

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 219 No. 4574 • 24 November - 7 December 2017

MODEL ENGINEER

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COVER FEATURE

Debbie
The Jan Ridders
Two Stroke
Engine

**Wally's
New Teeth**

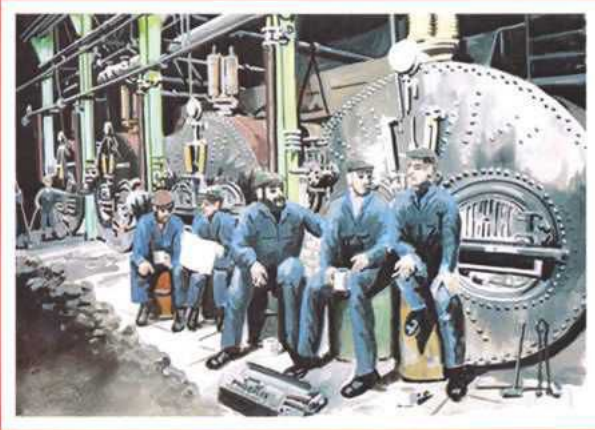
**SOMBRE
Harvest**

WATER
Everywhere

Wide-A-Wake Boiler



Retired Master Boilermaker, Alan McEwen's new book:



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Lancashire Mill Towns of the
1960s.

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RIVET LAD – Lusty Tales of Boiler Making in the Lancashire Mill Towns of the 1960s.

Published by Sledgehammer Engineering Press Ltd in hard back on high quality paper, 183 A4 pages with 145 monochrome photographs. RIVET LAD consists of 13 chapters:

- Obediah Blackroots's Owl Gob Mill Lancashire Boiler Job,
- Samuel McGrew's Grasshopper Brewery Cornish Boiler Job,
- Cranberry Sawmills, Ruston-Proctor Locomotive Re-tube Job,
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Vertical Boiler, a Stationary Locomotive Boiler, a huge steam Accumulator converted from a Lancashire Boiler and much more.

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Published by MyTimeMedia Ltd.
Suite 25S, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
+44 (0)1689 869840
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Model Engineer, ISSN 0026-7325, is published fortnightly with a third issue in May and October by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 93.00GBP (equivalent to approximately 132USD). Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineer, Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at dsb.net 3 Queensbridge, The Lakes, Northampton, NN4 7BF. Air Business Ltd is acting as our mailing agent.



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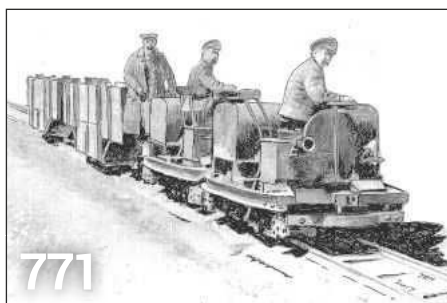


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Our front cover features Robert Knox's version of Jan Ridders' two stroke engine. (Photo: Robert Knox.)

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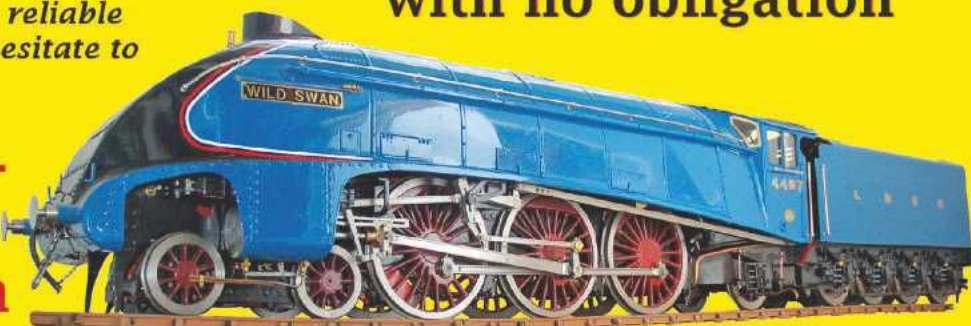
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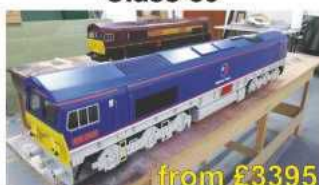
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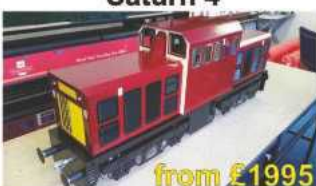
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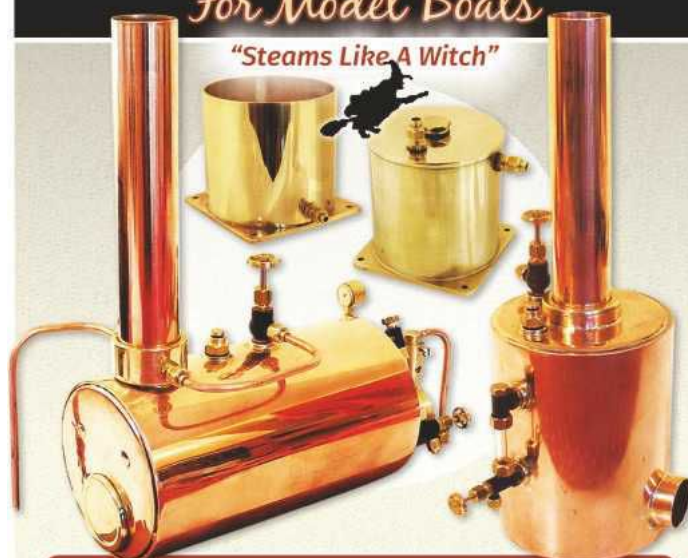


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Lest We Forget

The guns finally fell silent at the Battle of Passchendaele one hundred years ago this month. Terence Holland visited the battlefield and reports later in this issue on what he found there.

Most of us of my generation, I should imagine, knew someone who fought in the First World War. My own grandfather William fought at Passchendaele but 'copped a blighty' and was sent home. He lost an arm but narrowly kept his life. My great-uncle Fred also fought in the First World War and was, eventually, the only survivor from his platoon. After the war he was quite unable to take life too seriously, marrying my great-aunt, finding a comfortable position in the City of London as a shipping clerk and passing the rest of his life in a haze of whisky, cigarette smoke and rather off-colour jokes. Both he and my great-aunt lived to celebrate their one hundredth birthdays.

Neither of these two men would talk about their experiences of the war. They were made of 'sterner stuff' and belonged to a generation that has now passed entirely into history and will, before very long, also be beyond the reach of living memory. We have a lot to thank them for though and I hope they will never be forgotten.

Getting Started

There is a perception, I believe, that model engineering is a difficult hobby to get started in. After all, there are all those skills to learn, not possessed apparently by ordinary mortals, and all that expensive equipment to buy. This perception is not helped when the model engineering exhibition hall is entered and we are confronted by all those beautifully made models. I remember thinking 'I could never make that' when confronted by a particularly fine model. (I still can't, but then we can't all be Cherry Hill,

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can we?) Like anything of this nature, though, the journey of a thousand miles starts with a single step and the key, surely, is to enjoy the journey.

It's surprising what you can make with a few simple tools – a small workbench and a vice (the most important of them!), a saw, some drills and a set of files. From there, the collection soon builds up and the purchase of major items soon has to be considered.

Alternatively, of course, there is the kit scene. This went through a bad patch, I think, a few years ago when the offerings of a particular company sometimes left much to be desired. Although intended for the newcomer, with the promise of assembly using little more than a screwdriver, some of these kits proved to require the attentions of an experienced model engineer who could persuade the parts, often quite against their will, to fit together. These days, however, that is just a bad memory and it is possible to buy, at reasonable cost, a locomotive kit that will fit together and result in a really useful engine at the end.

Otherwise, it is likely that the first major purchase will be a centre lathe. This, for most people, will involve a major outlay of cash so it is a purchase that has to be carefully considered. Once it is bought and installed, the purchaser is then faced with what looks like a very steep learning curve to get it doing anything useful. A new series by Graham Sadler addresses these issues. Extending over the next several months

Graham's series, aimed at beginners, will take us through the selection and purchase of a lathe and then, step by step, how to get the best out of it.

Even if the purchase of a lathe is out of the question, at least for the time being, that shouldn't prevent a good start being made. There are clubs all over the country packed with the necessary facilities and full of highly experienced and knowledgeable members. It is surely very much in our interests to encourage new members and provide them with the opportunity to get 'stuck in', especially if they are youngsters, who are the life blood of our clubs in the future. The Eastleigh Young Engineers (see Pat Hendra's letter in *PostBag*) and the Pimlico Light Railway are excellent examples of ventures aimed at youngsters. We need more like them.

Club Secretaries

We are always very keen to publicise your events in our Club Diary so please send us, if possible, your calendar for the next six months or so, or longer of course if possible. Please drop me a line at the email address given below.

Martin R Evans, Acting Editor

Martin Evans can be contacted on the email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.

mrevans@cantab.net



DIANE
CARNEY
Editor



MARTIN
EVANS
Acting Editor

New Gears for Wally

Bob Reeve
moves on to
the cutting
of a new set
of teeth for
Wally.



Continued from p.660
M.E. 4572, 27 October 2017

The next stage was to cut the gear teeth in a blank. My blanks were mounted on an arbor held in a collet through the centre of the rotary table - again a CNC operation. The blank size for 48 teeth is given by $(48 + 2) * \text{mod } 0.5 = 25\text{mm}$. The blank must be mounted so that the centre tooth on the cutter is at the centre height of the blank (photo 11).

I opted for cast iron gears, partly because I had some suitable continually cast bar but also because it is easy to machine and the rack-form cutter has no relief. Machining was just as easy as I hoped but the programming provided the challenge I was looking for! To keep the program versatile I used parameters for the key variables such as number of teeth, face width and tooth depth with subroutines to provide multiple cuts to each tooth. The relevant code is given below.



CNC milling a gear.



Wally's World.

% Gear Hobbing

G15 G17 G21 G40 G49 G50
G69 G80 G90

%G15 CARTESIAN CO-ORDS
%G17 XY PLANE
%G21 MILLIMETRES
%G40 CANCEL CUTTER
RADIUS COMP

%G49 CANCEL TOOL LENGTH
OFFSET

%G50 RESET ALL SCALE
FACTORS TO UNITY

%G69 CANCEL CO-ORD
SYSTEM ROTATION
%G80 CANCEL MOTION MODE
%G90 ABSOLUTE DISTANCE
MODE

% SET DATUM position X=0
RH face of gear Y=0 Cutter
touching circumference of
gear Z=0 Mid tooth on cutter
on CL

M3 f60
M6 T0 S500
M3
G0 x0Y-10 A0
#41=0 (Start at Tooth no.)
#42=48 (No Teeth)
#43=2.4(Depth of cut)
#44=0.5 (Module)
M98 P100 Q[0+#42]
G0 Y-15
M5
M30

O100 (Tooth Cut)
G0 A[#41*360/#42]
G1 Y[#43*0.3*#44]
G1 x-18
G1 Y[#43*0.6*#44]
G1 X0
G1 Y[#43*0.9*#44]
G1 x-18
G1 Y[#43*#44]
G1 X0
#41=[#41+1]
M99



Assorted mod 0.5 gears.

As can be seen, the resulting code is relatively compact; just 25 lines (plus annotation) for gears with a sensible minimum of say 12 teeth up to the maximum capacity of the set up. The code was written for Mach 3 on an X3 mill with a fourth axis (axis A) but anyone using it should check its suitability for use with their own equipment. Some familiarity with parameters and sub-routines would be beneficial for making any changes. I recommend Marcus Bowman's book for those as yet unfamiliar with such things (ref 4).

I took the opportunity to make a few gears with the face wider than needed, more like the gear rods that are available commercially. It would then be possible to part off a gear for a particular application with exactly the correct face width and boss dimensions. I was pleasantly surprised how easy it all was. So much so that the world began to fill up with all sorts of gears that might be useful (photo 12).

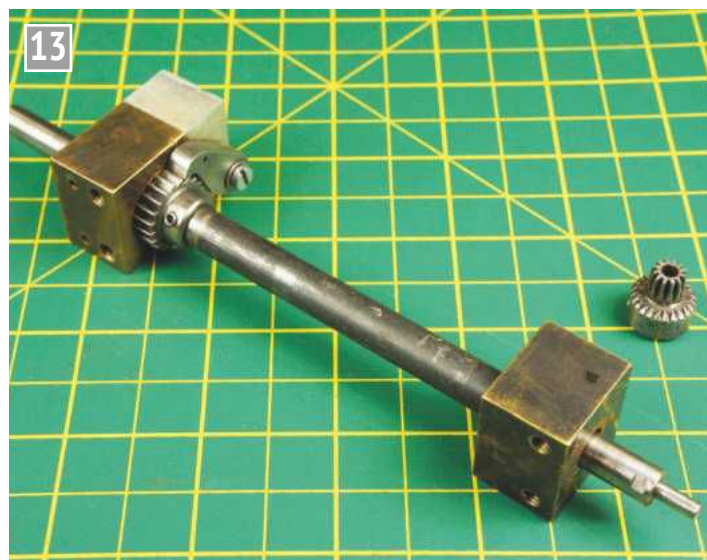
Eventually I settled on gears of 12 teeth and 48 teeth giving a reduction of 4:1. Two reduction stages would drive Wally and the first bell and a third 4:1 reduction would drive the second bell. I did encounter a problem with the gear centres needing to be greater than the theoretical value but more of that later. There was also the problem of

the 12-tooth gear being such a small diameter that I could only use a small diameter bore unless the gear was made to overhang the end of the 7mm diameter drive shaft (see photo 13).

I replaced the moulded gears in the first stage with cast iron and moved the drive to the bells and Wally so it would be after the last 4:1 reduction stage. I hoped this would make Wally's activities a little less frantic. I reasoned that, based on previous experience, there was no point in testing the windmill at home and took it straight to the Nephew's house, a decision that turned out to be a mistake.

The thing failed again within a few weeks. The cams that operated the bells had bent the lever arms and the cast iron gears were no longer in mesh and very rusty. Clearly water ingress was a problem and the drain holes I had provided had not done enough to prevent it. However, the bent lever arm was more problematic. It looked as if the wind turbine had been running in reverse but I could not see how that might have happened. The tail vane should have kept it pointing into the wind but all the indications were that it had not.

I straightened out the bent bits, re-engaged the gears, emptied out the water, drilled a few more drain holes and did what I should have done



Ratchet and pawl with 12-tooth gear.

last time - run it outside my own back door. On a balmy summer's day, with very light winds, the windmill swung slowly and intermittently through a considerable angle on its vertical pivot at the top of the mounting pole. This was indicative of more or less random changes in wind direction at short intervals. With this very variable light breeze it was possible that the wind speed could fall to near zero which would stop the windmill then, a short time later, the breeze would start up again more or less in the opposite direction. Before the tail vane could swing it back

to face the wind the turbine would run in reverse. I had not appreciated that the ball bearing mounted turbine rotor spun up very quickly and, with the multistage reduction gears, there was enough flywheel effect from the rotor to bend the actuating arms of the bell cranks, which had insufficient clearance to rock in the opposite direction. To stop this a ratchet wheel and pawl were added to the first stage input shaft (where the torque is low). In photo 13 the turbine rotor can be seen mounted at the top, left end of the shaft. The ratchet and pawl can be seen next to the bearing block and



Modified bell-striking mechanism.

the 12-tooth gear from the first reduction stage is shown on the right.

I also took the opportunity to alter the mechanism for ringing the bells. I had observed that rocking the bells was OK for the small bell but the larger bell was sufficiently massive to sway the mounting pole. I decided that I would remedy this before it proved another source of failure. The modification meant the bells were stationary and were struck by small hammers. I found this only worked well if the hammer did not rest on the bell; effectively it had to hit the bell and bounce off. This is something I should have realised by looking at the way striking clocks are designed. My arrangement can be seen in **photo 14**.

A successful test at home meant the windmill could return to the Nephew's house. There, to my relief, it ran for several uneventful months. No1 Nephew reported that the bells could be heard inside the house and acted as a sort of audible anemometer report. I had wondered about that. I imagined sleepless nights caused by the racket outside, followed by demands that Wally be despatched to the scrapyard!

Eventually however, the inevitable report came in from the children that Wally was slacking again. According to the - now familiar - routine I removed and dismantled the windmill to see what had gone wrong this time. I was beginning to wish I hadn't started this!

I tried ignoring Wally for a while and hoped that out of sight would become out of mind - wishful thinking on my part, as it turned out. Six months on, No1 Nephew's

youngest child would still ask "Has Wally been mended yet". This was not going to go away.

Yet another examination of the internals revealed more rust and water inside and the grease on the gears doing a good visual imitation of chocolate fudge. Better waterproofing was needed but the reason Wally had stopped was that the two input gears were no longer in mesh. These were the gears shown at centre in the partly dismantled drive train of **photo 15**. It appeared that the location of the drive shafts was not sufficiently rigid to prevent the gears forcing themselves apart and that wear in the gears and plain bearings had exacerbated this problem.

So - Wally needed some new gears yet again, plus a few other improvements - better sealing to keep the water out, for a start. This meant a move away from square tube. Round tube would allow 'O'-ring seals at least for the part containing the gears. Better location of the drive shafts would be needed and it would be preferable to replace all the plain bearings with ball bearings. I used the redesign activity to hone my rendering skills with TurboCAD, the result of which appeared anonymously in my article in MEW 255 (**ref 5**).

As a result of a trip to the local car boot sale, a third bell had been acquired and in order to keep the overall size down and minimise the off-axis drag I decided to mount them 'nested' on a common axis as in clock making practice. As a final improvement I decided that a bank of three bell actuating cams could be accommodated on one shaft.



The failed drive.

Then, with pin-in-disc type cams, the striking frequency for each bell could be varied by altering the number of pins.

In summary, the next design iteration was to have:

- Brass gears meshing with smaller steel gears where possible.
- A round aluminium body with 'O'-ring seals.
- 'O'-ring seals or gaskets wherever needed to minimise water ingress.
- Three sets of 4:1 reduction gears before driving the bells and Wally.
- A single camshaft having 3 pin-in-disc cams each with a different number of pins.
- Three striking bells mounted co-axially on the centre line of the windmill.
- Wally's winding house retained unchanged as far as possible.

The first stage in the redesign was to select some commercially available aluminium extrusions that might be suitable. The previous designs were tight for space so these needed to be a little larger. As a result of a trip to my ever-helpful metal suppliers (**ref 6**; usual

disclaimer) I selected 1¾ inch diameter aluminium tube for the body and a thick walled 1¾ inch square tube for housing the bell striking mechanism. Curiously all the aluminium stock is Imperial and everything else is metric. Presumably the aluminium suppliers are based in the USA.

First, a design was produced for the reduction gearing. **Fig 3** shows the reduction gears which were to fit in the aluminium tube to be used for the body. There were three 4:1 reduction stages with 0.5 module gears; only the middle one is shown as it would be installed. The remaining parts are 'exploded' to show how they were to fit together. Note the nose cap with two 'O'-ring seals and the ratchet/pawl. The input shaft is red, lay shafts are green, spacers are grey and the output shaft is orange.

It was based on the earlier design (that was never made) with some modifications to aid manufacture and improve water sealing. However, there was an issue of the gears having centre to centre distances that were not the theoretical values and my ideas on water sealing were unproven.

Reduction gears.

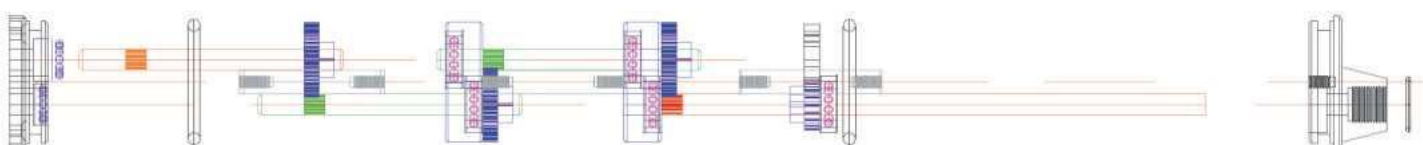


Fig 3



Trial gear assembly and end plate.



Modified 2MT collet.



