THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 220 No. 4587 • 25 May - 7 June 2018

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COVER FEATURE

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Daimler engine 1885

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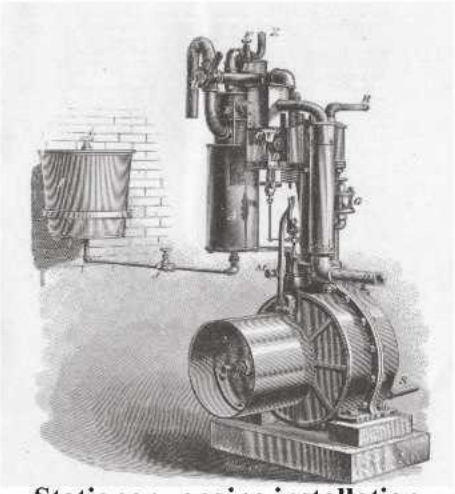


Stationary engine installation

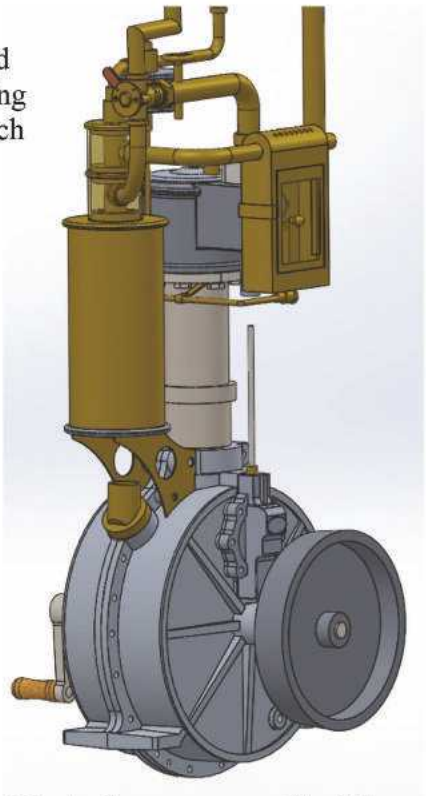
Our model detailed here is based on the four-stroke engine developed by Gottlieb Daimler and Wilhelm Maybach, nicknamed Grandfather Clock or "Standuhr". The first prototype unit ran successfully in 1884.

The history of the "Standuhr" engine goes back to the year 1882, when Gottlieb Daimler and Wilhelm Maybach began work in Cannstatt on a light-weight, high-speed, four-stroke engine. But the ignition represented a major challenge if they were to achieve higher engine speeds Maybach working through patent specifications came across Watson's uncontrolled hot-tube ignition system.

Both men were already familiar with the concept of the four-stroke engine from their time working at Deutz. They chose Otto's four-stroke patent DRP 532 but Daimler based his application for patent DRP 28022 on the principles of explosive ignition and rapid combustion. The experimental engine was compact and light, and therefore suitable for use not just as a stationary engine, but for mounting in vehicles. The engine featured a surface carburettor – developed by Maybach

During the course of 1886 an engine was mounted into a carriage frame – resulting in Daimler's fist automobile and the world's first four-wheeled motorised vehicle with petrol drive. In 1886 the engine was installed in a boat and became popular for this application.

This is a unusual engine from the beginning of the internal combustion engined automobile. At a time when the fundamental construction details were still being worked out. The cam is a disk with groves in it to produce valve events to match the otto cycle, being directly driven by the crank shaft avoiding the need for gears. Ignition is hot tube. We use a glow plug in our model for simplicity.



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Clutch drum	1
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Crank bushes	4
Con rod bushes	2
Valve springs	2
Glow plug	1
Brass tube	7

* may change

Our **drawings** are in book format with over 100 pages. Each part has a individual drawing. There are parts lists, assembly and section drawings to help with construction and some basic construction notes

The model is 280 mm Tall and has a 20 mm Bore

Catalogue available

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Published by **MyTimeMedia Ltd**.
Suite 25S, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
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CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

EDITORIAL
Editor: Martin R Evans
Tel: +44 (0)7710 192953
Email: mrevans@cantab.net

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching Manager: Brian Vickers
Ad Production: Andy Tompkins

ADVERTISING
Advertising Sales Executive: David Holden
Email: david.holden@mytimemedia.com
Tel: 07718 648689

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Kate Hall

MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

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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.
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IN THIS ISSUE

Vol. 220 No. 4587 25 May - 7 June 2018

ON THE COVER...

The half-scale Zenith carburettor from Stephen Wessel's ENV aero engine, with the float chamber cover CNC milled by Roger Davis (photo: Stephen Wessel).

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Are we Luddites?

Peter King, in his article on page 786, has very bravely shaken up a can of worms and spilled them across the bench. He asks the question "Is CNC model engineering?" and makes a very good case, I believe, for saying "Yes, of course it is", accusing those who may disagree of being 'Luddites'.

The question, though, goes wider than that. These days we are presented with an array of modern techniques which, although they may have been around for a little while, are now becoming more and more accessible to the 'men in sheds', i.e. us. These include, as well as CNC, laser and water jet cutting, 3D drafting and 3D printing. All these, once beyond reach for most of us, are now available to us at very reasonable cost. Laser cut parts (frames and motion parts, for instance) can be had for little more than the cost of the material. 3D draughting packages are available as free or low-cost downloads. 3D printers now cost just a few hundred pounds. Most of these require access to a computer but very few of us lack one of those nowadays. It is quite straightforward these days to convert an ordinary mill to CNC, as a number of articles in this magazine testify. Alternatively, a CNC mill can be bought for what is, when you consider what you are getting, a very reasonable cost. The question remains, though – is it model engineering?

I suppose the answer, to some extent, depends on how we judge a model. Do we judge the product - or the process? Is it the beauty of the model that we admire or the skill and application that went into its creation?

Perhaps the fundamental question is "Why are we model engineers?". It is of course a hobby, so our motivation may be our own personal satisfaction, sense of achievement or as an antidote to the more mundane aspects of life. For some of us, our primary objective is the production of the model; in this case, any opportunity to speed up that process may be justified. Laser cut frames save a lot of effort with the hacksaw and files and CNC makes short work of repetitive parts. A further benefit is that, for the same expenditure of effort, a much more detailed and authentic model is possible. For others, the objective is the process itself – the exercise and refinement of a set of skills. Exactly what skill-set is being developed, though, is surely a matter of personal choice. For some, it is traditional craft skills – the adept handling of a file or expert machining and fitting. For others it is mastery in the use of modern techniques and the programming of CNC machines or 3D printers. All of these skills, it could be argued, are aspects of engineering in general and so, surely, should all qualify as model engineering.

What do you think?

MSRVS rally

The Model Steam Road Vehicle Society (MSRVS) will be holding its 33rd rally on the weekend of June 23rd and 24th. Visitors will see approximately 70 model engines, most of them in full steam. Some of the owners will be offering 'driving lessons' and for a donation to charity the participants will receive on completion a 'Certificate of Competence'.

The rally takes place at Tewkesbury Rugby Club between 10.30am and 5 pm each day. The rally will also feature a classic car display, craft tent, model tent and many more attractions. You can find more information at www.msrvs.co.uk/steam-rally.html

Welshpool festival

Also on the weekend of June 23rd and 24th is the Welshpool Transport Festival. Welshpool and Tewkesbury are not so far apart so why not make a weekend of it and visit both shows? The event, organised by Welshpool Town Council and involving a host of local organisations and enthusiasts, will see the town centre become a hub of transport activity. The festival aims to represent as many forms of transport as possible, from cars to canoes, horses to huskies, trucks to trains.

Activities spread throughout the town will include vehicle displays, cavalcades, a special intensive timetable on the Welshpool & Llanfair Light Railway, horse-drawn narrow boats and coracle races on the canal, model exhibitions and much, much more.

Further information is available at www.welshpooltransportfestival.org.uk

Rosie's Governess car

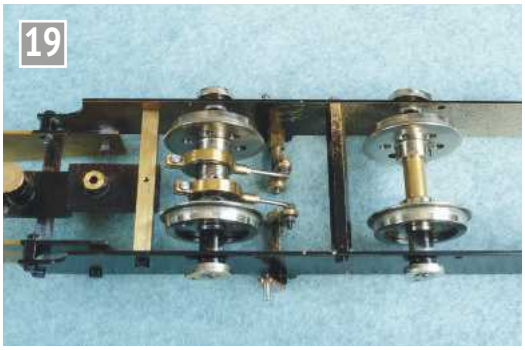
You may remember that I mentioned Rosie's Governess car (not 'cart', mind!) a few weeks ago (*M.E.*4580) while enthusing about what I'd seen at the London Exhibition in January. Unfortunately, I was not able to meet Rosie at the show but I did take the opportunity to ask Patrick Hendra, chief of the Eastleigh Young Engineers, to ask her to write about it. This she has done and you can find the result on page 784. Rosie is just 10 years old and I think she has done a fine job of her model so I commend her article to you.

FALCOR A Beginner's Locomotive in 32mm Gauge

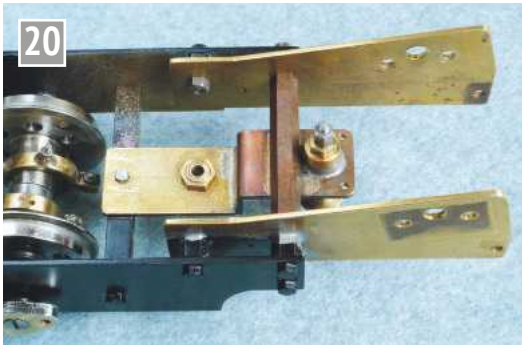
PART 4

Martin Ranson presents a design for a simple, quick build gas-fired 32mm steam locomotive.

Continued from p.649
M.E. 4585, 27 April 2018



Frames seen from below.



The front end of the frames.

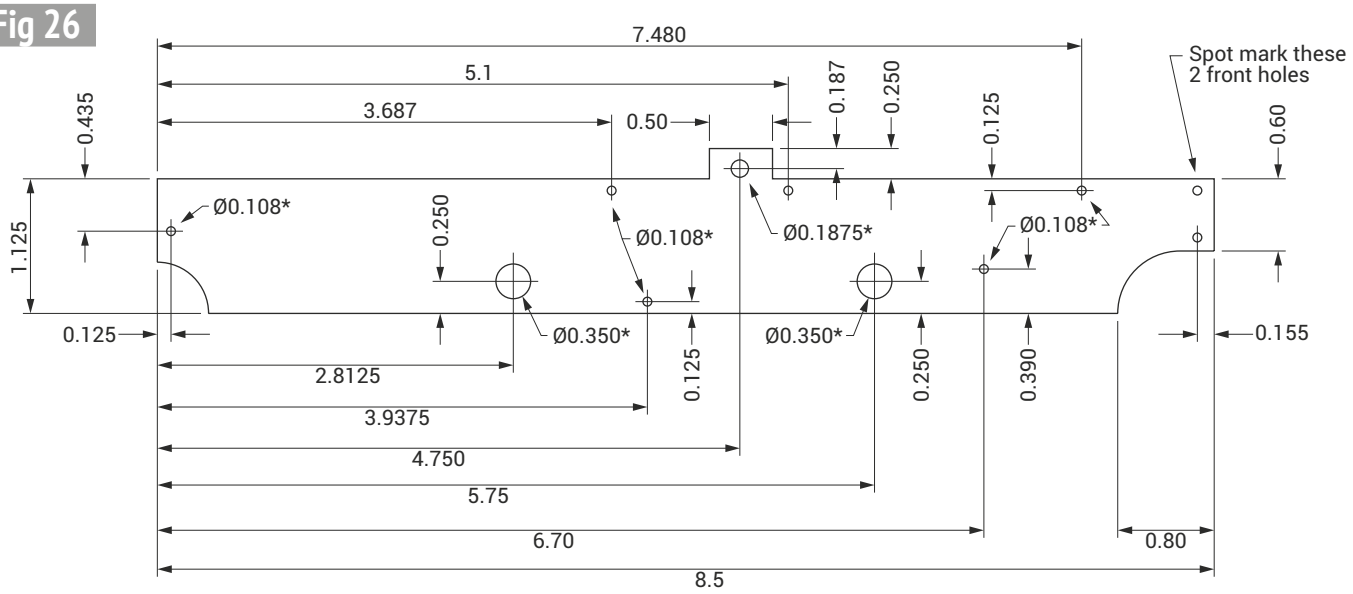
Frames (figs 26 and 27)

There are actually two sets of frames (**photos 19** and **20**), both made from 1/16 inch brass. The small frames at the front are recessed inwards towards each other; these are to carry the cylinders and to provide a rear support for the smokebox mounting. They also support the suspension for the front bogie. Initially I made the two sets so they could be split apart, then this was changed to be a solid assembly by using soft solder on all the spacers.

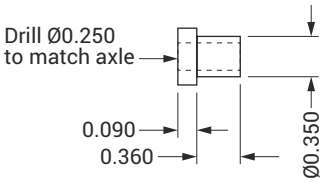
Both of the sets of frames were cut and drilled in pairs, then soft soldered, so they would match exactly. When this was complete the frames were separated and all the excess solder wiped off.

If there is ever a need for stripping down the completed frame assemblies the solder can be melted on one side. Note that the thickness of the six spacers determines the centre-line of the piston

Fig 26



Main Frames
Mat'l: 0.060 brass sheet, 2 off



Bushes
Mat'l: Ø3/8" brass, 4 off
Soft solder in place

* Distance between axles must be the same as coupling rods, see text

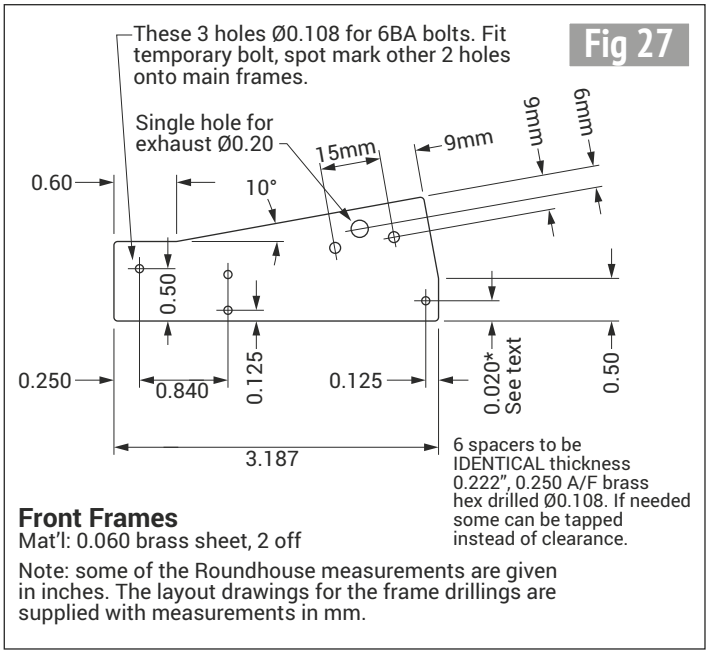
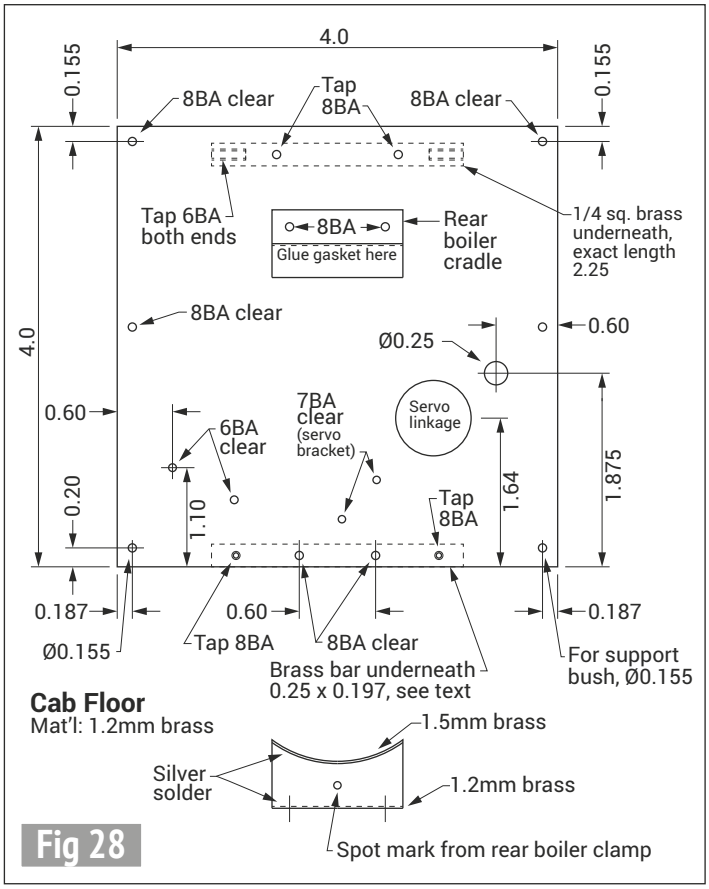


Fig 27

Front Frames
Mat'l: 0.060 brass sheet, 2 off

Note: some of the Roundhouse measurements are given in inches. The layout drawings for the frame drillings are supplied with measurements in mm.



Cab Floor
Mat'l: 1.2mm brass

Fig 28

rod and this spacer thickness is 0.222 inch with a frame thickness of exactly 0.060 inch. I assume the brass sheet that I purchased is a nominal size that could pass for either 1.5mm or 1/16 inch.

When I positioned the cylinders in relation to the crank pins I put the connecting rods nearest the pins with the coupling rods for the rear wheels on the outside. My assumption was that the maximum force from the pistons needed to be nearest the cranks. I have since been told this is not always the case for locomotives with six or eight driving wheels so if anyone wants to swap the positions of the connecting rods and the coupling rods then feel free to do so.

Between both frames there is a total of seven various spacers of which five are 2.25 inches in length. Four of these are ¼ inch square brass which is tapped 6BA at each end. Please ensure that all these are EXACTLY 2.25 inches in length. This saves lots of problems when all the bolts are tightened up. This way nothing gets distorted.

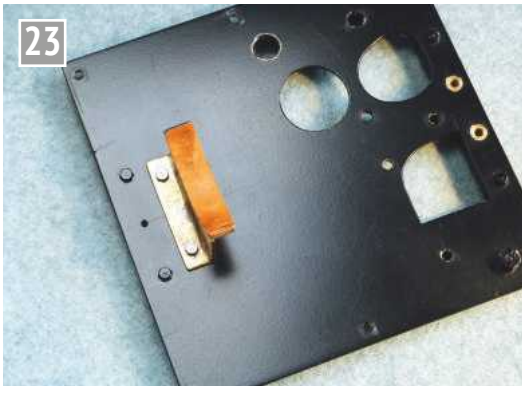
Looking at **fig 26** there is a note concerning the axle spacing. The exact distance is not critical but the critical part is that the two axle spacings and the two coupling rod spacings ARE identical. The size I was trying to match was 2.937 inches. The four brass bushes shown were soft soldered into the frames with all the various spacers in place and the bolts tightened up. A length of straight steel bar was positioned through each axle in turn before soldering, to make sure the bushes were pointed directly at each other.

There are also eight holes shown on the drawing; these are 6BA clearance, approximately 0.108 inch diameter for hexagon head steel bolts. Most have a length of 0.312 inch but those used to clamp the smaller front frames are a bit longer. Looking at **fig 27** for the smaller front frames it can be seen that the dimensions are mainly in millimetres; this is to match the Roundhouse cylinders.

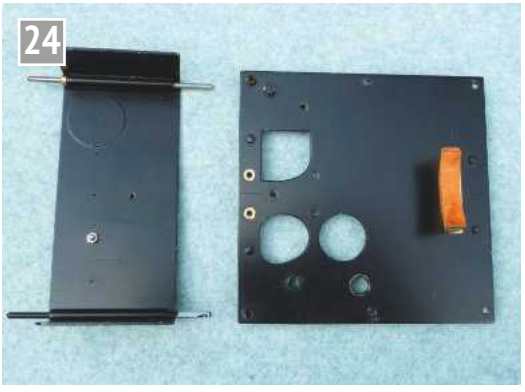
The two holes for the actual cylinder mounting do allow for a certain amount of slack to ensure the cylinders can be aimed directly at the centre of the axle. Shown at the left-hand side of the front frames there are three holes. Fit a temporary bolt in the hole at the left and join the front

Front buffer beam.

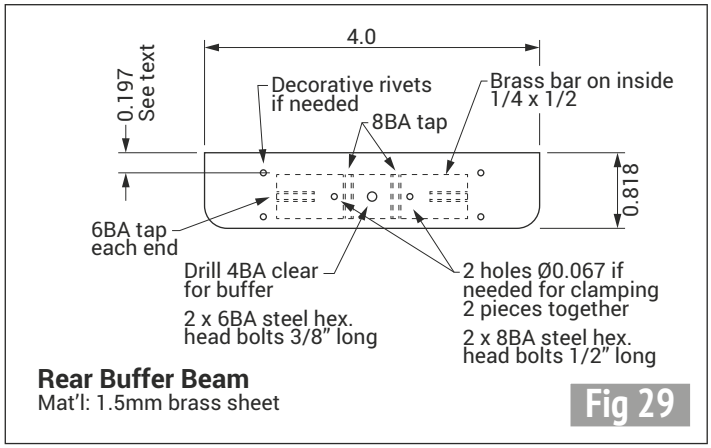
Front buffer beam from behind.



Cab floor.



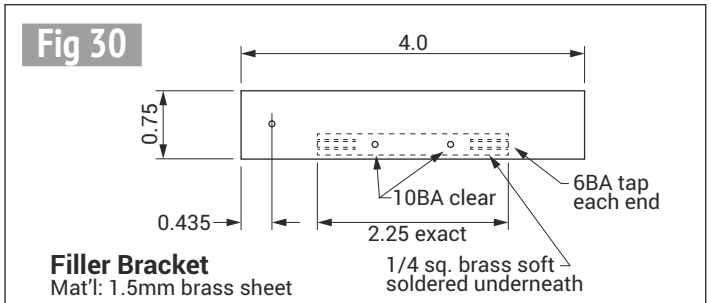
The cab floor and the rear surround, used if needed.



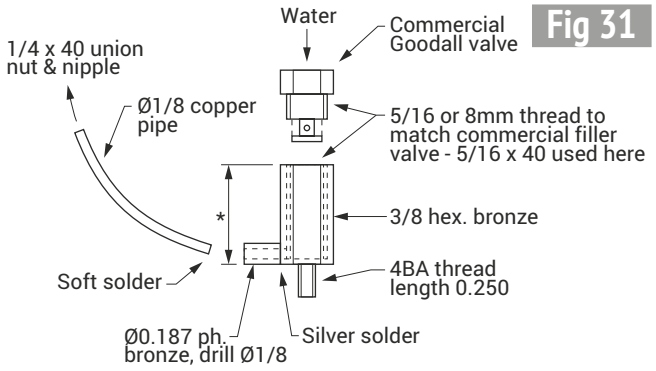
Rear Buffer Beam
Mat'l: 1.5mm brass sheet

Fig 29

Rear buffer beam.



Filler Bracket
Mat'l: 1.5mm brass sheet



Filler Adaptor

*This height to suit filler valve dimensions. Some valves much larger than others,height used here is 0.765

frames onto the main frames. The two bottom edges of both frames can then be set parallel to each other, which will ensure the front frames are still horizontal when everything is assembled.

Spot through the other two holes onto the main frames so that when all the six spacers have been made identical to each other it can all be bolted together and partially soldered or totally soldered according to your preference. On fig 27 there is a drilled hole of 0.108 inch diameter, which is the mounting for the front buffer beam. Note it is only 0.2 inch above the base of the front frames as the front beam is set lower than the frames to form one half of a channel for the bogie location arm. The front buffer beam is shown in **photos 21** and **22**. The actual metal part of the beam is covered on its front by a piece of plywood for extra strength in case the locomotive derails on a curve.

