type used for barbecue grills here in Finland – I prefer to use such a tank since, when empty, it can be immediately exchanged for a full one at almost all petrol stations. Filling a special, custom built tank (albeit better fitting a prototypical frame) would certainly cause problems in that respect...

The tank holds 5 kilogrammes/10 litres of propane. This is sufficient for some 3 to 5 hours of running a smallish 7¼" gauge engine, depending on load. In fact, the ugly brown 'drivers wagon' coupled behind the little 0-6-0 in photograph 1 contains an identical tank – but this new mail coach is intended mainly for my upcoming Ten-wheeler, which has a tender suitable for sitting on and to carry water for the engine, but no room for propane storage.

Photograph 3 shows the basic shape of the wagon as a passenger carrying vehicle, with the tank inside it. As you can see, the truss bracing under the frame holds the tank securely in place. Two padded seats allow either two adults, or four to six small children, to ride on the wagon.

RIGHT PHOTOGRAPH 2

Components for the 1:8 scale, orange mail coach seen in photograph 1. At right, a 5 kilogramme/10 litre propane tank, of the type used with our barbecue grills.



**ABOVE – PHOTOGRAPH 3**

The tank is inserted into the wagon frame and is held in place by the braces.

**ABOVE – PHOTOGRAPH 4**

Adding the top hides the bench and the propane tank.

RIGHT – PHOTOGRAPH 5

Small parts for detailing the mail coach.

The lid on top of the tank is still under construction – it will have a separate cover for the regulator valve which attaches to the top of the propane tank. Fold-up handles will also be installed on the outer ends of the seats. With the 'top' placed over the seat (photograph 4) the wagon is converted to a prototype-like mail coach. The roof will be made of thin steel plate, attached with wood screws to the curved ribs.

Many small details are needed to get this plywood box to look like its full-size cousin. Photograph 5 shows the small metal parts needed for detailing. The gates, railings and door handles are made of stainless steel and brass and are either TIG-welded or silver soldered together.

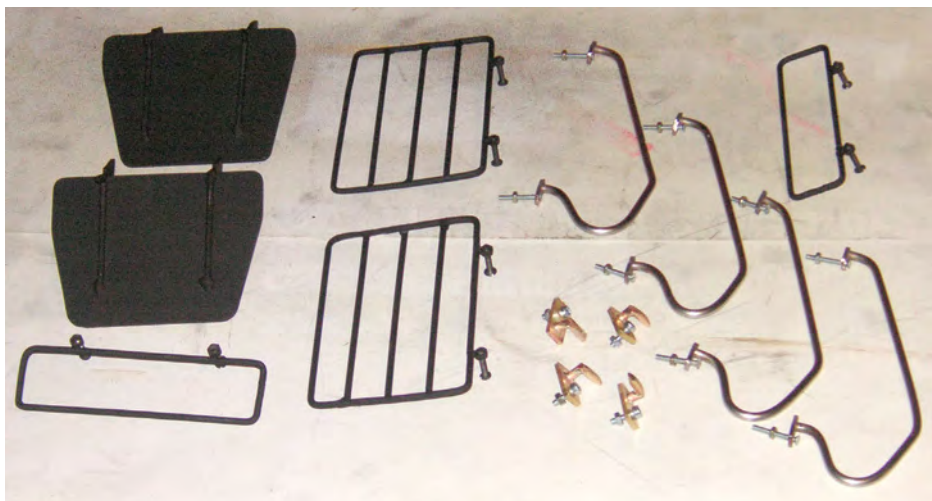
In photograph 6 'Switch Frog', our little garden friend, is wondering when the roof ventilators will be installed on the otherwise completed wagon...

A DUAL-PURPOSE OPEN GOODS WAGON

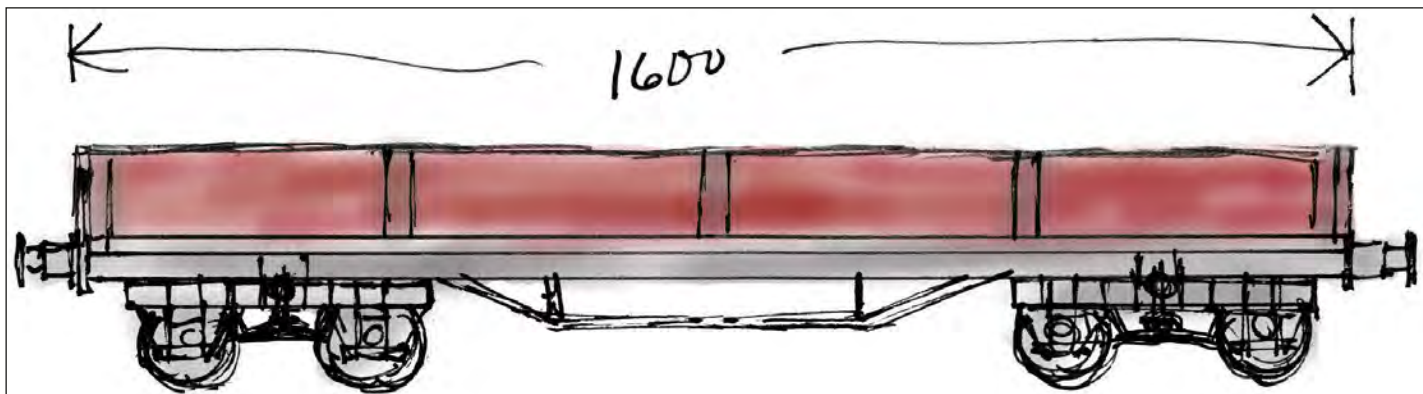
The orange mail coach and the two older, brown passenger coaches are all four feet long (excluding buffers), and can thus only take a limited number of passengers. I wanted to have one longer wagon for use at the museum. I also wanted this wagon to be convertible to something at least somewhat resembling a full-size prototype, just like the other wagons. Figure 1 shows a very quick, 'conceptual' freehand sketch of what I wanted it to look like. The goods

BELOW – FIGURE 1

A quick sketch to get an idea of what the new open goods wagon will look like...

**PHOTOGRAPH 6**

The almost finished mail coach – only the ventilators on the roof are still missing.



wagon's 'box' is over five feet long so, with the buffers, the total length of this wagon would be almost six feet.

Sketching some more, I tweaked the dimensions so that the sides and bottom of the goods wagon could be converted to a seat – figure 2 shows how. Note the shape of the coloured L's – one half of the wagon floor and its side (green) have the same shape and size (190 x 110 mm) as the vertical side of the seat and its foot rest (red). This means that the two L-shaped parts forming the wagon 'box' can each be rotated 90° (see the small inset at top right) and will then form the base for a bench – dual purpose parts! Adding a top for the seat (yellow), I'd have a bench as long as the wagon. End boards (blue) can be permanently attached to the frame.

After this little sketching exercise, I was ready to build the wagon! Using square steel tubing, cut in half with a thin, 1mm cutting disk in an angle grinder (photograph 7), I got two U-shaped channels of suitable dimensions. Small-sized steel channel is notoriously hard to find so this is a good way to fabricate your own. It is, however, very important to clean up the cut – as seen at left in photograph 8 the fresh cut is very ragged, with sharp slivers of steel that will certainly cut your fingers if you don't do something about it!