Milling the integral pinion shaft.



Gear depthing tool.

Some trial components were required as shown in **photo 16**. The end plate for the tube was initially made without any through holes. The 'O'-ring was fitted and the plate inserted in one end of the tube which was then filled with water by way of a leak test. I must have got the dimensions for the 'O'-ring groove about right because it was a reassuringly tight fit with not a leak in sight.

The gears were more problematic. Firstly, I had designed a 12-tooth pinion integral with the drive shaft rather than as a separate pinion. That meant I had to machine the teeth into a relatively long and slender 7mm diameter shaft. To ensure the maximum rigidity the shaft would need to pass right through the 2MT collet in the rotary table and my collets had a centre draw bolt that prevented that.

My solution was a modified collet with an external draw nut as shown in **photo 17**. It was unlikely to see much use so it was not hardened - something that might have presented another set of problems had I tried.

The collet can be seen in use in **photo 18** with the 7mm diameter shaft being machined to form the 12-tooth pinion passing through the rotary table.

The next problem was the centre to centre distances required for the gears. I decided that the first thing I needed was a means of measuring it; something like the clock maker's depthing tool but a bit more 'industrial' in style.

I decided that I might as well utilise the 'T'-slots in the table of the mill as a ready-made slide. Two 'T'-section bars were provided with reamed

7mm diameter holes to mount the pinion shaft and the shaft with the mating gear. **Photo 19** shows the result. The rod between the two 'T'-sections was to keep them in line so they could be an easy fit in the 'T'-slots. Standard 'T'-nuts clamped the sliding members in place.

The tool can be seen in use in **photo 20**. The centre distance was calculated from the

distance between the two 7mm diameter shafts as measured with a digital calliper.

The distance between the gears was initially greater than the theoretical distance and the correction required was 0.20mm. It was easier to cut the teeth in the 48-tooth gear a little deeper than it was to do the same in the 12-tooth pinion. The two gears in photo 16 are at the theoretical



Measuring the 12-tooth and 48-tooth gears.

centres distance. Three pairs of gears like these were required for the completed gear train.

The remaining component required to complete those shown previously in photo 16 was the bearing support. I had some aluminium bar slightly over the internal diameter of the aluminium tube so this was turned down to fit the tube. Then it was transferred, still in the chuck, to the mill. The centre was located as in **photo 21** prior to drilling and boring (**photo 22**) using the DRO for location.

For those who have not used a lathe chuck as a vertical vice in this way, please note that it requires the back of the chuck to run reasonably true; mine is better than 0.001 inch TIR. In return, it offers a quick and accurate mounting for bars longer than could normally be held vertically in a milling vice.

The final operation was to return the bar to the lathe, still in the chuck, so the components could be parted off. The photographs actually show the second component being made, the first having already been parted off.

●To be continued.



Finding the centre.



Boring the bearing location.

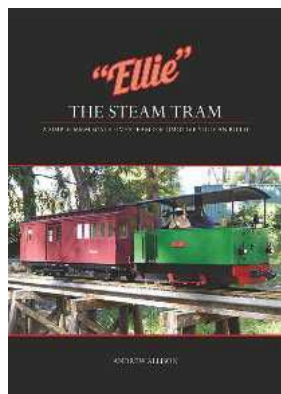
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5. Model Engineers' Workshop No 255 p59
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Book Review

Ellie The Steam Tram

By Andrew Allison



This A4 sized book is aimed at the beginner. The model is ideally suited to the younger engineer with its simple power plant and boiler. A number have been built so the design is well proven.

The model is in 16mm scale, running on either 32mm or 45mm track and is based on the many tram locomotives built by Bayer-Peacock, Dick Kerr and other continental builders. Two versions are offered; direct drive to the wheels via Meccano gears or via a jack shaft. The author has built a number of larger scale locomotives and uses his

experience to great effect in making the design simple to build and a sure-fire success.

The drawings are in colour and well presented. The description of how to make each component is concise and practical. The book has over fifty colour images of the build process and finished locomotive. The original pot boiler is fuelled by alcohol (it is Australian!) and the oscillating engine is single acting. One of the great things about this design is you can experiment yourself with gas firing, a more complex cylinder arrangement and alternative body panels. No two need be alike!

Available now from Camden Miniature Steam Services, this really is a must for any narrow gauge modeller, an ideal winter project which may actually



get finished before Easter, especially since laser cut parts will be available.

Malcolm High

Soft cover, 64 A4 pages with over 50 colour images. ISBN 978-1-909358-41-6 £12.95 (plus post and packing) from Camden Miniature Steam Services Tel. 01373 830151 www.camdenmin.co.uk

An Engineer's Day Out PART 2

Roger Backhouse pays a visit to Hull's **Streetlife** Museum of Transport.



Continued from p.725
M.E. 4573, 27 October 2017

Carriages and coaches

The horsedrawn vehicles here are mostly coachbuilder's classics rather than everyday carts. The earliest is a cabriolet of 1820, a light fast one horse carriage (**photo 17**). It drew on French designs. A dress chariot of 1860 owned by the Earls of Yarborough and used in Lincolnshire was built in London, a centre for high class coachbuilding (**photo 18**). Design ideas travelled across the Continent. An 1868 Landau was made in Paris and the Britschka originated in Eastern Europe (**photo 19**).

Other highlights include a simulated stagecoach ride - rather fun - and Lady

Chesterfields' delightful sleigh, a popular exhibit (**photo 20**).

Coachbuilding was a highly skilled craft aimed at combining light weight with strength. The museum recreates both coachbuilder's and wheelwright's workshops (**photo 21**). Display boards explain what was involved and how coachbuilders influenced car design and terminology.

Early motor cars

There's a representative collection of cars showing how designs progressed in days when petrol wasn't the only power.

A Gardner-Serpollet steam car of 1901 was coke fired with

a flash steam boiler. Designer Léon Serpollet used the term chauffeur - 'one who stokes the fire' - for the driver and this name has continued since (**photo 22**). Slightly later the US White Sewing Machine Company made the White-Stanhope steam car and the museum has one built in the first year. The resemblance to the rival Stanley Steam car may not be coincidence. It had a 12 mile range later extended to 50 miles (**photos 23 and 24**).

A Cleveland battery electric buggy was USA made in 1901. Electric cars were particularly popular before the invention of the self-starter as cranking petrol engines was disliked.



17
Cabriolet of 1820, light, fast and fashionable.



18
Dress chariot of 1860 made in London for the Earl of Yarborough and used in Lincolnshire.



19
The Britschka design originated in Eastern Europe.



20
Lady Chesterfield's sleigh remains popular with visitors.

© All photographs taken inside *Streetlife* are taken with the permission of *Streetlife* Museum: Hull Museums

Streetlife – Hull Transport Museum

Open free of charge Monday to Saturday 10-5 and Sunday 11-4.30. Last admission 30 minutes before closing. Website www.hullcc.gov.uk Tel 01482 300300



Recreated coachbuilder's workshop.



Gardner-Serpollet steam car of 1901. Leon Serpollet designed his first steam tricycle at the age of 18 then teamed up with Frank Gardner to build steam cars in Paris.



White-Stanhope steam car built in 1904.

Battery electrics even held the automotive speed record for a short time (**photo 25**).

Some early cars blended motor car and heavy-duty bicycle construction. Bicycle construction features in cars like the 1899 De Dion Quadricycle (**photos 26 and 27**). The Motette Tandem tricycle of 1898, designed by Léon Bollée and made in Coventry, was steered by a small hand wheel. Though 50mph was claimed, speed in service is likely to have been about 20mph (**photos 28 and 29**). It must have been an exciting ride.

Panhard et Levassor's motor wagonette of 1899 pioneered the placing of the engine in front of the driver with the gearbox and clutch in line, a design principle lasting over 70 years (**photo 30**).

The Sturmev Voiturette of 1906 is unique. With a De Dion engine it tested the Sturmev gear box, later adopted as the Sturmev-Archer bicycle hubgear (**photos 31 and 32**).



LEFT: White Stanhope steam car retained tiller steering. RIGHT: Cleveland battery-electric car built in the USA 1901. Electric cars did not need crank starting and were popular before the invention of self-starters. Electric cars even held the land speed record briefly.



De Dion Quadricycle built 1899, derived from a motor tricycle. This now lacks a front seat.



De Dion Quadricycle built 1899 detail of rear drive.



Coventry Motette of 1898 designed by Léon Bollée.



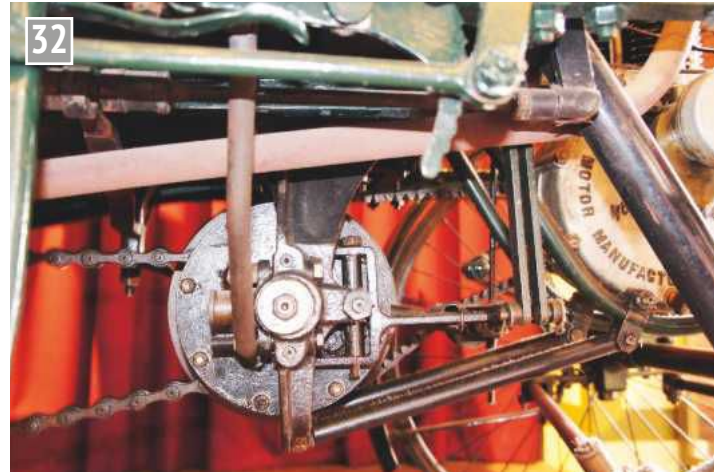
Coventry Motette detail - small hand wheel to steer.



Panhard et Levassor car of 1899. Emile Levassor pioneered the engine in front plus clutch and gear box in line.



Unique Sturmev voiturette of 1900 with a De Dion engine. Built to test a prototype hub gear later used as the Sturmev-Archer bicycle hub gear.



Sturmev gear detail - later developed as the Sturmev-Archer cycle three speed gear.



Lanchester open tourer of 1907-08 . Frederick Lanchester was ahead of his time as an automotive engineer. He pioneered the chassis and engine as one unit.



Morris 8 Series E car of 1939.



Jowett van, made in Bradford around 1952.



Quadrant tricycle made in Birmingham around 1885. It has a differential gear.

Frederick Lanchester was a highly influential car engineer who first designed the chassis and engine as one unit. A 1907/08 Lanchester open tourer features in the collection (photo 33).

In the street scene later vehicles include a 1939 Morris

8 Series E car and a 1952 Jowett ice cream van built in Bradford (photos 34 and 35).

Pedals and power

There's a recreated cycle workshop and a good collection of bicycles but most are difficult to photograph.



Raleigh made motorcycles as well as bicycles during the 1920s. This, their Model 17 made in 1926, alongside a Grigg motorscooter of 1923.

The Quadrant tricycle built in Birmingham around 1885 had a differential gear (**photo 36**). Another Quadrant used a prop shaft drive instead of a chain. Cycling's social side is well covered. Pre-war Hull cyclists even managed a holiday in Yugoslavia.

Many motorcycles are in stores, with few on show. A Grigg motorscooter of around 1923 is most unusual; it has unsprung wheels. A Raleigh Model 17 motorcycle of 1926 was restored by a Cottingham woman, Audrey Littlewood (photo 37).

Aviation

Pioneer flyer Amy Johnson was from Hull. Amy was the first British trained woman ground engineer and flew solo to Australia in 1930. Prisoners in Hull made a modern replica of her De Havilland DH60 Gipsy Moth plane, shown at Paragon Station (**photo 38**).

A rare Lincock F2 biplane fighter made in East Yorkshire in 1928 hangs in *Streetlife*. Intended as a light fighter, it did not sell well (**photo 39**).

●To be continued



Replica of De Havilland Gipsy Moth flown by Amy Johnson to Australia made by prisoners at Hull jail as engineering training - they did a good job.



Lincock light fighter made in East Yorkshire around 1929.

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A CNC Beginner's Experience

PART 13

Peter King's continuing narrative of a CNC learner driver; a few lessons learned during 'hands-on' operations.



Continued from p.305
M.E. 4567, 17 August 2017

I hope the advice that follows, in the form of a series of short articles, is helpful to those starting out with CNC in the workshop. I aim to assist in understanding any problems and lead you, eventually, to satisfactory operation of your CNC machinery.

The computer problem mentioned last time came to a head rapidly as the computer graphics card (yet another hidden fault on the old computer) got rapidly more erratic. The 'tool offsets' started to go awry and spurious 'depths of cut' (generated probably by the card) wrecked a couple of jobs by plunging to -4.7mm instead of -2mm for 'spotting'. When I realised it wasn't me but the old computer I called a halt and ordered a new computer. The old one – as previously mentioned – was one that had been written off and replaced at work due to age and was gathering dust as no-one wanted it. Not only was the graphics card eventually found to be defective but half the USB ports had 'fried' for unknown reasons during my use.

The new computer – 'why does it keep happening to me?' – despite having the complete original program set up transferred did exactly the same as the old one at the beginning and did not recognise that there was a 'Parallel Port'. Once again, I was back to finding out why the computer did not talk to the KX3 mill. Eventually the Technician and I got the computer to actually acknowledge that there was a parallel port. For some unknown reason 'Mach3' had also acquired the wrong I/O address again for the parallel port in 'Ports & Pins' (another one, not the default one in 'Mach3' – which was also 'wrong' but possibly 'right' in the USA) and still nothing worked. ('I/O Address' – I asked the Techies what it was – 'Input/Output address' – 'Oh really? – Well, well'.) When I found the correct 'I/O' address (look in 'Devices' in the 'Control Panel' of the computer) I entered it in the configuration 'Ports & Pins' screen of 'Mach3'. I now had some control of the KX3 via the 'on-screen shuttle' – X and Y axes moved in response to 'mousing' but X in the wrong

direction. Z and the spindle did not operate at all. A swift check with the remote shuttle (a 'Contour Design' *Shuttlepro*) showed that it still did not work. A 'G Code' program was run in 'Mach3' with Z switched out for safety – this led to even more puzzlement – the program ran on screen (in 'simulation mode') but nothing whatsoever happened at the KX3 – not even a 'beep'. Clearly having 'keyboard control' but no 'program control' was much less than useful. At this stage the new computer went back to the Techies for drastic remedies i.e. strip out 'Mach3', the shuttle program and the Sieg KX3 configuration as well as anything else that could by any remote chance be causing problems (we assumed that some other program was interfering with 'Mach3') and re-install essentials. The Techies descended on the computer with interest as CNC doesn't normally come their way – for a change I actually know more than they do! Alas it took a couple of years to find what the problem actually was – and it was absolutely basic.

After the Techies had applied '4 by 2 Psychology' to the computer it was re-installed in the workshop. A number of changes had clearly taken place; to this non-technical but slightly computer savvy operator these were a puzzle until I figured that I was now once again back to square one. (It's a bit like 'snakes and ladders'.) I will detail them to give you an idea of what to expect...

- All drives, including the spindle, were now reversed (instead of just one as in the original computer set-up last year and week) and had to be corrected in 'Mach3' in - *Configuration / Ports & Pins / Motor Outputs / DirLowActive column* – 'green tick' changed to 'red cross' for those three axes and the spindle ONLY. I had not yet run the 'fourth axis A' but when I eventually do I will check its response.

- *Step Pulse Width in Motor Tuning* had reverted to '1' and had to be increased to '5' (drives growl like a concrete mixer on '1' and purr on '5'). I have been told that if one is rich enough to have an oscilloscope (and know how to use it) the pulses on '1' look like road spikes and on '5' are a 'square' pattern.
- The 'Contour Design' *Shuttlepro* configuration program had to be exterminated and downloaded yet again from 'Artsoft' and the shuttle configured again. The original program had acquired an immovable blanket command somewhere in the circus to 'do nothing' on all key strokes.
- 'Cut2D' now had a suffix on its new '.txt' filenames – 'NC' (numerical control) – the Techies had downloaded the latest version of 'Cut2D' and installed the latest version of 'Windows 7'. 'Cut2D' had instigated this change as the file type to be saved had reverted to the most basic default. This however would not work with 'Mach3', which should be something like a *Mach2/3 arc (mm)* type with a *.txt suffix – this is in the list of configurations.
- 'Windows 7' had certainly changed things as there are new 'bars' with 'icons' that were not there before on most programs – *alas I did not 'twig' what the reason for that was, which caused a major problem to continue.*
- The two concentric 'jogging wheels' on the shuttle (see photo 4 in ME 4525) are now *Continuous* on the outer wheel and *Step* on the inner (this is what it was when first installed last year but it changed to only the outer wheel working at some stage in the year). These functions are a **PLUS** command on clockwise and a **MINUS** command on anti-clock rotation and applicable on whichever axis has been previously selected.

●To be continued.

The Sombre Harvest



Remains of a railway wagon at Hoge Crater.



Wagon on 60cm gauge track at Passchendaele Memorial Museum.

Terrence Holland visits the Battlefields of Flanders, Arras and the Somme.



Light railways at the front

In connection with the current constructional series dealing with Andrew Barclay well tanks, I recently visited the northern end of the Western Front. The visit took place during the 100th anniversary of Passchendaele – the Third Battle of Ypres - which was fought in Flanders between July and November 1917. I had hoped to come back with plenty of evidence for narrow gauge railway working at the front in the Ypres Salient, where the 0-6-0 Class F Barclay well tanks operated, but apart from a few items of well-rusted rolling stock I was to be disappointed.



Light railway remains at Hoge Museum.

The railwayana I found are illustrated in **photos 1, 2 and 3** and these were associated with the later battles in Flanders and on the Somme. These rusty, old artefacts do at least demonstrate that the light railways did exist!

Photograph 1 shows a staged collection of various battlefield detritus; the remains of a Class A wagon on a short piece of rail, along with shells and shell casings, all covered with a piece of galvanized iron from a nearby trench. These were photographed near Hoge, not far from Ypres on the Menin road. In the background is the local gardener's wheelbarrow!

In photo 2 a wagon base sits on a piece of track and it appears to be held in place with several 'corkscrew picket' wire supports – which were officially known as 'screw pickets' by the British Army. The French called them *queues de cochon* or pigtails. These were used on the Western Front to support the extensive barbed wire entanglements.

A section of Pechot 60cm gauge track is shown in photo 3. This portable track was named after its inventor Colonel Prosper Pechot, a French army officer. At the rear is a pile of sandbags. These were filled with earth from

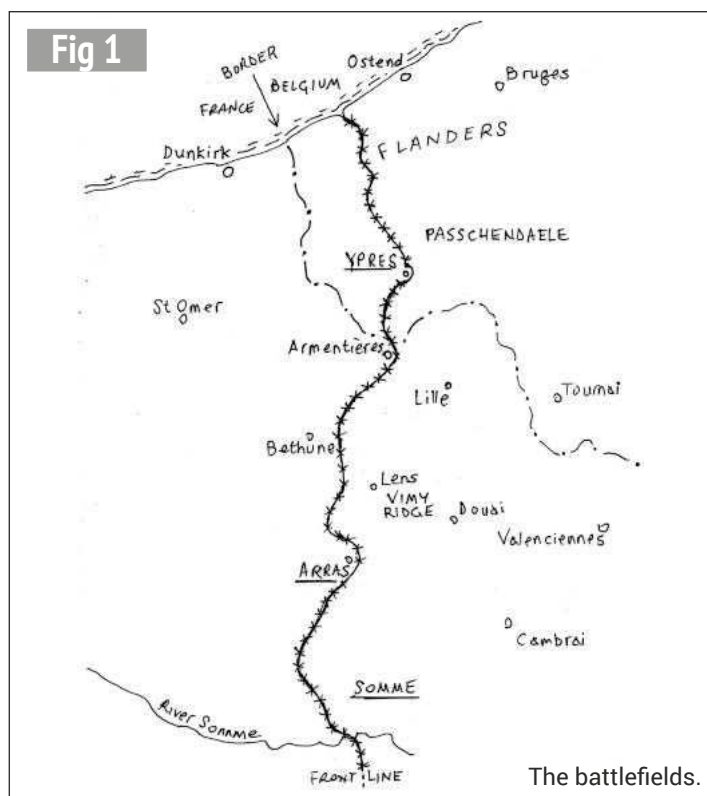
the trench works and used to provide troops with protection at both the front and rear of trenches (the parapet and parados) and were stacked some two or three feet deep.