The beam is soft soldered to the frame spacer and beneath this is a short length of ¼ inch brass angle. This is also soldered to the rear of the metal buffer beam. There are some 1/32 inch rivets for additional security.

Cab floor, rear buffer, water filler and support (figs 28 to 31)

There are various things supported by the rear floor (**photos 23** and **24**). As the design evolved to include radio control the gas tank was swapped from below the floor to above it, which is why there are some unused holes cut in the floor. These can be seen in the photographs but are no longer needed and are not shown on the drawings (**fig 28**). The floor also supports the rear cradle for the boiler along with its clamp bolt. The exact height of this cradle decides whether the boiler is level, tipped up or tipped down; mine is 0.611 inch in height to place the boiler horizontally - this includes the two orange washers seen in the photographs.

Two vertical bushes have been fitted at the very rear of the floor for a removable cab rear plate, should this be needed (photo 23). At the rear end of the cab floor on the underside is a spacer which has a height of 0.197 inch. The size was determined by filing one side of a length of ¼ inch square brass bar down to size. At this thickness the floor met the top of the frames properly. This spacer fills in the gap under the floor plate so it can be used to clamp the cab floor down to the ¼ x ½ inch brass bar without bending the floor plate.

The rear buffer beam is shown in **fig 29** and **photo 25**.

The bracket for the water filler (**fig 30** and **photo 26**) has a spacer underneath which is exactly 2.25 inches long, the same as all the rest of the spacers. The actual filler valve is shown in **photo 27**. Rather than fit a pump, this time a commercial filler was used (**fig 31**). This type is called a Goodall valve. It is mounted clear of the boiler just to keep the silicone tubing cool. The actual bush, silver soldered into the boiler, is angled - not the usual flat arrangement. This was intended to be capable of taking a curved steam supply pipe up into the steam dome if needed. Ultimately this was not necessary so the bush was used to fit a water feed.

●To be continued.

The bracket for the water filler.

Water filler valve.

PART 14

Lathes and more for Beginners

Graham Sadler discusses milling tools and explains why climb milling is a bad idea.

Continued from p.717
M.E. 4586, 11 May 2018

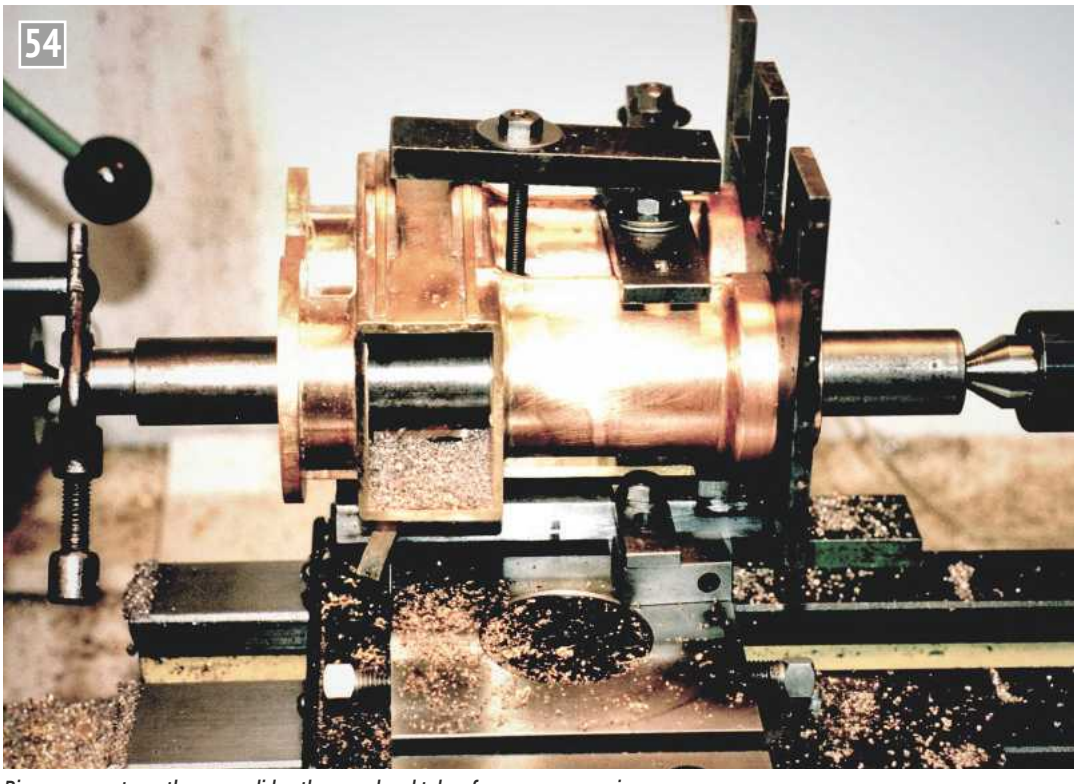
We have looked at basic turning, drilling, boring and we can now cut male and female threads. In order to make the tool post we will need to examine milling.

Although a small miller such as the Sieg SX2 series type can be purchased for reasonable cost, these days you can get a lot of machine for your money. My first miller was a Dore Westbury. This was supplied in kit form where all the big pieces had been factory machined, leaving the constructor to make a significant proportion of the machine. It took me a long time to make and was a very effective machine but, in the early 80's it was quite expensive, costing about the same then as the Sieg does now. Before the development of this kit machine, model engineers used a combination of a vertical slide, clamping onto the top slide, angle plates and a plethora of *milling sub tables* - plates with mounting holes fixed to the cross slide allowing work to be fixed onto it for milling.

Photograph 53 shows my vertical slide, purchased at the Doncaster show for £35 for this series - the one I used to own was sold a good while back. It seems to be in a sorry state, accounting for its low price, but it still works very well.

Firstly, the most obvious problem is the damage to the top 'T' slot, the edge of which has broken out. Not quite so clear, and revealed with very light filing, is that all of the slots are bulging along their

My distressed 'new' vertical slide showing why we need 'T' nuts!



Big components on the cross slide - the crosshead tubes for my wagon engine.

edges. Both of these problems have two possible causes. Firstly, far too much force has been used on holding down bolts especially when using a strap clamp with a bolt on either side of a big casting, joined over the top by a bar of flat steel pressing on the top of the casting. For this reason, it is a mistake to use bolts of too big a diameter as the larger nuts and spanner encourage you to tighten them too much - better to use a third clamp (two is the minimum).

The second reason for frequent failure is not using a long enough 'T' nut to anchor the bolts. The table casting is made from cast iron. This brilliant material is tremendously strong in compression, but in tension or bending, as experienced at the edge of the slot, it is extremely weak and brittle, exacerbated by the diminutive scale of the slots (the Myford cross slide is exactly the same). I don't now often bolt things down onto the cross slide or use the vertical slide but here's a picture (**photo 54**) of the machining of the crosshead tubes for my wagon engine. It shows just what can be achieved .

Whatever method for milling we use, it is essential to fix things gently yet securely to the machine and the best way to avoid the problems above is to make some long 'T' nuts. The longer these are, the more the load on the slots is spread out. I suggest making two of each size - about 25mm, 37mm and 50mm long. I have many of these, so only one will be made by me (**photo 55**). Make them in three lengths from 8 x 15mm material of length 78mm then cut it up - but before we start we will consider the cutting tool.

For milling there are three main types of cutter, two of which are the *slot drill* and the *end mill*, both coming in a standard length and a long series. **Photograph 56** shows a range of milling cutters. In addition a *fly cutter* of much larger diameter is used mainly for facing flat surfaces. I will indicate in the tool post project how easily you can make this simple and very useful tool.

The slot drill usually has two cutting edges and has the advantage of being able to cut directly into material axially i.e. a plunge cut directly into the material (the drill name part). This is because one of the cutting lips on the end is extended across the centreline of the cutter. However direct plunge action is rather fierce in our small lightweight flexible machines and, if using (say) a 6mm cutter, it's best to drill a 5.5mm hole first and feed the cutter into that.

In CNC machines, cutters are often *ramped* into the cut, by feeding down and along at the same time, resulting in a very shallow angled cut. When at the specified depth the cutter is moved back to the start point in order to give equal cuts with the special milling programs involved. This is all achieved automatically in the software and the resulting feed is consistent and gentle. We are not so clever and our jerky feed would snap off the tip of the cutter lip. As its name suggests, a slot drill is designed for cutting slots of an accurate width, which will be very close to the size of the cutter.

The end mill is designed for profiling the edge of a work piece and has four or more cutting edges. It usually has a shallow conical hole in the end, limiting the length of the cutting lip, making it impossible to be fed in axially by plunging, unless it's into a pre drilled hole - and even then it's not to be recommended. Some are centre cutting. The end mill **will** cut slots but, when in a slot, one cutting lip will tend to flex and push the cutter a trace off line by its cutting action, forcing the opposite lip to cut deeper. The slot drill, having only two lips, does not have this problem and can cut slots to a very close tolerance.

> Without quite expensive specialist equipment, which need skills beyond the scope of this series, it is impossible to sharpen milling cutters.

Without quite expensive specialist equipment (or a very long build for making your own), which need skills beyond the scope of this series, it is impossible to sharpen milling cutters. Looking at the speeds and feed rates recommend for industrial users may seem a total nonsense for us. Many of us in home workshops will tend to use very gentle feeds in order to preserve the cutter for as long as possible. This is not always a good idea as often the feed is too slow, leading to the tool rubbing, or irregularities of feed rate by hand can cause problems. It's better to take a smaller depth of cut but maintain the correct feed and rotational speeds.

Some cutters have three lips and can be used for both slots and profiling.

The basic material for these tools is HSS, but they can be improved by having a small amount of cobalt in them or various coatings. These are clear from the colour of the cutter, for instance giving it a gold colour with *TiN* - titanium nitride - which is said to improve their lifetime by a factor of three or more. The black appearance indicates a *TiAlN* coating - titanium aluminium nitride - which will allow double the HSS speeds but at a higher price premium of 50% more than TiN coatings. The next stage is for them to be made from solid carbide, a very heavy metal allowing even faster metal removal. Moving up the scale, we have cutters with indexing tips similar to the lathe tools. They are even more

The finished 'T' nut bar.

Milling cutters. Front row: Little Hogger single point carbide. Centre row, from left: three flute TiAlN coated, rounded edge, plain slot drill, 25mm diameter indexed. Indexed with TiN coating. Back row, from left: radius edge 25mmm end mill, rougher standard 20mm end mill, plain end mill, 35mm end mill (£5 new on eBay!).

>>

ER32 collet chuck for the lathe, home-made ER20 milling chuck in the front.

expensive but there many types on the market which allow even faster speeds and feeds.

In use, the maximum cut of the end mill is a quarter of its diameter for width with a depth equal to diameter, while for the slot drill its depth of cut is half of its diameter. The speed and feed are dependent on the tool diameter, tooth loading (how much cut each tooth is to make), the rotational speed, material being worked, the material of and possible coating of the cutter, rigidity of the machine and finally the method of chip clearance and cooling.

The ends of the cutter can have a screwed 20tpi thread, be a plain diameter or be plain with a notch designed to match with a grub screw to hold it in a special holder. In reality, all milling cutters should be held in a properly designed milling chuck or the cutting action will cause them to be pulled out bit by bit from the chuck. You must avoid the use of a drill chuck to hold a milling cutter as it is designed for axial, compressive forces rather than the tensile and lateral forces encountered in milling and has insufficient grip on the cutter.

Dedicated milling cutters need a set of collets. I prefer the ER type, as the collets have built in small adjustments of size allowing them to be used on metric and Imperial shanks. You now also have the advantage of being able to use the collets in a special chuck in the lathe, the advantage here being that their gentle yet highly secure all-round grip is great on delicate jobs and they are also very accurate with almost zero eccentricity. This means work is correctly centred unlike the standard three-jaw lathe chuck. **Photograph 57** shows a couple of collet chucks - the 32 or 20 is the diameter of the large end of the collet.

When making a cut with any milling process it is vital to feed in the correct direction. The cutter must be fed against the direction of rotation. This is known as *conventional milling* so if the cutter is above the work (on a lathe, using a vertical slide), you start with the cross slide almost fully in and feed outwards towards you. If the cutter is mounted below the work, then the opposite is true - the feed starts at the back and the slide is moved away from you. If one feeds in the reverse direction - that is, the feed is in the same direction as the rotation of the cutter - it is known as *climb milling*. This should not be used.

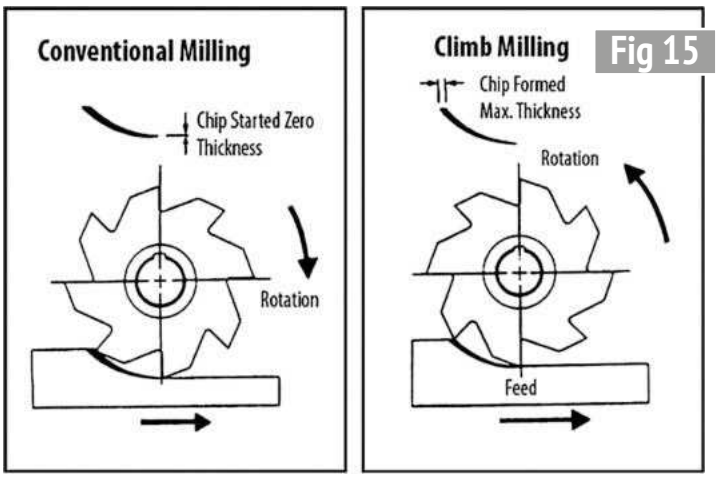
When making a cut with any milling process it is vital to feed in the correct direction. The cutter must be fed against the direction of rotation.

So, why the fuss? Firstly, this is not something to try or it is highly probable the climb milling will break the cutter. It is only possible in large industrial or CNC machines which are fitted with anti-backlash feed screws. We discussed the backlash problem in an earlier issue but for now let's assume we have a large backlash of 0.1mm in the cross slide. If we climb mill by starting the cut at the back when the job is under the cutter, we will be pushing the cross slide in compression, driven by the screw. As soon as the cut starts the cutting edge will hit the flat top of the work and try to cut it. The resultant rotational reaction force will try to push the cutter up and climb over the work. At the same time the work will be pulled into the cutter putting the slide into tension rather than compression, as before. The slide will immediately be pulled into the cutter until the backlash is fully taken up i.e. 0.1mm, representing a massive cut.

The recommended cut per tooth for a new Presto HSS 10mm end mill is 0.048mm per tooth (183mm per minute) at 955rpm. Tubal Cain recommends 0.025mm cut per tooth (65mm per minute) at 640rpm. Don't forget the next tooth of the cutter is on its way! Result, a broken cutter, perhaps with the work being grabbed and thrown backwards along with the sound of much cursing! A positive feature of climb milling (assuming the machine can support it) is that the cut is biggest at the start of each slice, reducing towards the end, giving an improved finish. At the same time the work is forced downwards usually onto its mounting platform, increasing rigidity. It also uses less power and is kinder on the cutter as it reduces rubbing at the start of the cut. With conventional milling, the cut starts small and increases tending to lift the work making it harder to hold in place (**fig 15**).

●To be continued.

Next time we will make ourselves a set of 'T' nuts.



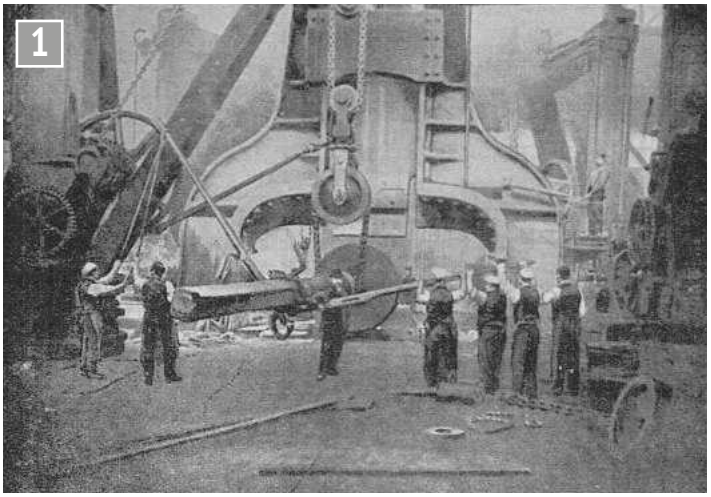
Climb and conventional milling.

More Shipbuilding in the Thames PART 1

Days of Iron Men and Iron Ships

James Wells looks back at the days when wrought iron was 'king'.

Having seen the advertisement for the book *Rivet Lad* by Alan McEwen I was reminded that, despite the well-known industrial north, it seems to be that now almost forgotten is that the south, including London, also had a considerable heavy industry.



The great steam hammer at Woolwich Arsenal.

As there seems to have been some reader interest in my earlier Thames article the Editor has kindly encouraged me to expand on this.

The Thames heavy industry was an early producer and user of wrought iron but little detail seems to have been written up about the practical problems that had to be solved for the commercial use of this material.

With its high melting point, wrought iron could only be produced in pieces of approximately 70lb maximum weight called 'blooms'. When the blooms arrived from the 'bloomery' these still had to be forged at nearly white heat under power hammers to work the slag towards the edges where this was cut off leaving a modest sized plate. The usual maximum plate size was approximately 10 feet by 4 feet and up to about an inch in thickness.

Operating the hammers to pound the hot iron was a horrendous job and the moisture allowance for each member of the hammer gang was a gallon of beer per man per day. In most of the hot working areas there was also a daily issue of clean sweat rags. Even in my time there were still legends of overalls so soaked in sweat that after having been removed and on drying out would stiffen sufficiently to almost stand up.

This pounding isn't a new process, being known from Roman times, and during the medieval period water mills operating small trip hammers pounded the then small slag filled blooms into usable grade iron. Although the buildings may be long gone the names have survived and one area close to where I used to live in south east London is still called Knockholt Pound. Being close to The Weald ensured a supply of the small sized blooms.

Wrought iron and shipbuilding

The largest ship built on the Thames was Brunel's *Great Eastern*, destined for a mixed future of fame and ignominy. Most histories of this ship quote the usual comment of how more than three million rivets were used to build this ship but nobody seems to appreciate that so many rivets had to be used as at the time industry could only produce the comparatively small wrought iron plates.

Another famous ship to be built on the Thames was the all iron warship *Warrior*. By coincidence this first all iron ship was built in the same shipyard that would build the last Thames built battleship, with both shipyard and battleship becoming East End legendary folklore.

Wrought iron proved to have several practical advantages. ≫

For the ship owner it was almost corrosion free and for the shipbuilder it could be shaped by simple means and would stand considerable abuse in construction. As I mentioned in my earlier article, wrought iron has a definite 'grain' structure similar to that of wood. When building up a large forging this grain structure had to be considered, especially if later machining was required.

From a fairly early stage the production of wrought iron began to divide into separate processes. One of these was that after being brought down from a bloom to a fairly flat plate it could then be rolled to a reasonable thickness and then the edges sheared.

Another process was forging. Before the days of electrical welding, wrought iron could be welded into larger pieces by comparatively simple technical, if brutal, methods. By heating to white heat and hammering, wrought iron could be readily built up into larger pieces. The famous 1000 ton hammer at the Woolwich Arsenal (**photo 1**) was first installed to produce ever larger forgings by the hammer welding process.

For these larger forgings the bloom would previously be forged down until the slag was worked out to the edges and sheared off and when several pieces were ready and glowing almost white hot, these would be piled on a hammer bed and pounded together. The combination of the heat and extra energy provided by the hammer blows effectively welded the pieces into one larger piece.

The heat and sparks produced by such a process were horrendous. Approaching such a working area, clothes would stiffen in the heat as moisture was boiled out of them. The beer ration seems almost inadequate and the phrase of 'Iron men in a heroic age' still seems very applicable.

For the small-scale user, such as the local blacksmiths, wrought iron was greatly appreciated for its ability to be welded using a standard coke fired forge and simple hand hammering. A phrase used was 'if you can't forge weld with iron you won't forge with anything'. I was told that it was a final standard trade test for a maturing farrier to be able to forge one new usable horse shoe from three worn out shoes.

The relative ease with which wrought iron could be forge welded had led to the specialist trade of the chainsmith. Such chains were popular as if overloaded the links would stretch slightly giving some visual warning of an impending break. Steel chains gave no such warning.

These limitations and advantages were well understood in the Thames industries and readily available to any customer. For the smaller shipyards even if the heavy machinery for building an all iron ship wasn't available, the building and shaping of iron frames was still possible.

The Thames dockyards also had a vast timber importation business. Ships would dock with whole trees as deck cargo and these trees would be cut to standard sizes by the legendary sawmill 'Toe Rags'. For a few years ships would be built using Iron frames with a wood 'skin'. Although not Thames built the last remaining example seems to be the *Cutty Sark* in dry dock at Greenwich.

The hard and long working day began at the barbers to get shaven. Most of the workmen had their own named brass shaving pots on nearby shelves and would be shaved before clocking in for work, usually at around 6am. The pots themselves were usually awarded to an engineering apprentice as he completed his apprenticeship and was no longer a 'young shaver'. The brass pots tended to disappear into the Woolwich Arsenal during WW1 as the ammunition shortage became acute.

In the age of gaslights and before the days of electricity, the hair cutters were powered by belts driven from a hot air (Stirling cycle) engine. This was considered sufficiently safe for the apprentice barber to start up and operate rather than a steam engine or the available hydraulic power from the London hydraulic ring main from the Rotherhithe pump house.

Although none of the hot air engines were actually in use during my apprentice days a couple of these were still carefully preserved in local barbershop windows. This may have been the start of my eventually intending to build a hot air engine, *Aeolus*

Steel moves in

It seems to be generally un-commented on that the Romans were the first to mass produce steel for their military forces. There must have been plenty of small pieces of hard steel left over to make razors and I've often wondered if the clean-shaven look for men began with the Romans.

Despite Roman uses it wasn't until the mid 19th century that additives such as carbon, nickel and chromium etc. and the affects these had on iron were understood and allowed the production of reliable qualities of steel. The Thames industrial scene readily adapted to the new materials.

Wrought iron, though, would survive for small scale use for many years after the wider use of steel, one example being road digging pickaxes. These were originally wrought iron bodies with high carbon points forge welded to the wrought iron body. It was with the WW1's vast demand for trench digging that all steel pickaxes were mass produced.

It was frequently an apprentice job to sharpen, then heat treat small tools, which gave experience of heat treatment and confidence in using a power hammer. For the smaller forges of traditional blacksmithing, for some odd reason, whale oil was apparently used for hardening and tempering small tools. This oil must have been readily available as the nearby Greenland Dock specialised in repairs and supplies to the various whaling fleets.

Wrought iron bows out

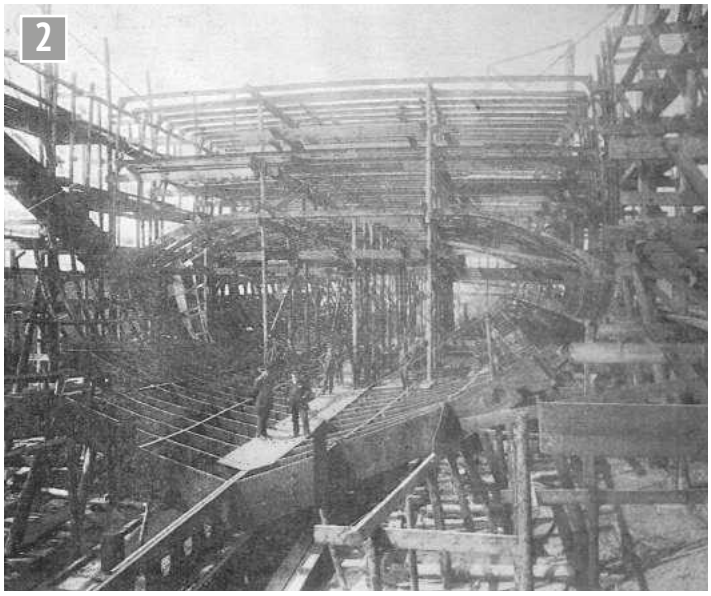
The last mass use of wrought iron was probably the so called 'compound' armour for warships. Although the early grades of steel were more resistant to impact these also tended to be brittle. Wrought iron being softer but more malleable was used to back up the more brittle steel face.