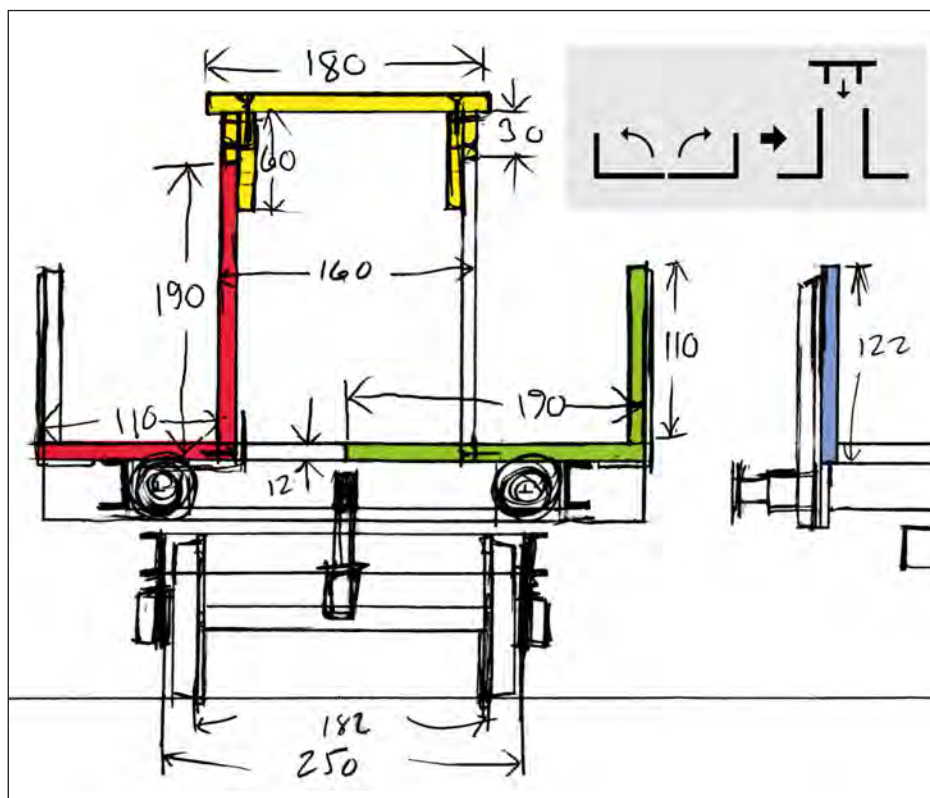
Applying the angle grinder carefully, in a slanted position to all edges, enabled me to clean up the cuts nicely, at right in the photograph. Now, I was ready to handle the material, and to build a wagon frame...

AN ODE TO TIG

Some years ago I bought a TIG welder (also called GTAW, for 'Gas-Tungsten Arc Welding') and I don't regret it for a moment! It is not one of the really low-cost, Far-East units, which don't have an automatic gas valve and require you to start the arc by scratching the electrode on the workpiece, with all the problems that entails. This model has 'HF' start, meaning that a high-frequency spark will automatically start the arc and supply the argon gas when you press the trigger. Sure, it did cost a bundle, around £1,000 including an automatically darkening welder's helmet and the necessary argon gas tank, but it has proved to be an invaluable tool in my Live Steam building.

The frame for my 0-6-0 loco, as well as the tender frame for the upcoming 4-6-0 were both assembled with angle iron in all corners (this was before I had the TIG). It takes quite a while to plan, mark out, drill and tap all the holes necessary to get frames assembled in that way, so this time, I decided to use welding, exclusively. This meant I could construct all the metalwork in a fraction of the time it would have taken otherwise.

Photograph 9 shows one of the frame stretchers, cut from 35mm x 50mm rectangular tubing, being welded to the sides of the frame. The king pin, an



ABOVE – FIGURE 2

Planning the metamorphosis; the wagon box converts to a seat. Measurements are in millimeters.

RIGHT – PHOTOGRAPH 8

Splitting a square tube in half.

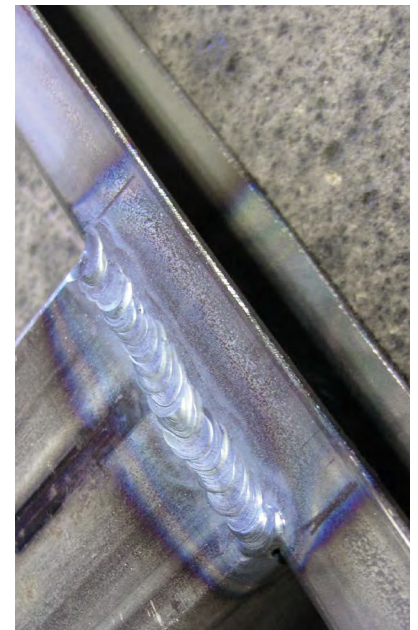
BELOW – PHOTOGRAPH 7

The ragged edges of the split tube must be cleaned up!



ordinary M12 bolt, is also welded, on both sides, into a hole drilled through the frame stretcher.

TIG welding is clean – it doesn't generate thick fumes or flying sparks, nor does it need any flux so the welds will not need the chipping away of slag, wire-brushing, cleaning, and possibly even grinding you have to do with a stick-welded seam. In photograph 10 you can see a very nice weld, if I may say so myself. Here, I used ordinary steel wire as a filler, melting the wire with the TIG arc and 'fusing' the frame parts together – a very calm process, compared to the often violent sputtering of stick or MIG welding. The photograph was taken immediately after welding – the joint isn't cleaned in any way, and it certainly doesn't need any grinding. Note, however, that the surfaces to be welded must be properly cleaned – and that you mustn't TIG-weld galvanized steel! If you do, the zinc will spatter and vaporize and, if you happen to inhale the smoke, you may experience a splitting headache... So, before welding galvanized steel, be sure to grind away the zinc coating from the area to be welded – as I did with the king pin bolt in photograph 9.



With a TIG welder, you can actually 'weld in miniature'! On thin materials you don't need the high amperage which is necessary for stick welding in order to melt the rod so very delicate work can be performed. I have, in fact, tested butt-welding 0.5mm thick steel plate – with only 10 amps of welding current, I got a very nice seam! In addition to current settings from 10 to 160 amps, my welder also has a 'pulse' function, useful for delicate work. In fact, whenever possible, I prefer TIG welding over silver soldering since it is much quicker and needs less preparation. Photograph 11 shows two buffer bodies; the one at left is stick welded, as carefully as I could, with ordinary rods, while the one at right is welded with the TIG, by just fusing the parts together, using no filler at all. The stick-welded part, here cleaned up, will still need substantial machining, for instance by turning on the lathe, while the TIG-welded one can be painted and used right away.

'Stick welding' is aptly named – if you happen to touch the rod to the molten weld bead, it sticks! That has happened to me innumerable times, using my old, cheap 'buzz box' welding transformer. I usually have to release the rod from the holder to cut the current – if I don't do that fast enough, the entire rod glows red hot!

Sure, TIG welding requires some manual dexterity too – the point of the electrode must be held very close to the seam, around 3 mm or even closer, depending on the amperage. The tungsten electrode is normally not consumed but it can stick to the weld if you accidentally touch the molten seam. This means you'll have to cut off and re-grind the point of the electrode, which does take a few

moments and consumes a few mm of the tungsten. I always have a set of ready-ground spare electrodes handy and simply exchange one whenever I goof, and re-grind the whole batch later. The most commonly available TIG electrodes contain 1 or 2 percent slightly radioactive thorium but, in order to avoid the risk of becoming glow-in-the-dark (by inhaling radioactive dust when grinding the points), I prefer to use somewhat more expensive, non-radioactive, cerium- or lanthanum-alloyed electrodes – a box of ten costs around £10 on eBay and, unless I goof very often, they do last a long time.

Even though the welder itself is expensive, the 'running cost' of TIG welding is about the same as for stick welding – since you don't need

ABOVE LEFT PHOTOGRAPH 9

The TIG welding work has begun.

ABOVE RIGHT PHOTOGRAPH 10

A neat TIG seam needs no cleaning up.