During the Great War, once the War Department Light Railways (WDLR) became fully operational after their creation late in 1916, there were some 700 miles of 60cm gauge railway in place serving the Western Front by the end of 1917 (1).

The narrow gauge track was laid with 20lb/yd rail and speed was limited in general to about 10mph, although on well-maintained 'main line' track speeds could be up to 20mph. Unfortunately, military historians, in the extensive quantity of literature available, have sadly neglected these ubiquitous light railways and the recent visit confirmed that this is indeed the case at the actual battlefield sites, museums and memorials in France and Belgium. **Figure 1** shows the position of the three British battlefields in relation to the North Sea coastline of Europe. By 1917 all of these areas were supplied with 60cm gauge feeder lines (2).

The four-wheeled A and B Class wagons, the wheels, axles etc. of which are likely to





The battlefields.

be those shown in photos 1 to 3, represent the tip of a mighty iceberg as far as WDLR rolling stock was concerned. See **fig 2**. Many other types of rolling stock were eventually used - in particular the longer Class E and D bogie wagons with four-wheeled bogies at each end - each with its own set of brake gear and a platform on which the brakesman would stand (**fig 3**). By the end of the war, almost 15,000 various wagons had been supplied for use at the Western Front.

English makers produced thousands of the following standardised wagon types for the War Department:

- Class A and B – open box wagons with four wheels;
- Class D – open bogie trucks – these were the most common twin bogie wagons;
- Class E – bogie well wagons with stanchions or wooden sides and used for transporting ammunition, rails, timber etc.;
- Class H – bogie tank wagons carrying 1,500 gallon drinking water tanks;
- miscellaneous bogie wagons such as open and closed trucks for transport of wounded, steel tipping trucks for ballast etc., breakdown vans and work trains with repair facilities etc.



Piles of battlefield debris at Hooze Museum.

Four-wheeled Class A wagons hauling supplies.

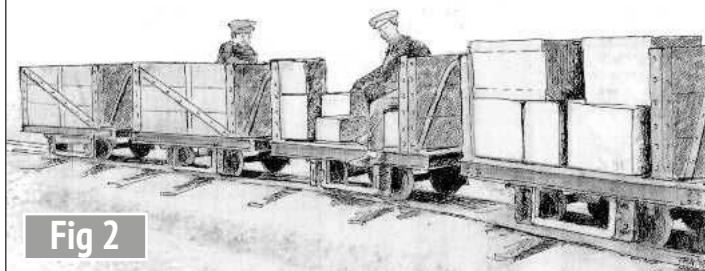
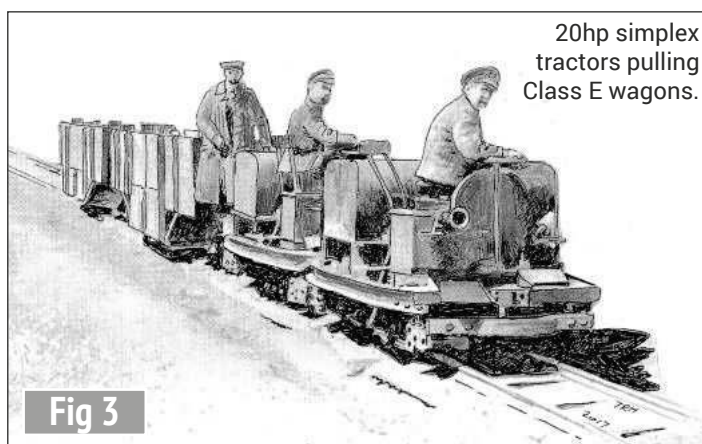


Fig 2



20hp simplex tractors pulling Class E wagons.

Fig 3

By the end of the war over 800 miles of narrow-gauge track had been laid, carrying up to 200,000 tons of traffic each week (2). This included munitions, food for the troops, horse feed, and materials for building/maintaining trenches and dugouts, among the many other necessities for a standing army occupying a border of approximately 500 miles in length.

The iron harvest

From an engineer's viewpoint all was not lost on the visit, due to this dearth of information regarding the WDLR, as there was plenty of evidence to indicate the enormous manufacturing effort expended during those four, long years between 1914 and 1918. An example is shown in **photo 4**. This shows a pile of shell casing and other scrap steel outside of one of the many museums in the area - this one a private museum at Hooze Crater on the Menin Road.

Producing the shells alone represented a huge task and massive industrial effort was required; foundries and machine shops for producing the metal components,

chemical factories for making the required explosives and filling factories where the shells were filled and assembled. Finally, they needed transportation to the front. LBSC was one model engineer involved in this effort and would have appreciated the problems. In his series entitled 'Virginia' the 3½ inch gauge American locomotive, published in 1957 (3), he wrote – 'When running the machine shop in the latter part of the Kaiser's war...'

With a total estimated usage of almost 1,500,000,000 shells (4) over the war years it would have been necessary to manufacture some 80,000 shells per day!

The following schematics give some idea of what was involved in shell manufacture but it was an extremely complex subject (4,5). Even a seemingly simple component such as a fuse could contain in excess of 20 precisely machined components – and there were no CNC machines in those days!

Shrapnel shells – These anti-personnel shells contained a payload of lead (or sometimes steel) balls, approximately half an inch in diameter. Only

a small explosive charge was included, which was sufficient to expel the balls from the shell 'in flight' on arrival. The gunpowder charge was activated by a timed fuse, which was preset before firing. The percussion cap was a small detonator for igniting the propellant. The driving band was a soft metal band that was forced into the rifling of the gun barrel on firing. The resin matrix held the lead shot in place and, on firing, produced a smoke burst, which allowed the gunners to adjust their range. At the receiving end, the effect was devastating and like a giant shotgun cartridge; peppering soft targets with large lead bullets which continued to travel along the shell's trajectory. The impact zone was an ellipse, approximately 300 metres long by 25 metres wide.

Figure 4 gives a general idea of the basic construction. The central tube transmits the flash from the timer fuse to the explosive charge behind the lead shot. After the shrapnel had been expelled from the shell, the casing, fuse and central tube fell to the ground intact and this explains the large quantity of these components on display

at various museums near the front (6). The bursting charge was normally gunpowder and the propellant could be gunpowder, smokeless powder (nitrocellulose) or cordite.

High explosive (HE) shells – There were many different types of these, each designed for a specific purpose, such as bursting on the ground (percussion fuse), exploding in the air (time delay fuse) and bursting after penetration into the ground (percussion fuse with delay). **Figure 5** is a simplified schematic of the HE shell shown without its canister and propellant. Explosives included gunpowder (used in older shells), picric acid (Lyddite), TNT (trinitro toluene or Trotyl) and 60/40 Amatol which consisted of 60% TNT with 40% ammonium nitrate. The primer/detonator was often Tetryl (2,4,6-Trinitrophenylmethyl nitramine) or fulminating mercury ($\text{Hg}(\text{CNO})_2$).

Gas shells – these are dealt with in some detail later and they are probably the most complex group of all the projectiles used at the front. **Figure 6** gives the general idea of their construction.

Fuses – The complexity of the various fuses increased

the amount of work involved in shell construction, and there were many different designs in use. The subject is extremely complicated and **fig 7**, of a WW1 British 'grazing' fuse, merely gives some idea of the intricacy involved, with no attempt to identify individual parts.

The production of shells was a very small part of the war effort – even without the destruction of property and loss of life involved, it was a tragic waste of human endeavour.

Locally, battlefield debris is known as the 'iron harvest' and even now, after over 100 years since the cease-fire, French and Belgian farmers still uncover unexploded munitions, which are taken away for disposal by controlled explosion - or in the case of gas shells by incineration of the contents. The 'harvest' consists of unexploded shells, bombs dropped from planes and balloons, trench mortar bombs, grenades and bullets along with slightly more inert objects such as shrapnel, barbed wire, screw pickets, old rifles, trench materials and, occasionally, human and animal remains. Photograph 4 shows some of this debris at Hooze Museum in Flanders. The 'wall' of steel

on the right and the 'pyramids' in the centre are composed of empty shrapnel shell casings.

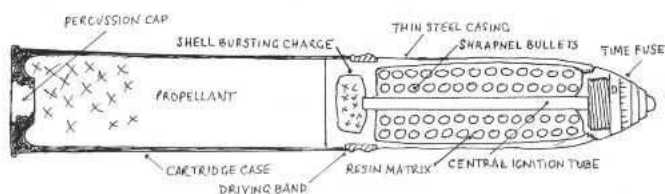
Hugh amounts of ordinance, from rifle bullets to 15 inch naval shells, were used during WW1 in a relatively small area each side of the 500 mile front. The concentration, therefore, of shells etc. expended on the Western Front was extremely high - a metric tonne of munitions per square meter of territory - and a high proportion of this has not been recovered and lethal relics are still emerging.

●To be continued.

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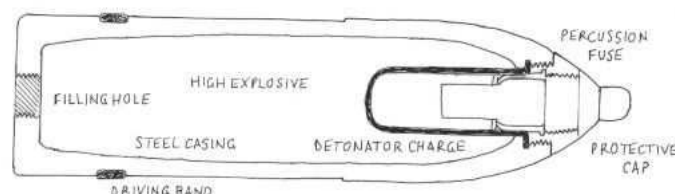
1. Railway Gazette and Railway News. Special War Transportation Number. First Edition 1920. Second Edition – The Mosely Railway Trust 2013.
2. W.J.K. Davies, 'Light Railways of the First World War', David and Charles, 1967.
3. LBSC, 'Virginia', Model Engineer 2904, January 1957.
4. Mark Fletcher, Daily Telegraph, July 2013.
5. www.passioncompassion1418.com
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Fig 4



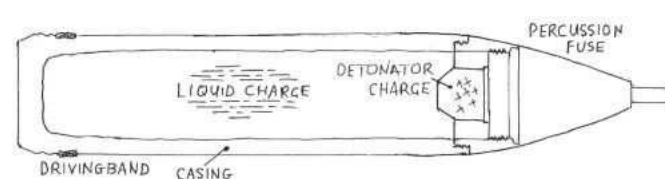
Shrapnel shell schematic.

Fig 5



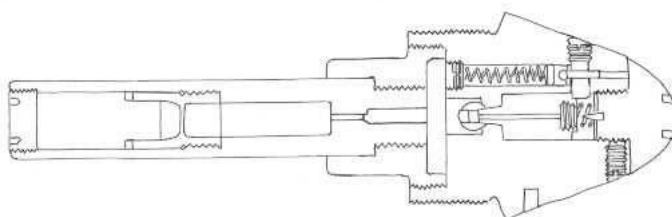
High explosive shell schematic.

Fig 6



Gas shell Schematic.

Fig 7



Typical fuse construction.

Ferrabee Pillar Engine, 1862 PART 8

Anthony Mount continues his construction series; an unusual stationary steam engine.



Continued from p.634
M.E. 4572, 27 October 2017

I was looking through some old technical books and came across an engine exhibited at the International Exhibition of 1862 (not to be confused with the Great Exhibition of 1851); I rather liked the look of it, thinking it would make an attractive model.

Support bracket (Part 24)

The end of the support tube adjacent to the cylinder has a support bracket (**fig 16**). It would have been a casting full size but for the model it might as well be fabricated, as it will be easier to make than try and hold a small casting for machining and, with the variables of manufacturing the column, the casting could be wrong anyway.

As the drilling of the hole in the column for the support tube may not be exactly in the required location, measure from the outside of the tube to the face of the slidebar bracket then subtracting half

the diameter of the tube will give a dimension that can be checked with the drawing - mine was 0.8mm out.

Another variable is the position of the tube vertically. I would recommend that a cardboard template of the side view of the bracket be made to the existing dimensions then cut out and tried in position.

I have specified brass as the material to use but mild steel could be used instead. The nearest material I had was 1 x 5/8 inch. This was milled down to 15mm and the web was machined giving a T section.

The eye was formed by turning a piece of bar down to 12mm diameter and drilling it 9mm. After parting off it was squeezed in the bench vice to give an 8mm inside width. A 2mm wide slot was milled in the centre along one flat face to take the end of the web and a 4mm diameter seating drilled for the screw boss.

The web was now sawn and filed top and bottom to give the curved edges. A piece of 1.5mm thick material was bent to a curve matching the bottom web and filed to its tapered shape.

The screw boss was made from 4mm diameter rod drilled tapping size for 8BA but it was only tapped after silver soldering.

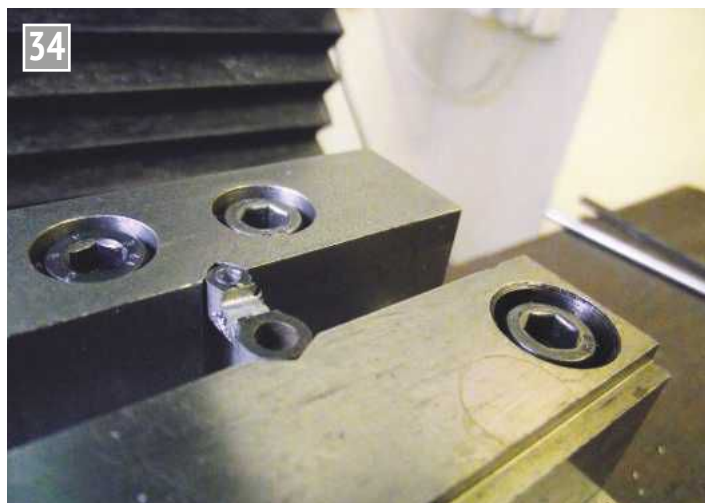
The four pieces were clamped together and silver soldered. I had hoped to wire it together but the shape

made this impossible so it had to be clamped together; it really is annoying if things start to fall apart once you have started heating the parts up so make a good job of the clamping.

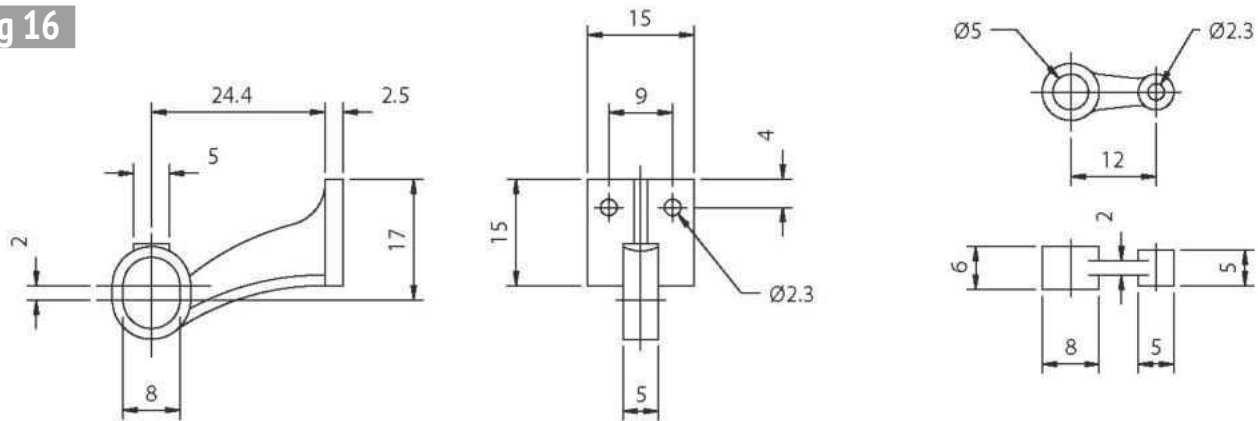
After cleaning up the bracket was offered up into position and the bolt holes marked and then drilled.

Valve rod rocker arms (Part 25)

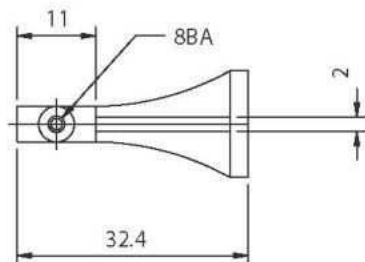
The valve rod rocker arms are supplied laser cut in 6mm material. The holes need to be opened out to suit the shaft and pin. The bosses are formed by holding the rocker in the machine vice with each end located in a central vee, see **photo 34**. A 5mm three flute cutter can put in grooves each side and



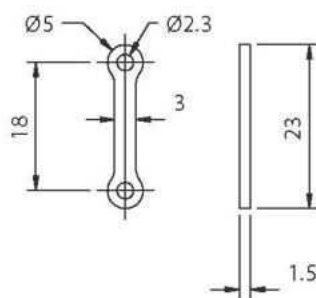
Forming the bushes on the valve rod rocker arms.

Fig 16

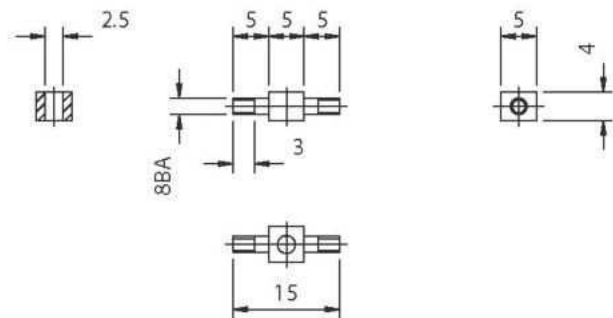
VALVE ROD
ROCKER ARM
2 OFF LASER CUT
MILD STEEL
PART NO 25



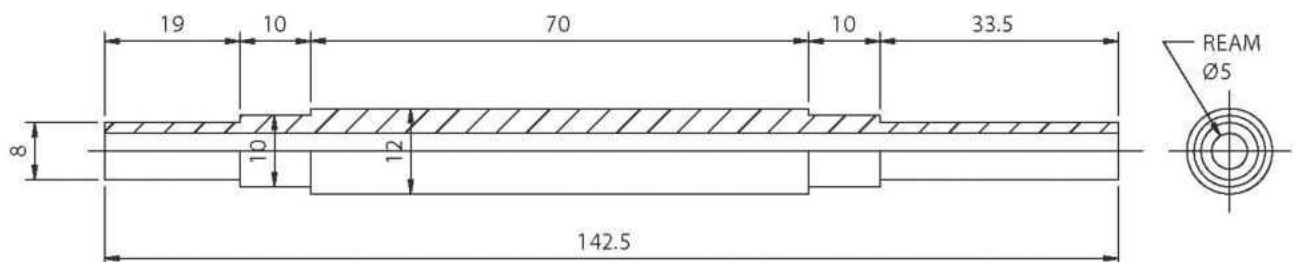
SUPPORT BRACKET
1 OFF BRASS
FABRICATION
PART NO 24



VALVE ROD HANGERS
2 OFF LASER CUT
MILD STEEL
PART NO 26

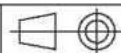


VALVE ROD PIVOT BLOCK
1 OFF MILD STEEL
PART NO 27



SUPPORT TUBE FOR
VALVE ROCKER SPINDLE
1 OFF MILD STEEL
PART NO 28

FERRABEE'S COLUMN ENGINE 1862



FIRST ANGLE PROJECTION

SUPPORT BRACKET

DRG NO 16

REV'

SCALE 1:1

DATE 02-07-13

Historic
Engines
South
West

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reduce the thickness of the smaller boss to 5mm. With the rocker now held in the bench vice, ideally within vees in the bench vice jaws, the corners of the groove can be rounded off by filing to form the round bosses.

Clean up all round. One rocker can then be Loctited to its shaft and the other can be fixed with a small cross pin, preferably a taper pin.

Valve rod hangers (Part 26)

The valve rod hangers are also laser cut but there is only one hanger in the set. However, it is 6mm thick so can be sawn down lengthwise to form the two hangers required. For filing to thickness the hangers were pinned to a strip of wood (perhaps they could be side by side) and it did not take long then to file them down to 1.5mm thickness.

Open out the holes as required and clean up all round with Swiss files.

Valve rod pivot block (Part 27)

A small pivot block takes the drive from the hangers to the valve rod; it can be made from 5mm square mild steel bar. Hold a length in the four-jaw chuck and face off. Change to the milling machine and cross drill for the valve rod.

Transfer back to the lathe and turn down to 2.3mm and thread 8BA. Use a parting tool to form the pin the other side of the central block and part off. Reverse in the chuck and thread the pin 8BA.