Producing compound armour was an interesting process. The wrought iron plate was brought up to nearly white heat, the steel to the safe upper limit of yellow hot, then the two rolled together the extra pressure of being rolled being sufficient to weld the two plates together. After that the plate was shaped as required and finally heat treated. For some forgotten reason the wrought iron plate was always the bottom plate when being rolled. The 1960s Woolwich Arsenal still had a few specimen compound plates to explain the whole process to school visitors.

The triumph of steel

Steel was almost inevitably going to win out against wrought iron as soon as the reasons for the brittleness were discovered. Mostly this was traced to the carbon content and subsequent incorrect heat treatment. Two major advantages with steel were that lacking the 'grain' of wrought iron there was little restriction to on how it could be folded and bent etc., the other being size.

Adding controlled quantities of carbon to iron to make steel considerably reduced the melting point and removing the slag content almost completely meant that the amount of molten steel that could be poured was limited only by the size of the furnaces. The physical size of a steel plate



A first-class cruiser under construction at the Thames Ironworks.

was also then limited only by the size of the available plate rolling mills and ships could become even larger.

The Woolwich Arsenal had its own Bessemer converters and did pour molten metal. It was an interesting sight, seeing the furnace slowly rotating and the molten metal poured into some sort of mould with a small specimen piece also being poured for metallurgical testing. As the furnace slowly moved into pouring position I was reminded of a rather ponderous elephant.

The peak of Thames shipbuilding was the building and launching of so called Super Dreadnought *HMS Thunderer* at the Thames Ironworks at Bow Creek. This ship was destined to be the last capital warship to be launched on the Thames and would win the fleet gunnery prize on several occasions. Whatever the real financial reasons for the closure of the yard just prior to WW1, this closure would become an enduring and bitter folklore memory still not forgotten in the 21st century.

At its peak the Thames Ironworks (**photo 2**) employed more than 4,000 workers of all grades and was the largest private employer in London. Legend has it that it was Winston Churchill who refused to purchase another battleship from the Thames Ironworks and that was the end of the yard. Almost overnight a vast workforce was unemployed and destitute. More than a century later an unexplained minor mystery has to be that if the Thames lost an order for a battleship why the yard didn't simply build smaller warships.

Big guns

The legend of the 'Big Gun' is also part of the Thames history and reading some recently repeated articles regarding the manufacture of such guns I am sceptical whether the writers of such articles actually saw or had any practical experience of such manufacture.

The barrel itself was forged down from a large billet to a long tube to eventually carry the rifled liner. The barrel was then mounted in a huge winding machine similar to lathe centres. Over this was wound several miles of the traditional 'wire'. This was a special 35-45 ton quality and probably cold drawn in manufacture to give this breaking strain figure. Missing completely from all the accounts that I have read is that this was actually ¼ inch square wire, which is probably more accurately described as square bar.

When the winding was completed the external wrappers were hydraulically forced over the completed wire winding. Here there is a usually an unobserved feature. The exit end of the barrel is usually thickened. The graphic description for this thickening was that without this feature 'on firing the barrel would peel like a banana'. I have long wondered when, where and under what circumstances this discovery was originally made.

The final stage was insertion of the rifled liner and here there seems to be a blank in the big gun story. There are accounts of big gun barrels heated to red hot and quenched in huge vats of oil. Doing this would considerably reduce the original strength of the wire around the barrel. It was the rifled liner that was heat treated before final fitting in the barrel.

When the liner was red hot it was plunged on end into an Olympic sized tank of rape seed oil. Just why rape seed oil was used in now lost but there was the usual gush of flame and smoke. When heat treating large liners it was usually necessary to inform the local fire brigade in case somebody nearby reported a fire in the manufacturers.

The normal propellant charges for a large naval gun were quarter, half and full charges. The usual peacetime gunnery charge was the quarter charge with occasional half charges, the full charge being reserved for war time use. The life of a gun liner on full charge war time use was apparently in the region of 180 rounds before the gas erosion of the liner became too severe for further use. A ship that saw considerable action such as *HMS Warspite* wore out several sets of liners, not the guns themselves.

At periodic intervals the barrel would be removed from the turret returned to the manufacturers for the worn liner to be pressed out and a new liner inserted. This removal of the gun from the turret required the use of the huge sheerleg (tripod) cranes at the various empire dockyards. The last of these sheerlegs was probably that in Gibraltar Dockyard and which was cut down in the early 1970s.

There is some interesting WW1 TV footage of a large naval gun being fired and surrounded by a cloud of wreckage. This is probably where full charges are being used for the first time and the crew being initially unaware of the scale of the ensuing blast shock wave.

Hard times

The Thames seems to have weathered the Great Depression of the late 1920s and 30s comparatively well. None of the people that I actually met who were old enough to remember those years seems to have been unemployed.

If during the General Strike, the world's press had descended on London expecting revolution; they must have been surprised at the amicable relations between workers and the nearby Woolwich Garrison. If the best-known London riot was Cable Street, compared to the riots in Germany and France, it was on a miniscule scale.

Overall, if times were tight in the Thames industry at least the destitution of the north seems to have been avoided. As one Great Depression survivor pointed out to me, with little sympathy for the northern counties, 'there was never a hunger march south to north'.

During my time in Thames industries, although there were numbers of Northerners who had moved south to find employment I've never heard of a Southerner relocating to the north for employment purposes although such companies as Vickers did have recruitment drives in the south.

●To be continued.

NEXT TIME: Thames industries and World War Two.

Designing Model Boilers Or, The Truth About Model Boilers

PART 2

Martin Johnson explains what really happens inside model boilers.

Continued from p.593
M.E. 4584, 13 April 2018

Validating the computer model

The gas flow in model boiler tubes, unlike full size, is streamline and the boundary layer characteristics inhibit heat transfer. I personally think it is semi-streamline or, if you like, semi-turbulent because of eddies set up by deposits in the tubes. – D.E. Lawrence ME 3417.

A complex calculation technique such as that described last time must be validated against test results. Two sets of miniature tests have been published (**refs 3** and **4**), those by Busbridge being the better tests, while those of Ewins reported by Evans were obtained using a convenient, but error prone, test method.

Busbridge's test on 3½ inch gauge *Brittania* boiler

Busbridge carried out a well controlled series of tests on a *Brittania* boiler to LBSC's design and published the results in ref 4. The tests looked at the boiler only and were conducted at the University of Cape Town. **Figure 2** shows good agreement has been achieved with Busbridge's tests across a range of grate loadings. The calculated stoichiometric ratio has been derived from Busbridge's measurements of carbon dioxide in the flue gas. It can be seen that the general pattern is for this ratio to asymptotically approach a value of around 15 at high grate loadings. At low grate loadings the ratio climbs to values near 30 or perhaps more.

The quality of prediction becomes worse at lower grate loadings, partly because variables in the program have been chosen to give better agreement at high grate loadings. However, the results suggest that free convection, probably in firebox spaces, become more significant at lower grate loadings. Since the program is intended as a design tool, accurate predictions at maximum grate loading are more important.

The computer confirms that flow in the fire tubes is indeed streamline (also known as laminar flow). Busbridge's tests included careful measurements on the non-radiant superheater performance, which is fortunate as this gives an accurate indication of heat transfer within the flues. The validation process also confirms D.E. Lawrence's opinion that the flow is not fully settled laminar flow, leading to much better convective heat transfer than well accepted correlations would predict. The results suggest that normal correlations of convective heat transfer need uplifting by about 60%. Possible reasons for this are:

- Gas flow from the firebox to the tubes is turning through 90 degrees, causing major disturbance to the boundary layers in the flues and hence improving heat transfer.
- Gas flow is well into the laminar regime (Reynolds number 500 to 1000 in a miniature firetube) but within the lengths of a miniature boiler, flow is unlikely to be 'settled', giving thinner boundary layers and hence improved heat transfer.
- I don't accept Lawrence's

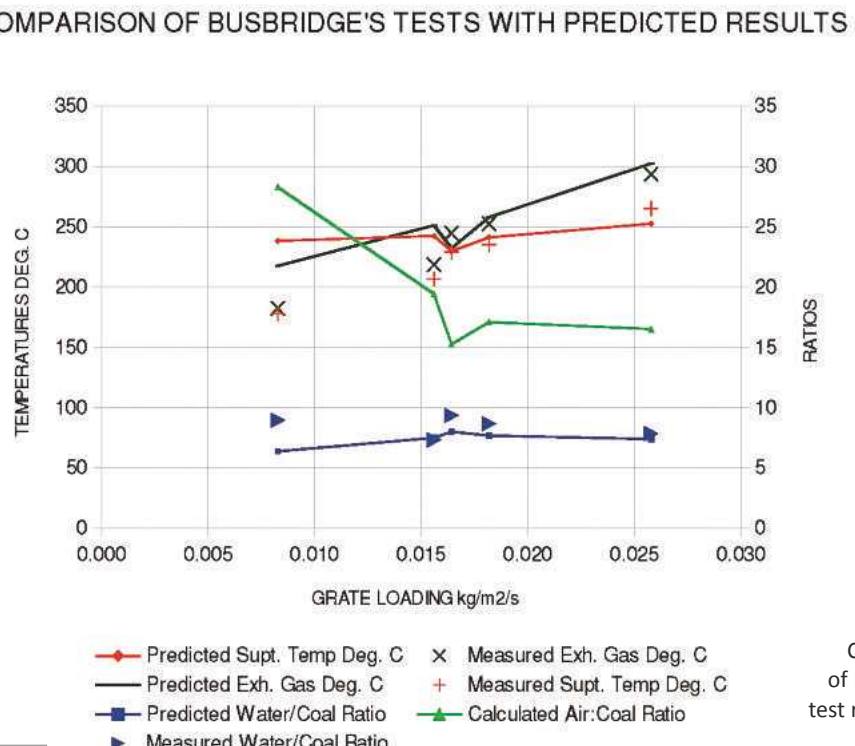


Fig 2

Comparison of Busbridge's test results with predictions from program.

opinion that 'deposits' would cause such an increase in heat transfer, as Busbridge's tests were on a new boiler.

Ewins's tests on 5 inch gauge *Mona* locomotive

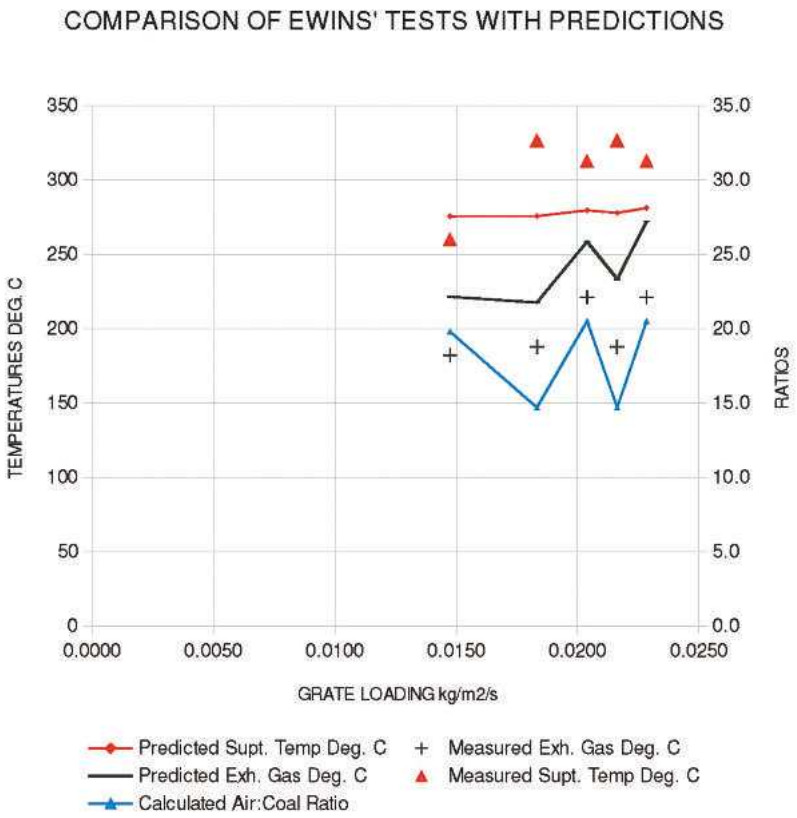
Correlations against Ewins's tests are somewhat frustrating. The tests are subject to significant experimental errors and inconsistencies as follows:

- Flue gas volume was measured by catching the gas in a large plastic bag and then measuring the volume by a 'water displacement method' - details not given. This seems very prone to large errors.
- The flue gas analyses are not consistent with a predominantly carbon fuel burnt in natural atmosphere. The calculations relating to flue gas analysis can be found at **ref 5**. These analyses are used to infer coal consumption and grate loading. This results in experimental error in interpreting how hard the engine was working. If the CO_2 and CO results are assumed correct when burning a good quality coal, the O_2 contents would be as follows:

Test No.	Experimental O_2 by Volume %	Calculated O_2 by Volume %
1	9	10
2	3.5	6.2
3	10	10.9

- The grate loading can be inferred from Ewins's values for 'coal consumption per DBHP hour' and 'DBHP per sq. ft of grate'. If this is done, the predicted flue gas production does not match his measurement of flue gas production. Grate loadings some 12 to 18% higher than those stated would be required to generate the stated gas volumes. Only some 4% could be accounted for by ash content and the calculation was conducted assuming no fuel is lost before burning, which is an implicit assumption in Ewins's data analysis.
- The smokebox and firebox draught measurements are not consistent with the inferred changes in grate loading. I am indebted to Duncan Webster for pointing this out.
- The gas temperature measurements in the firebox will be significantly in error due to the radiant heating from the fire. BS2790 appendix C states this error can be up to 300°C. Taking accurate temperature measurements in a highly radiant environment needs very specialised (and expensive) equipment.
- Multiple IMLEC results suggest a maximum efficiency of around 2.5% is feasible in miniatures, while Ewins claims an efficiency of 4.9% in Test 3, which illustrates the probable magnitude of experimental errors in Ewins's work.
- Some sources indicate the engine tested had thermal siphons in the firebox but Evans, in ref 1, makes no mention of these. I have sought the original SMEE papers of Ewins's tests but without success. If anyone is able to help with copies of these, I would be very grateful.

Fig 3



Comparison of Ewins's test results with predictions from program.

Nevertheless, I have attempted to compare some of Ewins's results with the numerical model. Grate loadings are based on assuming Ewins's readings of flue gas volume flow, CO_2 and CO readings are correct but the grate loadings inferred from stated values of 'coal consumption per DBHP hour' and 'DBHP per sq. ft of grate' are also included. The graph in **fig 3** summarises the coal/air ratio, superheater and exhaust gas temperature results.

The figure shows that Tests 2 and 3 were taken at very similar grate loadings, although the power produced by the engine varied over a 400% range, confirming that the 5% claimed efficiency of Test 3 is not true and the boiler was not keeping up with steam demand. The air/coal ratio shows a drop from around 20 at low grate loading to 15 at moderate loading, which is consistent with Busbridge's result, but then a sharp increase; this suggests the fire may have had a hole in it, artificially increasing the air ratio.

The superheated steam temperature observed is some 45 to 50°C higher than predicted, while the exhaust gas temperature is some 80°C lower than predicted at the higher grate loading. The actual rate of evaporation cannot be inferred from Ewins's results.

I have also compared the predicted temperature profile in the firetube for Ewins's Test 2, which appears to be the most reliable set of data. The results are shown in **fig 4**, which shows the program predicts temperatures some 175°C higher than observed at the tube entrance, reducing to 45°C higher at the tube exit. Firetube exit temperatures observed by Busbridge were also considerably higher than those noted by Ewins.

Ewins's observed fire temperatures are far higher than my predictions (1600°C ≫

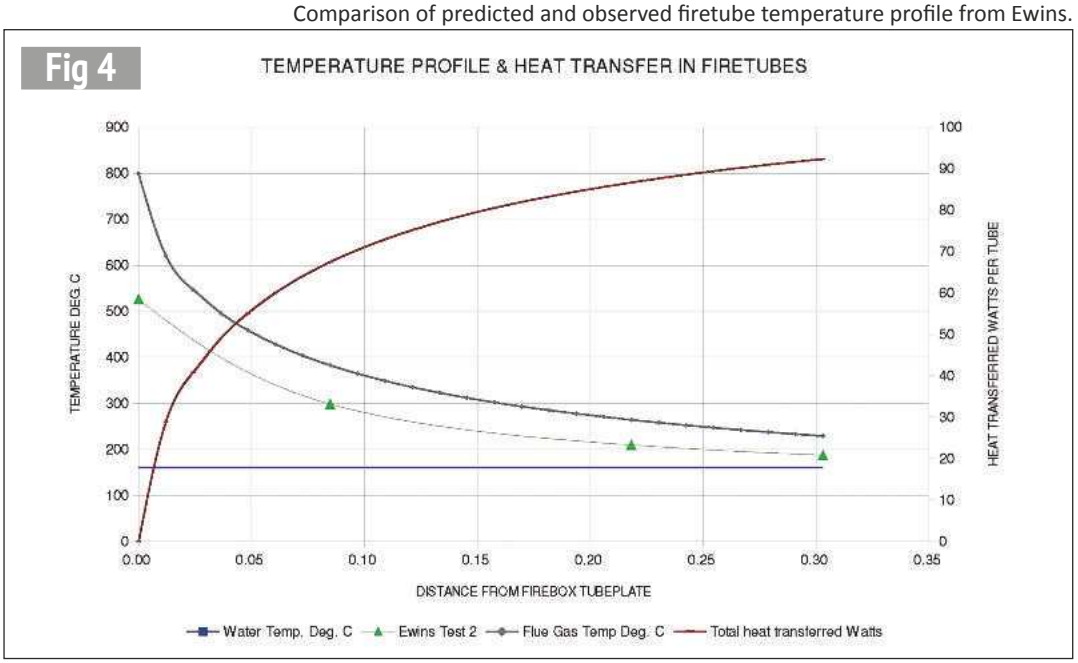
against 1150°C). If the fire were at the temperature Ewins claims the fire would be well beyond white heat. My calculation estimates the fire at yellow to white heat, which seems more logical. The experimental errors associated with measuring temperatures in highly radiant environments have already been noted. Therefore, it seems to me that Ewins's temperature readings must be treated with some suspicion and consequently so must many of his other conclusions.

Full size tests

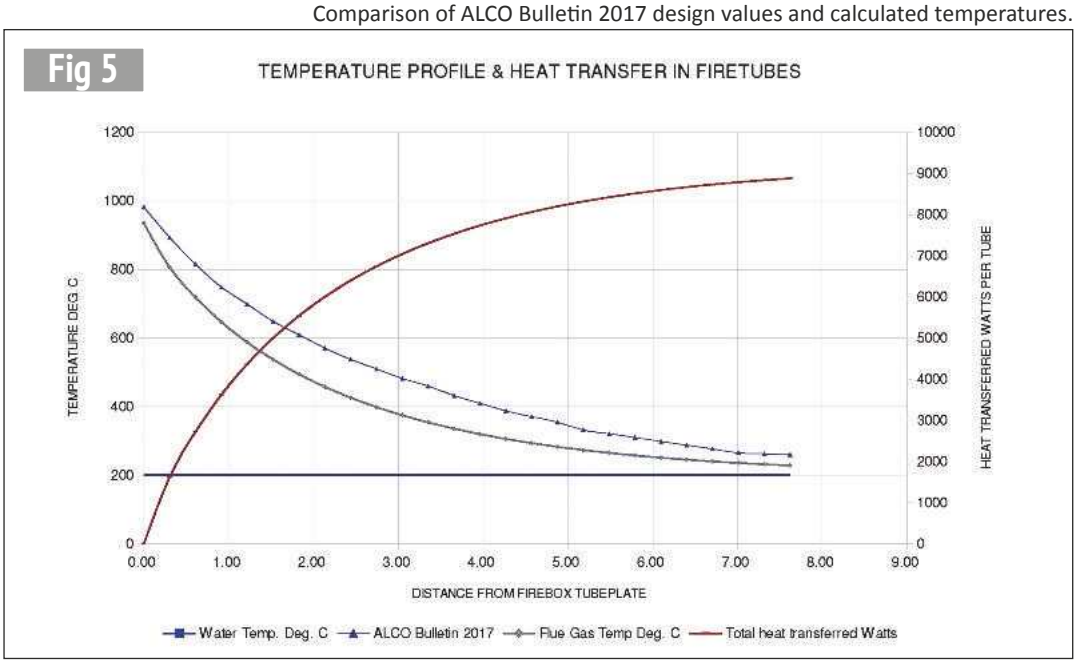
In **ref 6** I found a design chart for the temperature profile in boiler tubes. The chart, originally published in ALCO bulletin 2017, is based on a grate loading of 100 to 115lb/sq.ft/hour. Unfortunately, it does not state the relative areas of grate and tube gas flow area. However, I have tried reproducing the chart and have used boiler design details for the GWR *Castle* class, since I have that data to hand. This is probably not the best choice, since an American test was probably on a wide firebox boiler and certainly not burning best Welsh coal. The results of the comparison are shown in **fig 5** and, considering the potential problems as noted above, gives remarkably good agreement. Note particularly that the temperature leaving the firebox is very well predicted.

The flow in boiler tubes for full size locomotive boilers is turbulent, having Reynolds numbers in the range 7500 at tube entry to 13000 at tube exit. By comparison, the equivalent numbers in a miniature boiler are typically 500 to 900, which indicate laminar flow. This means there are completely different flow patterns in full size and miniature work and consequently the heat transfer rates are fundamentally different, which makes any attempt to draw parallels between full size and miniature dangerous; as LBSC said "you can't scale nature"!

Comparison of predicted and observed firetube temperature profile from Ewins.



Comparison of ALCO Bulletin 2017 design values and calculated temperatures.



To accommodate the difference in flow pattern and heat transfer, the program uses different formulae for heat transfer depending on the Reynolds number, so the comparison in fig 4 exercises a different part of the program to that used for model comparisons. One of the tasks on my 'to do list' is to obtain some of the Rugby and Swindon test plant data now held at York Railway Museum and use this to check and improve that area of the program.

Reference 6 also includes a design figure for evaporation due to firebox walls, which is quoted at 55lb evaporation per square foot. The program predicts evaporation of 64lb/sq.ft. It may be that the design is a conservative value to give some safety margin in design and there is also the issue of whether my assumptions match the original test boiler. If anybody can help with a copy of ALCO Bulletin No. 2017, the author would be very pleased to hear from them.

●To be continued.

REFERENCES

3. Evans, M. *Model Boilers*, Chapter 9, Model & Allied Publications (Dec. 1969) also summarised in ME 4558, 14 April 2017 and *Model Locomotive Boiler Performance,* Journal S.M.E.E. Vol. 3, No.9, May 1965.

4. Busbridge, J., *Model Engineer* 1st August 1964, pp 565-577 (1964).

5. *Steam, Its Generation And Use*, Babcock & Wilcox Company – Chapters 'Combustion' and 'Analysis of Flue Gases'. Can be found at www.gutenberg.org/files/22657/22657-h/22657-h.htm

6. Various – Locomotive Engineer's Pocket Book, 1929, Locomotive Publishing Co. Ltd. London (1929).

The ENV Aero Engine

PART 8

Stephen Wessel continues an occasional series on the construction of an elusive prototype.