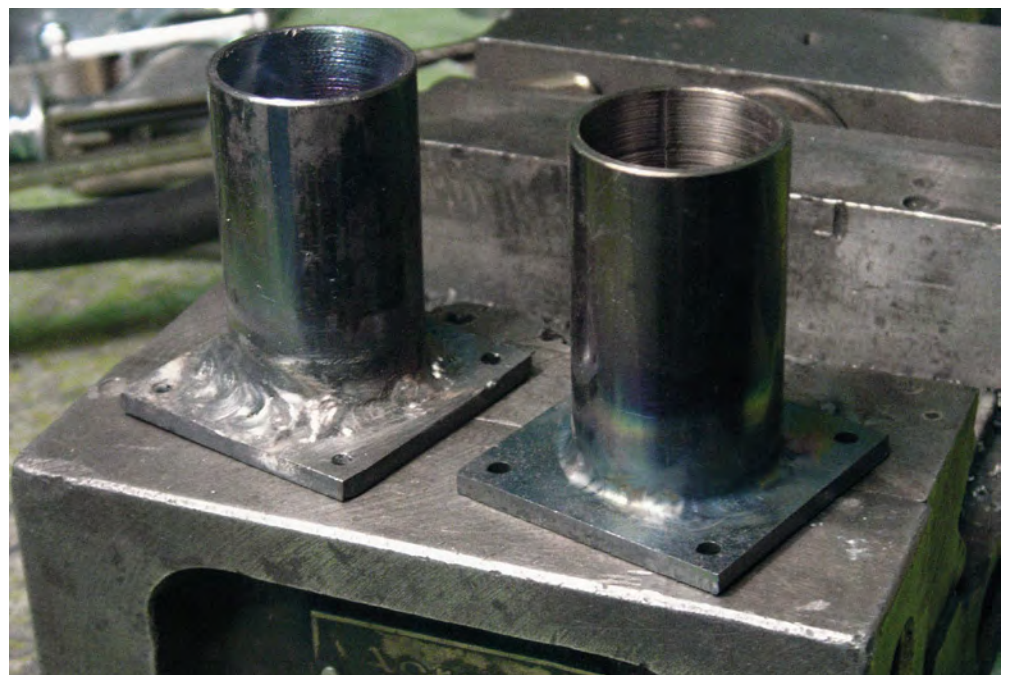
BELOW PHOTOGRAPH 11

There is a huge difference between stick and TIG welding!

to buy welding rods. With carefully formed parts you don't need any filler at all and, if you do, ordinary steel wire suffices – even strips cut from the material you're welding are OK. However, there is the cost of the argon gas – a refill of an empty tank will cost around £100, depending on location and transport costs. For this goods wagon, I used about a quarter of a tank, costing me £25 or so.

MIG (GMAW) welding is definitely more expensive since, with it, you need both gas and special, copper-coated welding wire. Personally, I would never even consider flux-cored, gas-free MIG, because of the very high cost of the cored wire, even though the welder itself can be cheap. Also, you cannot get a seam as neat as with TIG.

« TO BE CONTINUED »



Building a Panther Tank

Chris discusses the manufacture of the suspension, wheels and hubs for his 1/12th scale Panther G tank

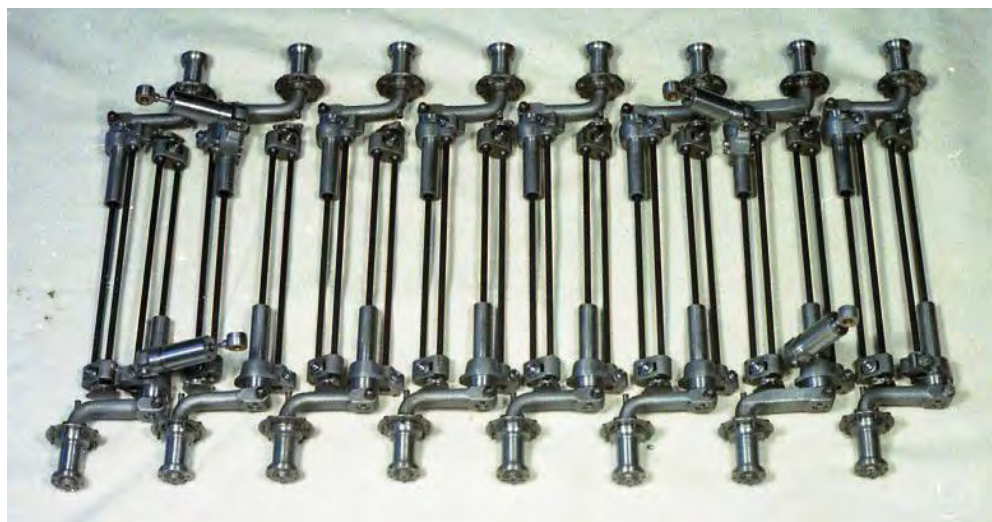
BY CHRIS MEYER – CONTINUED FROM PAGE 10 MAY 2017

THE SUSPENSION IN DETAIL

As I mentioned last time, there are eight swing arms on each side of the tank. The full-size Panther had three types of swing arms – I will loosely call them small, medium and large. Numbered from the front, no. 1 is medium, 2 and 7 left and 8 right are large with the remaining 10 arms being small. (Unfortunately my arms had been copied from photographs of the 'A' chassis in Spielberger's book which showed no. 7 as being a medium variety. I intend to make two new large arms - sometime.) The arms I have numbered had bump stops fitted to the chassis side plates and there were also shock-absorbers fitted to no's 2, 7 and 8. Obviously these arms had to resist higher twisting loads on the wheel spindles than the smaller ones. The small and medium arms were steel forgings, straight to begin with and hollowed out almost to the rectangular trunnion end. The opposite end was bent round 90°, this then being machined to form the spindle. The large arm was, I think, a solid steel casting, maybe a forging.

Back to the arms on my vehicle. I used ¼" by ½" steel strip to make the small and medium versions, rough taper turning them in a 4-jaw chuck and leaving the trunnion end as it was. A hole was drilled and reamed through this end on all the arms and the trunnions, and a grooved collar, fitted in these. I intended to fit 'O'-rings in the grooves to keep dust out. The arms were then bent at right angles. The large arms were cut from a wider lump of steel in a rough L shape. These were also drilled and reamed for the trunnions. The arms could then be drilled and tapped to fit the wheel spindles, which I had decided to make separately, and these were turned from EN8M rod.

A lot of time was then spent filing the small and medium arms to an elliptical section; the large arms had a roughly rectangular section. Once I was happy with the general appearance I silver soldered the trunnions and arms together. The cotter pin holes were drilled and spot faced.



ABOVE PHOTOGRAPH 12

All the torsion arm suspension units lined up for inspection.

BELOW PHOTOGRAPH 13

The right hand side, showing nos. 1 and 2 swinging arms, the final drive seating and bolt holes.

I then started on the trunnion bearing housings, hoping to make reasonable copies of what, on the FSV, were steel castings. Starting with around twenty steel blocks, the ½" hole for the bronze bearing was bored, using this subsequently as a reference to carry out a fair bit of the machining, some of it on a rotary table. The 6mm hole for the second shorter bar was drilled and reamed, the pitch between the bars being 0.4". The mounting face was turned to leave a rim around the ½" bore, which fitted in the ⅛" hole in the chassis side plate.

The housings were mounted on a fixture to drill the holes, set at 5° to

the vertical, into which the cotter pins fitted. This angle matched the cotters so that the flat on the second torsion bar was exactly vertical. It only remained to drill and tap the 12BA bolt holes, using a drilling template. Bronze bushes were then pressed into the housings.

TORSION BARS

Before I started on the torsion bars I had to test different diameters of spring steel. Past experience suggested that the bars on my vehicle would need to be of a smaller diameter than scale. The bars on the FSV were, as far as I know, just over 2 in. diameter. Reducing this to 1/12th



scale would give us a diameter of around .170". I knew this would be too stiff so I made up a test rig to hold two test pieces of 10SWG (.128" diameter) of the correct length, using grub screws to lock them in place. This device was a simplified version of the suspension components already described. I could then use a spring balance to pull the swing arm up against a degree scale. This at least gave me some guide for achieving the correct ground clearance, suspension travel etc.

As I mentioned last time the estimated scale weight of the model was around 56lb and this, spread over 16 axles, results in a static load of 3.5lb per wheel position. Although I knew I could easily try out a larger diameter of spring steel, I decided to press on with the production of the torsion bars using the 10SWG steel as this seemed promising.

I cut off the 32 plus a few spares and then it was a matter of fixing $\frac{1}{4}$ " diameter silver steel heads onto each end of the bars. When you say this quickly, it sounds easy. The heads are fairly short and I had some doubts as to how they could be secured.

I used a knurling tool fitted with two fine pitch straight wheels to raise the diameter of the bar by .006". I then applied 'Loctite' high strength retainer and pressed on the heads. After checking out some test pieces, I felt confident enough to proceed with the rest.

To get the correct appearance, I blended the smaller diameter bar into the larger head using a radius tool.

Once I had turned the heads to 6mm I machined the flats on one end of all the bars, leaving the other end until I could devise an adjustable jig for machining the relative angles of the different bars, as I really did not want to make these bars over again if I got it wrong.