Support tube (Part 28)

A support tube is needed for the rocker shaft passing through the column. Use a length of 12mm diameter mild steel and face off each end bringing to finished length. A long hole is required right through. Centre both ends and drill through halfway from one end, then reverse and drill through from the other end, hoping the holes will line up.

Use a pilot drill to start with then open out and ream 5mm. Long series drills will be needed and ideally freshly and accurately ground. As thin drills can wander, ideally use one with the cutting edges ground on the four facet principle; if you do have a problem open out the hole 6mm and use a thin bronze bush each end.

Turn down the outside to profile and the job is finished.

Rocker spindle (Part 29)

The rocker spindle is simplicity itself - just a straight length of 5mm diameter mild steel rod.

Main bearing caps (Part 30)

Two bearing caps are required. Start with a length of 10mm square mild steel, square off the ends in the lathe, bringing to finished length, and mill away at the sides to form the central tongue.

Place in position in the pedestal and mount both parts together in the independent four jaw chuck. Set to run true with the joint line on the



Boring the hole in the bearing pedestal.

centreline. Drill through and open out for the bearing then finish to size with a boring tool. You could if you have one bring them both to the same size with a reamer.

Setup in the machine vice and drill for the stud holes and oil cup hole. Reposition and mill away on each side to form the rebates either side of the rounded ends and finish by filing the ends round.

Pins to drop links (Part 31)

As a change to milling a pin can be turned in the lathe; it goes through the drop links that drive the valve rod. Turn down from mild steel rod threading the end 8BA.

Bearing pedestal (Part 32)

Machine up a couple of blocks of mild steel to finished overall dimensions, mill the slot for the tongue on the cap and machine the hole as described

for the cap, by putting the two parts together in the chuck and drilling and boring the hole, as seen in **photo 35**.

Drill the two holes for the studs; they can be spotted through with the caps clamped to the bodies, spotted with a clearance drill then drilled through and counterbored at the top.

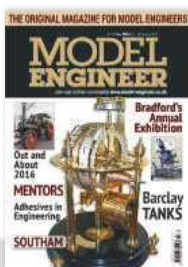
The studs are threaded at the bottom to screw into the tapped holes in the top of the column. The counterbores in the pedestals take the thickened parts of the studs, which act as screw heads.

Mill rebates either side at the ends and file the ends round. You will see on the pedestal drawing that there is a sort of curved foot both sides of the pedestal. This cannot be machined from the solid and I ignored it on my model but, if you wish to include it, proceed as before and then drill through from the top on the centreline of the studs and open out to 6mm. Hold in the machine vice of the mill and with the side of a milling cutter mill away to the centreline of the hole, leaving the foot at the bottom; the shape is automatically formed by the radii of the cutter.

Cut off two lengths of 6mm diameter mild steel, facing off the ends to the height of the pedestal, and drill and counterbore for the studs. The two pieces can now be silver soldered to the pedestal and you have the shape required.

●To be continued.

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Ramon Wilson adds the flue and water tubes to his boiler.



Wide-A-Wake

Continued from p.627
M.E. 4572, 27 October 2017



Wide-A-Wake is a 2 inch scale model of a clinker built steam launch that plied the waters of Lough Erne in Ireland at the turn of the 19th Century. The model, designed by H. Croker and built in similar fashion to the full size, is powered by a Stuart Turner Double Ten engine and was first featured in the February 1972 issue of *Model Boats* magazine.



Reducing the 10swg tube to 12swg,



Squaring the ends – the first use of the steady made twenty plus more years before!



The clamping fixture/drilling jig. Doubling the number of divisions allowed the opposite scribed line to be used as the other 'disappeared' beneath.



Drilling the first hole – the system worked better than anticipated.

As stated previously the original design utilised a 90 degree copper bend to take the flue gases out through the shell. This meant that the back plate of the boiler could not be stayed over a considerable area. Discussing this with Sandy, it was decided to utilise one of his previous designs as a basis and take the flue right through the boiler and out of the back plate to compensate for this and solder an uptake in to exit through the existing hole in the shell. In use the rear of the through tube would be blanked off and could also serve to contain a feed water heater coil just inside.

The first job was to make the 90 degree joint and solder the water tubes in.

The only copper tube available in the diameter required was 10swg and this was considered too thick. Two aluminium stub mandrels were turned to fit the inner diameter and its thickness reduced to 12swg on the lathe (photo 50). At the same time the ends were brought square and the flue brought to length (photo 51).

The next job was to put the holes for the water tubes in. Twelve in number, these were set in a spiral down the tube



Showing the moveable 'fixed' stop – reset after each hole.



Boring out for the uptake tube.



The end of the uptake was reduced to fit and to allow it to sit at the right depth.



Swaging the first end of the water tubes. The tube sits over a steel mandrel that controls the depth of the swage.



A successful operation with minimal kit gives great satisfaction.



Using a boring head to shape the uptake tube – note the insert to prevent crushing.



A dry run before final assembly for soldering.



First ends done with reasonable consistency.

through 180 degrees stopping just short of the uptake. Due to height limitations on the mill the usual dividing means could not be used so another method was devised. To start with, a small clamping fixture 'cum' drilling jig was made from a block of steel and one face marked off with twice the requisite number of divisions (**photo 52**). This was then clamped to the mill table against a stop and the tube, having previously had two lines on opposite sides carefully scribed down its length on the centreline, inserted. A line was aligned with one of the marks, the fixture clamped tight and the first hole drilled (**photo 53**).

Lateral movement between positions was controlled by use of slip gauges and a moveable stop, which was reset after each hole (**photo 54**). After each hole was drilled the tube was released and moved forwards, the tube rotated to align the scribed line to the next mark and the exercise repeated. The holes were not drilled through the opposite side as the burrs raised on the lower hole would have affected the transit through the fixture. Twelve holes were done first then and then the tube slid back, rotated through 180 degrees to align the second line and the opposite holes drilled (**photo 55**).

The same fixture was used to hold the flue while the hole for the uptake was bored (**photo 56**) then, using an aluminium insert to prevent crushing, the uptake tube was set in the mill to have its end machined to match the inner curvature of the flue (**photo 57**). The outer diameter was reduced slightly to allow it to sit firmly in the flue ready for soldering (**photos 58 and 59**) and this was then done with a higher melting point silver solder in anticipation of soldering the tubes in later.

It was obvious at this stage that the water tubes would need to be retained in some way to prevent falling out while the soldering took place. A simple swage was filed/turned to fit the tube but to expand it

to a 'square' section at the end (photo 60). Though the image gives the impression that the tube is held in the vice jaws it is in actual fact set over a mandrel that acts as a stop for the swage to give a uniform expansion (photo 61).

The holes in the flue were heavily chamfered inside and out, the tubes inserted in turn, set over the mandrel and the other end swaged. This created the restriction required but still allowed the tubes to be slightly loose to allow full penetration of the solder (photo 62).

A leaky tube was not on the cards for a second time so plugs were made for the three outlets utilising 'O'-rings to ensure a good seal and the whole given a pressure test to 100psi to check for any leaks (photos 63 and 64).

After a good clean up the work passed muster with the Boiler Inspector and it was ready for the next stage (photo 65).

●To be continued.

Next time – soldering up and finishing off.



Second ends swaged and ready for soldering.



Pressure testing to check for leaking solder joints - none this time.



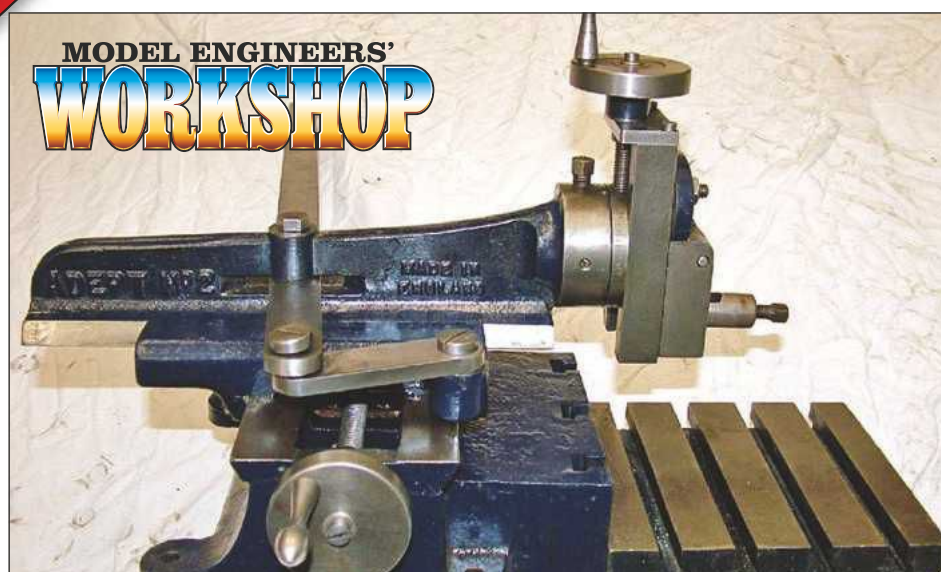
Double checking in hot water.



The finished flue, cleaned up and ready for inspection.

No.262

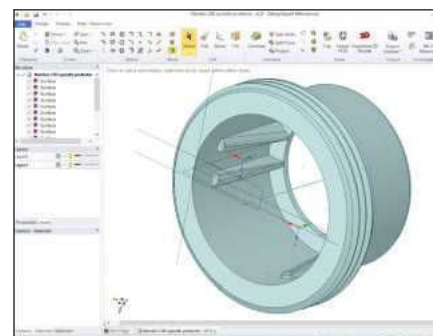
LOOK OUT FOR THE DECEMBER ISSUE, 262,
OF MODEL ENGINEERS' WORKSHOP, FOR EVEN
MORE FASCINATING TALES FROM THE WORKSHOP:



Using a shaper with Bill Morris.



An update on Peter Shaw's filing rest.



Darren Conway prints a spindle nose protector.

Ashley Best's illustrated description of an award winning, scratch built model in 1:16 scale.



Continued from p.514
M.E. 4570, 29 September 2017

When Number 46 was withdrawn for scrapping in 1937, it was just another typical British four wheel, double deck balcony tram. There was nothing to indicate that it was, in fact, a significant tramcar. This article explains the significance and describes the making of the model.



PART 7

Bolton Corporation No. 46

Canopy bends

Although there were some early exceptions, most British tramcar designs settled on the familiar curved ends, usually more or less semi-circular. Later developments strayed from this with some cars having multi-radius curves, flattened ends or ultimately streamlined ends. No. 46 had the usual semi-circular ends.

Making these for either deck required a robust wooden profile which would remain true and not twist out of shape. This can be cut from a solid piece by fretsaw but I made mine by laminating plywood strips and including a metal insert which helps to keep the desired rigidity. I first made wooden formers of the required profiles – the two

decks are slightly different. **Photograph 81** shows the set-up with $\frac{1}{32}$ inch ply strips laminated with a metal strip using Araldite or similar epoxy resin and then built out with further strips of wood and PVA glue. The formers are of course smaller than the finished curve which after several laminations should be the required size. I left the set-up for over 24 hours before removing the clamps. **Photo 82** makes clear the finished canopy bends and the metal strip in the lamination is easily seen. When finished, the structure has to be attached to the lower saloon bulkhead and set up to be absolutely horizontal. This needs to be regarded as a two stage job as a first fixing establishes the position but the upper saloon floor, with its camber, has to curve down at each end with



Canopy bend jig.



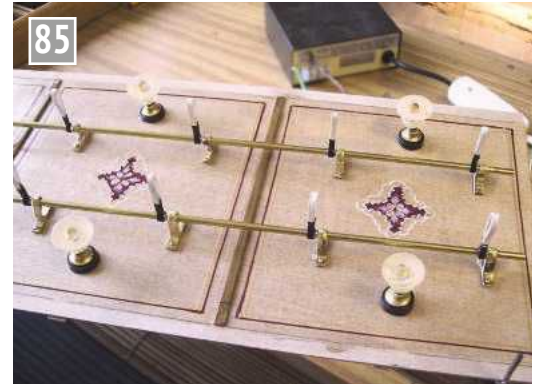
Canopy bends.



Platform assembly.



Ceiling supports.



The ceiling.



Wiring.



All lit up.



Switch gear.

planking cut to fit and glued down with special care and cramped for long enough for the adhesive to set and harden. I made large wooden blocks of the exact height to place under the canopy and be weighted down while the glue set and this seemed to do the trick. It was necessary to paint the bulkhead before this work because, although just about possible after fixing the canopy, it would be very difficult. Only after fixing the canopy was it possible to trial-fit the stairs which were given a fixing bolt through the bottom flange and platform base. **Photograph 83** is a trial assembly of one of the platforms.

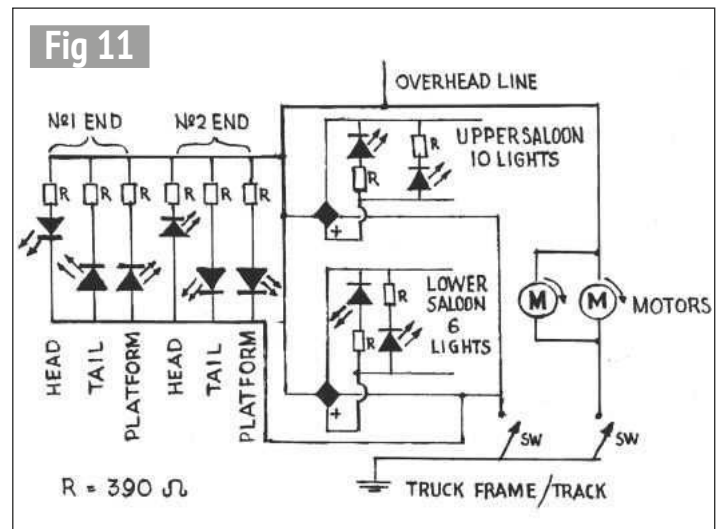
Ceiling

The lower saloon ceiling is a decorative feature in all the standard Preston designs and, of course, Bolton 46 was no exception. **Photograph 84** shows the support brackets and edge support strips on which the ceiling was to be fitted. The ceiling was made from $\frac{1}{32}$ inch ply and

was varnished, lined out and equipped with lights, grab rails and brackets so that it could be fitted as a complete unit (**photo 85**). Obviously, attaching these details and attempting painting after fixing would be impossible. The lower saloon ceiling has a gap between it and the upper saloon floor. This gap is of enormous use as it conceals the wiring for the lights and, should LED lights be used, the resistors. These features are visible in the view of one end of the lower saloon before the upper saloon floor had been positioned (**photo 86**).

Electrical items

I made an early decision to build the model with working lights. This, it has to be said, increases the complexity of construction by a huge amount and adds hours to building time, but the end result is worth it. An illuminated model tram on the layout really does do wonders for nostalgia (**photo 87**). **Figure 11** is a wiring diagram. The electrical requirements are firstly switch



gear to control motors and lights so that they can be operated separately (**photo 88**). No. 46 has the motors and lighting switch gear placed in the tool box on the platform at one end of the car (**photo 89**). The switches are operated by a purpose made hook/pusher.

Headlights

Although making a tramcar in 1:16 scale is mostly straightforward, there are three things that present more than



Tool box.



Head light.



Mandrel in chuck.



The dash.

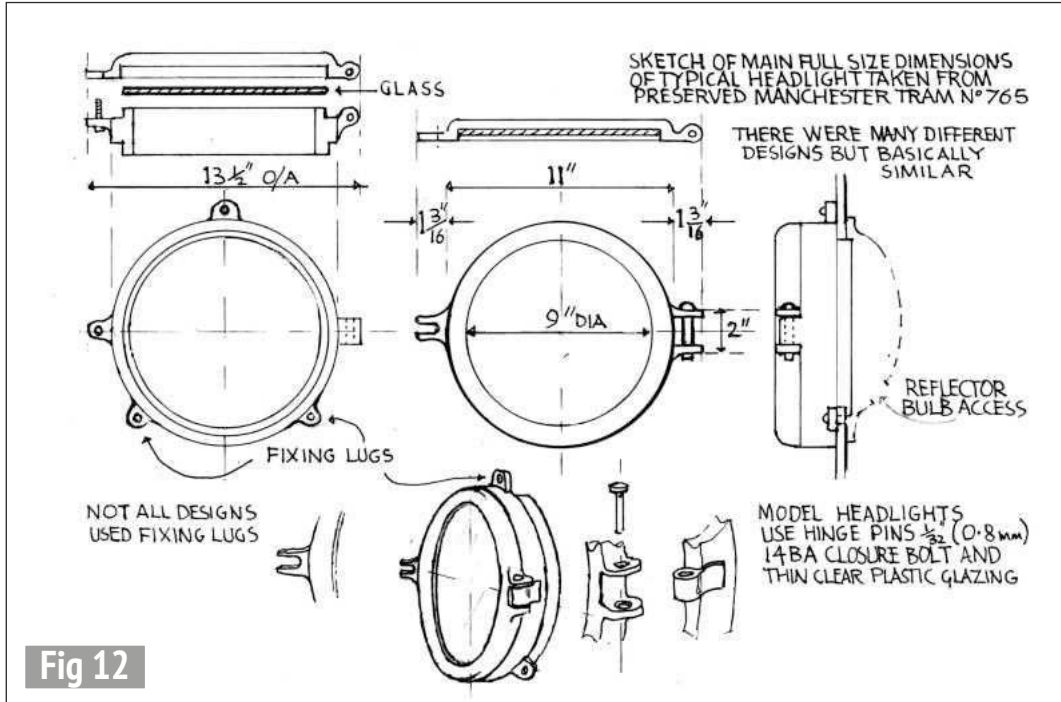


Fig 12

as working examples is much more satisfactory (fig 12). The main body is a lathe turning job, but the lens cover, being rather a delicate part, is where the difficulties start as it is almost impossible to produce an accurate profile without the aid of a mandrel. The initial turning of the body and cover is shown in fig 13. It will be seen that the lens cover is parted off after which the body flange is turned to fit. So far so good, but the cover is really too narrow to be set up in the lathe for finishing. I made an expanding mandrel to overcome this problem and this is shown in fig 14 and mounted in the lathe with the headlight rim in position in photo 91. A mandrel needs to be purpose-made for any particular headlight as there were many different although basically similar designs and sizes. Having made the basic body and cover, the hinges and closure fittings need to be added. Once again this requires silver solder; lead solder simply lacks the strength. Headlights are of

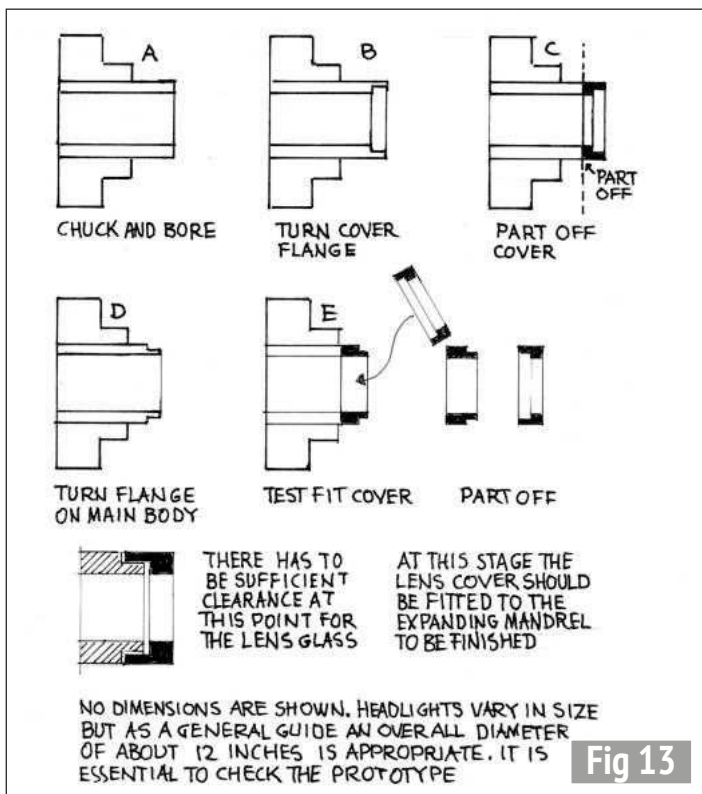


Fig 13

ordinary challenges. These are, in ascending order, the trolley mechanism, the spiral stairs and the headlights (photo 90). The last I consider to be the most difficult by some margin. If made largely for appearance, the difficulties can be avoided. Making them

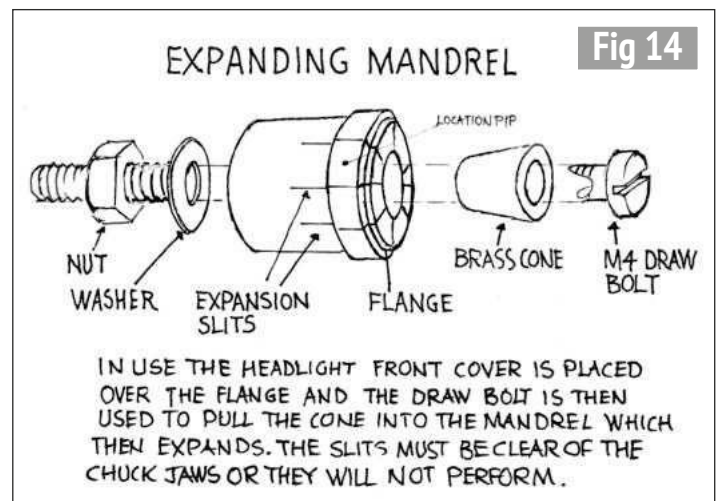


Fig 14



Tail light.

course attached at each end of the tram and so are best made in pairs. The lens covers are set up on the hearth and the hinge and closure brackets soldered in place (**fig 15**). These require finishing and cleaning up by hand, using needle files. The main bodies have to be soldered individually. This is more difficult than for the covers and again they have to be cleaned up by hand. There is a $\frac{1}{32}$ inch hinge pin on each lamp and drilling for this pin is a delicate operation. Closing the lamp cover uses a 14BA nut and bolt with the outside diameter of the nut reduced to scale. Locating the bolt in its fixing point may be done by tapping, but is more easily accomplished with soft solder. The finished lamps are soft soldered on to each dash. Reflectors are aluminium formed on a doming block and complete with bulb, glued behind the dash with Araldite. The dash with lamp body in place but without the polished brass cover is shown in **photo 92**. The wires for the lamp pass down through a small hole in the platform floor. Rear lights are positioned above the bulkhead step-side window. I used a red 12V LED in a brass turning (**photo 93**). The lower saloon lights are white LED bulbs fitted into turned brass lamp-holders with moulded clear shades (**photo 94**). Because the lamp-holders are brass, the LED bulbs needed one lead to be insulated. The clear plastic shades were made by pressing a former into the plastic sheet which was heated gently under the electric oven grill.