Continued from p.627
M.E. 4585, 27 April 2018

The *Zenith* principle

Referring to the diagram (**fig 3**), a basic carburettor is shown at the top, a *Zenith* below. The problem Baverey faced was that as speed increases the mixture becomes too rich. Venturi suction tends to favour the fuel over the air due to its greater density and viscosity. So, if the main jet is sized for slow to moderate speeds it will pass too much when the throttle is opened further.

Baverey's solution was to arrange for the main jet to be correct for high speeds but for low speeds (above idle) a second jet would kick in to augment the weak mixture emerging from the main jet. This second 'compensating' jet draws from the float chamber but is fed via a small secondary well which is open to the atmosphere. Increasing suction at the choke will draw fuel from this well but not have any effect on the flow through the jet itself. So, as speed increases, the contents of the well are used up and the mixture is provided solely by the main jet. The secondary well provides the necessary richness when the throttle is opened rapidly from idle.

A third orifice, also drawing from the secondary well, feeds the idling circuit. In my carburettor I have made this variable too and included an adjustable air bleed so that the idling mixture can be set correctly.

Calibrating the jets

The standard method devised by the American Zenith Company in the early 1920s was to use water from a constant head device. The head was originally set to 1m but later reduced to 36 inches. Each nozzle was screwed into a fitting and water allowed to flow through for one minute into a graduated receptacle. The stated units were usually ml/min. The head of water chosen represents the approximate pressure reduction through a typical venturi, about 1.3psi.

As my jets are adjustable I only needed to check that I could obtain the maximum likely flow, which I calculated to be around 90ml/min at full speed. The set-up was extremely simple and by using it at different screw settings I got an idea of how many turns would be needed. I hope this will make it quicker to do final adjustments when the engine is running.

The float chamber

The float and its valve were the hardest part of the project. Early Zeniths, unlike nearly all later carburettors, had the entry valve at the bottom of the bowl. The valve stem passed up through the float itself and through a hole in the lid. Two tiny levers sitting on the float converted the upward movement of the float into a downward movement of the valve (**photo 44**).

The flow into the bowl should be about double the maximum flow through the main jet to ensure it is always full. This flow depends crucially on the valve design and the feed pressure. I propose to use a gravity feed from a tank only about a foot above but this may need increasing. The valve has to close completely when the float has risen a precise distance depending on the required level of fuel. Needless to say, this is a difficult balancing act; much depends on the float being as buoyant as possible and therefore very light.

My first attempt in thin brass turned out far too heavy so I made another out of very thin aluminium and this seems alright. Testing with water is misleading as it is so much denser than petrol, causing the float to have more buoyancy and therefore more closing force on the valve. Visible in the photographs is a sight glass which I consider to be an essential indicator to show whether the beastly thing is working! The pilot will have to keep his eye on it.

Construction

As mentioned previously, the body was built up from bits of brass tube and a solid piece of half inch plate to hold the jets (**photo 45**). Careful fitting of the parts was needed prior to brazing, which was done in stages, all with Easyflo No 2. Sadly, I forgot to take any pictures of this episode.

Float and mechanism. As the float rises the two levers push the valve stem downwards with a mechanical advange of about three.

The carburettor assembled from the basic parts.

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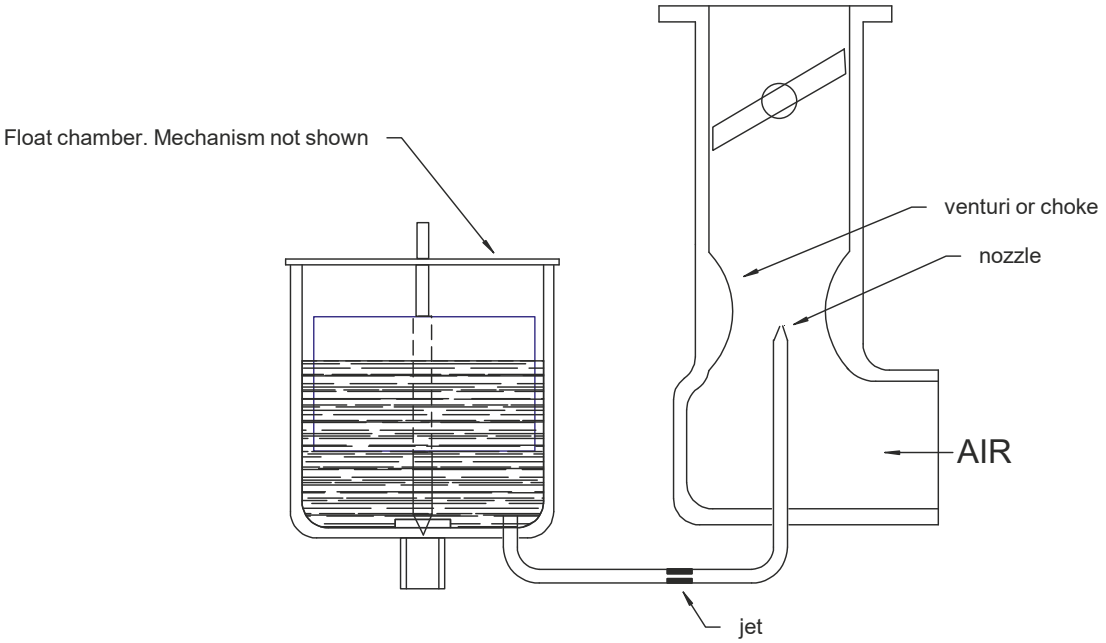
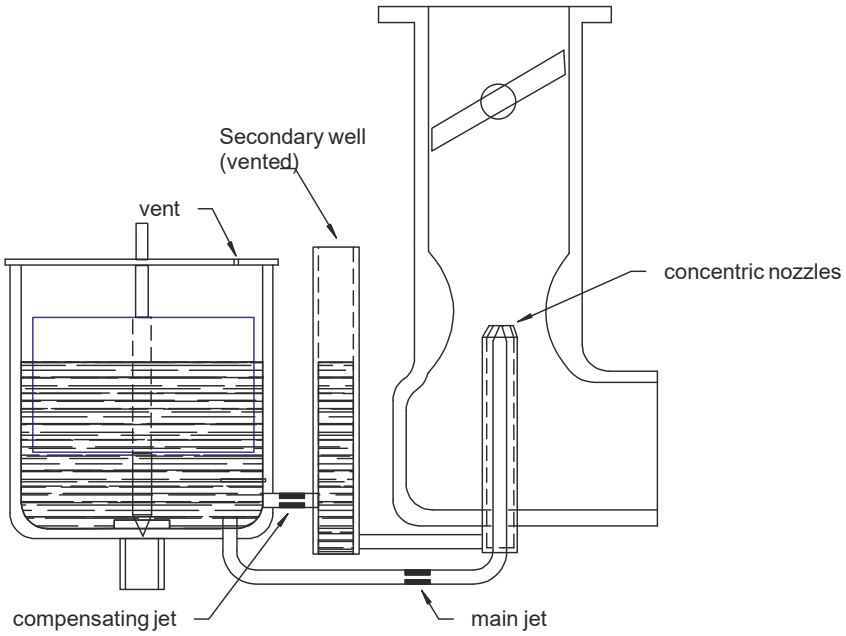


SIMPLE CARBURETTOR

As throttle is opened increasing suction causes mixture to become richer

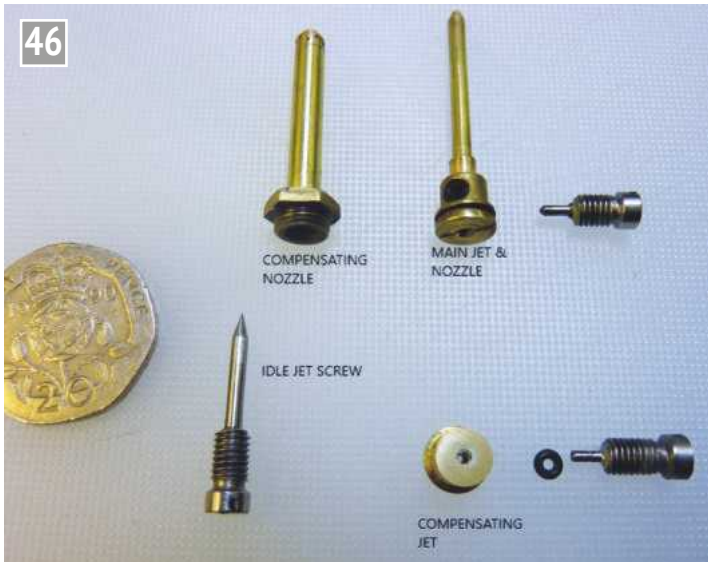


BASIC ZENITH

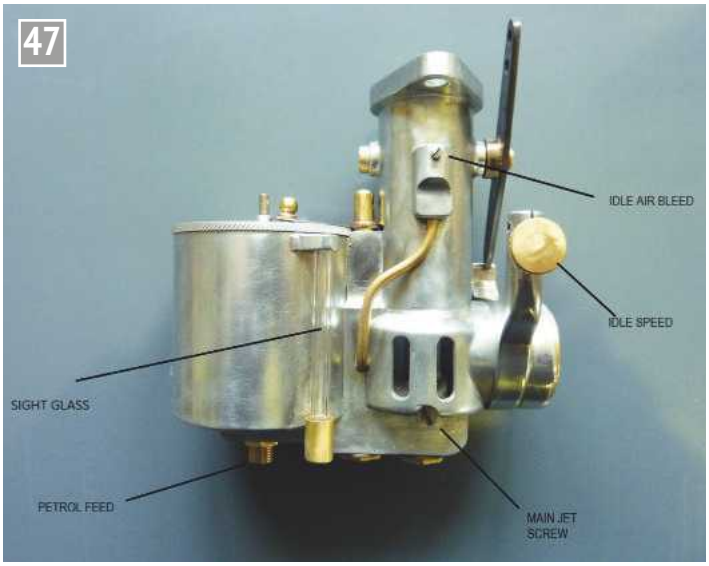
Main jet is sized for high speed running so will
give a weak mixture at slower speeds.
Increasing suction will not increase flow through compensating jet so
secondary well offers enough extra fuel for low speeds but gets used up quickly when throttle is oped wide.

Idle circuit not shown but draws fuel from secondary well
through a third jet.

Fig 3



Nozzles, jets and screws. The 'cap' nozzle at the left fits over the main nozzle but both discharge through an array of tiny (0.3mm) holes to aid atomisation.



The finished carburettor. The narrow brass tube carries fuel to the idle discharge hole near the throttle plate.

My first attempt in thin brass turned out far too heavy so I made another out of very thin aluminium and this seems alright.

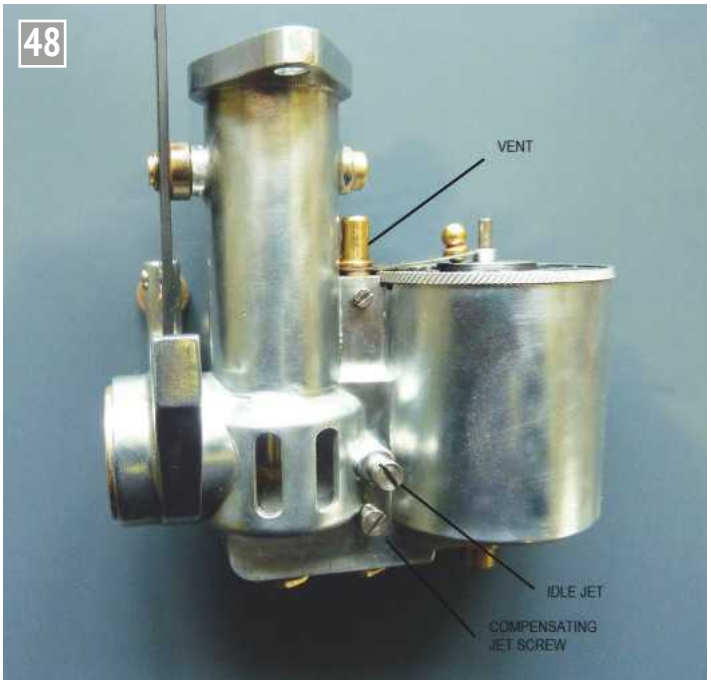
Before plating, the work was thoroughly cleaned up with rotary *Scotchbrite* wheels, getting rid of excess solder and softening all the edges. All the small holes were then plugged with silicone rubber. Once this was cured, the job was put through its cleaning routine and then zinc plated for one hour. For this I used a kit supplied by Gateros Plating.

The jets are in the form of a brass plug with a 0.05 inch orifice drilled through the centre (**photo 46**). A second hole of the same diameter breaks into this at right angles and carries the business end, or spigot, of the adjustment screw, which can therefore be used to partially block the orifice as required. A tiny 'O' ring prevents fuel seeping into the screw thread. I chose to machine cut the threads, 5/32 x 40, in order to keep them exactly concentric with the spigot.

The remaining photographs show the finished carburettor.

So - will it work? I cannot see why not for it is a really simple device and, providing the fuel is properly filtered, it cannot fail to be drawn into the engine. Using the various adjustment screws will need plenty of patience and a logical approach but there is much written about how to set up a *Zenith*. In theory it could be tested independently before fitting, given sufficient apparatus to measure air and fuel flows, but somehow I feel too lazy to go through all that. So, I shall stick it on the engine (once finished), swing the propeller and see what happens.

ME



Opposite side. The secondary well is just a deep vertical hole capped by a brass plug that allows venting through a tiny gauze filter.

The bowl lid is secured by a leaf spring that can be slewed sideways.

Roger's superbly cut lettering shows up well (see page 788). The patent numbers are mostly invisible on the full-size carburettor. Apart from the first and last digits I have no idea what they should be. The Internet search went very cold indeed.

PART 15

Technologie sans Frontières

Dr. Ron Fitzgerald looks at English and French locomotive design in the second half of the nineteenth century.

Continued from p.645
M.E. 4585, 27 April 2018

'The Nord, the Midi, Paris-Lyons-Mediterranean, the Ouest and the Est have adopted six coupled types... The Baden lines are worked by these engines... It was for these lines, indeed, that I designed the first of the six-coupled types. The Gotthard expresses are worked by four-cylinder compounds of the same type built at Winterthur; Roumania has also ordered some twenty engines of the same general type... The locomotive drawings were made by the Société Alsacienne de Constructions Mécaniques (S.A.C.M.) and the engines were built at their works at Belfort.' Alfred de Glehn to Charles Rous Martin (ref 1**).**

The Baden, Midi and Nord 4-6-0s

The clouds of glory trailed by *Les Grandes Chocolats* and the Atlantics tend to obscure the fact that they occupied centre stage for a relatively short period of time and that, numerically, no individual class attained three figures on any railway. The de Glehn six-coupled locomotive was substantially more prolific, much longer-lived and of more seminal importance.

The genesis of the Alsatian compound 4-6-0 was reviewed in a previous article where it was shown that Alfred de Glehn originated the type in 1894 for the Baden State Railway (**ref 2**). In 1896, S.A.C.M. completed further locomotives to this design for the Midi Railway, differing in that the boiler carried a Belpaire firebox where the Baden machine had used a round top firebox (**photo 74**). In addition to the 5 foot 3 inch (1600mm) wheel version, a larger 5 foot 9 inch (1.750mm) wheeler was also put into service on the Midi (**photo 75**), both types with cylinders 13¾, 21⅝ x 25½ inches (350mm, 550mm x 650mm).

Number 1303 was loaned to the Nord for trials on the Paris – Amiens run and the success of this exercise prompted

Midi 1424 of the small wheel (1.600m) 1400 class. The first French de Glehn 4-6-0 and the smallest driving wheels anywhere in France at 1.600m.

that railway to commission fifty machines to an identical design, differing only in the Nord details of Serve tube boiler with variable cone blast pipes, boiler mounted sandbox, chimneys and domes. S.A.C.M. built the first ten of these machines, builder's numbers 4686-95 of 1897, Nord running numbers 3.121-30. Five-Lille accounted for 20 more between 1897 and 1898, their numbers 3019-38, Nord 3.131-40/41-50. Schneider added a further 10 (**photo 76**), builder's 2647-56, Nord 3.151-60 and the *Société de Construction des Locomotives Batignolles* of Paris built Nord 3.161 to 3.170 in 1898 (Batignolles 1335-1344). The Nord continued to add further batches until 1913, by which time it had 277 in service (**ref 3**). Of this total, Schneider and Five-Lille had each built 50, S.A.C.M. 47 and Cail 20. Along with the later 2-8-0s, of which there were 279, they constituted the largest class of locomotive to operate on the Nord.

The de Glehn 4-6-0s in Germany

As far as S.A.C.M. was concerned the Nord was a significant but not the leading customer for the 4-6-0. In the account of the historical development of Andre Koechlin's company (**ref 4**) it was shown that, following the Franco-Prussian war of 1870, the *Société Alsacienne* wore something of a Janus face with manufacturing capacity in France at Belfort and in Germany at Graffenstaden. Its home railway was the Alsace-Lorraine, part of the French Est Railway until 1870

The 1301 class, 1.750m large wheel version of the Midi 4-6-0.

Nord 3.152 built by Schneider in 1898.

but thereafter, until 1918, the German state Elsass-Lothringen Eisenbahn. It was this railway that was ultimately to head the lists in terms of S.A.C.M. built 4-6-0s (**photo 77**). Eighty-eight machines of the original Baden Railway type were supplied to the Alsace system commencing with four in 1898 and concluding with twenty-eight in 1908. The Alsace machines had Nord style *Grande Chocolat* Belpaire-firebox boilers rather than the more characteristically Germanic round-topped fireboxes used on the Baden locomotives. They were part of a larger class, lesser numbers of machines having been supplied by Henschel.

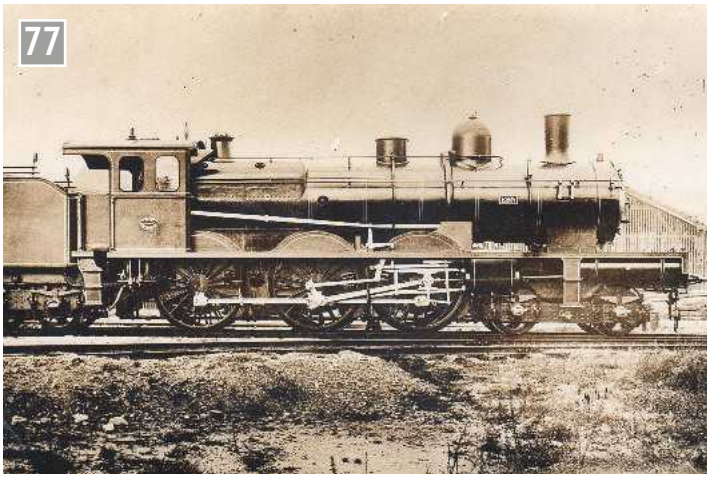
The Prussian state railway had been the largest user of the de Glehn Atlantic type in their Graffenstaden I, II and III classes S7. Dr. August von Borries, locomotive head of the Hanover division of the state railway system, was one of the earliest and most effective apostles of compounding but, after 1895, Dr. Robert Garbe of the Berlin division was increasingly ascendant. Garbe was hostile to compounding and, more generally, to builders outside the Prussian state. Under his influence both the S.A.C.M. tradition and compounding decayed on the north German system. The Baden State Railway confined itself to a further seven 4-6-0s, all delivered in 1895 and the few remaining examples of the type were concentrated into the Rhineland; 6 for the Elberfeld division, 4 for the Frankfurt division and 3 for Cologne. No further de Glehn compounds of any type were supplied to Prussian railways after 1902 although Garbe's antipathy to compounding was to be severely challenged by the superb Maffei compounds served up by Anton Hammel, director of Maffei and Leppla, his head of design.

In the event, German Railways, including Alsace Lorraine, only accounted for about 7½% of all compound 4-6-0s built by French manufacturers, a statement that embraces de Glehn compounds generally. Of the remainder, 83% were destined for the railways of France itself and, if the French colony of Algeria is included, the figure rises to 90%.

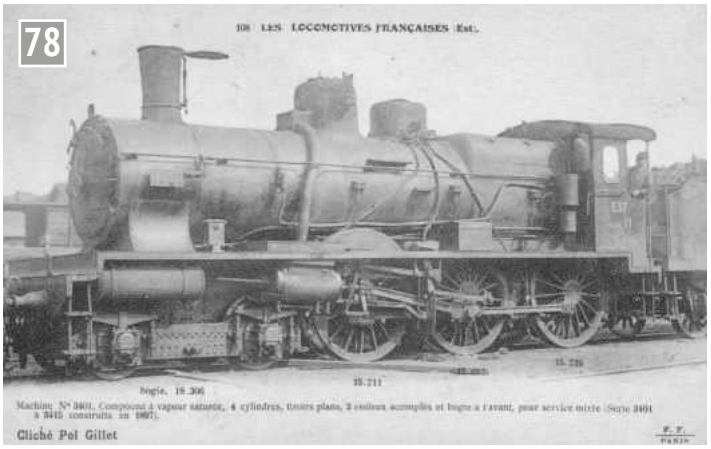
The Est mixed traffic 4-6-0 3401 Class, 1897

The Est, whose triangle of main line running ran from Paris to Strasbourg via Nancy in the north, Paris to Basle via Chaumont in the south and the linking Basle-Strasbourg line running south-north, embraced all three of S.A.C.M.'s manufacturing centres, Mulhouse, Graffenstaden and Belfort until 1870. This being so, it might have been expected to have regarded S.A.C.M. as its home team and even after that date, inasmuch as Belfort remained a French possession. Instead, the Est was inclined to rely more heavily upon its own manufacturing facilities at Épernay and where locomotives were bought outside the company showed a distinct affinity for the German builders. This notwithstanding, it proved to be the most enthusiastic user of the de Glehn design of 4-6-0 type (**photo 78**).

Two locomotives, Est 3401 and 3402, were delivered in 1897 from the Épernay shops, the first of a series of one hundred. Dimensionally they largely adhered to the Midi large wheel format with driving wheels 1.750m, spaced at exactly the same centres as the Midi machines, 2m from trailing to driving and 1.9m from driving to leading. The bogie, again of the outside framed Alsace design, was reduced in wheelbase by 50mm. The cylinders were 350mm and 550mm by 640mm. There were slight differences in the Belpaire-firebox boiler. The heating surface of the Est machines was raised to 2.51m^2 whilst the Serve tubes were increased in number from 112 to 130



Elsass-Lothringen Eisenbahn 4-6-0 Ehn.



Est 3401 of 1897. The first series of Est 4-6-0s. 1.750 m driving wheels.

but the length remained the same at 4.1m. Pressure was increased from 14kg/cm^2 to 16kg/cm^2. Boiler mountings were to the Est pattern; Lethuillier-Pinel safety valves mounted on the flanks of the flat-topped dome and a tapered chimney with an annulus around the rim and at the base of the taper. The Crampton steam pipes were attached to the front of the dome. The machines were over ten tons heavier than the Midi version.

A second series commenced production almost before the first was completed. In 1901 Salomon, the Est's Chief Mechanical Engineer, enlarged the dimensions, retaining the same cylinder sizes. More significantly, the first twenty, Est 3501-20 of 1901 from Maffei of Munich, were fitted with piston valves, a development which will be discussed more extensively in a succeeding article. Schneider followed with Est nos. 3521-50 in 1901 (Schneider 2736-65). 390 locomotives were eventually built to this class, the last in 1912. Of these, 110 had been built at the company's own Épernay works. The French private builders were Schneider, 105, S.A.C.M. 55 and 10 by Five-Lille, the smaller concerns Blanc Misseron and Batignolles each supplying a further 20. Outside France, Franco-Belge built 30 but the German builders, Maffei, Henschel and Hartmann claimed 80.