All the angles of the cotter pins and the position of the swing arms relative to the ride height had to be considered and, to further complicate matters, no's 1 and 8 bearing housings on the right hand side and no. 7 on the left, were fitted with the shorter bar behind the trunnion. One other little thing – all the cotter nuts to the rear of the engine bulkhead were underneath the housings. Access was through holes in the belly plate, with small cover plates closing them off; this is the same as on the FSV. It took me quite a while to work out what angles applied to which bars. Anyway, I finally succeeded in getting the model sitting at the right height.

Fitting all the bars takes quite a time, not helped by the limited space inside the chassis. The shorter bars had to be fitted first from the opposite side, through the $\frac{1}{2}$ " holes and through the appropriate 6mm holes in the yoke and locked in the bearing housing. I locked all the long bars in the swing arms, fitted them into the bearing housings and the hole in the yoke and tightened the central cotter. Finally, the bearing caps closed up all the $\frac{1}{2}$ " holes.



ABOVE – PHOTOGRAPH 14

Left-hand rear track adjuster and rear shock absorber.

BELOW – PHOTOGRAPH 15

Underside of the belly plate, showing holes giving access to the suspension tapered cotters – right-hand rear end.



This arrangement of twin torsion bars allowed the bogie wheels to be pushed upwards nearly twice the distance as would be possible using a single bar. So I assume the designers at MAN thought it was worth all the extra complication but I bet the people having to replace broken bars, in often freezing conditions, failed to share their enthusiasm!

BOGIE WHEELS AND HUBS

The bogie wheels are basically partially dished steel pressings. I started off with .037" sheet, cut into squares with a central hole. These were turned on a mandrel, ten at a time, to produce discs of the required diameter. I turned a simple punch and die with a central spigot to locate the wheel discs and then used a press to form them. The mounting faces are flat; the outer face has the rims bolted to it and the inner faces are fitted to the hub flanges. A lip is formed, which is at 16° from the horizontal, on the edge of the wheel. I actually rolled this lip after pressing the blanks.

On the FSV the rims are turned to the same angle so that, when bolted together, they form a shallow 'V'. The tyres had steel wires moulded inside, to stop them expanding, with the inner diameter formed to the same shallow 'V'. In principle this holds the tyre on the wheel but the arrangement did cause problems in service. Two different rims were used, one type having a flange to protect the side of the tyre against damage caused by the track guide horns. These rims were used on the centre pairs of bogies.

As for my wheels, I decided to bond the tyres to the rims. I made two split tyre moulds which also located the rims and using a product called 'Devcon Flexane', a two part mix synthetic rubber (having already treated the rims with Devcon Primer) I injected the mix using a large metal syringe. The whole operation was quite successful, finishing up with the required 32 wheels, plus 4 spares. To add a little extra touch, I engraved the sides of the mould with the name of one of the

manufacturers 'Continental', plus the size, '860/100 - D'. This was a bit tricky as the sides of the tyres are angled. The mould was set up on a rotary table, turning it to give the right spacing between the characters, and using reversed characters, of course. It was only necessary to engrave the two sides of the mould which produced the tyres for the outer pairs of wheels.

Then I had the tedious job of drilling all the holes in each wheel and rim. I made up drilling jigs for this operation. The complete bogie wheel/suspension units alone required 1280 12BA hex head screws and 1056 nuts.

The hubs were fabricated using steel tube which required the inner end to be expanded. To do this I made up two punches and dies; one smaller pair to get the initial expansion, after annealing the tubes, followed by the finishing pair. The outer end has a collar silver soldered on. I mounted the tubes on a mandrel to finish turn the outside, then silver soldered on the inner wheel flange. The bores were then machined to fit two 'oilite' bearings and a single lip oil seal. All that remained then was to drill and tap the wheel mounting holes at the outer end of the hub.

IDLER WHEELS

The idler wheels consist of six spokes, which are steel sheet, shaped over a former, a hub and an 'L' section rim. All these bits were silver soldered together, turned and bored to receive two ball races and one lip seal.

The idlers are mounted on a cranked axle, again with a long trunnion fitted in a bushed housing and, as with the swing arms, an inner bearing within a housing, soldered to a raised section at the rear end of the bearing longitudinals.

These housings have a circular plate with a centre hole, which has two cut-outs to receive the inner end of the trunnion, which is machined to leave two lugs at 180° to each other to act as a bayonet fitting. The plate is bolted to the inner face of the housings, copying the fitting on the FSV. All this complication was to allow the trunnion to be pushed through the housings and the plate to lock it in place. To make assembly of these parts a little easier I made the bayonet end as a separate part which fitted in a tapped hole in the trunnion. Before machining the flats on this piece I screwed it in far enough to get minimum end float of the idler assembly and then scribed a vertical line to enable the flats to be milled in the correct position. I had to make a special spanner with a rectangular socket to unscrew the fittings.



**ABOVE
PHOTOGRAPH 16**

Left-hand side – the outer bogie wheels and the final drive are yet to be fitted.

**RIGHT
PHOTOGRAPH 17**

Track brake housing with shock absorber behind.



**BELOW
PHOTOGRAPH 18**

The final drive housing and contents.



In between the housings there is a substantial link, keyed to the trunnion (this is splined on the FSV). Fitted in the link is a large diameter pin with a hole tapped to take the threaded adjuster spindle. The two spindles each run in a spherical bearing seated in housings secured to the backplate with two long bolts. The rear ends of the spindles have hex sockets to allow for track adjustment. There are covers each side, held on the bolt shanks which protrude through the backplate. Some of my photographs may show the original housings which were soldered onto the backplate – this was before I got more ‘inside information’.

FINAL DRIVES AND SPROCKETS

I have always been very interested in the various ways of steering track vehicles and the number of different methods tried out over the years has amazed me. Some were fairly simple, such as the two clutches and brakes used on a lot of earlier tanks. It was cheap and easy to manufacture and was used on all the Russian T34 tanks. On heavier vehicles, however, it is not so good.

Once I had decided on the Panther, I was sure of one thing, I did not wish to use the simple method as used on a lot of model tanks, that is, two motors with separate speed controllers. I wanted one motor, installed in the engine compartment at the rear, with a suitable steering unit and gearbox at the front. Short shafts would couple to the inputs of the final drives. This is the setup on the full-size Panther.

As the final drives would decide the output shaft centres, on whatever steering unit I came up with, I decided to make them first.

At that stage I had gathered quite a lot of measurements and photographs from various sources. There is a good sectional view of the drives in the Spielberger book so from this information I completed my own drawings. I really wanted to make as close a copy of the full-size units as I could.

The housings are quite a complicated shape to reproduce. Three shafts, each running in two bearings, carry the input pinion driving a spur gear with an integral pinion, fitted to the centre intermediate shaft. This pinion drives a spur gear mounted on the output shaft which has a large flange at the outer end and the sprocket is bolted and doweled to this.

I fabricated the housings and the rear covers from various parts to simulate the steel castings used on the FSV. The rear covers have two bearing housings, with the sides machined to form a figure 8. The input housing is longer to accept an oil seal, which protrudes through the apertures in the side plates, as mentioned earlier on. All the parts were screwed, then silver and soft soldered together. The covers were screwed and doweled to the housings, then the bearing bores were machined. Six ball races and two lip seals were fitted on each side.



ABOVE – PHOTOGRAPH 19

Right-hand sprocket and bump stop - the final drive shown is the early one, replaced after new information had been acquired.

BELOW – PHOTOGRAPH 20

Final drive housing bolted onto the left-hand side plate, and the front bump stop.



The gear ratio on the full-size unit is 8.4 to 1. The gears I purchased at the time gave a reduction of 7.4 to 1. Even then, the clearances within the housings were very tight.

The sprockets were constructed in the same manner as on the FSV, that is, with two toothed rings, the hub and the outer carrier plate with the six apertures. I made the sprocket rings from $\frac{1}{8}$ " plate, drilling 17 holes on a pitch circle diameter slightly larger than that of the finished pitched circle of the teeth. I made a form cutter using four pieces of gauge plate screwed to a circular hub and form turned to the correct tooth profile. I then had to back off all the gauge plate blades to give a cutting clearance, followed by hardening and tempering. (I had numbered the blades and the appropriate positions on the circular hub.)