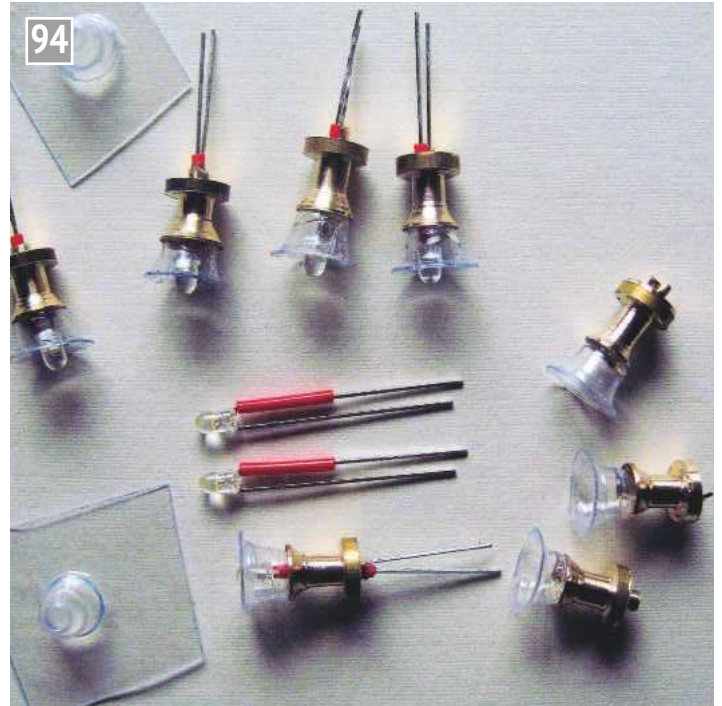
White LED bulbs require a 390ohm resistor. A touch of button polish or shellac dulls the excessively white light producing a more realistic colour.

The Dash

This conspicuous part was made from annealed brass cut to size after marking out from a card pattern. A hole for the headlamp was cut and filed precisely to size. Half round wire beading and brackets for the harness rail were soft soldered into place as was the headlight body. From photographs, the number and position of rivets was worked out and these were created with my home made false-rivet tool (**photo 95**). Some of the false rivets at the bottom of the dash were drilled out to leave holes as fixing points for actual $\frac{1}{32}$ inch rivets to aid in fixing the dash to the platform. The completed dash was painted and lined before fitting. Foot-steps and used ticket boxes are uncomplicated items. The ticket boxes were painted and lettered and then glued in place on the already painted bulkhead near-side. There is also a cranked hand

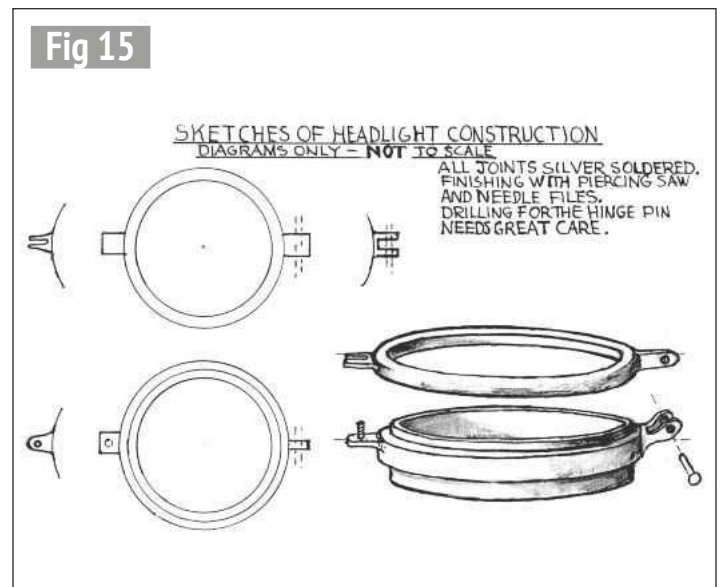


False-rivet jig.



Saloon lights.

Fig 15



rail in the same area and this was made and adjusted before the final fixing (**photo 96**). Foot-steps were left off the

car until near the end of the construction as they damage easily.

●To be continued.



Hand rails.

A 1/8 Scale Big Boy Locomotive in Istanbul

Bruno Cianci

reports on an impressive new acquisition at the Rahmi M. Koç museum in Istanbul.



Photos courtesy of Bruno Cianci/RMK Museum.

These extremely powerful locomotives are said to be the longest in the world. They went into production in 1941 and were built by Alco (The American Locomotive Company) for the Union Pacific Railroad for use on the mountainous area between Utah and Green River Wyoming for pulling loads of 3,200 tons without assistance.

Istanbul's Rahmi M. Koç Museum (**photo 1**), with more than 13,500 exhibits on display, all related to the history of transportation and industry, has completed the restoration and the extension of the wing dedicated to the railway transport. This



A view of the area fully devoted to the collection of Raoul Cabib of 19 models, 12 drawings and nine paintings at the Rahmi M. Koç Museum of Istanbul.

operation was dictated by the need of housing the recently acquired Raoul Cabib collection of models and another impressive piece that was purchased by Mr.

Koç himself in the UK earlier this year (**photo 2**): a 1/8 scale model of the locomotive number X4003 and its tender, known in the United States as *Big Boy*. It was during construction of the first of the engines that an unknown employee chalked 'Big Boy' on the smokebox. The name stuck and from then on they were known as 'Big Boys'.

The model on show in the museum today was built by a model railway enthusiast who had a passion for large locomotives. It is quite a rare model in this scale; only one other example was known of in the UK and this has since moved to New Zealand. It is thought a few built to this scale exist in the USA but the size and weight of the model limit the number of builders capable of handling them.

The model (**photo 3**) is built to 1/8th scale from original blueprints and took several years to complete.

It was built as a working model rather than a fine scale exhibition model. It ran for many years on a model railway



The Turkish tycoon Rahmi M. Koç poses next to Big Boy during an inspection at the Tasdelen workshop.



The original coal tender of the Big Boy locomotives were 14.4 metres long and weighed some 155 tonnes (342,200 lbs) when loaded.



Several parts of Big Boy, manufactured by Mr. Ian Rough of Windsor, await their turn before being re-assembled.



Union Pacific Big Boy #4014 (photo: Wikipedia).

that runs in the grounds of the famous Ascot Race course and it also ran as a guest locomotive on other tracks in the UK. The model, like the full size locomotive, is very powerful and often pulled sixteen wagons with six to eight passengers on each wagon - up to 128 people with no trouble.

When acquired the engine had been running on a regular basis for some years and was due for a major overhaul. This work has been carried out by the skilled engineers in the museum's extensive workshops (**photo 4**) to give us the fine model on display today.

Built as twenty-five specimens between 1941 and 1944, these articulated steam locomotives of class 4000 (4-8-8-4) (**photo 5**) were manufactured by the American Locomotive Company (ALCO) of Schenectady, New York, on behalf of the Union Pacific Railroad, which needed a powerful traction machine (when the American industrial production was geared to a war situation) to tow freight trains of more than 3,600 tons along the harsh railways of Wyoming and the Mount Wasatch slopes in Utah. The maximum speed reached by such locomotives was 80mph (129 km/h).

The *Big Boy*, one of the most powerful steam machines ever built, with a power output of 4,700kW (6,400hp), was powered by coal and operated effectively even when burning Wyoming's low quality combustible. One

of the locomotives, number 4005, was experimentally modified to burn naphtha, but the conversion turned out to be ineffective and was thus abandoned. The increase in the price of coal and the progressive adoption of diesel locomotives, road vehicles and aeroplanes in the post-war period drove to the withdrawal of the 4000 class locomotives within a few years. In 1962 the last of them extinguished their boilers for good.

Of the twenty-five original locomotives built by ALCO, only eight have survived and are all to be found in the United States of America. The X4003 locomotive, built in 1941, no longer exists. The steam scale model (**photos 6 and 7**) was manufactured by Ian Rough of Windsor, measures 5.05 metres overall (of which 3.25 metres is the locomotive, the remaining 1.80 metres being the tender), weighs over 1.4 tonnes and is in working condition. The restoration involved a general cleaning and the replacement of some internal mechanical parts to ensure its efficiency and comply with an unwritten rule according to which each single item exhibited at the Rahmi M. Koç Museum must be in mint condition.

As of November 21st, 2017, *Big Boy* will be officially displayed in a custom-made wood-and-glass case that will be positioned next to the Raoul Cabib collection. Along with nineteen models, this collection features twelve drawings and nine oil paintings. One is a portrait of



A frontal view of the 1:8 scale model of the Union Pacific Big Boy X4003 in the Tasdelen workshops where all the items of the Rahmi M. Koç Museum are restored.

the late Mr. Cabib (**photo 8**), an antique dealer from Genoa (Italy), holding a 1935 green *Mallard* locomotive in his hands. The engines this Italian gentleman had purchased were all awarded gold medals in competitions held between the late 1960's and the 1980's and were mostly manufactured by British model makers. Among these scale jewels are the aforementioned *Mallard*, a Class A3 locomotive *St Simon*, a Southern Atlantic Railroad 4-6-4 locomotive made by Louis Raper, a Caledonian Railways 2-4-0 locomotive, a 2-6-2 tank engine made by Roy Amsbury, a Clayton Undertype steam wagon and a 2-6-2 narrow gauge steam locomotive made by Barry Venables and many more made by Norman Lewis, Harry Powell, Basil Palmer, William Deane, John Adams and Brian Wollston.

The Rahmi M. Koç Museum collection includes several dozen other train models, layouts, railway memorabilia

and a selection of full scale locomotives, wagons and carriages. The most relevant pieces are an original Fiat Littorina (one of the two still existing), a Prussian coach that allegedly brought Kaiser Wilhelm II to Istanbul on the occasion of his last (out of three) journeys to the Ottoman capital city and a Victorian coach donated by the British government to sultan Abdulaziz in the 1860's. Moreover, for those who would not mind a short ride, a narrow gauge diesel-powered train is operated on weekends along the shores of the Golden Horn, Istanbul's natural harbour, where the museum is located in the district of Hasköy. ME

For more information:

www.rmkm-museum.org.tr



The 1:8 scale model measures 5,05 metres overall in length, 3.25 metres of which is the locomotive, 1.80 metres the tender.



A portrait of the late Raoul Cabib, an antique dealer and passionate collector of train models based in Genoa; in his hands is a green scale model of the famous *Mallard*, holder of the world speed record for steam of 126 miles per hour in 1938 (model built by Louis Raper in 1969).

Water Storage at the Lynton and Barnstaple Railway

'Water, water everywhere, nor any drop to drink' - for the locomotives, that is.

Steve Orchard reports on improvements to the 7¼ inch gauge railway water storage at the Lynton and Barnstaple Railway.



Samuel Taylor Coleridge, the author of the *Rime of the Ancient Mariner*, quoted above, loved North Somerset and Devon, as do our family. My adopted 'full-sized' railway is the 600mm Lynton and Barnstaple railway on Exmoor. I first came across a reference to this when on my first holiday after getting a motorbike in the late 1960's. I had bought a tent, sleeping bag and a *Camping Gaz* cooker and I was off on my first holiday on my own.

I rode down through Bristol and carried on down the A38 until I got to Bridgewater and then turned right to pass by the Quantocks and on to Exmoor. From sea level at Lynmouth the road climbs up to Blackmoor Gate at 1000 feet. Imagine my surprise, therefore, that facing me across the crossroad was a hotel called the *Old Station Master's House Hotel*. What on earth could this mean? Surely there couldn't possibly have been a railway so high up in such a remote area. There was absolutely no evidence of it at that time.



The former watering arrangements.



The author's 7¼ inch battery electric locomotive Tyndale.

Over the next forty years as I visited it with the family I gradually acquired more information about the railway and when we saw that real progress was being achieved in its regeneration I became keen to be involved, albeit in some small part. A bonus was the fact that they have a 7¼ inch railway which was used during the Spring (May) and Autumn (September) Galas.

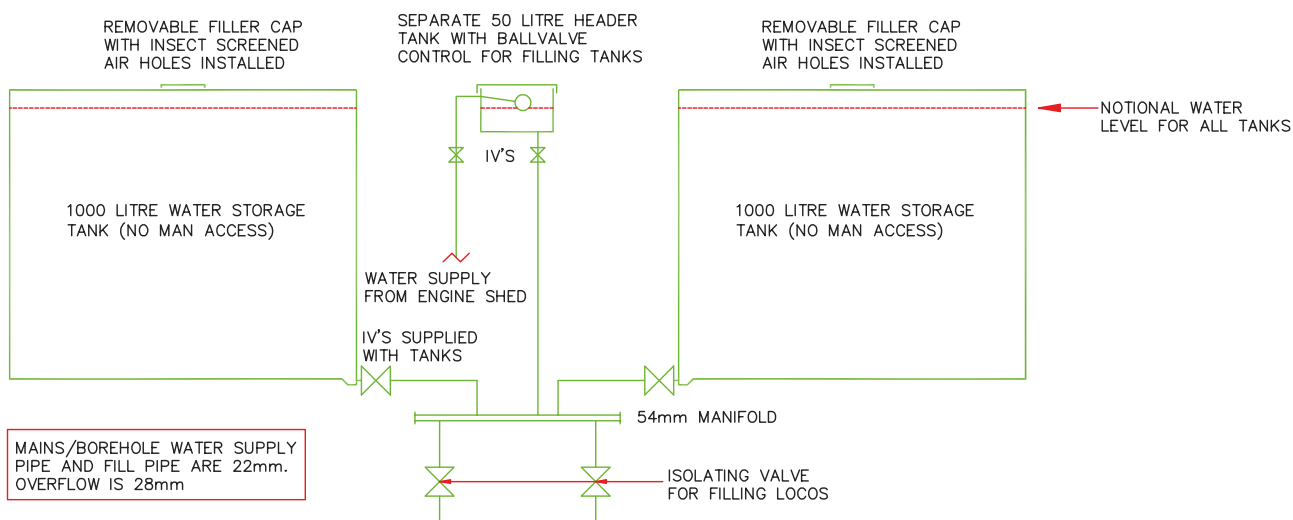
It was in 2011 that I started volunteering for the three day working weekends in November, January and March, when there are no scheduled services, so track as well as landscape maintenance could be undertaken. I also took my 7¼ inch battery electric locomotive *Tyndale* down with two wagons to each of the Gala weekends (photo 1).

Although I was not running a steam engine it soon became apparent that refilling the steam locomotives with water

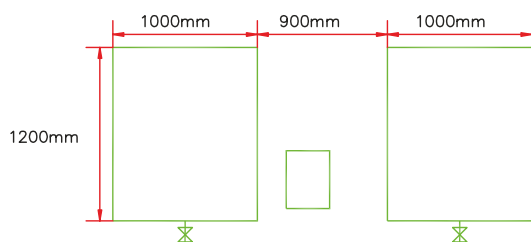
was a problem. The water supply is from a well and pumped by a borehole pump into a storage tank in the engine shed, which is only just above the level of the 7¼ inch track. The water supply for the miniature railway was down the line from the steaming bay and platform so when a locomotive goes to refill with water it is blocking the running track as well as taking a long time to refill (photo 2).

A crisis point was reached during the 2014 Autumn Gala where we had record crowds with lots of children, most of whom wanted more than one ride on the railway (once you have paid for your ticket, repeat journeys are free). At one stage we had to turn away disappointed parents and children since there was no prospect of running a train for at least half an hour.

Two or three of us decided there and then that this state



SCHEMATIC OF TANK ARRANGEMENT



PLAN OF TANK ARRANGEMENT

Fig 1

LYNTON AND BARNSTAPLE RAILWAY

SKETCH OF 7.25 INCH
WATER SUPPLY SYSTEM

DATE: OCT 2015

DRG. NO: FIG. 1

of affairs could not continue and we started to plan how to resolve the problem. Our analysis concentrated on:

- A new location for the water supply away from the running track.
- Substantial storage capacity to enable gravity fed water to refill several locomotives in quick succession.
- Continuous make up from the water supply from the borehole pump with a ball-valve shut off to allow us to leave it refilling overnight without the fear of wasting water.

Cost and aesthetics were also important as this area is within the Exmoor Area Of Natural Beauty.

Initially we considered options such as multiple water butts but searches on the internet highlighted plastic containers of approximately 1m³ in 'wire cages'. The internet showed that these could be obtained for about £40.

However, while visiting our local recycling depot in mid Gloucestershire one day I noticed a number of these containers in an adjacent industrial unit. I went straight round and saw one of the employees and asked did the containers come in empty and go out full? No, he explained, they come in full and go out empty, having brought in alcohol for a fruit based liqueur they produce. They had a couple of slightly damaged, but still functioning, ones and they were happy for me to take these away at no cost. I came back with my tools and the Managing Director helped me get a container minus its base into my small van (**photo 3**).

After the third journey I now had two containers, together with their bases, safe at home.

Once I had them home I could study them more closely. Each tank had a sturdy 38mm lever action valve on the outlet and a large filling cap on the top. This, however, was only 150mm diameter so there was

no way in which man-hole access could be obtained for fixing a ball valve in each container. I was reluctant, however, to introduce more penetrations with the complications of waterproofing them. I therefore concluded the easiest option would be to use an entirely separate make up tank with ball-valve at high level and 'backfeed' the containers using a 50mm

manifold connected to both the outlet valves. The water level to be maintained in the containers would be controlled from the makeup tank and I would make air vents in each filling cap to avoid any chance of developing a negative air pressure during periods of very high water draw-off (**fig 1**).