The Ouest mixed traffic compound 4-6-0s

The Ouest was the next French system to adopt the de Glehn design for the six-coupled wheel arrangement. In 1896 Schneider built four, simple-expansion, mixed traffic locomotives for the company with six driving wheels, machines which were the most powerful simple-expansion locomotives in use ≫

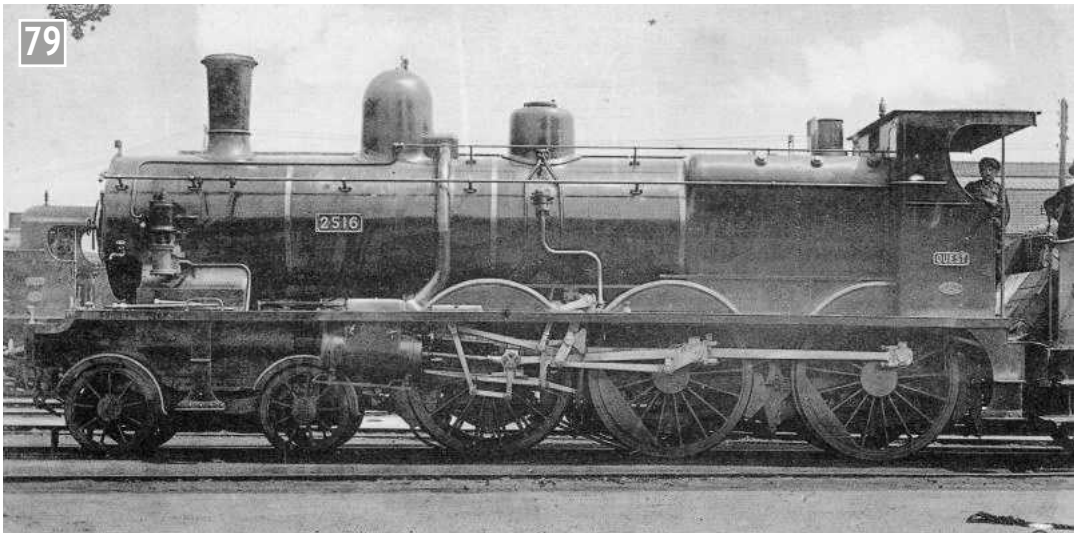
in France before 1900. Despite their estimated 920hp, these locomotives demonstrated that simple-expansion had reached a plateau of development compared to the four-cylinder compound. The Ouest reacted to this situation by revisiting the de Glehn formula already successfully applied to their Series 500 4-4-0s. The four simple-expansion locomotives had shown the superior adhesion value of the 4-6-0 wheel arrangement for mixed traffic workings and the Ouest decided to follow the pattern set by the Midi 1301 class as interpreted by the Nord, using 5 foot 9 inch (1.75m) diameter driving wheels. The Ouest compound locomotives 2501-2510 (**photo 79**) were built by S.A.C.M. at Belfort, builder's numbers 4941-50, recorded in their order book under the year 1899 (**ref 5**).

Although Vilain suggests that many of the details of these machines were identical to the Ouest's series 500, they were essentially as the S.A.C.M. Nord 4-6-0s, completely so below the running plates but with the Midi 1300 4-6-0 Belpaire-firebox boilers, 10% enlarged in grate area with tubes lengthened from 4.10m to 4.30m and 14kg/cm^2 boiler pressure. As in the Nord machine, the sandbox was mounted on the boiler top but the bogie was of the by-now standard Ouest type with inside frames.

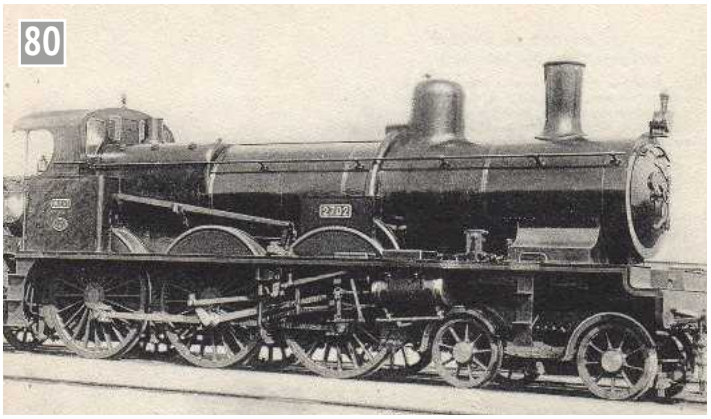
At the same time that the Ouest's 2500 series locomotives were beginning to handle the slower, heavier goods and local passenger traffic, the French Ministry of Public Works (**ref 6**) issued its national circular strongly recommending the adoption of bogie corridor carriages with the implication that the tare weight of carriages was likely to rise from about 12 tons to 34-35 tons. The Ouest responded by introducing its first corridor bogie coaches in 1899, severely testing the express passenger 4-4-0s. Despite the fact that similar developments elsewhere had promoted the adoption of the Nord Atlantics, the Ouest, uniquely amongst French railways, did not follow the trend. Clerault had been succeeded as the Ouest's Chief Engineer by Maurice Dumoulin in 1896 and this equally perceptive engineer doubtless observed the loss of adhesion resulting from weight transfer from the trailing drivers to the rear carrying axle that plagued the Atlantics on starting. He could contrast this notorious malediction with the superior performance of the railway's mixed traffic 4-6-0s.

In 1901 the Ouest's own workshops at Sotteville built ten 4-6-0s (Series 2701-10) with driving wheels of 6 feet 4⅜ inches (1.94m), intended to deal with express passenger traffic (**photo 80**). By increasing the driving wheel diameter from the 5 feet 9 inches of the mixed traffic 4-6-0 Dumoulin produced the first large wheel 4-6-0s built for express passenger work in France (**ref 7**). The cylinders, at 350, 550 x 640mm (13¾, 21⅝ x 25¼ inches), were identical to those of the 1.750m driving wheel 2500 mixed traffic 4-6-0s whilst the boilers were practically the same as the 500 series 4-4-0s with a slightly larger grate area, 2.45m^2 compared to 2.40m^2, but notably longer (Serve) tubes raising the heating surface from 134 to 201m^2. Handsome to the English taste, the Ouest features of flat topped dome, tapered chimney and sandboxes integral with the leading driving splasher gave the machine its family identity. They immediately demonstrated their potential to accelerate heavier trains and a second series of ten were built by the workshops in 1904, incorporating details found to improve the performance of the first series, mobile cone exhaust nozzles and a narrower chimney and at the same time, left-hand drive was adopted.

●To be continued.



Ouest 2500 Series 4-6-0, no 2516. 1.750m driving wheels.



The Ouest Express Passenger 4-6-0, 2702 of 1901 with 1.940m driving wheels. The first French 4-6-0 to have driving wheels in excess of 1.750m diameter.

REFERENCES

1. *The Engineer*, December 30 1898, p.649.
2. *Engineering*, December 10 1897, p.707.
3. Vilain's numbering is confusing at this point. Vilain op. cit., *Dix Decennies…* page 141: Serie 3078-3353 - he gives the number series as extending from 3.121 to 3354 (233 locomotives) whilst elsewhere in the same section he numbers the class between 3078 and 3353 (275 locomotives).
4. *Model Engineer*, Vol. 219, No. 4563, 23rd June 2017, p.24.
5. Vilain, *l'Oues*t, p.137 *…furent mises en service en 1898…*
6. The French Ministry of Public Works was equivalent to the British Board of Trade but differed in that it was inadvisable to ignore the recommendation of the French authority. Continuous air brakes were rapidly introduced after the Ministry recommended their universal application which contrasts strongly with the British experience where a series of wholly unnecessary accidents ultimately enforced action.
7. Op. cit., Vilain, *Orleans*, p.105.

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PART 4

A Large Capacity Coventry Diehead Attachment

David Earnshaw describes an attachment for fitting a Coventry diehead to a larger lathe.

Continued from p.659
M.E. 4585, 27 April 2018

The shank

On the original diehead the shank is used to clamp the diehead into the machine. In this attachment the shank (**part 8**, **fig 6**) needs to be a good sliding fit in the main body and is much longer than the original. In operation, a pin is fitted through the shank and slides down the slots in the main body. This pin prevents the shank (and diehead) from rotating and when it gets to the end of the slots it arrests the sliding action of the shank, which causes the diehead to trip. It was realised early on that allowing the shank to slide to the end of its slot each time would leave the unit always operating at the limit of its travel. This would not be good practice and the diehead would always have a maximum overhang making it a little unwieldy when cutting shorter threads – which would probably be most of the time.

Looking at the suggested design in the handbook (*The Book of the Coventry Diehead*, 16th edition, published by Alfred Herbert Ltd) there was an additional stop rod fitted and it seemed a good idea to include this in the unit. However, this meant that there would have to be some redesign of the flange

of the shank in order to provide a lug for fixing the stop rod on to. Also, if made from one piece of material, there would be a tremendous amount of waste produced. So, the shank was made in two pieces, one for the main circular part and another for the flange. The two pieces could be welded together or, perhaps, joined using high strength *Loctite* (usual disclaimer) or similar adhesive. I decided to put my faith in the adhesive method.

A start was made on the long circular portion and the material selected was oversize to allow turning to size to achieve the good fit. I had some 30mm diameter mild steel so a piece was sawn off to correct length with a trifle extra for facing off at each end. Using the larger lathe allowed me to mount this material in the four-jaw independent chuck, set dead true, face off and deeply centre drill one end. The material was then turned around in the chuck and again set true in the four jaw, faced and again centre drilled.

Without disturbing the set-up, the next operation was to drill the 9/16 inch diameter hole, firstly by using a 3/8 inch diameter drill followed by the 9/16 inch diameter drill to a depth of 3 5/8 inches. The diameter of this hole is not critical and is only a clearance to allow threaded rods to pass through after being threaded by the dies in the diehead. It could be as large as 5/8 inch diameter as it is possible to buy 5/8 inch dies for the 1/2 inch diehead but, as I didn't foresee any use for 5/8 inch dies, I decided that 9/16 inch would

Plate for the flange, marked out and chain drilled on a piece of plate which had been chained drilled out of some other project.

Plate located by the tailstock centre and clamped on to the faceplate.

give plenty of clearance for the ½ inch threads.

Then, the end of the bar was bored out to ¾ inch diameter for 17/64 inch deep. This is to accommodate the ¾ inch diameter x ¼ inch long snout that there is at the back of the diehead so it should be a close fit on the diameter, although the 1 inch diameter x 1/16 inch long register on the end on the shank is what gives the true location between the shank and diehead. Before leaving the hole a very small taper was bored on the edge of the ¾ inch hole. This was achieved by setting the topslide round at 30 degrees and boring the slight taper. This acts as a centre hole when turning between centres later when finish turning the outside of the shank.

Before removing from the chuck a short shoulder was turned on the outside of the bar to form a seating for the flange to fit upon. The exact diameter of this shoulder is not really important - around 1⅛ inch diameter is fine and the length was made a little less than ½ inch. This completed the roughing out of the main part of the shank.

To make the flange, a scrap piece of bright mild steel flat was used. The profile was carefully marked out and chain drilled outside of the outline and the central hole drilled with a centre drill (**photo 26**). This was then roughly sawn out with a hacksaw and mounted on to the face plate using a tailstock centre to centralise on the centre drilled hole. Two clamps were then used to secure the plate to the faceplate (**photo 27**). After checking, by rotating the faceplate by hand, the tailstock centre was withdrawn and the hole opened out with several drills, being careful not to allow the drill to enter the Morse taper bore of the main spindle.

The hole was finished by using a boring tool, again being careful not to allow the boring tool to damage the spindle taper. To allow the correct clearance for the adhesive, the diameter of the bore was enlarged to a size of about

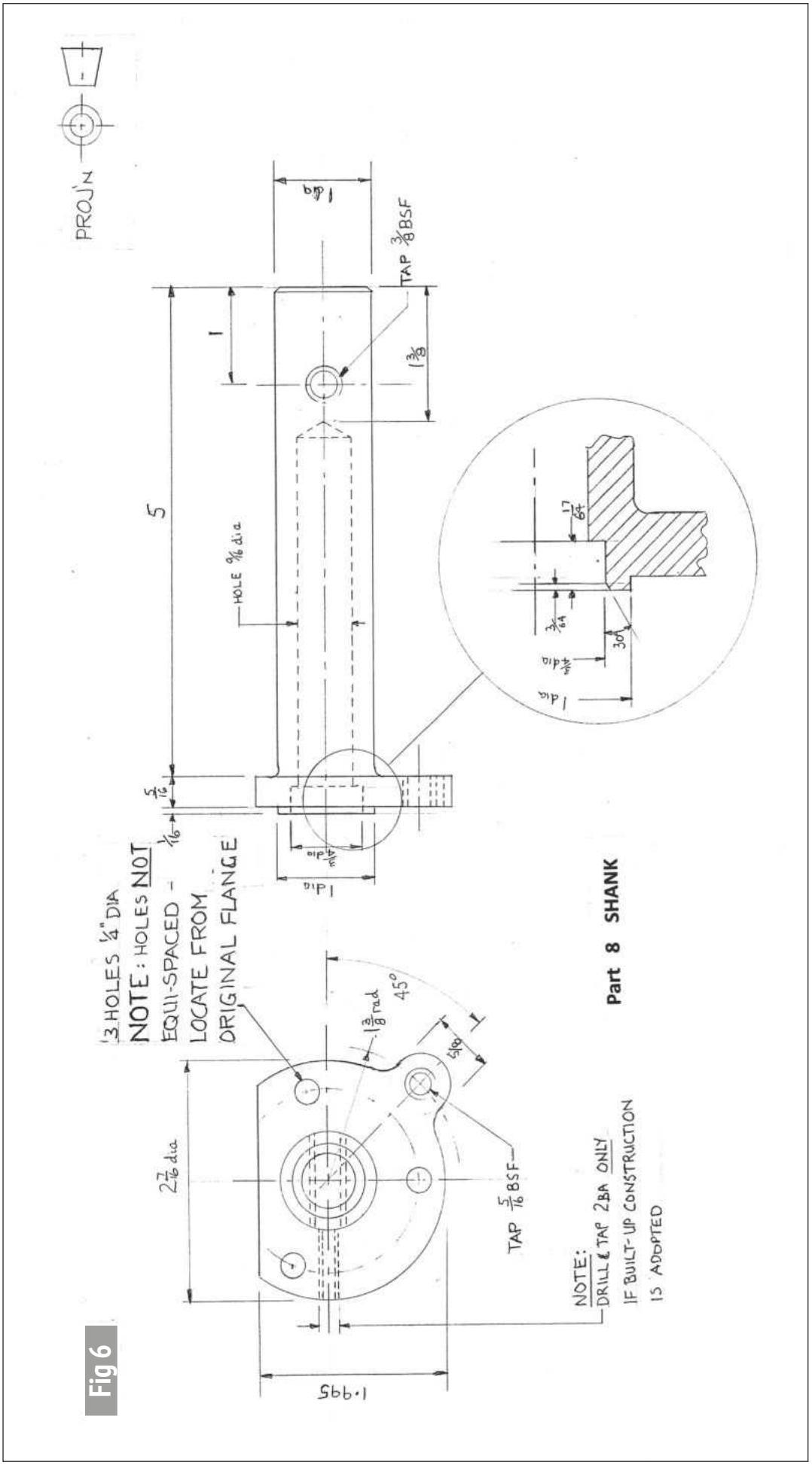


Fig 6

0.002 inch larger than the 1⅛ inch shoulder previously turned on the shank. The plate was then removed from the faceplate and the hole in the centre of the lug was drilled and tapped in the drilling machine.

Machining the outside profile

Before *Loctite*-ing the two parts of the shank together, attention was turned to the outside profile of the flange. It was impossible to turn this in the lathe due to the lug projecting from one side so the rotary table was mounted on the table of the vertical mill.

To centralise the table to the machine spindle I have a short length of ½ inch diameter silver steel, threaded like the shank of a milling cutter, which is fitted into the collet chuck. In the centre of the rotary table I have a centralising plug with a ½ inch diameter reamed hole. The rotary table is placed on to the milling machine table in the approximate place required but without clamping it tight. The X and Y axes are then adjusted until the ½ inch silver steel enters the hole in the plug easily (**photo 28**). Once in such a position the tee bolts are tightened, clamping the rotary table in place. Before the ½ inch silver steel probe is withdrawn from the hole the dials on the X axis and Y axis are set to zero (or the DRO zeroed on each axis).

To attach the embryo flange to the rotary table, firstly a locating ring was turned up, the outside diameter of which was made a nice smooth fit in the hole of the flange. The inner hole of the ring was reamed to fit on a ½ inch spigot fitted into the central plug in the rotary table. Two clamps were then used to clamp the flange to the rotary table. Two parallel, thin, sacrificial, packing strips were also placed underneath the flange to protect the surface of the rotary table. It was impossible to machine all round the profile without moving the clamps so the machining was carried out in three stages (**photo 29**).

The actual machining was carried out using a ½ inch diameter end mill working carefully to the marked out lines. Firstly, the X axis feed was moved sideways so the cutter was outside the marked lines and then the cutter was lowered to just graze the surface of the workpiece. The work was then moved back along the X axis to bring the cutter exactly up to the marked line and the X axis slide locked. The rotary table was then carefully rotated until the cutter came up to the line denoting the edge of the lug on the flange. A stop was fixed on the rotary table at this position. Machining this section of the edge was completed by setting a depth of cut of about 0.020 – 0.030 inch and rotating the table up to the stop.

This procedure, although a little slow, produced a good finish. When the first section had been completed the cutter was lifted, the rotary table stop released and the table rotated to allow the cutter to 'jump' over the lug and the previous procedure repeated on the second section of the profile (**photo 30**).

To machine the outside of the lug a new centralising pin was made to locate in the tapped hole in the centre of the lug, the clamps repositioned, and a similar procedure to that above used to profile around the lug (**photo 31**).

In order to attach the shank to the flange I had elected to use *Loctite* or similar adhesive but in order to 'assist' the *Loctite* I decided to drill and tap a 2BA hole in the edge of the flange in the position shown in the drawing (belt and braces!). The position of this hole is important as it needs to miss all of the three mounting holes which will be drilled later. The shank and flange were then cleaned, as recommended for using adhesives, the adhesive applied and carefully worked in to the joint and then left aside to cure.

Finish machining of the shank

To maintain utmost concentricity the final machining of the bonded shank and flange was done by 'turning between centres' and I adopted a variation of the usual set-up which I have not seen in print before. This variation does not require the three-jaw chuck to be removed and so saves some set up time.

The first stage of the set-up is to put a stub of mild steel in the chuck, set the topslide round to 30 degrees and turn a point on the stub of steel in order to create a 'centre' (**photo 32**). This ensures that the point of the centre is true – even if your three-jaw chuck is not as true as it used to be. The usual arrangement is made at the tailstock end, using either a rotating centre or, for preference, a solid (hard) centre.

The workpiece can then be placed between centres but it needs some form of carrier to take the drive from the chuck. A bent tail carrier effectively fills this need, the bent tail of the carrier engaging with one of the chuck jaws. In this case a bent carrier of the necessary size was not available but, as the component had a tapped hole in it, it was simple to fit a short cap head screw and lock nut which would catch on one chuck jaw and provide the drive (**photo 33**). This arrangement allowed the main length of the shank to be turned down to a smooth finish and a good

Using a plain silver steel probe in the autolock chuck to centralise the rotary table.

Machining the first section of the outside profile of the flange on the rotary table. The cutter is raised to allow photography.

Machining the second stage of the outside of the flange.

Work reset on a pin to locate in centre of the lug and exterior of lug machined.

sliding fit in the body unit. The back of the flange was also faced at this setting.

Once this had been achieved the workpiece was turned end for end, a bent tail carrier attached on the just turned surface, with soft metal protection in between, and the opposite face of the flange finished together with the all-important 1 inch diameter x 1/16 inch long register to locate in the back of the die head.

The next operation on the shank was to drill and tap the ⅜ inch BSF hole for the lever pin to fit in. It is important that this hole is exactly central through the shank and perpendicular to it. This was achieved by gripping the shank in the vice of the vertical milling machine and carefully setting the machine spindle exactly over the centre of the shank. Tapping was also done, by hand, with the shank still in the milling vice. Finally, a ⅜ inch diameter end mill was used to just take out the top of the tapped hole so that a flat seating was produced for the lever pin to screw up to. **Photograph 34** shows this operation prior to drilling and tapping.

Turning a centre point on a stub of mild steel in the three-jaw chuck.

Cap head screw fitted into tapped hole in the plate being used as a driver whilst turning between centres.

Creating a flat seating for the lever pin.

Transfer plate – made to transfer the fixing holes from the original shank to the new shank.

Drilling the holes in the transfer plate, using the original diehead shank as a drilling jig.

Jig drilling the new shank from the transfer plate. Note the 'F' (front) marks on top of the plate to give correct orientation.

Fixing holes

The last operation on the shank was to drill the holes for the screws to attach the shank to the die head. I have access to two examples of this style of diehead and in one of them the holes are tapped ¼ inch BSF and in the other they are tapped ¼ inch UNF. The holes are on a pitch circle diameter but they are NOT equi-spaced around it. The simplest way to get the holes in the correct place was to locate them from the holes in the original shank. To achieve this, it was necessary to produce a transfer plate.

A slice of mild steel, 2½ inches diameter and about ⅜ inch thick was cut and faced flat on both sides. The centre of this disc was bored out to a close fit on the 1 inch diameter locating spigot on the original shank and the flat was also machined to correspond with the flat on the original shank. **Photograph 35** shows this plate and the letter F is to denote the front when in use.) With the lettered side of the plate underneath, and carefully lining the flat of the plate up with the flat on the original diehead shank, the plate was clamped to the shank using a toolmakers clamp. This assembly was then supported on parallels on the drilling machine and the three holes carefully drilled using a drill the same size as the holes in the original flange (**photo 36**). There is a fourth, smaller hole which exposes a screw in the back of the diehead and this hole was replicated at the same setting. Once drilled, the transfer plate was separated from the original diehead shank and fitted to the newly made shank, with the lettered surface to the outside and, again, aligned with the flat, clamped ready for drilling. As the new shank is a long workpiece, it was held in a lathe chuck for drilling, which was removed from the lathe and placed on the drilling machine table. The length of the workpiece projected out of the back of the chuck but, fortunately, the projecting piece passed through the hole in the centre of the drilling machine table so the set up was secure. The same size drill bit was used to transfer the holes into the new diehead shank (**photo 37**).

Mark 2 emerges!

It was at this point that I thought that I would make another shank to fit the CHS Style diehead. Then I could, quite simply, remove the lever pin and withdraw the CH Style diehead complete with its shank and replace it with the CHS Style diehead. I thought that it would be a good idea to turn up another embryo shank before proceeding further. However, on closer investigation it proved that I had not looked carefully enough at the shank on the CHS style head and it would not be such a simple task so a redesign for the CHS diehead shank emerged. With the editor's approval this will be detailed at the end of the series (*Granted! – Ed.*)

●To be continued.

Governess Car

Rosie Turner (aged 10) explains what a Governess car is and how she made one.

My name is Rosemary Turner. I am a member of Eastleigh Young Engineers (EYEs) and I have been working on a scratch-built model Governess car.

A Governess car is a small carriage used for safe travelling with children, owned mainly by rich people and used by their Governess. The car appeared around 1900 and at about the same time as the dog cart. Some people wonder why it is called a car rather than cart. The answer to this is simple: a cart is a horse-drawn vehicle used for transporting produce to the market, whereas a car is used for moving people from place to place safely (*Noted – Ed.*). People used to use them for going to the nearest town to do the shopping, to visit a neighbour or even to visit the church. It was rarely used to go more than ten miles.