I set up the four sprocket rings in a dividing head and successfully cut the teeth. When I first drove the tracks I noticed they tended to hang up on the sprocket, causing the track to bunch up against the leading bogie wheels. I had recently purchased a book on the MAN tank works which contained a lot of good quality photographs, one, in particular, of an early Panther on test with the track doing exactly the same thing. When I next went to Bovington I took a decent protractor with me and very carefully checked the FSV. I did find that the teeth were slightly more angled than mine so I set about grinding the blades and then mounted the rings up again to re-cut the teeth. It did make a difference – no more hanging up.

« TO BE CONTINUED »

CLUB NEWSROUND



BY JOHN ARROWSMITH

There are a couple of good rallies this month that could make a good day out. At Cardiff MES the 27th Welsh National Rally will be held over the 10/11th June in Heath Park and on the same weekend the 25th Sweet Pea Rally will be held at the Rainsbrook Valley Railway of the Rugby Society. As always, if you are interested in attending either of these events contact the respective clubs direct for full information.

Inote in the railway press that the owners of the 10¼" gauge railway in Poole Park in Dorset were given 24 hours to quit the site and stop operations. The reason is that the Council has decided that it no longer meets current Health and Safety standards and they have decided to implement the H & S Executive's 28 page 'Passenger Carrying Miniature Railways Guidance on Safe Practice' document. The council do want to keep it operating but to comply with their new conditions will require a great deal of money and new investment. Fencing alone will cost £30,000 so how they think possible investors will cover costs like these I don't know.

In contrast the **Merseyside Live Steam and Model Engineers** line will be moving to a new location in Calderstone Park where they have been for 75 years. If planning permission is granted then the move will be completed by the end of 2017. The move will also give them their own club house and will enable them to open more often and allow larger locomotives to operate. Let's hope all this work is successful.

I note there is a project in place to construct a new miniature railway in Riverside Park at St Neots in Cambridgeshire where the local Rotary Club have contributed £500 towards this venture which it is hoped will be up and running in May. I have no details regarding gauge etc. but it will be interesting to hear about this development and who will be operating it. Yet another new miniature railway is to be built, this time in North Cornwall where a site adjacent to the Mawgan Porth Village Hall will see a new 7¼" gauge railway constructed, half a mile long. A Royal Scot locomotive is available and another is on order. There will also be a station building and platform along with all the usual offices as well as a 40-space carpark. Exciting times in the miniature railway world.

There has been lots of winter maintenance taking place at Broadfields, the home of the **Isle of Wight Society**. One of the Wednesday gang's projects has been to make some additional curved track sections which will link the turntable to the running line in the forward direction. This will remove the problems with locomotives having to 'back up' onto the track. A new alarm has been fitted to the level crossing. Refurbishment work has also been taking place on

rolling stock both for the raised and ground level tracks. The club has a new editor for their newsletter. Tim Ostley has taken over the job as well as overseeing the website. The boating section is seeing an increase in numbers and the club has decided to re-introduce a 'pay-as-you-go' area to their boating lake so that visiting members of the public can try their hand at model boat operation. This could be quite a revenue earner if it is successful.

BELOW

A super new set of points built by members at the Kings Lynn Society.



**ABOVE**

Traversing the splendid girder bridge at the North London club at their New Year 'Steam Up'.

At the **North London SMEE** the raised track was closed in February whilst the shuttering for the new step over blocks was poured. When completed it will improve the access to the tunnel shed and COSH cabinet. The members have devised a good way of carrying out this work. The concrete is mixed in the car park and then poured direct into their hopper wagon where it is transferred by rail to the site where it is shovelled into the shuttering. Whilst this is going on they are also rebuilding the steps at the steaming bay to a better height and width. Additional work at the site includes a new roof to their garage with a major refurbishment to the main station roof as well. The traverse for the new steaming bay is taking shape and plans are in hand for the new machine shop to be sited close to the steaming bays for the raised track. New wheelsets are also being fitted to some of the passenger carriages to replace the worn out sets. Plenty of winter activity here which will no doubt stand them in good stead for the operating season.

The **Southern Federation of Model Engineering Societies** AGM was held at The Claymills Pumping Station at Burton on Trent in March. This interesting venue provided the opportunity for all the attendees to see the work of the Claymills Pumping Engine Trust. It has been a mammoth task to restore the engines in this Victorian pumping station, which is still virtually as it was in its heyday. Five coal-fired Lancashire boilers are still in position with two fully operational and the venue really is an excellent example of Victorian engineering.

At the meeting itself, the various reports contained all the usual information regarding membership numbers and all the relevant Health and Safety details. The boiler Registrar reported that some club boiler inspectors are still not completing the paperwork in the correct way. This really is important because should there be a problem with any boiler covered under the scheme then, without the correct information being available, the insurance cover could be invalid, with all the problems that could bring. The meeting was requested to ensure that all paperwork is completed correctly and on the right forms. Some boiler paperwork is still being received using the old forms which of course are not valid. Accident claims were highlighted by the Club Insurance officer and it was pointed out that the cost of claims is increasing; an example was cited where a payment of £5000 was made to a claimant and this was almost matched by solicitor costs of £4000. So be warned, incidents like this are always a possibility, so make sure your H & S procedures are fully up to date together with the necessary Risk Assessments as a major incident could be very serious for any society. The Annual awards were also made and these are detailed in the Young Engineers page.

The **Romney Marsh MES** do not open for public running operations but the members here do have a busy schedule of meetings and site work to keep them all fully occupied. During their winter meetings program they enjoyed talks on a wide range of subjects from the making and servicing of injectors to Swiss Railways and the mysteries of AutoCAD to name just a few. On the

site a new loading ramp/traverse is under construction and the Chairman is working on the hydraulics to ensure the swing bridge is easier to operate.

Ongoing work at the **Ryedale Society** has included the replacement of point work at Erimus yard and Gilling no. 4 after re-sleepering. The curve from Erimus has also been reset to a 40-foot radius as it had become a bit tight. The signal box here has had the Box Diagram updated as it had become difficult to read. Work on the 'lean to' has been completed and attention has now been focused on the workshop. This has resulted in signs that this is becoming a reasonable workspace. Maintenance has also been carried out on the club's carriages ready for the running season.

It seems strange to say that it has been a busy summer at this time of year but down under at the **Steam Locomotive Society of Victoria** that's exactly what it has been. The Saturday 'Gatherings' are being well attended with members being brought up to date with the committee details and being able to see what other members are working on. Around the track the new locomotive unloader is proving its worth making it easier and safer to get locomotives onto the track. New air operated mechanisms have been installed at Petticoat Junction along with relocating all 16 point levers. It's not all good news though as a massive rainstorm flooded the tunnel with nearly a metre of water and debris.

The latest issue of the newsletter from the **Worthing & District SME** reports on the passing of one of their long-serving members Dr John Sayer. The family presented the club with the contents of his workshop and the resultant sale provided sufficient funds to purchase a new 5" gauge Class 73 diesel-electric locomotive. This has been painted in Pullman style livery along with two existing coaches. The locomotive was named Dr John and the two coaches were named after his daughters. A naming ceremony took place at one of their operating days and the family were delighted that Dr John has been remembered and honoured in this way.

It is over two years since the club decided to improve the existing toilet facilities but they are now well on their way to seeing this becoming a reality with planning permission being granted. It was the work of member Ian Aitken who made it all possible but sadly he will not see the results of his efforts as he passed away last year. Members here have also renewed three sections of corroded steelwork on their track, which is seeing increasing numbers of passengers being carried on their operating days. To help reduce the waiting times for trains two new carriages are being constructed which hopefully will provide the extra capacity needed. ■

YOUNG ENGINEERS

BY JOHN ARROWSMITH

The AGM of the Southern Federation took place at the Claymills Pumping Station in March along with the awards for the Federation's Young Engineer of the Year. The Young Engineer of the Year for 2016 was Angus French who is 16 and is a member of the Eastleigh Model Boat Club. Angus has built a number of quality models including a self designed 3D printer which has been the Class winner at both the Midlands and Brooklands exhibitions. It has been shown and demonstrated at different exhibitions around the country and, combined with his commitment to the club and his help with younger members, it all contributed to his selection as this year's winner. Members at the AGM responded to this award with acclaim but unfortunately, due

to other circumstances, Angus could not be there to receive the handsome trophy. It will be presented to him in the near future at a suitable venue by Mike Chrisp, the Federation Award officer.