We were offered a suitable position adjacent to one run-around loop but which would



That's a close fit!

require some excavation work to provide a level site. One concern was the visual impact of the tanks so, since there were a number of redundant timber sleepers available, it was decided to create a compound using them to be more in keeping with the atmosphere of the railway.

I was due to deliver the first tank on my trip in November 2014 during the first working weekend of the winter but unfortunately I slipped on a neighbour's steep drive and suffered a compound fracture of my right elbow! That meant I was effectively *hors de combat* for two months. A colleague and I therefore took the first one down for the end of January working weekend with the tank filling all the internal space of the van and the black plastic base tied to the roof rack. In the meantime, a good start had been made by laying the underground water supply pipe from the crew room and on the groundwork (**photo 4**).

Alistair Hall, who organises the 7¼ inch track couldn't make it after all - his day job as a Civil Engineer for Network Rail interfered - but he assured me he would be able to make it for early in February. I therefore loaded up the second tank and headed down the M5 for the railway on the next Thursday, their usual weekly workday. By this time Alistair and Nigel were hard at work organising 600mm square concrete slabs to make a smooth base for all the tanks. The separate header tank was securely mounted at the right height on sleepers cut to length (**photo 5**).

While Alistair and Nigel were finishing off the base, I disappeared into the workshop to fabricate the ABS plastic manifold connecting all 3 tanks. I couldn't find an adaptor from the tank outlet to the ABS manifold so I came up with the idea of drilling the centre of the threaded cover of the tank outlet with a 25mm tank cutter. This allowed a 22mm plastic tank connector to be glued in place. I did the same in each blank end of the pipework manifold. Then, by



Progress is made with the groundwork.



The plumbing is well advanced.



Removing a section of sleeper allows access for isolating a tank.

fitting a copper pipe adaptor to each of these tank connectors I could fit a short length of 22mm copper tube with olives which would enable each screwed fitting to be tightened without undoing the opposite end (**photo 6**).

During the spring, Alistair and Nigel continued assembling the sleeper walls and making the final water connections (**photo 7**). A 'cut-out' was provided in front of each tank so a section of sleeper could be slid out to get access in order to isolate each tank (**photo 8**). Draining down in winter would be by opening the accessible stopcocks on each of the supply connections. **Photograph 9** shows the completed access and water filling arrangement.



The first tank is installed.



Fully concealed watering facility.



The business end.

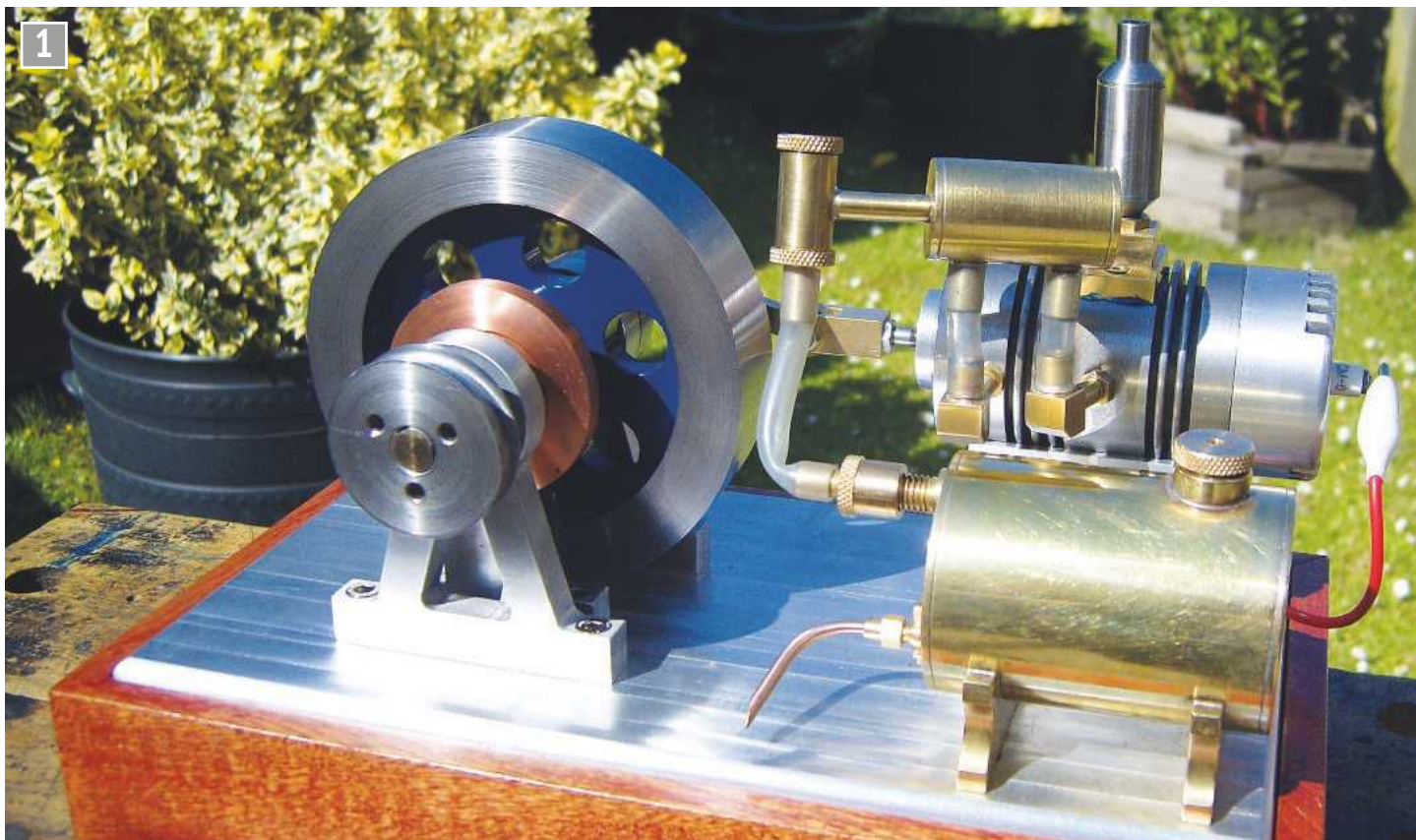
During the final working weekend at the end of March I was able to turn on the water supply and to check that everything was in place for the opening of the season at

Easter (**photo 10**). The system has now been up and running ever since and has coped very well so far!

ME



The new watering facility in action.



Debbie – the Jan Ridders two-stroke engine.

Debbie - Jan Ridders' Two Stroke Engine

Robert Knox tells the story of his version of Jan Ridders' simple two stroke engine.



The view from the back end, showing the transparent fuel tank end and spark plug.

Back in the winter of last year I just happened to be leafing through some old copies of *Model Engineer* and came across the articles that Jan Ridders had written about a small two stroke petrol engine (named *Debbie*). I thought that this would be a nice simple quick-to-build project as a change from steam engines and this is an account of what took place along the way. **Photograph 1** is the finished engine from the fuel tank side - the keen-eyed reader will notice that the tank is a little larger than usual. I just used a piece of brass tube that I already had, near to the specified size, and adjusted other parts to suit.

Photograph 2 shows the modified cylinder head, the reasons for which I will go into later on.

Now we go into the insides of the engine and **photo 3** shows the setup in my milling machine to cut the 3mm radius around the crown of the original piston, which was made to the drawings to fit in the bore of the cylinder. I had previously made the cylinder from a piece of grey cast iron. The turning of the inside and outside diameters was all done without removing the bar from the four-jaw chuck, just to keep everything concentric.

The cylinder bore was honed using one of those little spring-loaded gizmos with three stones on them that I bought from my local autofactor and all looked ok. I made the original cylinder head and the bottom cover from some bits of aluminium flat and threaded the cylinder head 10mm to suit a commercial sparkplug.

I checked the fit of the piston in the cylinder and it was a bit tight at the bottom half of the bore so I mounted the piston on its rod in the lathe and using some metal polish I lapped the piston and cylinder together to ease the tightness.

I had already made the crankshaft, cylinder pedestal, bearing pillars, connecting rod etc. so I put the cylinder and everything else together to check that the engine turned over all right. All seemed good so I fitted the fuel tank, non-return valve and expansion chamber.

Things were looking good. I had fitted a belt pulley on the end of the crankshaft and I had made another to fit in the chuck of my electric drill so I made up a suitable belt from a rubber 'O'-ring with the aim of using this to start the engine.

On the first try, without the sparkplug, the engine needed a lot of tension on the belt to get it to turn over. The Teflon seal where the piston rod went through the bottom cover was a snug fit, too snug in fact. When I made the Teflon seal I didn't have an 8mm reamer to hand so I used a new end



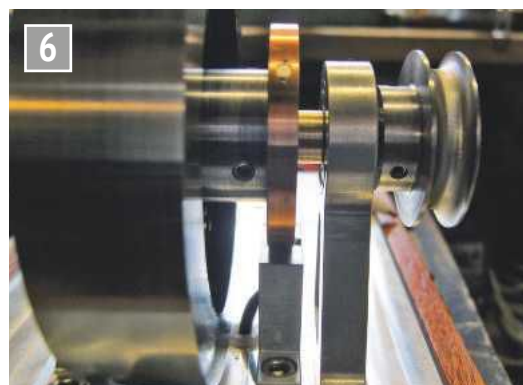
Cutting the radius around the crown of the piston.



Cylinder bottom cover and piston rod seal.



The electronic ignition system installed neatly under the baseplate.



A view of the Hall effect sensor and its actuating magnet.

mill to finish the hole to size. The seal fitted the stainless steel rod that I used for the piston rod perfectly but when I pushed the seal into place on the cover it contracted slightly. The bottom cover and the seal assembly can be seen in **photo 4**, where I am checking the fit.

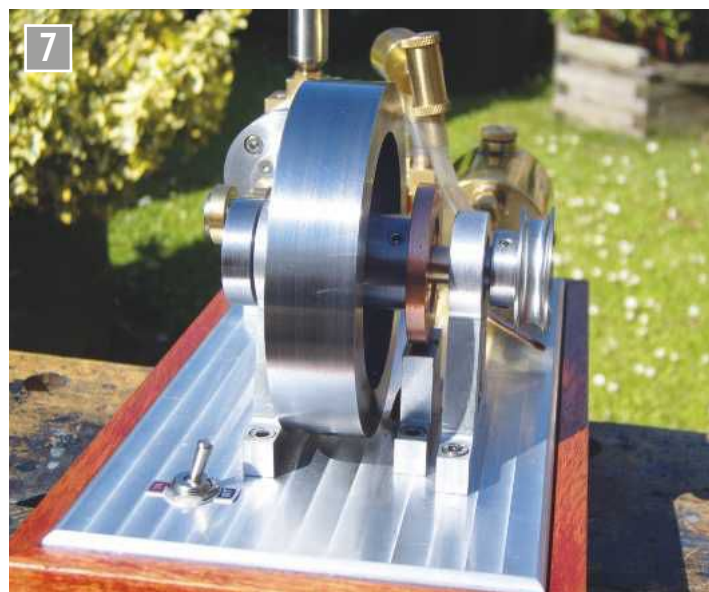
What I did to ease the tight seal was to take off the pulley, put the end of the crankshaft in the chuck of my cordless drill, apply some thin oil to the piston rod and into the cylinder, then turn the engine at about 40rpm for a little while, then checking to see if things had eased up. This had to be done a number of times, always ensuring that the piston rod and the cylinder were well lubricated.

So, eventually, when all was freed up I put in the sparkplug, which was connected to the *Minimag* (www.minimag.net) electronic ignition system installed under the baseplate (**photo 5**). The system used a Hall effect sensor which was triggered by a rare earth magnet set in the rim of the brass disc,

which can be seen in **photo 6**. **Photograph 7** shows the location of the bracket for the sensor and the main ignition on/off switch. The ignition timing was set to TDC as recommended in the articles.

So - it was back to the pulley on the crankshaft, the rubber 'O'-ring drivebelt and the pulley on my electric drill. I had some 40:1 petrol/two-stroke oil mixture that I used in my

hedge cutter so I put some into the fuel tank. I switched on the ignition, set the air valve and spun the engine over - the drive belt snapped and the engine didn't start. I re-glued the joint and we did all again. This time the belt was okay but the engine still wouldn't start. When I was driving the engine with the drill it seemed to be firing and as I adjusted the air valve it seemed to be picking



This view shows the location of the sensor bracket and the main on/off switch.

up but it wouldn't continue on its own when I took the belt off.

I tried all sorts of settings on the air valve, I moved the ignition timing, I added some pure petrol to the fuel tank to make the fuel more volatile but still couldn't get it to run.

I hadn't checked the ball valve but when I did there seemed to be a tiny leak in the ball seating. I obtained some new balls and, using a suitable piece of brass, I used one of them to reform the seating by giving it a careful tap with the hammer. I checked the seating under a magnifying glass and it looked good. Using another new ball I tested it and there were no leaks. However, when I put all back together the engine still wouldn't run on its own.

After saying some bad words (*tut! – Ed.*) I checked for cylinder compression and found that it wasn't great. I had made everything to the drawings in the articles but it wouldn't run. I took off the exhaust pipe and checked that the piston stroke was right but it seemed ok. I was still worried about the lack of compression so I took off the cylinder head and took out the piston. I checked the fit of the piston at the top end of the cylinder and found it to be over the recommended clearance but perfect at the lower end of the cylinder so the cylinder bore was not parallel.

I looked up an internal combustion engine builders' site on the internet where the person had built an engine the same as mine and he had also had problems getting it to run. He had made a number of pistons to try to get it to run but with limited success, although the bore of his cylinder was parallel as he had finished it with a reamer.

I made a parallel steel lap to the maximum diameter of the cylinder bore and using very fine grinding paste lapped the cylinder out to perfectly round and parallel throughout its length. I looked on the site again at a photograph of an alternative piston designed by *Aussie Jim*. No dimensions were available though so I



The new piston.



End-on view of the new piston, showing the inlet and exhaust cutouts.



Using a drill to line up the ports with the cutouts.



A view of the engine showing the new, finned cylinder head.



Three pins engage the engine pulley for starting.



Starting the engine.

worked some out by scaling from the photograph that I had. **Photographs 8 and 9** show the new piston and **photo 10** shows how I lined up the cutouts in the piston crown with the ports using the shank of a drill in the intake port.

I rebuilt the engine and tried it but it still wasn't going all that well so I had another look at the compression problem. I wasn't altogether happy with the position of the spark plug, as it was shorter than the home-made one that Jan Ridders used, so I decided to redesign the cylinder head to get around these issues.

I made a new thicker cylinder head with the spark plug sitting deeper down into the combustion chamber, reduced

the depth of the chamber by just under 1mm to increase compression and put extra cooling fins on the outside to help dissipate the extra heat from the higher compression.

I set the piston to clear the exhaust port at TDC and checked the clearance so that the flat top of the piston cleared the location ring of the cylinder head by 0.5mm.

I rebuilt the engine again, checked the compression and it seemed better. **Photograph 11** shows the engine in its final form with the finned cylinder head. I had lost patience with trying to start it with the rubber belt and two pulleys so I modified them. The pulley on the engine had three holes drilled in it and the pulley for

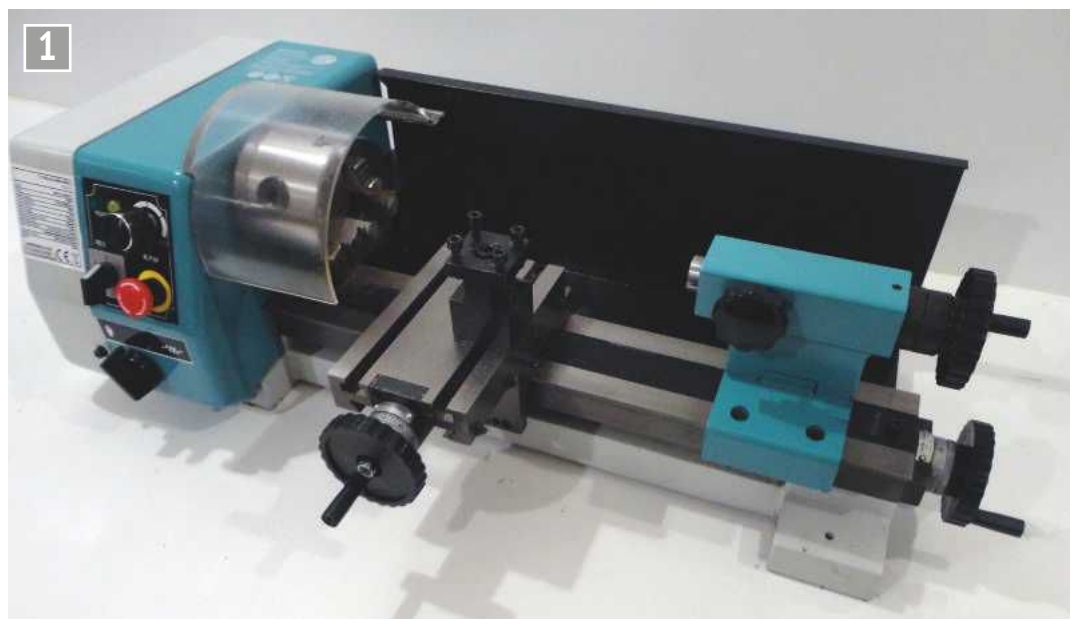
the drill had three pins fitted to match the holes on the engine pulley - **photo 12** shows the drill pulley, and **photo 13** shows the device in action.

After all the hours spent solving problems, some of my own making, I am happy to say that at the second attempt she started and kept going and she sounds good, just like a small stationary engine. The two-stroke mix that I used isn't ideal fuel for her and she does spit and she fourstrokes a bit but she keeps going which makes me very happy.

Just for the fun of it I did a video of her running outside and put it on *YouTube* under the title 'Modified Jan Ridders two stroke engine' if you would like to see it.

ME

Matt Chapman reviews the Axminster Model Engineer Series C1 Micro Lathe and SX1 Micro Mill.



The C1 Micro Lathe.



The SX1 Micro Mill.

Tool Review

Introduction

The C1 Micro Lathe (**photo 1**) and SX1 Micro Mill (**photo 2**) are from the Axminster higher specification and extremely professional looking 'Model Engineer Series' of machine tools. The SX1 Micro Mill is the smallest in the series and the C1 Lathe the second smallest. The size and specification of the two machines is such that they complement each other perfectly and should deliver a highly capable package to the smaller model engineer's workshop. This article provides

a review of my experience of both machines from initial setting up straight 'out of the box' through to actual use over a number of weeks.

C1 Micro Lathe

It has to be said that though very small, at a distance between centres of 250mm and a centre height of 70mm, the C1 has a lot of extremely useful features for a machine of this size. Perhaps most noteworthy is a powered lead screw giving automatic feed to the saddle and, for a modest

additional cost, a set of change gears adds the ability to screw cut a selection of metric threads.

Unboxing and Setup

The C1 is supplied firmly bolted within a sturdy wooden shipping crate and, once removed, weighing just 22 kg, is easily carried/manoeuvred around the workshop. Once unboxed the lathe has to be cleaned of the heavy corrosion preventative grease which should be replaced with good quality machine oil. Even with the handy oil applicator bottle supplied within the standard accessories I did find accessing the lead screw for oiling slightly tricky due to it being shrouded within the lathe bed with no easy access oiling point. Only a few items are required to fully assemble the C1 – predominantly the hand wheel handles and safety guard - these take minutes to fit.

Even though small, the lathe (and SX1 mill for that matter) must still be securely mounted to a rigid bed; three M6 clearance holes are provided for this purpose. Following mounting, the lathe



Turning on the C1 is vibration and chatter-free.



The clear and simple controls on the C1.

was inspected for accuracy and adjustment; I was quite interested in the results of these tests as the 'out of box' accuracy of machines of far eastern manufacture in general is sometimes criticized. The C1 spindle had barely measurable run-out, the tapered roller bearings proving effective here. The spindle clocked 100% true to the bed and the tailstock was in perfect alignment over the approximately 200mm tested - all in all a very impressive start.

The C1 In Use

The lathe on the whole is extremely smooth and quiet running; there is no discernible vibration or chatter when turning (**photo 3**). The controls of the lathe are clear and easy to use (**photo 4**) with the speed being electrically variable between 100 and 2000 rpm though there is no built-in indication of what the actual spindle speed is, as found on larger Axminster lathes. I have a cheap hand-held laser tachometer, which is a perfect remedy to this issue. The 150W motor performed faultlessly and has a surprising amount of torque though it would have been nice if the lathe had a slightly higher top speed which, at 2000 rpm, is perhaps slightly lower than ideal for a lathe of this size.