My sister Poppy and I go to Crawley (that's near Winchester) on Saturdays and after school on Mondays. Poppy works with Patrick Hendra who teaches us how to do model engineering. She is working on a model party boat and I work with my Dad. It took me roughly 10 months to complete the entire model including the homework. I also showed it (incomplete) at the Midland Model Engineering Competition (I entered the Junior Class and won). It was also on show at the London Model Engineering Exhibition on the Eastleigh Young Engineers Stand at Alexandra Palace in January 2018.

The prototype and inspiration for the model.

To help in building the car, I had a book on building small horse drawn vehicles (*Making Model Horse-Drawn Vehicles* by John Thompson, Thompson, Fleet, 1977) and from this I got many of the dimensions. I also have a real Governess car at home (**photo 1**) that we use with one of our ponies. The design I went for was a mixture of the book, the carriage and my own ideas. It is not a completely accurate scale model but the scale I based it on was 1:12.

Wheels

One of the first things done was that my Dad cut off a ring of 80mm aluminium tube on the band saw from tubing we had in stock. Then, I put the shortened tube into the lathe, faced off the end and cut two narrower pieces off to make the metal tyres for the wheels. They are of 4mm width. I then made two rings of Delrin 6mm wide and I turned the edges so they fitted snugly into the aluminium rings.

Next, I made two bosses for the middles of the wheels with 5mm holes through the centres so I could attach the axle to the wheels. Then, I mounted each Delrin ring on the dividing head and drilled holes at 30 degree angles to hold small cocktail sticks for the spokes (**photo 2**). I then did the same for the bosses. I assembled the wheels by pushing the twenty-four cocktail sticks into a hole in the rings and a hole in the bosses. I sanded all the sharp edges to be smooth and flush with the wheels and painted the wheels with the chosen Burgundy colour. I chose this colour because our Governess car at home is Burgundy.

I was taught how to cut M5 threads on brass rod in the lathe and connected the two wheels to the rod to make the axle (I put Nyloc nuts on the ends so that the wheels would not fall off).

The body

For the body/tub I used plywood and used Superglue to keep it together. The base

Rosie uses a dividing head to drill the holes for the spokes.

was made of 3mm plywood and cut on the band saw, then shaped on the band-sander. It was then drilled to fit the springs using M2 Screws. The tub was made from wood 0.5mm thick - I got it from chip baskets. We were given these and they are made of very thin wood which I think is pine. This was easy to cut but was very difficult to make into the shape I needed.

I found that I had to thicken it and so I glued on thin strips of card to make it 1.5mm thick in places like the top edge.

By the end of all that, the entire tub was finished but, as it happens, my dear Mother is a rather clumsy individual and dropped the FRAGILE car and crushed a small part of the back of it causing me to cry (almost)! Fortunately, being a kind soul, she fixed it. The damage is still visible.

Patrick then cut the springs from clock spring (because we are not allowed to handle spring steel). I then made four big hooks of aluminium and joined them to the tub and the springs. I made two wooden blocks to hold the springs to the axle. I made the shafts from 6x6mm hard wood and fitted them under the tub using small countersunk M2 screws. The result was a complete body with shafts and wheels (**photo 3**).

Details

I made a rein-rail, to go at the front of the tub, out of brass wire and solder. The rail is held onto the car using M1.6 screws (**photo 4**). I then made two hinges and a door. The hinges were very tiny and incredibly difficult to make; they were made on a piece of brass strip and, once they were finished, cut off on the band-saw. Then I made a catch to keep the door closed (**photo 5**). I did all the drilling and milling but not the band sawing. The hinges and the catch were fitted to the tub using M1.6 screws (very fiddly).

The upholstery was made by me. It was made of pieces of old 8mm thick camping mat foam. I stuck fabric leather onto it with carpet adhesive and I made studs with bent pins. My beloved Mother made the harness for me, as she does do a lot of things with horses.

Most Governess cars have mudguards but I left them out.

Display

I was given a beautifully carved wooden horse (and then a plastic foal). I was helped with the step at the rear of the car but I put it together and attached it with tiny M2 screws by myself.

I made a stand and a way of holding the Governess car securely so that it can be transported and put on show; two M2 screws come up through the base and through two of the legs of the horse. A rod passes through the wheels as you can see in the picture (**photo 6**).

I entered my Governess car into the Midlands Model Engineering Competition in October 2017 and it was highly commended. I then showed it at Alexandra Palace on the Eastleigh Young Engineers' Stand in January 2018 (*I saw it there and was very impressed – Ed.*).

All lots of fun.

I'm currently working on another model and I will tell you about that another time!

ME

The partly completed Governess car.

A view from above, showing the rein-rail.

The catch and hinges are rather fiddly.

The completed Governess car.

PART 18

A CNC Beginner's Experience

CNC machining with a Sieg KX3 and some comments to the reactionary

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

Continued from p.646
M.E. 4585, 27 April 2018

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.

I hope this long saga of problems and advice has been a help to those who have problems or need advice – leading them to a cure to their problems and satisfactory operation. Even more I hope that you do not have the problems I had – with no more knowledge of computers beyond that of an operator. I could have got through the problems much, much quicker with more knowledge. As it was, there were lots of 'crossed fingers' and tentative starts.

Now my 'moan' - you may be told by reactionary club members (as I have been) that - of CNC - "It is not Model Engineering". From this I presume these people consider the hobby should be sweated labour as of *circa* 1800 and not a relaxing pleasure. Yet many of the same people use modern technology:

- Digital callipers
- Digital read-outs
- Electronically controlled power feeds
- Electronically controlled variable machine speeds
- Tungsten carbide tools
- Coated tools etc.

The 'It's not Model Engineering' proponents are showing all the signs of being incipient 'Luddites'. If they are asked "what is 'Model Engineering' then?" I find that they actually have no answer – I figure that if they wish to be engineering dinosaurs with closed minds that are laboriously sawing and filing parts out of plate then I let them. Some of them will probably number among those who never finish a model because they insist on using methods of production that were current in about 1830 or earlier. Others I figure are just parroting what someone else has said without thinking about it. Perhaps ask 'them' why they are using a modern lathe and mill instead of files, along with a hammer and chisel.

I dread to think how long my Mallet locomotive would take to make by antique methods – from 2000 I spent two years of spare time preparing drawings and the last fourteen years making parts (when not amending drawings). There are of course four separate cylinders and valve gears and a tortuous intestinal tangle of steam and exhaust pipes and both have to swivel whilst 'steam tight' as well! So, while making 'one offs', I have the CNC mill buzzing away at the other end of the workshop making repetition jobs.

I consider that the major problem with the "It's not Model Engineering" proponents is not just that they have painted themselves into a corner but that they are creating an attitude that is – to some extent - dragging the hobby with them to its detriment. I do note with relief that there are a number of non-conformists valiantly keeping up with technology and also writing up their experiences in readable form – all strength to their arms.

I have never understood why if someone wants to make a model, they should be expected to use those slow, laborious and inaccurate, grossly obsolete methods of manufacture. Is it maybe because the original of the model dated from an earlier era? Perhaps it is time to start asking these reactionaries what **they** mean by 'Model Engineering' – I suspect that because 'they' do not understand the newer technologies, 'they' denigrate them. Just remember that *LBSC* around 50 - 60 years ago predicted that 'Numerical Control' (at the time an electronically read 'punched tape' precursor to Computer Numerical Control – CNC) would soon disappear (among many other predictions of his that were wrong). I fear that, despite his abilities, he could not understand the concept so denigrated it. I appreciate that some may not have the equipment and perforce have to saw and file their way to a model but that is no reason why others should follow.

In all aspects of Model Engineering it is necessary to have the skill to produce a drawing (preferably an accurate one) or read one and then decide on what machines to use and the settings of tools, feed and speed. It is also necessary to design many jobs so that a series of operations is carried out in order to complete the machining. The drawings, being the first stage, take quite a lot of skill. When using CNC for example this might involve setting parameters in a CAD program. Further, if there are dimensions that are essential and are to 0.004 inch or 0.01mm tolerance then this must be set at 4 (Imperial) or 2 (Metric) decimal places as a dimensional limit. For those who do not and have not used 'CAD', these limits mean that the computer produces in its memory a series of vectors to those limits between

Cartesian Co-ordinates. Think of it as 'lines' that are of no dimensional thickness (difficult to imagine but it is a fact, the print out line to paper is clearly thicker and centred on this imaginary line). That 'line' will be on the dimension that you set it to and the computer will be given a tool path by a CAM programme using that CAD drawing that will allow cutting to that line – which is of no thickness - within the designed tolerance of the CNC machine. Machining to a 'scribed line' cannot be as accurate as CNC because in order to be seen, the scribed line has to be about 0.001 to 0.003 inch (0.076mm) wide. I doubt there are many that could split a 0.003 inch line. I also doubt that there are many who could scribe a line closer than two or three 'thou' to a dimension by eyesight alone.

If I in my 70s can go back to 'Tech' and keep up with the embryo engineers in their 20s, so can you - **IF** you want to update your knowledge. You, as model engineers, actually have a tremendous advantage in that you will have a lot of 'hands on' experience, which those young men in my class lacked - and yours will also show! Often our tutor would promulgate an operational conundrum - then say "Peter keep quiet, I know you know, but they have got to think it out!". He, being about 20 years younger than me but with a lot more industrial machine shop knowledge and years as a tutor, knew if they thought 'it' out they would remember 'it' – if just 'told' would probably forget 'it'. The main advantage to me of the 'Tech' course was a much, much deeper understanding of CNC operations and the 'tricks and dodges' peculiar to it. I learned how to set up a job for efficient production on basic CNC vertical milling machines and on CNC lathes. I also learnt what the sundry technical terms and features in Cut2D and Mach3 actually meant and how to use the features to my advantage. An example: the back plate of the mounting frame for the Baker valve gear that bolts to the frames of my locomotive has twelve radiused corners. CNC did those radiused corners whilst cutting the outer profile in **one** operation – a manual machine would require twelve set-ups with a rotary table and an end mill. The same frame plate has sundry holes (of two sizes) drilled through for the mounting bolts. It also has several shallow slots of two different sizes milled across to locate other plates for silver soldering and there is also one larger round hole that was milled out in a pocketing operation. This was five program operations – four tool changes (one tool used for two operations) – and took one hour ten minutes per plate.

Now if I had done the above operation manually I would have spent about a couple of hours 'marking out' and checking four plates. Then there would be half an hour drilling three different sizes of hole, followed by about 1½ hours setting up a registering jig and milling slots. Profiling would have taken about two hours or more, then would come the 'corner rounding' – three or four hours? The probable total would be around 10 hours (?). Instead it took about 4½ hours whilst I was doing something else - including lunch! The biggest advantage, though, is that there were no mistakes or general 'oopses' etc.

I have also used the CNC Mill to make a part for a plough which will keep it operational. The company who made it ceased operations circa 1952 so there are no spares beyond Sheares (the horizontal cutting edge on the lower front of the mould-board) / Skieths (vertical cutting disc for grass sod and soil) and mould boards (which all wear away) from foundries that specialise in such replica components. One of these companies is occasionally a client and told me there must be about a thousand of my particular model of four furrow plough still in use after over 65 years. And besides, as I wrote way back, 'it's a nice toy, but shush!'.

●To be continued.

PART 2

Warco WM18 CNC Mill

Canon Roger Davis describes how he converted his Warco mill to CNC operation.

Continued from p.630
M.E. 4585, 27 April 2018

Optional extras

Before moving on to the electrical/electronic side of the conversion I will mention two additions to my basic three axis CNC conversion which I thought worth making. The first arises from the very limited speed range available at the spindle of the WM18. The top speed 2250 rpm is much too low for very small drills and engraving cutters. Fortunately, in recent years high speed spindle motors have become widely available (see eBay!). I chose a 3HP air-cooled three phase motor complete with matched inverter control unit (**photos 12** and **13**). This is attached to the bottom of the quill by a CNC machined aluminium yoke. This motor has a maximum speed of 18,000rpm and came fitted with a balanced ER20 collet chuck. It has proved invaluable for very fine machining and engraving using cutters down to 0.1mm diameter.

The second addition is a fourth axis capability (referred to as the 'A axis' in CNC speak) (**photo 14**). This is essentially a digitally driven rotary axis similar in purpose to a dividing head that can be mounted on the table and horizontally aligned along its length (X) or, less often, at right angles (Y). Alternatively, it can be mounted vertically (Z) where it can be used, for example, for mill turning. Again, research into the subject on the Internet highlighted the necessity of minimal backlash and the special desirability of harmonic drives in this context. I was fortunate enough to locate one by HD Systems on eBay which gives a 1:34 reduction with <0.05 degree backlash. It is driven by the same type of *Nema 23* stepper motor as the other axes. The motor and gearbox are mounted on a re-purposed very heavy angle plate that was itself

Original Warco WM18 Mill.

High speed spindle mounting yoke.

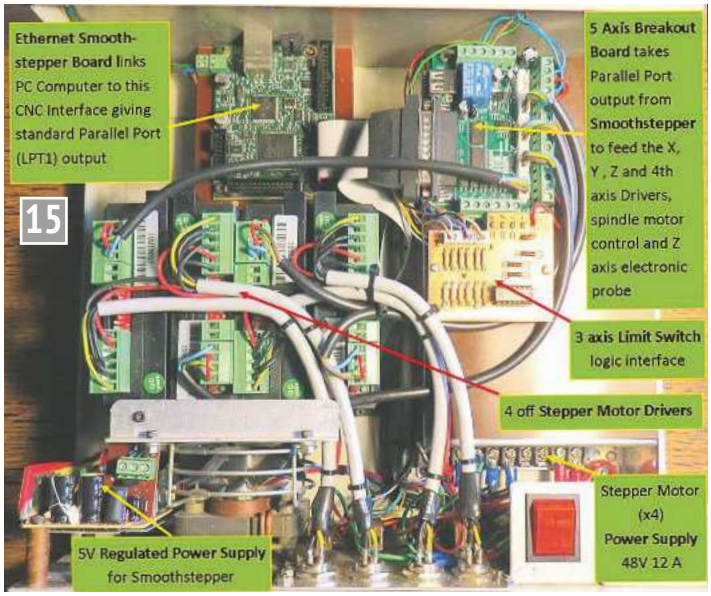
High speed spindle motor three phase inverter/control unit.

CNC machined on this mill. I designed this unit to pair with an existing *Vertex* tailstock for use when machining between centres.

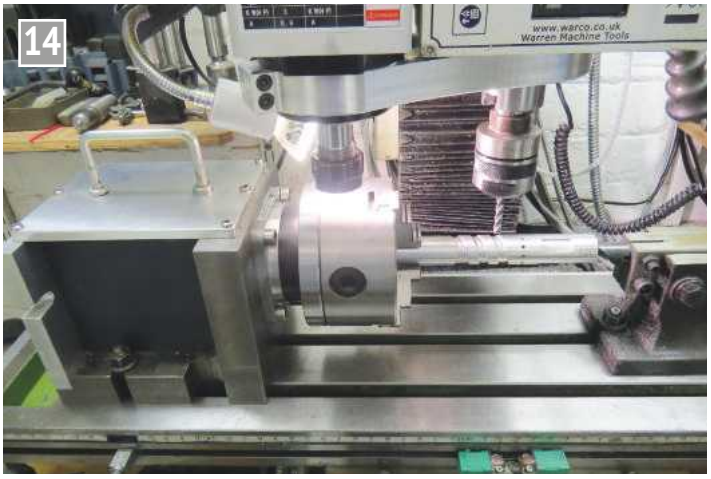
Electrics and electronics

With all the mechanical work complete on the mill itself we turn to the interface between the machine and the computer. This must process all the G-code produced in the initial CAD stage for any particular design and turn that into three (or four) axes of movement at the tool. Once again, drawing on the wisdom and experience of others gleaned from the Internet and copious information available from the CNC4YOU web site (https://cnc4you.co.uk/) I designed and built my own version. To house the power supplies, various circuit boards and stepper motor drivers I reused a rather nice instrument case that had served numerous previous (amateur radio) projects in the past. This unit sits under the bench on top of an old tower style PC that is dedicated to its new role of running *Mach3* CNC software. The internal layout and rear connection panel of the interface unit can be seen in **photos 15** and **16**.

Mach3 from the Artsoft division of Newfangled Solutions is probably the most widely used CNC software used by homebrewers (see: http://www.machsupport.com/software/mach3/) . It is available on a 'try before buy' basis which is always helpful. It runs on Windows computers. In the next stage of the CNC process the output from the *Mach3*/PC has to feed a 'Motion Controller'. In earlier days connection was made through the PC's parallel port (LPT) but now this is rarely if ever available on newer computers. The choice is now between the serial USB or Ethernet ports. The former is susceptible to electrical noise and cable length is restricted. The Ethernet connection is far more reliable and there are no cable length restrictions. Whilst my initial testing and proving was done with a cheap Chinese USB motion controller board, occasional and annoying glitches soon persuaded me to invest in an Ethernet Smoothstepper available in the UK from **Emvio Engineering** in Bristol (again, usual disclaimers). This has proved entirely reliable and is very fully documented and well supported. The Smoothstepper connects to an inexpensive and widely available parallel port breakout board. This latter provides all the connections to the stepper motor drivers, the limit switches, spindle motor control, emergency button and Z axis probe.



Machine/computer Interface – internal component layout.



Fourth axis in place with Vertex tailstock.

These two boards with the power supply unit for the stepper motors, their individual driver units and a small 5V PSU for the Smoothstepper are all housed in the instrument case (330w x 300d x 110h) cooled by a small fan.

All connections between the interface case and the mill itself are made through screened multicore cables. There are rather a lot of connections to the limit switches, spindle motor control and Z axis touch probe so a small junction box on the side of the mill column terminating the multicores helps to keep things as neat and tidy as possible.

As far as operational control and monitoring of the CNC machine is concerned I was very fortunate to find on eBay a 15 inch POS monitor with touch screen facility. This is a very handy bonus for quick selection of buttons on the various Mach3 screens. I also have a small wireless keyboard for character entry and in place of the usual mouse use a trackball (**photo 17**). A trackball is much more convenient in the workshop environment as it does not need a flat and clean surface to operate on! I also use a

Machine/computer Interface – back panel connections.

Wireless pendant and trackball.

Emergency stop button mounting.

High speed spindle motor CNC machined yoke.

Morse tutor unit – case and front panel CNC drilled and engraved.

LED illuminated desk sign CNC reverse engraved.

LED illuminated desk signs CNC reverse engraved.

Commemorative mount – CNC routed base and engraved and profiled plaque.

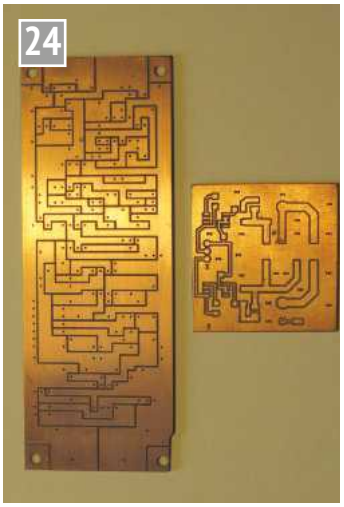
wireless pendant for important changes 'on the fly' to, for example, tool feed rates. It makes jogging on all axes much easier than using the keyboard or screen buttons and provides repeats of the digital readouts together with emergency stop buttons etc. Please note also that there is a large immediately accessible STOP button on the front of the mill base (**photo 18**). This is vital! Believe me, you will need it sooner rather than later to avert disaster; CNC machines do exactly what they are told fast and hard but are very subject to human frailties, oversights, miscalculations and "oh, I should have thought of that" reflections and not, I understand, just by newbies to the art!

Final thoughts

As a complete newcomer to the world of CAD/CAM I had tentatively looked at some of the many software design programmes available. I dabbled with TurboCAD, Alibre, Design Spark and SketchUp among others but in the end found Fusion 360 from Autodesk both intuitive and extremely well supported with weekly if not daily tutorials and all manner of examples of practical solutions, especially on YouTube. Fusion 360 is a completely integrated package for 2D and 3D design and execution not only for CNC but also for 3D printing - another little personal sideline. I have come to like it a lot and not least because it is FREE to non-commercial amateur users and comes with no restrictions to its hugely professional array of capabilities.

Initial setting up of Mach3 and then Smoothstepper with all the different parameters involved does take some time but there is huge support available out there. Of course, there will be some long head scratching moments and getting to grips with some of the terminology feels slightly daunting at times. But it can be done and the feeling of satisfaction when your design emerges from the computer screen to hard reality on the milling table is immense. I remain fascinated by the speed and accuracy of the CNC process and, for example, watching a couple of hundred 1mm holes in a printed circuit board being executed in minutes and with total precision is fascinating – particularly by one who has done this all by hand over many hours in years gone by!

There is a large immediately accessible STOP button on the front of the mill base. This is vital! Believe me, you will need it sooner rather than later to avert disaster...



CNC milled printed circuit boards.

Examples

Here are just a few examples of very varied CNC output possible from this much modified WM18.

Photograph 19 - this is the yoke used to mount the high speed spindle motor onto the existing WM18 quill, designed with Fusion 360 and entirely CNC milled from a slab of aluminium (250 x 100 x 25mm) on the modified WM18. The fine finish is just as it came off the machine with no fettling. (The four holes are for work-holding as both sides are machined.)

Some samples of recent personal projects and some carried out for friends and family are shown in **photo 20** - a Morse code tutor unit; **photos 21** and **22** - LED illuminated desk signs (reverse engraved); **photo 23** - a commemorative display case made for a special piece of coal treasured by an ex-Bevan Boy (a then very young conscripted WW2 coal miner) where the mahogany base is CNC machined with router cutters (as were the LED display bases) and the brass plaque is CNC profiled and engraved; **photos 24** and **25** - CNC milled printed circuit boards. The larger one was for David Tompkins's currently *Model Engineer* featured ***1902 Curved Dash Oldsmobile*** sound system (see page 792), the smaller (50x50mm) for my antenna power & SWR meter using surface mount.

Finally, **photos 26**, **27** and **28** relate to ***The 1909 E.N.V. Aviation Motor*** – Stephen Wessel's latest aero engine project also being serialised in *Model Engineer* (see page 773).

PCB (50mm x 50mm) complete with surface mount components.

Reproduction half scale Zenith carburettor float chamber cover.

Stephen challenged me to CNC a float chamber top cover for its replica *Zenith* carburettor. The original would have been a casting with raised lettering. This, like the rest of his model, is to half scale. It is 1⅝ inches in diameter. As the smallest characters are less than 1mm high it required a 0.3mm cutter running at 18,000rpm and 34,000 lines of G-code to achieve a realistic result!

ME

Reproduction half scale Zenith carburettor.

Half scale E.N.V. aviation motor with Zenith carburettor in place.

PART 3

Six Inch Oldsmobile

David Tompkins describes the construction of an electrically driven half size horseless carriage based on the 1901 Oldsmobile Curved Dash car.

Continued from p.655
M.E. 4585, 27 April 2018

The half scale electric *Oldsmobile Curved Dash* car.

Ancillary components

Once the body and the chassis had been completed all the 'bits' sticking out had to be dealt with. These included mudguard stays, mudguards, lamps, lamp brackets, steps, steering tiller and seat brackets.

Brake cable compensator.

The steering tiller was produced first as it required nickel plating, in keeping with the norm for the early 1900's, rather than chrome plating. My local plumber kindly lent me his tube bender which was just able to bend the 16mm steel tube for the tiller. This tube and the knuckle joint at the bottom of the tiller were then sent to the local plater.