Three other young men were selected to receive a special award this year from the Federation to acknowledge their abilities and commitment to club activities in model engineering. All three were from the Hereford SME where they are valued and trusted members of club. Ewan Willcocks, 15, Noah Eggar, 14, and James Newby, 15, have completed the Bronze and Silver levels of the 7¼" Gauge Society's Proficiency Scheme and all of them have built a range of quality models as well as being fully active members at the club. They have been involved in all sorts of different activities from helping the more

junior members to operating the signal box on Public Running days. They had all travelled to Claymills to receive their certificates from Mike Chrisp, which gave them a new experience of a working Victorian Engineering establishment that is totally different to today's working environment.

It might be appropriate here to mention the DBS (Disclosure and Barring Checks) procedure which has replaced the CRB checks. It would appear that in the main it is not compulsory for model engineering clubs to undertake DBS checks for their members. Hopefully this will encourage more clubs to invite young people onto their sites and again try and persuade them that engineering and model engineering in particular can help them in their future careers. ■

BELOW

The group photograph of award winners, their families, instructors and sponsors.



JUNE DIARY

1 4	East Somerset SMEE. Railway Operating during the Royal Bath Show each day.	4	Chelmsford City MR. Public running at Meteor Way 14:00 – 16:30 every Sunday.	4	Portsmouth MES. Public running 14:00 – 17:00 Bransbury Park every Sunday.	11	Leeds SMEE. Public running at Eggborough from 10:00.
3	Bridgend MR. Open Day at Parc Slip Nature Reserve noon – 16:00.	4	Chingford MES. Public running in Ridgeway Park 14:00 – 17:30 every Sunday.	4	Rochdale SME. Public running Springfield Park noon every Sunday.	11	Ryedale SME. Public running at Gilling 12:30 – 16:30.
3	Crowborough Light Railway. Public running 14:00 – 17:00 Eridge Road.	4	City of Oxford SME. Public running in Cutteslowe Park 13:00 – 16:00.	4	Sale Area MES. Public running in Walton Park noon – 16:00 every Sunday.	11	Valley Road MES. Public running from noon.
3	Ickenham & DMES. Public running noon – 17:30 at Ickenham.	4	City of Sunderland SME. Open Day at Roker Park from 13:30.	4	Scunthorpe MES. Public running 11:30 – 16:30 Victoria Park.	11	Westland & Yeovil DMES. Public running 11:00 – 16:30 Westland Leisure Centre.
3	Model Engineers of NI. Public running Ulster Folk Museum noon – 17:00.	4	Coventry MES. Public running at Ryton Pools Railway 13:00 – 16:00 every Sunday.	4	Taunton SME. Public running at Vivary Park 14:00 – 17:00.	11	Wolverhampton MES. Public running at Baggeridge Park 13:00 – 17:00.
3	Nottingham SME. Pacific Locomotive Rally. Contact the club direct for more information.	4	Crawley MES. Public running at Goffs Park Light Railway. 14:00 – 17:00 every Sunday	4	Welling & DMES. Public running at Falconwood 14:00 – 17:00.	11	Worthing & DMES. Public running at Field Place 14:00 – 17:00.
3	Romford MES. Public running from 14:00 at Arleigh Community Centre.	4	Doncaster MES. Public running at Thorne Park Railway 11:00 – 15:30.	4	West Riding SLS. Public running 13:30 – 16:30 every Sunday.	17	Bradford MES. Open Day at Northcliffe 10:00 – 17:00.
3 4	Model Steam Weekend at the Battlefield Line, Market Bosworth, from 10:00.	4	Esk Valley MES. Public running at Voigrie Country Park 14:00 – 17:00 every Sunday.	4	West Huntspill MES. Public running 14:00 – 16:00.	18	Guildford MES. Public running at Stoke Park 14:00 – 17:00.
3 4	East Herts Miniature Railway. Public running at Great Amwell 10:30 – 16:30. SG12 9RP	4	Echills Wood Railway. Public running at Kingsbury Water Park.	4	Wirral MES. Public running at Royden Park 13:00 – 15:30.	18	Huddersfield SME. Open Day at Greenhead Park 11:00 – 16:00.
3 4	Malt Kiln Farm Steam Rally, Tinklers Lane, Eccleston 10:00 – 17:00. PR7 5QY	4	Frimley Lodge MR. Public running at Sturt Road 11:00 – 17:00.	4	Wimborne MES. Public running 11:00 – 16:00. BH21 3DA	18	Melton Mowbray MES. Steam Up at Whissendine 10:00 – 14:00.
3 4	Merthyr Tydfil DMES. Public running at Cyfarthfa Park noon – 17:00 every weekend.	4	Fylde SME. Public running at Thornton Cleveleys 13:30 – 16:00.	4	Wortley Top Forge MR. Public running from noon. S35 7DN	18	Northolt MRC. Public running 14:00 – 17:00 Northolt Village Community Centre.
3 4	North Staffs and Cheshire TE Club Steam Party at Klondyke Mill Draycott in the Clay. DE6 5GZ	4	Grimsby & Cleethorpes MES. Public running at Waltham Windmill noon – 16:00 every Sunday.	6	Bromsgrove SME. Public running at Avoncroft Museum 11:30 – 15:00 every Tuesday.	18	Plymouth Miniature Steam. Public running in Goodwin Park 14:00 – 16:30.
3 4	Ryedale SME Driver Training Weekend at Gilling. Contact the club direct to book a place.	4	Harrow & Wembley MES. Public running every Sunday from 14:30.	9	Birmingham SME. G1MRA 70th Anniversary visit.	18	Rugby SME. Public running at Rainsbrook Valley Railway 14:00 – 17:00.
3 4	Saffron Walden MES. Public running noon next to Audley End Railway.	4	Halesworth & DMES. 'Steam Up' from 10:30 Reydon, near Southwold.	10	Brighton & Hove MR. Public running in Hove Park 14:00 – 17:00.	18	South Downs Light Railway. Public running 11:00 – 15:30 Pulborough Garden Centre.
3 4	Sussex MLS. Public running at Beechurst Railway 14:00 – 17:00 every weekend.	4	Kinver & West Midland SME. Public running 14:00 – 16:30.	10	Frimley Lodge MR. Charity Day for the Air Ambulance 11:00 – 16:00.	18	West Huntspill MES. Fathers' Day Special 14:00 – 16:00.
3 4	Vale of Aylesbury MES. Miniature Traction Engine Rally at the Buckinghamshire Railway Centre.	4	Lancaster & Morecombe MES. Public running Cinderbarrow Railway 10:30 -15:45 every Sunday.	10	Leyland SME. GWR Rally and all things Brunel from 11:00.	18	Worcester & DMES. Public running at Diglis 14:30 -16:30.
3 4	Whissendine Miniature Steam Open Weekend from 10:00 daily at Melton Mowbray.	4	Malden DSME. Public running 14:00 – 17:30 Thames Ditton Railway.	10	Nottingham SME. English Electric Day (GCRN) from 11:00.	21	Derby SMEE. Visit of Vintage Mopeds and Autocycles to the club.
3 5	International Steam days at City Park, Turnhout, Belgium.	4	Mid Cheshire MES. Public running at Blakemere Village noon – 16:00 every Sunday.	10 11	Avonvale MES. Public running 11:00 – 16:00 at Dunnington.	24	MSRVS Rally at Gander Lane, Tewkesbury from 10:00 both days.
4	Ashmanhaugh Light Railway, Open Day 14:00 – 17:00.	4	Mold MES. Public running at Celyn Wood 11:00 – 15:00 at Northop, Flintshire.	10 11	Claymills Pumping Station Open Day non-steam from 10:00.	24	Evergreens MR. Public running 10:30 – 16:00 at Main Road Stickney, Lincs.
4	Basingstoke DMES. Public running at Viabes Craft Centre 11:00 – 16:00.	4	Moorlands Railway Charity Day 14:00 – 17:30 between Scarborough & Whitby.	10 11	Model & Miniature Weekend at Stapleford Park Leicestershire from 10:00. LE14 2SF	24	Ipswich MES. Ipswich Transport Festival 10:00 -16:00.
4	Bournemouth SME. Public running at Littledown Park 11:00 – 15:30 every Sunday.	4	North London SME. Public running at Colney Heath 14:00 – 17:00.	10 11	25th Sweet Pea Rally at Rugby MES Rainsbrook Valley Railway from 10:00 daily.	25	Birmingham SME. Forest of Dean Historic Vehicle Day.
4	Carlisle & DMES. Public running 14:00 – 16:30 Blackwell Road. CA2 4PS	4	North Staffs MES. Public running at Brampton Park 14:30 – 16:30 every Sunday.	11	Steam Locomotive Society Victoria, Echuca Steam Rally, Rotary Park, Echuca.	25	Chesterfield MES. Public running at Hady noon – 16:00.
		4	Northampton SME. Public running in Delapre Park 14:00 – 17:00.	11	Bedford SME. Public running at Summerfields Railway 10:30 – 16:00.	25	Harlington LS. Teddy Bears Picnic 11:00 – dusk High Street.
		4	Polegate Oaks Railway. Public running 14:00 – 17:00. BN26 5AY	11	Bracknell Railway Society. Public running at Jocks Lane 14:00 – 16:30.	25	High Wycombe MES. Public running 11:00 – 17:00 Holmer Green.
				11	Bristol SME Special Steam Day at Ashton Court noon – 17:00.	25	Phoenix MES. Public running at Telford Steam Railway 11:00 – 16:00.
				11	Cheltenham SME. Public running at Hatherley Lane 13:00 – 17:00.	25	South Durham SME. Open Day 10:00 – 16:00 Hurworth Community Centre Darlington.
				11	Harlington Locomotive Society. Public running 14:00 – 17:00 High Street.	25	Sutton Coldfield MES. Steam Up at Little Hay from 10:00.
				11	Hereford SME. Public running Broomy Hill noon – 16:30.	25	Taunton SME. Creech Miniature Steam Rally from 10:00.