Although only a feature in the longitudinal axis, the automatic feed is a real asset and easy to engage/disengage. The lathe does not come with a compound slide, tools being mounted in tool post fitted directly to the top slide. A compound slide is available to purchase as an optional extra. The scales of both axes are clear and easy to read though I did find the graduations on the cross-slide frustrating to use. After a little experimentation I realized that each division, engraved as being 0.02mm, represents 0.02mm of physical cross slide movement and is not compensated for turning i.e. showing material removed off the workpiece diameter. Another slight frustration is that the larger divisions on the scale are a simple sum of



The tailstock is locked to the bed using two M5 screws.

the small divisions and not a measure of material removed in millimetres. Though these issues are relatively minor it is frustrating and slowing when trying to calculate depth of cut and the lack of diameter compensation could potentially lead to cutting double the amount of material required - in all likelihood on a critical cut! Replacing the scales is something I would consider exploring and being lucky enough to own a Taylor Hobson engraving machine have manufactured similar scales in the past.

Backlash on the cross slide was found to be 0.1mm and the lead screw to be approximately 0.25mm. There is no means of adjusting out the backlash.

The slideways are ground as opposed to scraped, but were smooth in operation and have effective gib strip adjustment.

The C1 spindle is bored to a 2MT taper and has a 10.5mm through hole for extended work pieces. The tailstock is bored to a 1MT taper. The tailstock is a substantial construction performing faultlessly in all operations. There are a couple of ergonomic issues I found with the tailstock. Firstly, the means of locking the assembly to the bed of the lathe is via two M5 cap head screws (**photo 5**) which of course becomes frustrating quite quickly. I think my first modification to the machine would be to replace these screws for locking levers of

'Bristol' pattern or similar. A second minor issue I found with the tailstock is a slightly limited 20mm of barrel travel that is slightly annoying when drilling deeper holes - of course the replacement locking levers would help speed up the process of shuffling the tailstock forward for deep hole drilling.

The C1 is supplied with a good range of accessories with many more available for an extra cost. The supplied 3-jaw chuck with reversible jaws is not the smoothest in operation but was found perfectly adequate in use.

Overall the C1 is a really capable little lathe and, a few minor ergonomic issues aside, a real pleasure to use. The lathe is really smooth in operation, quiet and surprisingly rigid - even coping well with intermittent cuts. Being as small as it is it is easily portable and perfect for the smaller workshop where it can easily be stored out the way when not in use.



The SX1 mill emerges from its packaging.

SX1 Micro Mill

The SX1 is advertised as a mill/drill and has the capability of tilting the column 45 degrees either side of the vertical. Its working envelope is 255mm from the nose of the spindle to the table (Z-axis), 180mm of longitudinal table (X-axis) movement and 90mm lateral (Y-axis).

Unboxing and Setup

Being somewhat heavier than the C1 lathe at 32kg the SX1 requires a little more effort and care when unboxing. My technique in the end was to remove the top and one side panel from the crate and slide the mill onto the workbench (**photo 6**).

The first step once again is the removal of the corrosion preventative grease; it was a slight shame that this had soaked into and damaged the control decals somewhat (**photo 7**). I am a fan of the Axminster Model Engineer Series colour scheme but on the SX1 under review there



The control decal was slightly damaged by the rust preventative oil.

were one or two areas in which this paint was quite damaged (**photo 8**). Assembly once again was a breeze, limited to just attaching the hand wheel handles.

Before use a series of tests was conducted and the machine was found to be in a really well setup condition. Of particular note was that even taking into account the adjustable column and transit the machine had been through, the tram of the mill head was only 0.03mm over the full 240mm length of the table. The quill clocked perfectly perpendicular to the table which I have found to be slightly out on similar machines.

Standard accessories include a 10mm drill chuck, selection of hand tools and 4 'T' nuts – there is no other clamping kit provided to go with the 'T' nuts which I find slightly odd as they are a little superfluous on their own, especially to someone starting out in the hobby with no other tooling. That said there is wide range of accessories including clamping equipment available from Axminster at extra cost.

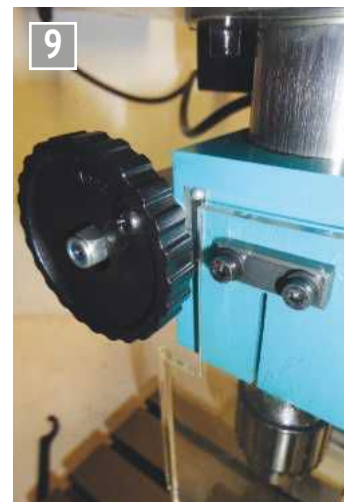
The SX1 in Use

The 150W motor drives the spindle through a two-speed (high and low ratio) gearbox with plastic gears. This gearbox works perfectly well and it is easy to change between the two speeds although it does make for quite noisy running – nothing earth shattering just noticeably noisier next to the smooth running C1 Lathe. The speed of the motor is electronically controlled from 100 to 2000rpm in high ratio but again there is no feedback on the actual spindle speed. The motor is plenty powerful enough and didn't flinch through the quite demanding use I exposed it to with a range of tools and materials.

The spindle is bored to accept 2MT and the mill is supplied with an M10 threaded draw bar. I did find the spindle guard slightly frustrating (to be fair I don't think I have used a



There were some small areas of damage to the paintwork.



The safety guard is difficult to remove.



Column tilt graduations.



The slide clamps are simply M5 screws.

guard I didn't find frustrating! Safety first though...) in that it is rigidly fixed with no means of folding out the way (**photo 9**) – I think a simple modification introducing a hinge would be sensible here. Also note in photo 9 that the guard and fine feed hand wheel make it very difficult to read the fine feed scale.

Handles for both the X and Y-axes were smooth and easy to operate with the dials being crisply engraved with 0.025 mm divisions.

The Z-axis and column tilt include a coarse linear scale for approximate setting (**photo 10**) with the quill fine feed dials being engraved with 0.05 mm increments.

The X and Y axes had 0.1mm of backlash. A means is provided to adjust out backlash in the X and Y axes only and this is through the lead screw nuts having a slot cut half way through the nut that runs parallel with the threads. There are then two socket head adjustment screws that

allow this slot to be closed slightly thereby adjusting the backlash out. The slideways are ground as opposed to scraped but were smooth in operation and have effective gib strip adjustment. The slide clamps are simple cap head screws (**photo 11**) which, space permitting, I would swap for locking levers similar to that which is provided for the Z-axis (head clamp).

The head is partially slotted and an M8 cap head screw used to clamp the quill; again this may benefit from being replaced with a locking lever for ease of use. With the quill, head and all axes not being used firmly locked up and sensible cutting loads I found the SX1 to be perfectly rigid when milling with no chatter at all.

Overall, I would highly recommend the C1 and SX1 as the perfect beginner's package. They are delivered at a perfect level of adjustment which, combined with a minimal amount of setup,

makes them ready for work straight away. Beginners aside, both machines are robust and highly capable making them equally suitable for the smaller more experienced engineers workshop. The ability to store the machines away under a bench or on a shelf could make them an additional asset to already established larger workshops; I am sure we have all had been in a position with a complex and lengthy setup taking up our primary machines and another quick job is required...

It is worth noting that both the C1, SX1 and Model Engineer Series generally, carry a standard 3-year guarantee supplied free of charge from Axminster which, combined with the well known and fantastic customer support, are additional attractive features of the overall package. Full details on the exact specifications of both the C1 and SX1 can be found on the Axminster website: www.axminster.co.uk.

ME



Write to us

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Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.

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LEDs

Hi Diane, I have just received ME 4570 in which Ron Head gives details of making LED lamps for his loco.

Ron suggests that the constructor marks the LED body before cutting the leads to length so that correct orientation is not lost. In fact, the manufacturers anticipate this problem and as well as the anode lead being longer there is also a flat moulded into the body to denote the cathode lead. All manufacturers adopt this approach. On a conventional diode, for example an axial diode such as the 1N4000 series, the cathode is marked with a line to ensure correct orientation.

However, I am a little concerned about the omission of a current limiting resistor in the diagram. Most LEDs have a forward voltage of about 2V and if there is no method of limiting the current they will attempt to draw excessive current from the supply. LEDs are in fact similar to zener diodes in their operation; they clamp the voltage to the forward voltage and if the applied voltage rises so does the current drawn to stabilise the forward voltage. The reason it appears to work in the article is because the 9V PP3 battery cannot supply very much current but if a battery with much higher current potential were used the LED

current could be above the safe rating and cause failure. A much better method would be a constant current source which is set to only supply a certain maximum current. Some of the newer LEDs have this included so they can be operated on a supply much higher than the normal types. The most common type with this feature is the 'Flashing LEDs' which have an internal IC to switch the LED on and off at about 1/2-second rate. These are normally red and can operate from 3V to 15V without any external resistors.

Inchanga

Coventry Die Heads

Dear Diane, Having read Mr. Earnshaw's articles about Coventry Die Heads this brought back memories of my apprenticeship in Eastleigh Locomotive Works, now 50+ years ago(!). One of the stages was on the Firebox Stay gang which consisted of a Chageman, a semi-skilled turner and three apprentices and their sole purpose was to machine firebox stays.

As many of your readers are no doubt aware, in full-size practice the stays are waisted in the middle to save weight and corrosion. The machines used were Ward turret lathes, fitted with roller boxes which could be fed in to produce the waisted section before threading $\frac{5}{8}$ x 11tpi (I think) produced by the Coventry Die Head. The waisted section was less than the core diameter so the head needed to be travelled along this section of about 4 inches, but this was not as straightforward as it appears. The boiler plate and firebox plates were tapped simultaneously by long taps so in effect producing a continuous thread, but how was this achieved on the stays? The lathes were equipped with an additional lead screw above the main spindle so, when necessary, the die head, via the turret, was engaged with this screw by two half nuts and taken right along, cutting both

ends in turn whilst remaining in pitch. When the travel limit was reached the nuts automatically opened and in turn so did the die head. The aforesaid screw was actually in two sections so shims could be inserted to correct any pitch errors, suitably checked by placing a stay against a standard.

Incidentally, in Mr. Earnshaw's final instalment he mentions the suitably covered long bar feed with which these machines were fitted. However, I remember my mother, during an 'Open Day' visit to the 'Works', recalling how, when she worked in an armaments factory during WWII, a fellow worker was very seriously injured when his overalls snagged on a rotating bar not adequately covered.

Sincerely, L J White (Eastleigh)

Young Engineers

Dear Diane, A few days ago, the Eastleigh Young Engineers (EYES) ran away with everything they could possibly win at the Midland Model Engineering Exhibition and Competition at Warwick. Although I would contend that the very best Lass and Lad were awarded for their efforts and Angus French, as usual, produced an amazing submission (Angus is 17 and showed a 6 axis robotic arm, self-designed and constructed) there is a real problem with this result. By the way, this problem happened last year and before.

The EYES have almost no competition.

I can instruct and assist my own club (the EYES are tiny and based near Winchester) but I can't assist you miserable shower. Am I to assume that you Model Engineers and your Clubs throughout the country are not interested in encouraging the young or are you simply just 'chicken'?

The EYE's are happy to take you on - all of you - at once.

Come on - be brave and give us a run for our money (but don't count the cash just yet!).

Pat Hendra (Winchester)

Steam Hammers

Dear Diane, Well done for another fine edition (M.E. 4571). I am pleased to see the introduction to power hammers, although only in scale form. I am looking forward to the next bit.

It is important not to underestimate the contribution these hammers made, and still do, although probably not steam powered nowadays.

There is a 2cwt Open Space Massey hammer within our family. I believe this is the smallest in the range. Small? The anvil block weighs 1 ton!

Smaller hammers in use today include *Goliath* - I think Fred Dibnah had one - and *Blacker*. I have used one of those - it was really nice and very responsive.

There were probably several tricks with hammers. One was to be able to close a matchbox and another was to transfer engineer's blue to an egg.

Best regards, James Buxton



Chris Tigwell (Frimley), 3½ inch LBSCR E2 0-6-0T. Chris was the first visitor to register.



Andrew Prentice (Taunton), Simplex 5 inch 0-6-0T. This was also driven by a friend.

Southern Federation 2017 Autumn Rally

Martin, Linda and George Gearing report from the Southern Federation autumn rally held at the Fareham club.

This rally, like most, depended on the weather and, despite the various forecasts for doom and gloom, it proved to be almost perfect for the whole day. It was a great relief that the organisation in the months before the rally actually took place really paid off by producing rather more than the confirmed six locomotives and two traction engines - actually becoming in excess of twenty steam locomotives that ran throughout the day, in addition to two electrics! The number of locomotives that actually attended was even greater, as we believe there were at least three other locos brought to the Rally, but the owners chose not to run them but instead enjoy the pleasure of seeing those already on the track.

It will be difficult to convey the atmosphere and do justice to the enthusiasm, professionalism and humour that all the visitors brought to the rally. This was supplemented by the sheer

variety of locomotives that came with them. There were only two engines to the same design but even these were painted to represent different operating companies/periods.

Other activities of note, that ran throughout the day,

included, on the boating pond, a pirate boat searching for anything of value to plunder but - this being Fareham - gave up and left! This allowed a very smart canal boat to cruise gently in the sunshine without fear of being boarded.



Roger Lunn (Southampton), 5 inch King Arthur 4-6-0.



Paul Gardner (Frimley), 7 1/4 inch Baldwin 2-6-0.



John Hunt (Leeds), 5 inch Simplex 0-6-0T.
John won the award for the greatest distance travelled.



Sam Weller (Oxford), 5 inch Gresley 2-8-0. Sam got an honourable mention for actually travelling the second furthest distance - but only because he had to return to Oxford, having forgotten the locomotive's grate!



Simon Mulford (Oxford), 5 inch NG Russell 2-6-2T.



Dennis Mulford (Oxford), 7 1/4 inch Baldwin 2-4-2T.



Joshua Allen. (Oxford), 5 inch Hunslet 0-4-0ST.



Jose Nottridge (Frimley), 3½ inch Mogul 2-6-0.



Owen Mace (Frimley), 3½ inch LBSC Molly 0-6-0T.



Dave Finn (Southampton), 5 inch Springbok 4-6-0.



Mike Wheelwright (Worthing), 5 inch LNWR Claughton 4-6-0.



David Murray (Staines), 5 inch GWR Class 56 0-6-2T.



Bernard White (Maidstone), 5 inch Merchant Navy 4-6-2.
Winner of the Commonwealth cup.



Sue Parham (Maidstone), 3½ inch LBSC Juliet 0-4-0T.
This was a past winner of Little LEC.



Martin Parham (Maidstone), 5 inch Duchess 4-6-2. This was also driven by Sue.



Pete Farmer (Southampton), 3 inch scale Burrell traction engine.



Ron Head (Oxford), 5 inch Adams Tank 4-4-2T. An elusive locomotive to photograph!



David Mayall (Bracknell), 5 inch Speedy 0-6-0T. This was fresh from the 2017 IMLEC where it achieved 2nd place - confirmation of David's incredible driving skills.



Paul Dean (Southampton), 3 inch scale Fowler traction engine.

On the garden railway, steaming past the numerous varied buildings that had been completed and installed recently, could be seen an industrial internal combustion mine locomotive bumbling along pulling five tipping hopper trucks. A very smart Round House Billy with the

addition of a tender could be seen hauling a selection of three trucks, followed by a double Fairlie 0-4-4-0 hauling a rake of nine slate wagons.

Mention must be made of the help from various Southern Federation council members who provided great assistance with the

organisation and of course the continuous cheerful attention to detail, care and hard work by all the Fareham club members who freely volunteered their services. These ranged from the lonely task of greeting and giving the visitors directions and an information sheet for the day as they arrived, to keeping everything running smoothly in the steaming and unloading bays, assisting the Southern Federation with the difficult job of judging, organising the running on the garden railway, seeing that everything ran smoothly on the boat pond, supplying sausages and

burgers non-stop for nearly five hours and the provision of endless cups of tea, coffee and snacks, from start to finish during the whole event (truthfully the most important job of all!).

Finally (all too soon for some) the awards for the Australian Commonwealth Cup and the 'Furthest Distance Travelled by a Visitor' were presented at an appropriate ceremony, with much whistle blowing by the locomotives in steam in the station area. This, along with the brilliant weather, conspired to make this one of the most rewarding rallies that Fareham has hosted. ME

Garrett 4CD Tractor PART 37

in 6 inch scale

Chris Gunn
machines
the flywheel.



Continued from p.665
M.E. 4572, 27 October 2017



This article has been written to guide the builder through the construction of the 6 inch scale Garrett 4CD tractor designed by Chris d'Alquen. The writer has previously built a 4 inch scale Garrett and a 6 inch scale Foden wagon so has the benefit of considerable experience in larger scale modelling. Most machining can be done in the average home workshop but the supplier from whom the castings and drawings are currently available is able to provide a machining service for the largest items if required.

The flywheel is supplied as a casting of course and, as this was 20 inch diameter as a raw casting, I had to take it to my friend with the Triumph 2000 and also remove the gap to enable me to swing the flywheel. I could just get this in the chuck and miss the front of the gap. I chucked it by the bigger boss and trued it, and it did run true all over, including the inner rims. The boss was faced off first and then drilled $1\frac{1}{4}$ inch. A boring bar was then deployed to open the hole to 15 thou under the $1\frac{3}{8}$ inch finished diameter. This hole was true of course, being bored, and then the hole was reamed $1\frac{3}{8}$ inch to match the crankshaft.

A live centre was brought up to support the wheel and then the front face was machined - and very easily as well, the cast iron being machined like butter. The outside diameter was then turned parallel and, once it had cleaned up, I swivelled the top slide over about a degree and machined a slight taper on the outside diameter from the front face to the centre of the flywheel. Then I swivelled the top slide over a degree in the opposite direction, before cutting the second taper from the centre towards the back face. This was to give the flywheel the semblance of a crown and the centre of the flywheel was cleaned up carefully with a

Drawings, castings and machining services are available from A. N. Engineering: Email: a.nutting@hotmail.co.uk

file to round and flatten the point where the two tapers coincided.

The flywheel was removed from the chuck and I made a slightly tapered sacrificial mandrel, with a centre in the end, and the flywheel was tapped on to the mandrel making sure all surfaces were clean and the live centre brought back into play to support the mandrel end. The back face of the rim was gently turned and chamfered and then the face of the boss, after relieving the mandrel to allow the knife tool to pass by the bore of the flywheel a touch. That was the job done but, while the wheel was still in the lathe, the power was switched off and the gears disengaged. I then rotated the flywheel by hand and wrapped the outer rim in a couple of layers of duct tape to protect the finish while the flywheel was being handled.

The flywheel was at this stage as cast and with the usual minor rough spots on the face and prominent flash on the parting line in the oval holes adjacent to the rim. I smoothed both faces with a sanding disc in my 4.5 inch

disc grinder and used a flap wheel to dress the inside of the wheel rim both sides. I set about the flash with a new toy - my hand-held belt sander. This is one of those tools I should have bought years ago as it is so handy. I bought it initially to clean up the block casting ready for painting, after struggling with everything else I had, and it saved hours of time. One can work in places which are impossible to get at by any other means. One word of warning though; it should be noted that the sander will remove material at a very fast rate and in no time one can have a ½ inch wide slot where one should not be, especially with a fresh belt. One needs to keep the belt moving from side to side rather than let it dwell in one spot. This made short work of the flash and I was able to work on it on the flat, without continually moving the flywheel, which is quite heavy. It would have been hard work removing the flash by filing it out in this orientation.

I have a gib head key retaining the flywheel on my 4 inch Garret but this is fitted into a parallel keyway and was always coming loose, in



Broaching machine.

common with other engines I see on the rally field. Many are now fitted with spacers and retaining washers to hold the keys in place, as mine is, hidden under brass caps on the end of the crankshaft.