As all four wheels are fitted with cable operated disc brakes a compensating lever arrangement was assembled to ensure that even with slight miss-adjustment of the individual cables all brakes would have the same force applied to them. **Photograph 4** shows the construction. However, without a small but significant addition, the loss of one cable, for whatever reason, would allow the brake pedal to 'hit the floor'. By connecting the brakes in a diagonal manner, nearside front/offside back and so on, and adding a travel limiting pin for the primary lever at least one pair of brakes would operate symmetrically about the length of the car.

Half of the mudguard stays are straight and, other than being welded to a small plate, needed little manipulation. The other half of the mudguard stays and the seat arms needed to be bent. To achieve nice smooth curves I raided the scrap box and the pile of metal tucked in the corner of the workshop to make a bar bender (**photo 5**). With that, bending the 8mm diameter steel rod was a simple task.

I had considered making some dummy headlights and a tail light but to have some of the Edwardian curviness displayed on the original car lights I chose to buy veteran acetylene motorcycle lamps. Now, these are available in some numbers at motorcycle auto jumbles but finding a matched pair is more difficult

as even one manufacturer, such as Lucas, produced many different models. Once the lamps were to hand the dross of years of acetylene production had to be removed. LED's were fitted and a power socket installed at the rear of the lamp. Brackets for the lamps, which allowed them to be fitted to mudguard stays, were machined from aluminium.

If you carefully inspect early coaches and horseless carriage mudguards you will notice that, rather than a wire swaged into their edges for extra stiffness, there is a raised bead just inset from the mudguard edge. This caused a little head scratching at first but it was soon realised that a simple bead roller could produce the extra stiffening. Again, the scrap box plus a small pair of gears resulted in the bead roller (**photo 6**). Mudguard blanks were laser cut to size then formed to the correct main curve using a set of rolls. The bead was formed around the edges by the bead roller. It was a two person job to achieve this; one to turn the roller handle, slowly, whilst the second person carefully fed the mudguard into the roller - fascinating to watch this as it developed.

As per the prototype the mudguards (**photo 7**) have four fingered spiders at the attachment stay points. The centres of these spiders have a boss that allows a grub screw to fix the mudguard to the stays.

Electrical components

The two geared motor units were simply bolted on to runners fixed to the chassis main frame cross bars using nut plates under the motor flanges, thus only needing single sided access for chain adjustment.

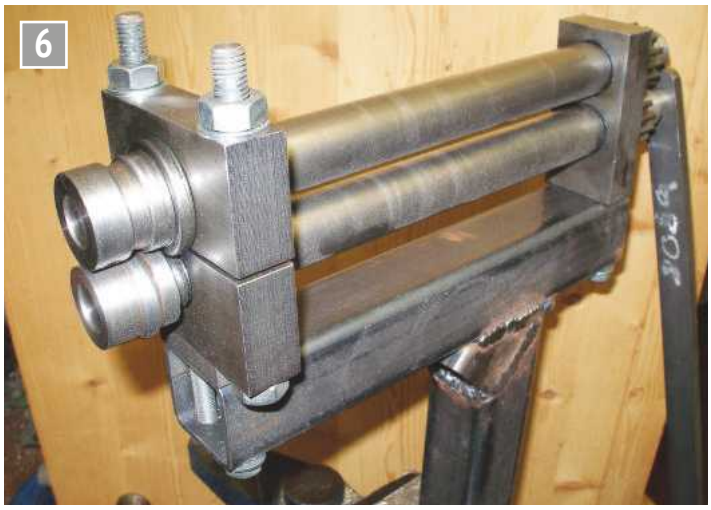
Bar bender.

For the power source I have employed two 12V, 80Ah leisure batteries providing 24V for a 4QD Pro-150 controller (**photo 8**). The batteries were sourced from the local caravan suppliers.

I have no commercial connection with 4QD other than being a long-time customer. I have used their Pro-120, now replaced by the Pro-150, on three of my model projects, along with installing three in friends' models and four commercial applications. I have had no problems with these units at all. The improvement between the Pro-120 and the Pro-150 is mainly, from a user's point of view, the ease of programming the operating parameters.

The power cabling between the batteries, the controller and the motors is fairly simple but in the power feed there is a 60A circuit breaker and an isolator switch. The regenerative braking function of the controller, even when not powered up, can be a problem when manoeuvring the car at times. To disable this function when required I have fitted a four-way terminal block where I can safely isolate the two motors from the controller without the concern of cables flapping around and touching points they should not.

To regulate speed and direction there are the linear potentiometer, actuated by the throttle pedal, and the forward/



Bead roller.

Mudguard.

Body interior.

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Forward/reverse lever.

Foot well.

backward selector lever (**photo 9**). Loosely in keeping with the prototype, the forward/reverse lever is to the right-hand side of the seat and has a crisp ball and notch detent to give it a 'mechanical' feel rather than an electrical switch feel. The actual electrical switching is performed by micro-switches triggered by the lever. Next to the lever is a battery power indicator with a nice brass bezel styled in keeping with the rest of the car.

The LED lights are designed for 12V operation and I wished to ensure both batteries had equal loading, so I fitted a converter module to take the batteries' 24V and efficiently bring it down to 12V. A second converter was installed to provide a 15V supply for a sound generator.

Fortunately for me a very capable electronics friend and his son, a sound engineer with the BBC, were able to analyse the sound that the prototype cars produced and provide a circuit to match this sound. This was a little more complex than the sound for a steam locomotive as there are two phases, namely the tick-over and the changing rate as the car increases speed. To check the car's speed there is a sensor on the output shaft of one of the motor-gear units. The signal is then processed to increase the 'chuff' rate once the car speed exceeds the tick-over speed. The sound card feeds into a 24V amplifier and then on to a loudspeaker fitted in the bottom rear of the body. Again, slightly mimicking the prototype, the light switch and the volume on/off switch for the sound are fitted to the bulkhead under the front of the seat (**photo 10**).

After completion

During construction various family members expressed a concern that the car would not fit into the back of my car – I am pleased to say it did fit with the closest point having over an inch (25mm) clearance, as I expected.

Where my expectations were not met was the stiffness of the springs. This is important as the less than ideal chain drive/spring geometry means that the chain tension varies greatly with the compression of the springs - more compression, more chain tightening.

As the design of the springs was a vital layout factor in the early design I took a flyer in their specification. However, in my estimations based on scaling of weights and spring stiffness I left out a deflection factor and ended up with springs that needed to be stiffened by a factor of two. (The payload of an adult was not scaled by a half.)

Fortunately for me the necessary modification consisted of adding two extra leaves to the spring. As the springs are straight, the production of the extra new parts did not present the spring manufacturer with any problems.

Project overview

On the day the model was completed and running, prior to final modifications to the springs, I checked when I started the design layout and discovered that it was exactly one year to the day. I had managed a relatively fast build.

Overall there was little in the construction that I had not done before with the exception of rolling and edge swaging the mudguards. It just took a little persistence and great support from my wife and family.

The satisfaction achieved is on two levels; the first is that I have an attractive looking, nicely working model and the second is the glow felt when watching my grandsons ably and happily drive the vehicle.

ME

The Inquisitive Fiddler: Learning the Trade! PART 2

Mitch Barnes tells how, without access to machinery or facilities, he used incomplete and abandoned projects as his way into Model Engineering, to start learning about his chosen hobby.

Continued from p.662
M.E. 4585, 27 April 2018

One of Anthony Mount's lovely models would be ideal for a beginner who wants to start with a scale model.

Stage 2
The nervous beginner begins...

Not to be forgotten as a reason for finding unfinished models in the marketplace is that there are beginners who, like me in the early days, take on something above their pay grade. This beginners' hubristic over-ambition must be especially true of many entering model engineering from a previous interest in making fine scale models in plastics, such as military models, model railways or aircraft. They'd only be satisfied with an engineering model if it was also of fine scale appearance; too many engineering models are 'semi-scale' to use aeromodelling parlance and look too crude to cut the mustard for their fine scale taste. As one of these semi-scale models, even my coveted Stuart No9 was anathema to my eyes unless I embellished it with some scale looking details as best I could.

Our New Model Engineer will find that there is a further order of magnitude of high-level skills involving complexity, finesse and more equipment required in order to make a fine engineering model compared to something more basic, just as it is in the interest they are considering leaving behind. In model engineering, this requires a greater expenditure in equipment than it does in the scale modelling field he or she is used to (**photo 5**). Even when compromising by starting with something semi-scale that could be later improved upon, our neophyte model engineer finds even then that making anything in metal takes far longer than at first thought. It can take an hour or more of setting up to mill a piece of steel whereas an equivalent cut in plastic or wood, to achieve what initially may seem to be a comparable result, can take minutes or even just a few seconds.

Above the beginner's pay grade? A finely detailed model like this by the late John Dilly will appeal to many model engineers but requires additional equipment and skill to produce over the simpler beginners' models they would be best advised to cut their teeth on.

Barely 40mm tall, this one part might look nice but it is the result of two weeks of lunchtimes and tea breaks, starting with a strip of steel, some careful milling, a bit of even more careful bending and many hours of very careful filing – with the best files the engineer can afford.

Eventually it will be too much; all that work, setting up to achieve... okay it looks nice but just *this* tiny part (**photo 6**)? Such thoughts will niggle away and then, dissatisfied with the result of this attempt or lacking the patience needed to build something more detailed, the neophyte engineer returns to the previous pastime, leaving the engineering model only partly completed. Perhaps empathising with Edmund Burke's comment that it is wiser "...to know the best time and manner of yielding what it is impossible to keep", the project is 'temporarily' put aside while he or she has a think about it...

Having said this, Anthony Mount's designs are all scale models and some may be within the abilities of the beginner with experience making models in other materials (**photo 7**). Most have been the subject of his highly readable and approachable but detailed construction articles in magazines, often starting with the raw beginner's abilities in mind. Castings are good quality and readily available from Polly Models and others.

Stage 3
A solution: machined kits!

My experiences were far from unique and from the earliest days of model engineering as a hobby this dilemma has been recognised. While I lacked experience and access to a lathe, help was at hand at that

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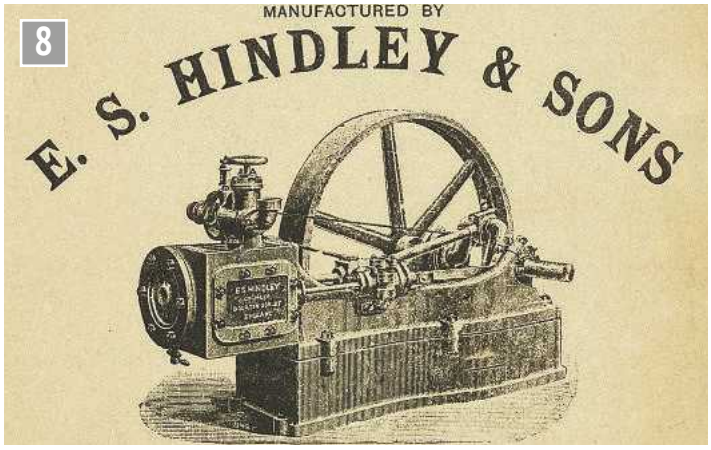


The 10H reminded me of this engine and looked as if it could be improved to look a bit more 'scale' in appearance.

first show. A very helpful chap on the Stuart Turner stand showed me a machined kit. There it was: all the stuff I couldn't do was already done!

No doubt many other machineless but enthusiastic wannabes over the years had started here too. Trying out a machined kit is a great way of finding out if model engineering is for you, without the expense of buying vast amounts of equipment and tooling. An aid to the beginner for at least a century (Stuart's 1915 catalogue listed the new No. 10 in machined kit form and other suppliers had been doing so long before that), a machined kit may be the answer and is a great start for the terrified. Only fitting and bolting together to do. And painting. And tweaking. And…a display base - and a case perhaps? And…anyway it was far more plausible; I could even have a model mill engine after all, though the No. 9 wasn't one they offered as a machined kit in those days - they do now!

Encouraged that all I now needed to fulfil that long-held dream was a lot of enthusiasm and some commitment along with hand tools - most of which I already owned - I went home enthused and laden with all the catalogues I could find at the show.

Armed with those catalogues, I now needed to go through them to see if there was anything I particularly liked. There was. I found that both Stuart Turner and Maxwell Hemmens made machined kits. Both had models I liked – lots of them! On a visit the following week to Steam Age in Kensington, I saw examples of both and some weeks later returned from a prearranged extended lunch break there with a Stuart 10H, having saved up for it. I didn't know then how hard it often was to get hold of Hemmens kits and it would be another 18 years before I found examples of their lovely little horizontal and launch engines, whose appeal has never flagged.

Whatever your route into model engineering may be, I cannot over-emphasise the importance of finding your chosen first model appealing, for whatever reason. This could be due to its appearance or its performance of course. While the all-important vision of seeing it completed and receiving admiring compliments from friends and family will spur you on, I can guarantee that your interest will wane if you are non-committal as to its looks or performance.

One thing that I found with Steam Age and also Cherry's of Richmond was that just like the models I'd seen at the show, every model they sold seemed really well made; this was inspiration and a standard to aim at, especially as most models I came across could with some effort, be brought up to that standard.

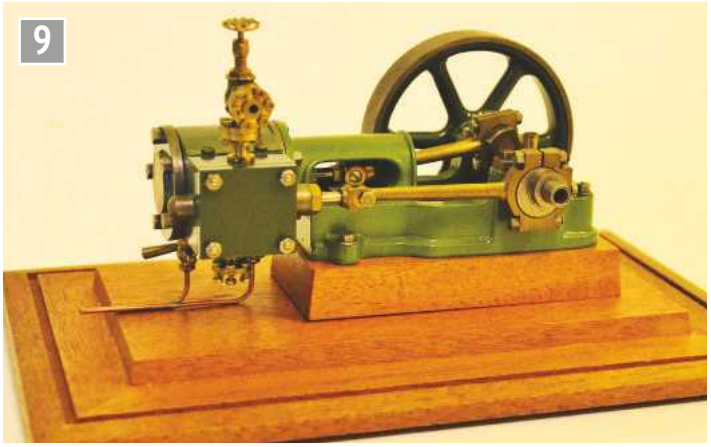
Even a machined kit still takes far longer to build than most people think. When I built my model I was sure even then that incompletion must be the fate of many models, including mine, especially if I had taken on something rather too ambitious from the start. It looked charming but a bit crude and I already wanted to make it look a bit more 'scale' in appearance, to resemble the small Hindley workshop engine it reminded me of at Kew Bridge Steam Museum and the example of the cover of their reproduction catalogue I had meanwhile bought (**photo 8**).

After buying some more books on full size engines for inspiration, I realised that adding a bit more detail really was within my abilities; I'd tapped holes at school so I could add oil cups, cylinder drain taps and a nice Maxwell Hemmens valve on the valve chest. I also applied beading around the crosshead tunnel openings with 'plod' (car body filler) and fitted cylinder drain taps and representative pipework.

Feeling a bit more confident by this time and using techniques developed in my years of experience on the machine, I used the 9 inch *Startrite* woodworking circular saw in a manner not exactly in the instruction manual. One lunchtime, while the boss was away at a meeting but my colleagues weren't, I produced a far more delicate and believable crosshead from the simply functional kit item. Safely encased in protective equipment, I effectively milled it, with it encased safely within a very substantial home-made Perspex jig, using the saw blade as a milling cutter! I should say that I took very light cuts and this was a precision TCT tipped 88 tooth *Perspex* cutting blade, not one with teeth the size of a great white shark's, like something mountain men slice up giant redwood trees with out in the rural backwoods of America. Having safely completed the task, I looked up to find that my colleagues were all cowering behind solid bits of the building. Don't try that at home folks!! This whole 10H project exercised the credulity of my colleagues too. None of them had handled cast iron either and, unbeknown to me, they had been running a sweepstake, not on when I'd finish it but when I'd give up!

Despite all this, not only did I complete the model but, to my amazement, while running it under compressed air and surrounded by my colleagues, including the boss, it worked, as smoothly as a sewing machine! "Is that all it does?" the boss asked glumly. I didn't mind - I was hooked (**photo 9**).

I was really pleased that I'd chosen that Stuart 10H machined kit - it was my stepping stone that enabled me to circumvent the obstacles. I would not be writing this nearly 30 years later if I had been disappointed with it - I was anything but! Even so, it was a long time after it'd been completed before circumstances allowed me to get properly started in model engineering.



The first attempt, after much work and some embellishment.

Stage 4
Working on other people's discarded projects

My lack of knowledge of metal machining meant that even after completing the 10H, the odds on completing a model from raw castings didn't look too rosy. To be honest, anything I attempted would be guaranteed to wind up like lots of its uncompleted brethren packed away again, patiently waiting perhaps in vain, for growing abilities and inspiration to make a return visit.

While I knew I currently lacked the ability to complete a model I assumed that I would pick up the requisite skills in due course as I went along, building up the range of necessary techniques as I went. This was more or less how I had progressed as an architectural modelmaker. So, I decided to purchase a number of models that took my eye and work on them as and when I could until I reached the point on each one, beyond which at that time I could not continue until I learned how to do the next bit. When I mastered the skill to proceed, I would. Eventually they would be finished, probably all at once! I had nowhere in my rented home to put a lathe that I'd have to take with me when I moved but small model stationary engines were no problem.

I was still completely clueless but fascinated, daunted and awestruck at the same time, something that would linger for years while I circled the subject, without actually diving in.

Without machines or circumstances where I could keep one, I wasn't able to consider building a model from a set of castings but I knew that eventually this would change.

Meanwhile, I would have to do it the long way.

Surely there must be some examples of those catalogue-illustrated Stuart and Hemmens engines I liked so much but unavailable as kits, out there wanting to be finished?

I remembered an Open University maths programme where they had a wise solution to overcoming a difficult example of something and it has stuck with me ever since: "Try an easy case first."

This enables you to get the hang of the principles without getting lost in the detail and losing sight of what you are doing. Having put my own unique stamp on the 10H by embellishing it, I launched myself on a quest for incomplete projects that I could apply my limited abilities to.

Pre-internet, I put ads. in the classifieds of *Model Engineer* and had a few responses. I still hadn't been cured of the desire for a No. 9 and that was one of the first I sought. Peter Slater, who sold it to me, became my mentor, answering my endless dippy questions over the phone, and I bought a couple of other projects from him when he had a big clearout. His No. 9 was beautifully machined but neither finished or painted and I did a lot on it including refining its lines around the cylinder/bedplate, during tea and lunchbreaks at work, before another forced house move (renting hell, sold under me again) pushed it into storage a year or so later. I still have it though, and… here it is, eight house moves later, unwrapped for this photo (**photo 10**) and loosely toshed together for the first time in 25 years! I gave it balance weights (cast in whitemetal in a silicone rubber mould, from my pattern) and it seems to have acquired a nice patina but that clumpy governor and the enormous valve rod gland will have to go! I think it'd look even prettier with a larger flywheel…

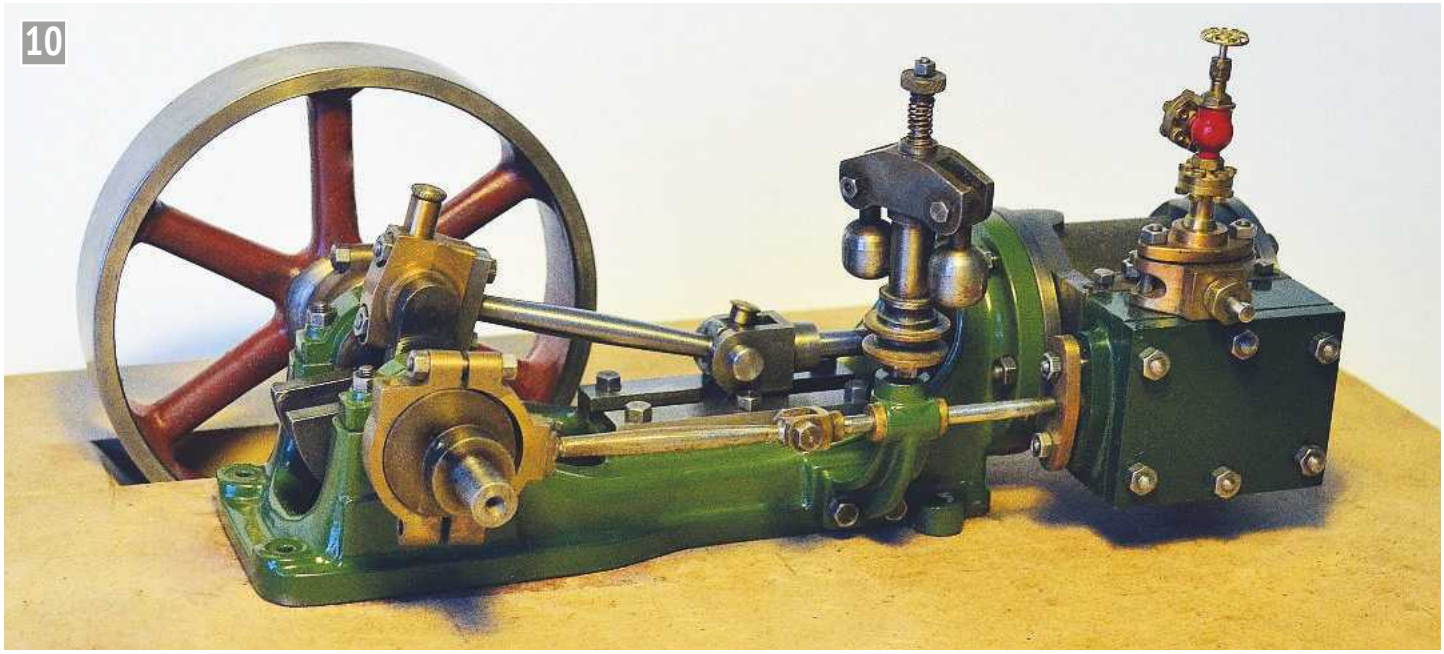
Starting with the few jobs that I could do by tweaking this and other discards, I kept the interest alive and built on my inadequate skills to the point that I am now vaguely competent at many of them.

A huge advantage of engineering models is that, unlike a wooden scale model ship or a tissue-covered model aeroplane, one can easily dismantle them. This means that newly finished parts of a better standard or finer appearance can be bolted on as your skills improve, replacing previous iterations that your eye always went to straight away because you knew you could do better… as seen above!

By following this path, I got around the obstacle that is inexperience by restoring and reworking some finer more complex models that would have been far beyond my abilities to build from scratch or castings at the time, thus satisfying my need for fine scale models. At the same time, I was also learning about how it's done without losing my perspective, because an essentially completed model sat before me, helping me keep the unknowns in context.

So, bit by bit I added to, replaced and remade lots of parts I did have the abilities and facility to work on, without getting frightened off it as being something for the 'too hard basket' and at the same time feeling the satisfaction that I was getting somewhere with my hobby.

●To be continued.

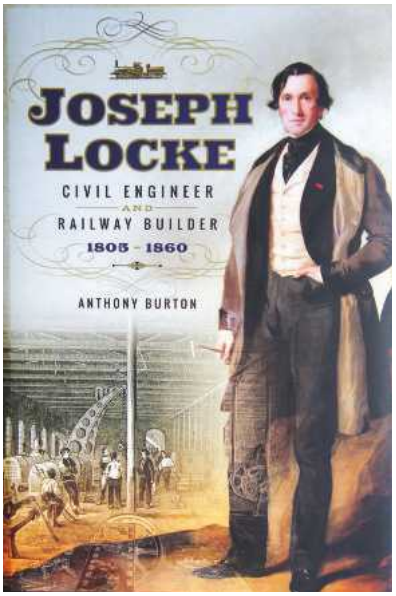


Still not finished then??? Circumstance!

Book Review

Joseph Locke: Civil Engineer and Railway Builder 1805-1860

By Anthony Burton



Definitely not to be confused with the Irish singer of the same name, Joseph Locke was one of the great railway engineers of the 19th century, though never as well-known as Brunel or George and Robert Stephenson.