Details for inclusion in this diary must be received at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of where every event is being held. Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions.

Index to Volume 38

SUBJECT INDEX

A

Adding a Captive Drawbar: **2/57**
 Araldite Millstone: **6/204**
 Atkinson Steam Wagon: **1/13, 2/50, 3/90, 4/129, 5/148, 6/185, 7/12, 8/13, 9/19, 10/24, 11/29, 12/18**
 Automata Review: **1/8**

B

Book Reviews:
 'Great Western Eight Coupled Heavy Freight Locomotives': **4/127**
 'Great Western Manor Class': **9/18**
 'Laser Cutting and 3D Printing for Railway Modellers': **11/13**
 Breather Valve for the EMCO FB2: **1/29**
 Building a 3D Printer: **1/24, 2/62, 3/96, 4/135**
 Building a Panther Tank: **11/7, 12/33**
 Building the LNWR Coal Engine: **1/18, 2/65, 3/75, 4/133, 5/173, 6/198, 7/29, 8/19, 9/24, 10/14, 11/34, 12/9**
 Building the LNER/BR Y4: **1/31, 2/47, 3/88, 4/137, 5/162, 6/181, 7/15, 8/36**
 Burrell Road Locomotive: **10/7**

C

'Chicken' – Building a Live Steam Engine: **1/10, 2/39**

D

Daily Grind: **2/64**
 Designing MR No. 1104: **9/34, 10/26**
 Dual Purpose Coaches: **6/194, 7/32, 8/27**

E

Electric Traction Engines: **3/81**
Exhibition Reports:
 Bristol Model Engineering Exhibition: **5/170**
 Doncaster Model Engineering Exhibition: **2/43**
 London Model Engineering Exhibition: **7/24, 9/7, 10/10**
 Manchester Model Engineering Exhibition: **10/37**
 Midlands Garden Rail Show: **8/17, 9/14, 11/22**
 Midlands Model Engineering Exhibition: **6/210, 7/7, 8/23**
 Spalding Model Engineering Exhibition: **12/7**

G

Gear Hobbing: **1/22, 2/68**

H

'Hart' No. 12: **3/105**
 Holes and More Holes: **12/25**
 Home Workshop Lighting: **11/14, 12/26**

I

Injectors for an Isle of Man Peacock: **10/20**

K

'Katie' Update: **5/155**
 Kempton Steam Museum: **12/13**

L

London Museum of Water and Steam: **7/35**

M

Making a Regulator Clock: **1/1, 2/59, 3/100, 4/121, 9/42**
 Making and Using Wooden Laps: **1/7**
 More Church Clocks: **4/128**
 More Convertible Rolling Stock: **12/29**

N

New BESTT Training Initiative: **1/26**
 Notes of a Beam Engine Builder: **6/205**

P

Portable Track: **9/29, 10/31**
Product Reviews:
 EXPO Cutters: **12/24**

Q

'Quick and Dirty' Loco Shed: **11/18**
 'Quickie' – Building a Battery Powered Locomotive: **3/94, 4/112, 5/158**

R

Rally Reports:
 Cardiff Steam Rally: **3/79**
 Great Dorset Steam Fair: **5/145**
 Sacrewell Steam Rally: **4/118**
 Shrewsbury Steam Rally: **6/192**
 Sweet Pea Rally: **8/33**
 Taunton Steam Rally: **5/153**

Readers' Letters:

DAG Brown: **6/209**
 Martin Gearing: **8/12**
 Howard Lewis: **2/46**
 Jan-Eric Nyström: **6/209**
 Graham Sadler: **8/12**
 Jarmo Schrader: **6/209**
 Peter Squire: **6/209**
 Chris Stapleton: **8/12**
 Phil Wiseman: **6/209**

S

Simple Singing Bird Automaton: **3/85**
 So You Want to be an Ironmaster: **9/22**
 Spring Tensioner for a Bandsaw Blade: **9/10**
 Steam Plant: **4/109, 5/165, 6/201, 7/20, 8/7, 9/15, 10/33, 11/23, 12/22**
 Stirling Engine – a Bicentenary: **3/73**
 Strong Enough?: **8/10**
 Stumpf Goes Home: **7/18**
 Swarf Spinner: **10/18**
 Swiss Boiler Test: **4/116**

T

Turning Buffer Heads: **1/16**
 Two-Faced Encounter at Rippingale: **11/28**

V

Visit to the Pimlico Light Railway: **12/16**

W

Workshop from Scratch: **2/37**

Y

'Yorkie' – a Yorkshire Engine Company 0-6-0: **1/5, 2/54, 3/98, 4/125, 5/167, 6/190, 7/40, 8/30, 9/9, 10/22, 11/11**
 Yorkshire Clock: **9/28**

NOTE:

Articles are referred to by their issue number within the volume and the page on which they start. Issue numbers run from 1 (July 2016) to 12 (June 2017). The issue and page are separated by a ' / ' so, for instance, '5/47' refers to page 47 in the November 2016 issue.