I wanted the correct tapered keyway to be cut in the flywheel so that a gib head key could be used to retain the flywheel and would stay in place once fitted. I had the keyway cut at a local company that had the right equipment to cut taper keyways. Most companies that sell power transmission equipment

will have access to keyway cutting equipment. **Photograph 338** shows a typical vertical broaching machine. The work is clamped to the table and advanced towards the broach to cut the keyway. If a taper keyway is required the rectangular plate shown resting on the machine bed is placed between the bed and the work and this has the requisite taper across its length. This tilts the work slightly thus generating the correct taper.

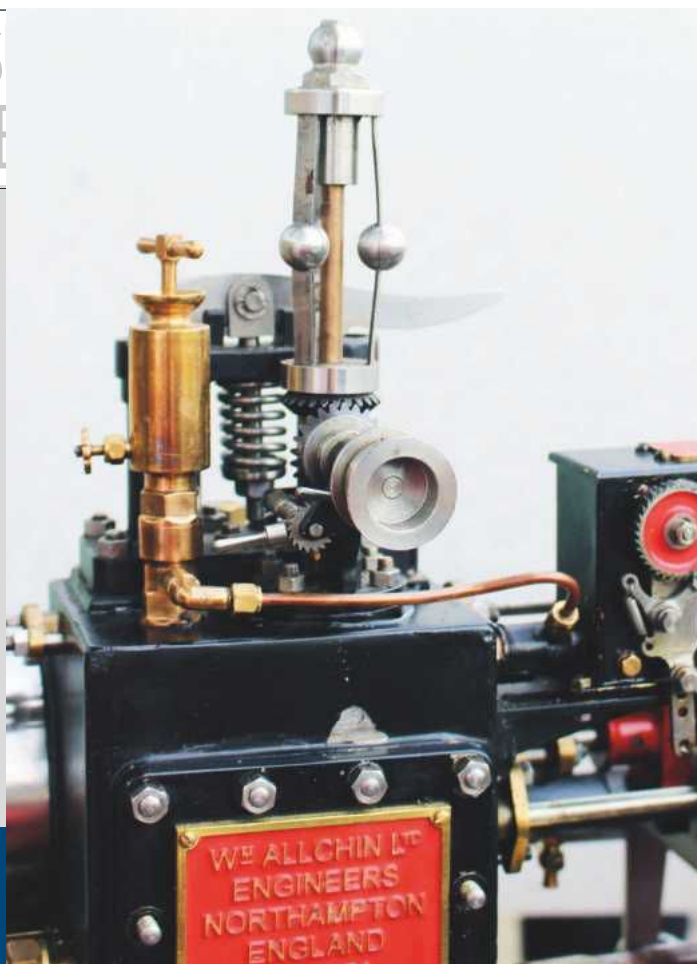
● To be continued.

ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE

- **Displacement Lubricator**
Nigel Walton describes a bottom-entry displacement lubricator for his Allchin traction engine.
- **Barclay Well Tanks**
Terence Holland completes the valve gear and makes the reversing rod for his well tank.
- **Hull Streetlife**
Roger Backhouse concludes his visit to the Hull Streetlife Museum.
- **Out and About**
Martin Wallis reflects on this summer's road steam scene.
- **LBSC Rally**
Richard Linkins reports on the LBSC Steam Rally held at the Romney Marsh MES.
- **Steam Hammer**
Ray Griffin now moves on to the piston road and the hammer itself.

Content may be subject to change.

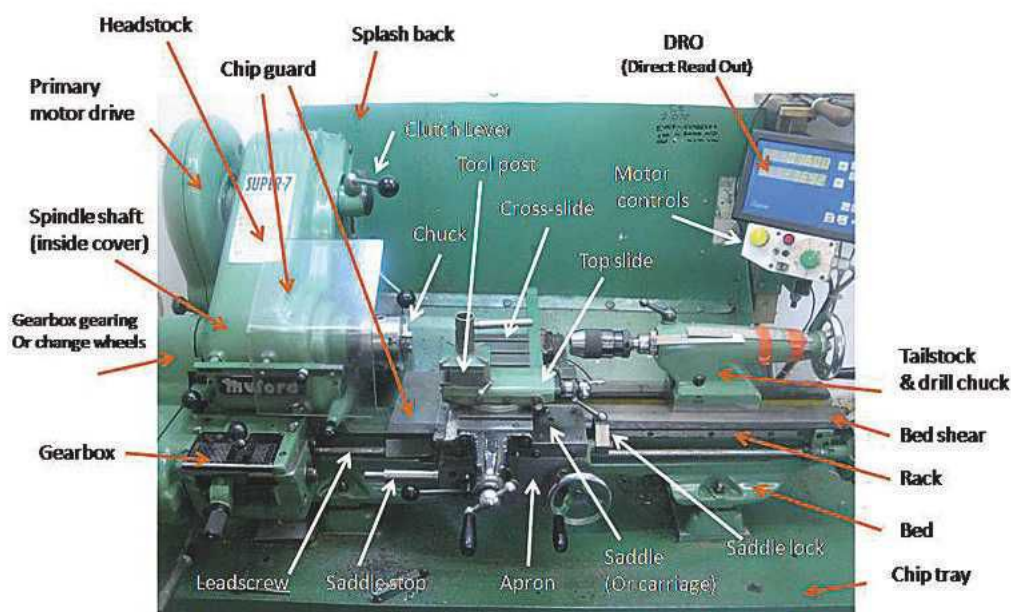
ON SALE 8 DECEMBER 2017



Lathes and more for Beginners

PART 1

Graham Sadler, in this series aimed at the newcomer to model engineering, takes us through the acquisition, setting up and use of the metal-working centre lathe.



This is the start of a long series about how to use a lathe and perhaps, if there is demand, we can go further to cover milling and the use of a tool and cutter grinder but this subject cannot be covered for the beginner without a lot of referral to other aspects of engineering. I do hope that there will be a lot of useful pointers for the more experienced as well as the complete beginner. In the past there seems to have been a number of 'beginner' articles in various magazines but from my point of view many seem to use a lot of kit and use techniques which are very far removed from the beginner, who will have a limited budget, with such a lot of kit needing to be purchased.

I am an ex-teacher specialising in product design at 6th form level and my students achieved a lot of top grades. These teaching skills will also help me to explain things to you in a way you will be able to cope with and understand. In addition, I have personally been awarded top awards for both my models and workshop equipment so I hope to be able to help you along to engineering success. Things may seem slow at the start but this is because I want to be thorough, covering it all in fine detail; things will speed up as we progress through the series. There's a lot of terminology to learn but I will *reference each new bit in italics* to make it easier for you to refer back to and I'll

introduce these as and when needed. I will mention the kit I have now throughout the articles but do remember it has taken me 45 years to build up this collection. I'll tell you what I started with throughout and give what I feel are the priorities and when to buy them.

Choice of lathe

I'll discuss the main parts of a lathe during this entry stage but I won't go into any detail about the actual makes and types as this depends on your budget. We are talking about a *centre lathe*, which may be described as a *GB lathe*. 'GB' is not made in Britain but means *gap bed*. The centre distance is the space between the *headstock*, the part housing the

spindle and the *chuck* which is mounted on the left of the *bed* (the chassis of the lathe) on which the *saddle* – the bit with all the gubbins hanging off it which slides along the bed. On the right is the *tailstock* ('tail' of the machine) which will enable you to hold drills and other tools exactly on the same *centreline* as the *spindle*, i.e. the bit in the centre of the headstock onto which chucks etc. are fitted. The gap enables larger diameters to be *turned* but only for a limited width to be worked on thus increasing the local capacity of the lathe. This facility is useful for stationary steam engine flywheels or traction engine wheel rims etc. It is particularly useful for a *faceplate* (a flat plate with slots in it onto which work can be bolted) but covering that is a long way away! Some gaps are removable pieces enabling better support for the slides close to the chuck while some lathes don't have a gap.

The bed for older designs of lathe tends to be flat and the saddle hooks under the top of the bed (called *shears*). The edges of the bed are generally square but some lower cost and small lathes are angled to form what is known as a *dovetail*. The square or dovetail shears are used to control the *slide* so that it has a smooth movement where it should have it, without any play side to side, and will not allow lift. Another form of bed has a pair of raised inverted 'V's on the front and back shears. One will guide the saddle, the other the tailstock. 'V' bed machines are now a lot more common and tend to be of a better quality. However, my Myford Super 7 has the flat bed, was purchased new in 1983 and is still supremely accurate.

The next thing normally quoted is the centre height and distance between centres (of the spindle and tailstock). This will describe the maximum length of shaft and radius which can be turned over the bed; the radius over the saddle will be less but difficulty here is rare. Sometimes the

swing is quoted and that's the maximum diameter which can be *turned*. The standard model engineers lathe used to be the Myford 7 series which is 7 inch swing. Smaller lathes (mini lathes) now tend to have about 5 inch swing, but many are now bigger.

New or pre-used?

If you get to one of the excellent exhibitions, of which there are four main ones every year, you will see a number of new lathes for sale. They now present remarkable value and usually come with a good range of the basic tools needed to work them. When I purchased my Myford in 1982 (a legacy enabled this) it cost £1056 and came with costly accessories, namely a large faceplate, raising blocks and a can of oil. There was no motor, no motor switching control and no chuck; it took a good while before it cut any metal! The gearbox was added later but now the cost of this alone would be greater than the cost of my whole lathe.

The size of course depends on what you want to do but it will pay to take your time. A lot can be done with a Myford on its own if you get a vertical slide which will allow milling (albeit with small cuts). *Hotspur* did this for his 7¼ gauge Beattie Well Tank engine, covered in *Engineering in Miniature* a few years back. He wanted to prove it could be made without a milling machine (my own engine is being built with a miller and CNC mill) but, to be honest, it won't be long before you get a miller to work with - but more on this at a much later date.

A 7 inch swing lathe will enable you to build some designs of 3 inch scale traction engines or steam wagons; anything bigger will require a much larger machine, although there are not all that many parts which will not fit on the 7 inch swing lathe. Should you be interested in building stationary or aero engines or 5 inch gauge locomotives then this size of machine is perfectly adequate. Of course

you could buy pre-owned - there are many very good examples with a large range of various bits and pieces which will help you in your work. Trading sites like eBay are a good source if you are patient but in most cases you will have to remove and transport the machinery. Do not commit to buy here without viewing the actual machine and preferably not alone.

There are specialist firms who will move machines but the cost of this must be taken into consideration. Auction sites are great - I recently was involved with one in Chesterfield. There were no small lathes but some real bargains e.g. Bridgeport millers (much bigger than the scope of this series - they weigh in at about ton) going for £600-£700 plus fees but you needed to make your own arrangements to move the machines, which must be done within a week of the end of the auction. Dealers will deliver for a fee and will often get the machine into the workshop but not set it up and this is the route I took with my Bridgeport. These will generally cost less than the specialist mover and you should be able to trust these machines better than a basic private sale but dealers will often remove many accessories to be sold as separate lots. All this is balanced by a bigger choice and the knowledge that most dealers will perform checks to sort out the major errors of a machine.

Price is usually related to the condition and complexity of the machine but do consider the availability of the spares and accessories that you may need in the future. Ex-industrial machines are great value but most have three phase electrics, needing 400 – 440 volt supplies. While the addition of an *inverter* (a sugar bag sized box of electronics which will change single to three phase and allow variable speed output) will allow it to run on domestic mains, the conversion does need a lot

of electrical messing about. These conversions are not difficult but do need a number of individual circuits and confidence. When I converted my Colchester Student (12 inch swing) the main rebuilt 240v control box had 20-25 wires (not as complicated as it sounds as there were so many individual circuits, all of which could be dealt with individually and tested in stages). In fact my inverter has just been replaced as it was clear that a repair to the inverter would probably cost more than a new unit. One thing is certain - if you go for a three phase machine and intend to go down the inverter route, check that the motor plate shows a dual voltage, i.e. 400 and 240 or the inverter won't work.

Lastly, do a good check of the machine if buying pre-owned; ensure the spindle seems to be free from play and the slides seem to move without binding - and look at the general condition. I once turned down a Myford just before I got my new one. One accessory included was a 200mm grinding wheel which the owner said he mounted in the chuck to grind lathe tools. The dust and grit would soon destroy the accuracy of the lathe. My 190 mile trip from Sheffield to Guilford was thus a bit of a waste. One last point - the distance between centres for many of the mini lathes may seem large but, once a drill and drill chuck are in the tailstock and a chuck on the spindle, what seems a good centre distance can leave little for the work piece. The standard Myford is 19 inches or 500 mm. The biggest thing I have machined is the back axle for my 3 inch Atkinson uniflow tractor which was 540mm long.

A visit to the website lathes.co.uk is a must – it's a brilliant web site. Many machines are there for sale but in addition it contains a very large database of a whole range of lathes with photographs and detailed descriptions of them.

●To be continued.

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25 Cardiff MES.

Steam up and open day (no public running). Contact Rob Matthews: 02920 255000.

25 Chesterfield & District MES.

Club running day. Contact Ian Blackburn: 01909 562458.

25-26 Vale of Rheidol Railway.

'Autumn Colours' event. Contact: 01970 625819.

28 Wigan DMES.

Bits & Pieces. Contact Kevin Grundy: 01942 522303.

30 Cardiff MES.

Carl Pinkstone: Engineering Topics. Contact Rob Matthews: 02920 255000.

DECEMBER

1 North London SME.

Club Christmas Party. Contact: Ian Johnston on 0208 449 0693.

1 Rochdale SMEE.

Auction Night. Castleton Community Centre, Rochdale, 7pm. Contact Len Uff: 0161 928 5012.

1 Stockport DSME.

Bits & Pieces. Contact Dave Waggett: 0161 430 8963.

2 Grimsby & Cleethorpes MES.

Public running and 'Santa at the Mill', 10am-2pm, Waltham Windmill site, weather permitting. Contact Dave Smith: 01507 605901.

2/3 Bedford MES.

Public running, Santa Specials. Contact 07498 869902.

3 Basingstoke DMES.

Public running at the Viabes Craft Centre, 11am-4pm. Contact: Austin Lewis 01256 764765.

3 Chesterfield & District MES.

Santa Specials, 11am - 1 pm. Contact Ian Blackburn: 01909 562458.

3 NW Leicestershire SME.

Santa Special, 11am to 3pm. Contact Den Swain: 01530 412048.

4 Peterborough SME.

Bits & Pieces and Mince Pies. Contact Terry Midgley: 01733 348385.

5 South Cheshire MES.

Auction night. Contact Stuart Daw: 01782 767587.

6 Chesterfield & District MES.

Club running day. Contact Ian Blackburn: 01909 562458.

6 Leeds SMEE.

Christmas Dinner. Venue TBC. Contact Geoff Shackleton: 01977 798138.

7 Cardiff MES.

Tony Bird: Topic to be decided. Contact Rob Matthews: 02920 255000.

7 Sutton MEC.

Bits & Pieces night. Contact Jo Milan: 01737 352686.

10 Bradford MES.

Santa Specials, Northcliffe Railway, 11am-3pm. Contact: Russ Coppin 07815 048999.

10 Chesterfield & District MES.

Santa Specials, 11am-1 pm. Contact Ian Blackburn: 01909 562458.

10 Frimley & Ascot LC.

Public running, Santa Specials, 11.30am-2.30pm. Contact John Evans: 01276 34970.

10 NW Leicestershire SME.

Santa Special,

11am-3pm.

Contact Den Swain: 01530 412048.

10 Rochdale SMEE.

Santa Specials at Springfield Park from 12 noon. Contact Len Uff: 0161 928 5012.

10 Sutton MEC.

Afternoon running from noon, Christmas Dinner. Contact Jo Milan: 01737 352686.

Apology: The diary last time was a fortnight 'out of sync' but I hope I have got it right this time - Acting Ed.

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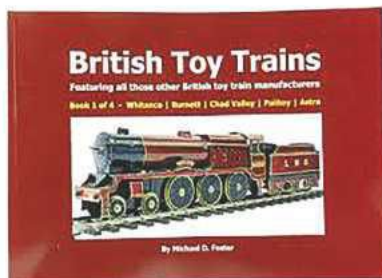


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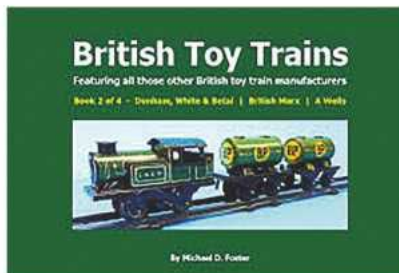
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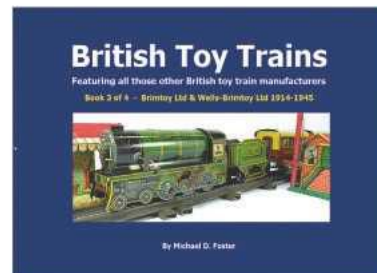
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LASER-CUT parts for "Ellie" - since publishing the construction Manual for "Ellie" The Steam Tram last month, copies have been flying off our shelves, but are still available at **£15.05 UK** postpaid. A 16 mm scale model, "Ellie" is a really simple beginner's project for a live-steam locomotive. And now we have also launched a range of laser-cut kits for the Frames, and other parts for this model to help you speed construction. Too many to list here, but have a look on our website to see the full range, or request a copy of our list of the kits.



..... now some really good BOOKS:

NEW!

Here be Dragons • Girdlestone • £39.90

The autobiography of Phil Girdlestone - a man who spent his life actively and successfully keeping steam alive. Having started by rebuilding 'Linda' on the Ffestiniog, he then modernised 2 foot gauge Garratts in South Africa, worked on mainline steam in the Sudan, South Africa, Russia and Australia, and supplied a new narrow gauge Garratt to Argentina. Highly interesting both technically and about preservation, notably on the Ffestiniog. 134 pages full of colour photographs, drawings and charts. Hardbound. A great Christmas present!



BACK IN PRINT!

The Darjeeling Garratt and the engine it tried to replace Manning • 27.35

Available again, here are Peter Manning's detail dimensioned drawings, plus 3D CAD ones, of the second Garratt locomotive built - the 'D' class for the Darjeeling Himalayan Railway, plus drawings for the 'B' class 0-4-0 tanks it was intended to replace. Whilst a significant locomotive development, the 'D' class wasn't repeated, and the 0-4-0 tanks continue to the present. With a model of the Garratt available in 16mm narrow gauge, and drawings and castings available for the 'B' class in the larger steam gauges, this is a very useful book for modellers. 72 landscape format and ringbound pages.



BACK IN PRINT!

Building Stirling 1 • Warbrooke • £ 8.90

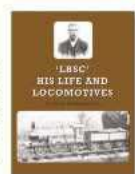
Reprinted after some years, the author describes how to build a unique form of Stirling Engine which has no displacer. The theoretical possibility of such an engine had been long considered, but as far as we are aware, Ted's was the first design that actually worked. As the only moving parts are the piston, crankshaft, crank and flywheel this is a very simple engine to build, and an ideal beginner's project. It also has great appeal to Stirling Engine enthusiasts as a basis for experimentation. This book contains drawings for this engine, plus hints and tips on building it, assembly photos etc. *Stirling 1* requires no castings, and can largely be made from bits in the scrap box. High quality 32 page A4 paperback.



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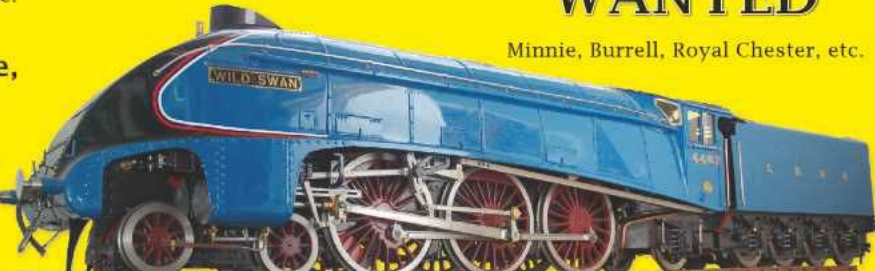
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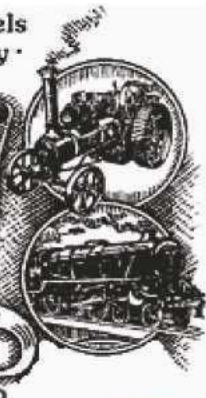


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