AUTHORS' INDEX

A

John Arrowsmith: 2/43, 3/79, 4/116,
5/170, 6/192, 6/210, 7/7, 7/24, 8/17,
8/23, 8/33, 9/7, 9/14, 10/10, 10/37
Don Ashton: 12/25

B

Alan Barnes: 10/7
DAG Brown: 4/118, 4/128, 9/28, 11/28, 12/7

C

Patrick Carnegy: 2/37, 6/205
Paul Carpenter: 4/127, 9/18
Trevor Carter: 8/10
Derek Crookes: 1/5, 2/54, 3/98, 4/125,
5/167, 6/190, 7/40, 8/30

E

Martin Evans: 11/22, 12/16

G

Graham Gardner: 9/22
Martin Gearing: 4/109, 5/165, 6/201,
7/20, 8/7, 9/15, 10/33, 11/23, 12/22
Edward George: 5/145

H

David Hartland: 1/16, 2/64, 5/153, 6/204
Mike Haughton: 1/22, 2/68, 11/14, 12/26
Doug Hewson: 1/31, 2/47, 3/88, 4/137,
5/162, 6/181, 7/15, 8/36
Malcolm High: 1/5, 2/54, 3/98, 4/125,
5/167, 6/190, 7/40, 8/30, 11/13
Hotspur: 1/18, 2/65, 3/75, 4/133, 5/173,
6/198, 7/29, 8/19, 9/24, 10/14, 11/34,
12/9

J

Ian Jones: 3/81

K

Nick Kane: 3/105

M

David Machin: 1/7
Jacques Maurel: 9/10
Graham Meek: 1/29, 2/57
Chris Meyer: 11/7, 12/33
John Moorhouse: 3/85

N

Jan-Eric Nyström: 1/10, 2/39, 3/94, 4/112,
5/158, 6/194, 7/32, 8/27, 9/29, 10/31,
11/18, 12/29

R

Alan Reid: 10/20
John Reynolds: 1/1, 2/59, 3/100, 4/121,
9/42

S

Graham Sadler: 1/13, 2/50, 3/90, 4/129,
5/148, 6/185, 7/12, 8/13, 9/19, 10/18,
11/29, 12/18, 12/24
Graham Sheard: 3/73
Mark Smithers: 1/26, 5/155, 7/35, 12/13
John Spokes: 7/18
Michael Start: 1/8

T

Roger Thornber: 1/24, 2/62, 3/96, 4/135

W

Mike Wheelwright: 9/34, 10/26
Peter Wood: 10/22, 11/11

QUICK GUIDE

CONSTRUCTION ARTICLES:

Atkinson Steam Wagon: 1/13, 2/50, 3/90,
4/129, 5/148, 6/185, 7/12, 8/13, 9/19,
10/24, 11/29, 12/18
Building a Panther Tank: 11/7, 12/33
Building the LNWR Coal Engine: 1/18,
2/65, 3/75, 4/133, 5/173, 6/198, 7/29,
8/19, 9/24, 10/14, 11/34, 12/9
Building the LNER/BR Y4: 1/31, 2/47,
3/88, 4/137, 5/162, 6/181, 7/15, 8/36
'Chicken' – Building a Live Steam Engine:
1/10, 2/39
Designing MR No. 1104: 9/34, 10/26
Dual Purpose Coaches: 6/194, 7/32, 8/27
Electric Traction Engines: 3/81
'Hart' No. 12: 3/105
Making a Regulator Clock: 1/1, 2/59,
3/100, 4/121, 9/42
More Convertible Rolling Stock: 12/29
Notes of a Beam Engine Builder: 6/205
Portable Track: 9/29, 10/31
'Quick and Dirty' Loco Shed: 11/18
'Quickie' – Building a Battery Powered
Locomotive: 3/94, 4/112, 5/158
Simple Singing Bird Automaton: 3/85
Steam Plant: 4/109, 5/165, 6/201, 7/20,
8/7, 9/15, 10/33, 11/23, 12/22
'Yorkie' – a Yorkshire Engine Company
0-6-0: 1/5, 2/54, 3/98, 4/125, 5/167,
6/190, 7/40, 8/30, 9/9, 10/22, 11/11

GENERAL INTEREST ARTICLES:

Araldite Millstone: 6/204
Automata Review: 1/8
Burrell Road Locomotive: 10/7
Daily Grind: 2/64
'Katie' Update: 5/155
Kempton Steam Museum: 12/13
London Museum of Water and Steam:
7/35
More Church Clocks: 4/128
Stirling Engine – a Bicentenary: 3/73
Two-Faced Encounter at Rippingale:
11/28
Yorkshire Clock: 9/28

GENERAL RAILWAY ITEMS:

New BESTT Training Initiative: 1/26
Stumpf Goes Home: 7/18
Swiss Boiler Test: 4/116
Visit to the Pimlico Light Railway: 12/16

WORKSHOP PRACTICE,
TOOLS AND EQUIPMENT:

Adding a Captive Drawbar: 2/57
Breather Valve for the EMCO FB2: 1/29
Building a 3D Printer: 1/24, 2/62, 3/96,
4/135
Gear Hobbing: 1/22, 2/68
Holes and More Holes: 12/25
Home Workshop Lighting: 11/14, 12/26
Injectors for an Isle of Man Peacock:
10/20
Making and Using Wooden Laps: 1/7
So You Want to be an Ironmaster: 9/22
Spring Tensioner for a Bandsaw Blade:
9/10
Strong Enough?: 8/10
Swarf Spinner: 10/18
Turning Buffer Heads: 1/16
Workshop from Scratch: 2/37

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ADVERTISERS' INDEX

17D Miniatures.....	4
Abbots Model Engineering.....	5
College Engineering Supply.....	45
Ems (International) Ltd.....	5
Gauge 1 Model Railway Association.....	6
Greenwood Tools.....	5
Home And Workshop Machinery.....	48
Horley Miniature Locomotives Lip.....	46
Iseasteam.....	46
Items Mail Order Ltd.....	46
Laser Cutting.....	46
Live Steam Models Ltd.....	44
Lynx Modelworks.....	6
Macc Model Engineers.....	46
Maxitrak Ltd.....	44
Model Engineering Supplies (Bexhill).....	46
Parkside Railways.....	45
Polly Model Engineering Ltd.....	44
Power Capacitors Ltd.....	46
Pro Machine Tools Ltd.....	46
Ride On Railways.....	45
Routout CNC.....	45
Station Road Steam.....	47
Stuart Models.....	2
Tee Publishing Ltd.....	43 & 46
The Steam Workshop (Hewson Models).....	6
Tracy Tools Ltd.....	4
View Models.....	46
Walker Midgley Insurance.....	44

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3 1/2 INCH GAUGE OK KRAUSS 0-4-0T

Built from an O.S kit twenty years ago and kept for display since, it's in new and unsteamed condition. Silver soldered superheated boiler, feed by axle pump with auxiliary hand pump in the offside side tank. Complete with its original factory assembly instructions and display track. **£3,250**



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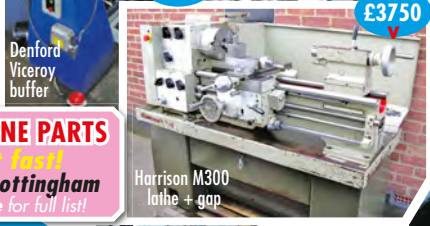
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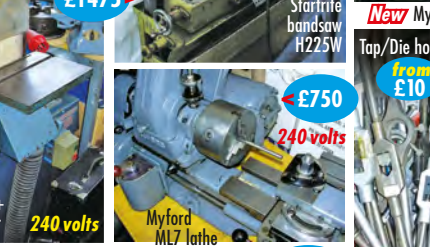
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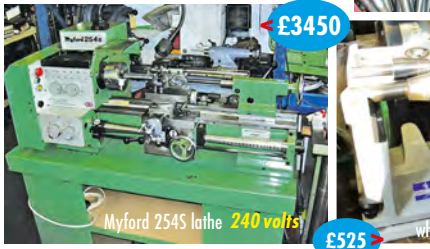
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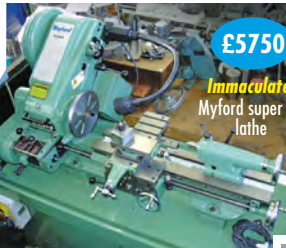
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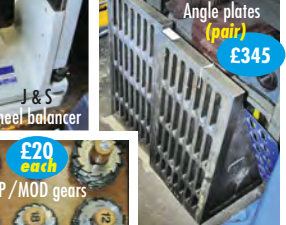
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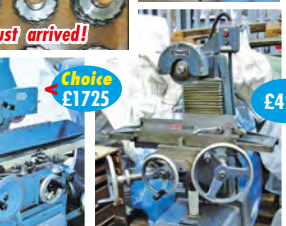
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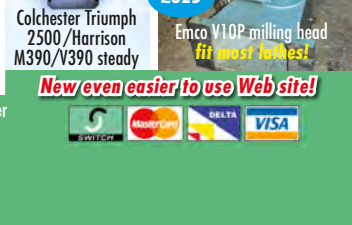


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