Joseph's father William was a colliery viewer or manager, first in Attercliffe, then working for Sir John Ramsden near Huddersfield and finally at Barnsley. So, Joseph grew up as a Yorkshire lad and is commemorated today with a statue in Locke Park, Barnsley.

His rise to prominence was decidedly shaky. He walked out of two apprenticeships, worked as a part time coal man and as a clerk before going to Robert Stephenson's new locomotive works at Newcastle as an apprentice. He showed mathematical ability and, early on, acted as resident engineer for a colliery tramway at Black Fell, learning surveying, then working as engineer on the Canterbury and Whitstable Railway where he overcame problems with the tunnel.

He was called to help construction of the Liverpool and Manchester Railway, correcting surveying errors and engineering the crossing of Chat Moss. Joseph Locke drove Rocket on the opening day. Although loyal to George Stephenson, Joseph left to become resident engineer and then chief engineer for the Grand Junction Railway, extending south to Crewe and Birmingham. Unlike the more slapdash George Stephenson, his policy was to set out detailed plans and specifications for works. So that no contractor was overcommitted, he limited all contracts to a maximum 10 miles of track. In this, he displayed a far more modern approach to engineering than was usual at the time.

Locke developed a strong working relationship with the contractors Thomas Brassey and William McKenzie. He went on to do much work with them both in the UK and abroad.

Although Locke triumphed with the construction of the Woodhead Tunnel, then the longest in Britain, he really made his name building the London and Southampton Railway. He took over from an incompetent engineer and rerouted parts of the line to avoid major cuttings. His greatest innovation was to use sleepers and chairs to support rails in place of the stone blocks of the Stephenson era. Brunel ignored this practice and went on to waste thousands of pounds developing his own baulk track for the Great Western but Locke's system became the British Railways standard.

His attention to detail meant his railways were always delivered on time and to budget. He recognised that locomotive power would inevitably increase and therefore used steeper gradients, saving on construction costs. This was shown to greatest effect when he engineered a line over Shap Fell even though a tunnel would have been better in the short term.

Abroad, Locke engineered the Paris to Le Havre line with Brassey and McKenzie, who brought most of their workmen over. As a disciplined group, used to hard physical work, they provoked one impressed French observer to say "Les Anglais, comme ils travaillent" ("The English, how they work").

Other European projects followed, including the first railways in Spain. He was then responsible for the line north of Carlisle to Glasgow. Locke became MP for Honiton, a pocket borough, but he was wealthy enough by then. In his spare time he was a keen poetry reader, fond of Byron. His great-nephew Alfred Austin became poet laureate.

Anthony Burton always writes a readable book and, though offering little new in this biography, rightly ensures that Joseph Locke is seen as one of the engineering greats. Strangely enough, the triumvirate of Robert Stephenson, Isambard Brunel and Joseph Locke died within months of each other. Locke's rather modest gravestone is in Kensal Green Cemetery near the larger Brunel monument. Yet it was Locke who did even more than Brunel to shape Britain's railways, perhaps an even greater engineer.

Roger Backhouse

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PART 2

The Tea Coaster Steam Plant - The Wright Way

Tony Wright adds a dinky boiler to his tea coaster steam engine.

Continued from p.665
M.E. 4585, 27 April 2018

The boiler

Things don't get any easier than this so don't worry. Starting with a suitable piece of copper pipe or tube (7) (what is the difference? Answers on a postcard please) cut to length. If your lathe is big enough to chuck the boiler tube, take light cuts to square up the ends; if not, set to with a file and a try square. If you look carefully on the surface of the tube you should see parallel lines along its length. You can use these lines to aid the marking out of the bush positions. If there are no lines use a length of say, ½ inch angle resting along the length - it's a lot easier than trying to hold a rule.

The bushes are turned from cast bronze or copper (though brass will do at a pinch). Remember not to fully thread the holes until the boiler is silver-soldered. The flanged ends are now required (you could use preformed copper stop ends if you want, but it won't look as good as proper flanged ends). Start by turning up a flanging former - just a short end of BMS will do. The diameter should be the internal diameter of the tube minus two thicknesses of the copper plate you are going to use, plus about 1/64 inch (this will allow for spring back when you form the flange). Cut yourself two discs of 18 gauge copper (the diameter of the flanging plate + ¼ inch). I use an off-cut of copper tube cut down the middle, heated to red hot, let cool then opened out and flattened. You can now proceed to form the flanges by gripping the copper disk and flanging former in your vice: knock over the copper to about 45 degrees, slacken the vice and move the whole lot round to continue forming the flange. Take the copper disk out of the vice, reanneal it then finish the flanging. The flanges should be a nice snug fit in the ends of the boiler barrel. You might want to assist the fit with a few light taps of the hammer.

Before we commence the soldering, clean up all the parts to be joined with fine glass paper (there's no need to use acid pickle unless you are going to leave the job for a while).

The boiler is ready for testing.

The tea coaster engine awaits the opportunity to impress your guests.

Let's solder on

Now, on a job as small as this a DIY blow lamp will provide more than enough heat for our requirements. Just make sure you use a full (butane/propane) canister. Apply flux to the parts you want to join (mix the flux with water to the consistency of thick cream) and silver-solder. I use JM Silver flow 55. Set your heat source onto the subject and once the boiler turns a dull red you can apply the solder. Just use enough to join the parts; there's no need to go mad - it isn't cheap you know! Once the job cools down give it a good clean up. I use a rotary wire mop in my drill press but wire wool or some such will do the same.

Testing ... testing ... one two three!

After you have finished tapping the safety valve bush you should think about testing your little kettle (**photo 3**). Very simply, find yourself an old high pressure bike inner tube and cut the whole valve stem off. Next, take a length of any ½ inch diameter metal rod, about an inch long; turn one end to suit the boiler bush and drill the other end to accommodate the tyre stem.

Drill through to connect with a 3/32 inch drill and adhere it with Superglue. We now have a one-way valve with a fitting to which we can connect a car foot pump! Normal foot pumps have a crude pressure gauge which will do for us. Connect the pump to the boiler, place the boiler in a bucket of water and pump up to about 40psi. On a boiler as simple and small as this one I would be very surprised if we had any leaks but if there are - clean up, re-flux and re-solder.

The case and the base

The base (8) is just a square of 1/16 inch stainless steel sheet (or if you have a suitable size metal coaster why not use that?) with a few holes drilled in it - no problems. Likewise, the boiler casing (9) is a simple job to mark out, drill and cut to shape (**photo 4**). When you've done that, set to with your folding device (two bits of angle and a soft headed hammer). Fold on the dotted line (as they say); secure the corner with a couple of rivets - pop or snap-head … you decide. The fuel tray (10) is simply cut, filed up and bent. That's it!

The safety valve and the *chim-chiminy*

The chimney (11) is just a length of brass tube cut to length and cleaned up in the lathe; it should be a slight push fit. If it's a bit slack give it a nip in the three jaw, just enough to - shall we say - improve the fit?

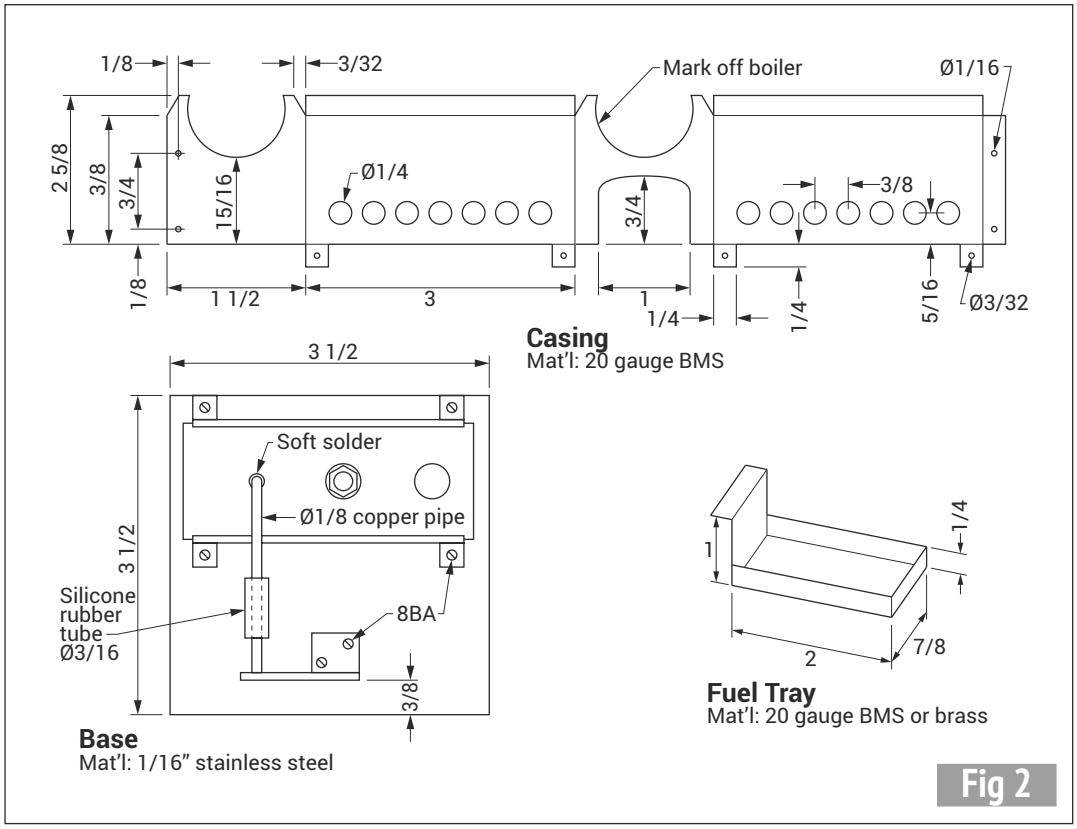


Fig 2

The safety valve (12) body is turned from a suitable length of hexagonal brass. Turn the threaded part first then cut or part off to length. Re-chuck the face, centre drill and finally drill for the valve stem. The valve stem (13) is a simple turning but you will probably have to turn it a bit at a time, otherwise you will just end up with a bent part as the tool digs in! Finish of with an 8BA thread. Assemble the safety valve with a suitable stainless steel or bronze spring and a couple of brass nuts. The valve should just start to open if you press down a set of scales (no, not the bathroom type) when it reaches about two and a half ounces (approx. 60 grams).

Final assembly

I think you will be able to figure out this bit yourself but, just in case … bolt the engine to the base using 8BA bolts and nuts. Do the same with the boiler casing and *make sure everything is nice and square,* okay?). The boiler should be just a slight interference fit in the casing. Mark the position of the steam outlet and drill it to accept the 1/8 inch diameter copper pipe. Now, clean up the area where the pipe fits, apply soft solder flux then heat it up and apply just enough solder to make a neat joint.

A silicone pipe connects the boiler to the engine (**photo 5**). This will stop the boiler from moving about. Make sure the ports are not blocked (easily overlooked) otherwise it won't run!

Ready to run?

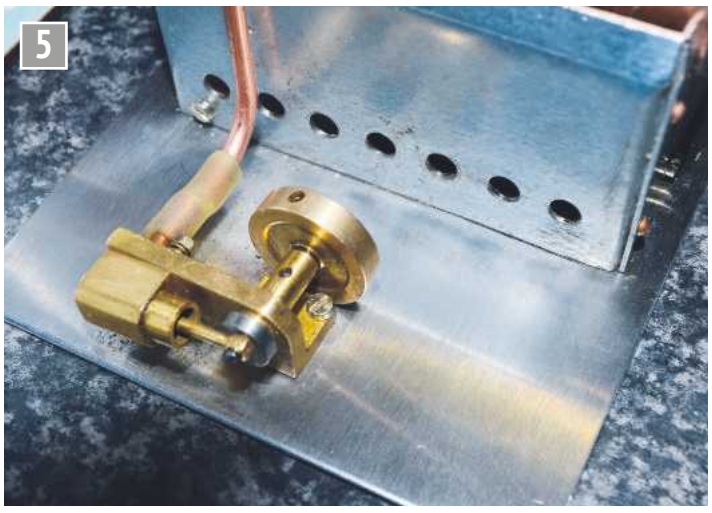
Fill the boiler with hot water, about two-thirds full. Place a lighted fuel tablet under the boiler (where else?) and now, whilst you are waiting for everything to get hot, go around with the oil can. When there is steam give the flywheel a spin.

Job done!

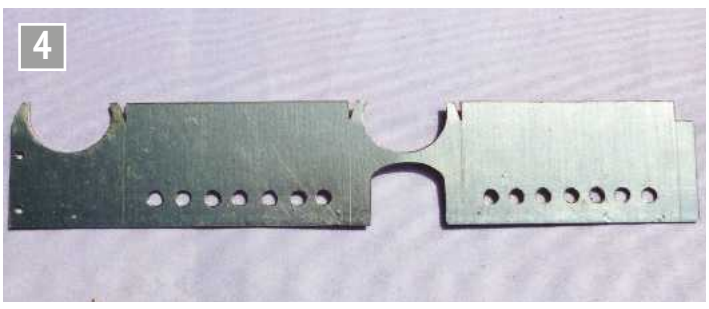
If you have any problems give me a shout.
thepufango@gmail. com

Until the next time, bye bye!

ME



The steam plant, all plumbed up and ready to go.



The case, drilled and ready for folding.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

I recently joined the Defence Electronics History Society, of which I have only recently become aware. They sent me the last few newsletters, the first of which is 90 pages long! I'm going to enjoy this.

I have bought a new, basic, stripped out, all-band radio transceiver from India. I will have to make a case for it and drill for switches, display etc. Other users have claimed it compares well with new equipment at ten times the price or more. I have cleared the decks and will report in due course. Motivation! That's what gets me out of bed in an afternoon...

Whilst I was writing my regular column this afternoon, Debs was bottling her latest batch of chutney. *'Whack for my Daddy-O, there's chutney in the jar'* as Thin Lizzy didn't sing.

I recently entered a competition on an amateur radio website. I reckoned I had a good chance as it only has a few thousand members. I won a set of coaxial adapter cables, converting from several common types of connector to several others. Wow! Very useful. It was not 'click-harvesting' (well, it may have been) but I did win several useful items, which have now been delivered.

I watched a YouTube video last night, in the Modern Marvels series. The Development of Stereophonic Sound. Yet again, it claims that America invented it, as it does radar, jet engines etc. Look up Alan Blumlein for the true story.

Graeme Hall's Upside Down I/C engine from Blast Pipe. (Photo courtesy of Peter Anderson.)

In this issue: steam powered aircraft, not changing gauge, ADSL, Twitter, promotion, a challenge, making wheels without a lathe, van mods, festivals, photosensitive epilepsy, a refreshment rooms feeding more than just passengers and franchising.

Andre Rousseau writes recommending this video on radial-engined motorcycles: https://www.youtube.com/watch?v=WR-FfL5Nf6Y. Andre is also looking for 'anyone with (or an online (free) archive of) a collection of the British *Automobile Engineer* who might be able to scan pages 170-175 of the June, 1925, Volume 15, No. 203 issue? Also on my 'hit list': *Engineering* page 252, August 12th, 1921, Volume 112 (Note; Grace's Guide was no use - they only archived the index subject reference). Another thread mentioned steam-powered aircraft. I pointed out that the Messerschmitt Me163 Komet was steam-powered, albeit in the form of mixing Hydrogen Peroxide with Hydrazine. The two are 'hypergolic' meaning they ignite on mixing, generating steam, which provides the exhaust thrust. It was a very advanced aircraft, including 'swept wings' but the fuels were dangerous to pilots and ground crew alike. Another use of steam was in the Walther engine of the same period, used in torpedoes and submarines, all having similar problems. Indeed, it may have been these which caused the Kursk tragedy.

David Turner's Brian Rupnow-designed I/C engines. (Photo courtesy of Peter Anderson.)

Blast Pipe, April, from **Hutt Valley & Maidstone Model Engineering Societies** has some good pictures of stationary engines at the Palmerston North Weekend, including Graeme Hall's Upsidedown I/C engine and a couple of Brian Rupnow-designed engines by David Turner (**photos 1** and **2**). Caleb Scott has an Ashcroft Indicator, boxed; see www.ashcroft.com for much information about this company.
W. www.hvmes.com

Welling & District Model Engineering Society, *Magazine,* April-May has Brian Simmonds writing about

his railway holiday in North Wales. His best trip was up the Great Orme tramway. He is somewhat critical of the Festiniog and Llanberis Lake railways, which I think is rather harsh. The Festiniog is one of the busiest railways in the country and just getting time to clean and maintain the carriages must be difficult as they are intensively used. Bob Underwood, musing on the various official names for the States, (the 'Sunshine State' etc.) wondered about The Buckeye State (Ohio). The Buckeye coupling was made in Ohio but why 'Buckeye'? It seems that it is a tree, common in Ohio - a Horse Chestnut, no less, bearing conkers. So, (says Bob) a Buckeye Coupling is 'Conker sex'... A certain Mike Holman designed a locomotive which ran on rollers, which, in turn drove flanged wheels bearing on the track. This was greeted with some astonishment but a moment's thought will show that the trolleys could be made in several different gauges but all useable by the one locomotive. (See also 'Polly Trolley'.) Only one was ever built, for the Soo line, although it might have been a scam. A photograph taken at Angmering Model Railway Exhibition last year, shows an N Gauge railway running around a lavatory seat, complete with sectioned cistern and the obligatory notice about not using the device whilst the train is standing in the station.
W. www.wdmes.co.uk

The Link, April, from **Ottawa Valley Live Steamers & Model Engineers** has an item by Editor, Graham Copley, disparaging social media. (I digress briefly here: on the subject of internet line speeds, I note that on ADSL lines, disconnecting the third 'bell wire' to leave a balanced two-wire line can improve the line speed considerably. ADSL is being superseded by Fibre to the home so eventually ...). I finally learned what the Acronym, 'Twitter' means: Toilet Wall Information Transfer Technology for Excitable Retards ... I suspect that Facebook has been caught out by its high ideals (naivety?) in that they didn't bargain for people harvesting readers' details then selling them on. President, John Stewart notes that roller clutches are becoming rare, as their main market of typewriters has disappeared. Also, brass half-round beading, which was used to make cotter pins. (Split pins, I think. In the UK cotter pins are wedge shaped pins tightly held with a nut and washer.)

Guy Cadrin took pity on a Flexispeed lathe (from Sheffield) which was homeless and unloved at the last club sale. The tailstock was broken but he repaired it with a cast iron rod and silver-solder.

Stockholes Farm Miniature Railway reports the success of two young members: Alex Priestly has gained his Duke of Edinburgh Bronze Award and Danielle Wainwright, whose achievements will appear in the next newsletter. Meanwhile, Harry Billmore, who has been attending SFMR since he was two, has been appointed Technical Editor of *Engineering in Miniature*.
W. www.sfmr.co.uk

The Whistle, April, from **British Columbia Society of Model Engineers** starts a new feature - *The Builders Amongst Us,* beginning with 11-year-old Tor who built a simple steam turbine using a tin can. As Editor, Paul Ohannesian says, like most people, he (Paul) began with H0 model railways, erector sets, 'screwdriver' models and took it from there. By the time Tor is 16, he will no doubt be champing at the bit to qualify as a Driver.
W. www.bcsme.org

The Bristol Model Engineer, Spring, from **Bristol Society of Model & Experimental Engineers** features a 2 inch scale Fowler Showman's Engine by Davinder Matharu who won the H. W. Webb Trophy for outstanding workmanship, at the AGM. This year's Chairman's Challenge is to get a raw hens egg into a bucket 25 yards away. Points will be awarded for ingenuity so simply walking over to the bucket and placing your egg into it will not score highly! Mike Williams mentions that the Portuguese NRM built a 7¼ inch gauge railway without using a lathe. The wheels were the only circular items and were produced by welding a steel backplate (the flange) to a very short length of pipe (the tread) and a small pipe welded in to run on the axle. It works! Ladies Night heard about the Land Girls of WWII. A visit to the Bloodhound SSC project was fascinating, with lots of detail about the car and its requirements.
W. www.bristolmodelengineers.co.uk

Norwich & District Society of Model Engineers' *eBulletin* for March has Brian Parker rethinking his transport needs after his RTA last year. He replaced his car/trailer combination with a Renault Kangoo van, laid rails in the back, LED floodlighting, CCTV so he can reverse up to an unloading point and an electric jack to equalise the heights. He also says that it has Satnav, phone and aircon. Vans have improved considerably of late! An added bonus is that he doesn't have to move anything to get the bins out... A photo of *Elidir* asks where is it photographed and where can you find a miniature version. I think I know both answers, I await the details with interest.
W. www.ndsme.org

Model & Experimental Engineers Auckland begins their March newsletter with Michael Cryns repairing a musical box. It took him eight days and was commercial madness. An economic price was just not possible and he is unlikely to attempt another.

The Editor of *On Track,* 1st April, from **Richmond Hill Live Steamers**, Canada, waxes lyrical about the coming of Spring, Easter, Passover, May Queen, Hanami and Cherry Blossom festivals (I had to 'shoehorn' a Polish festival in here...) Furthermore, it is proposed that a 'lifting station' be built to enable passengers to easily move from the GL to the Raised Track. This is explained in some detail for the unwary. The Editor's trip to England is well illustrated by his pictures and, as he says, 'the collections are all so close together.'
W. www.http://richmond-hill-live-steamers.tripod.com

The Journal, April, from the **Society of Model & Experimental Engineers**, Stuart Walker tells how an evening class finally got him to understand end mill tooth gashing as witnessed by the subsequent state of the temple curtain. Arthur Rowe takes up the matter of small turbines and Mike Tilby expands upon his ideas, before then continuing his well-established series. Norman Billingham demonstrated 'a collection of learning opportunities (mistakes) looking vaguely like a GLR Tina horizontal engine.' In his series on balancing, Bob Bramson tells of shrinking on the tyres by heating them as a colleague watched the digital thermometer. After a while, as the tyre turned blue, they realised that the thermometer needed new batteries.
W. www.sm-ee.co.uk

Ryedale Society of Model Engineers notes an absence. No Snow! At the shunting trials conducted at Shildon, everyone forgot their shunting poles!
W. www.rsme.org.uk

Offcuts, from **Bromsgrove Society of Model Engineers** has a feature by Professor of Neuropsychology, Graham Harding, on his interest in garden railways. Also, whilst working on EEG readouts he noticed a phenomenon which has since been the subject of 350 papers and two books! He also worked with the BBC on photosensitive epilepsy, originally triggered by strobe lighting on *Top of the Pops*. This culminated in the Harding flash pattern analyser, which is now the industry standard.
W. www.bromsgrovesme.co.uk

Leeds Lines, April, from **Leeds Society of Model & Experimental Engineers** has Chairman, Jack Salter thinking of a 'Problems on the Table' as

>>

well as the usual items to be admired and discussed. At a recent meeting he mentioned a 'shrinking hammer' which brought forth an enquiry as to what that was. And, Lo! A new topic. Eggborough power station (where they meet) is due to be decommissioned soon, leading to the usual round of nostalgia and wistfulness amongst the employees, several of whom are or were members of the LSMEE. The 12 volt blower supply at the steaming bay is being improved by Charles Appleyard, with the incomprehensible language which accompanies this, like 'regulator', 'toroidal transformer' and 'temperature controller'.

W. http://www.leedssmee.btck.co.uk

Port Bay Express, April, from **Portarlington Bayside Miniature Railway** has Norm Houghton writing about the refreshment rooms from 1945 on QR at Jericho. Prices were strictly regulated but the building used was eventually attacked by termites and later cockroaches. These latter were dealt with not by poison, on which they appeared to thrive, but by the installation of modern kitchen equipment. However, this made the service uneconomic and so it ceased in 1968. The Express closes with a cutting from the *Geelong Advertiser* in 1999, upon the original opening of the railway.

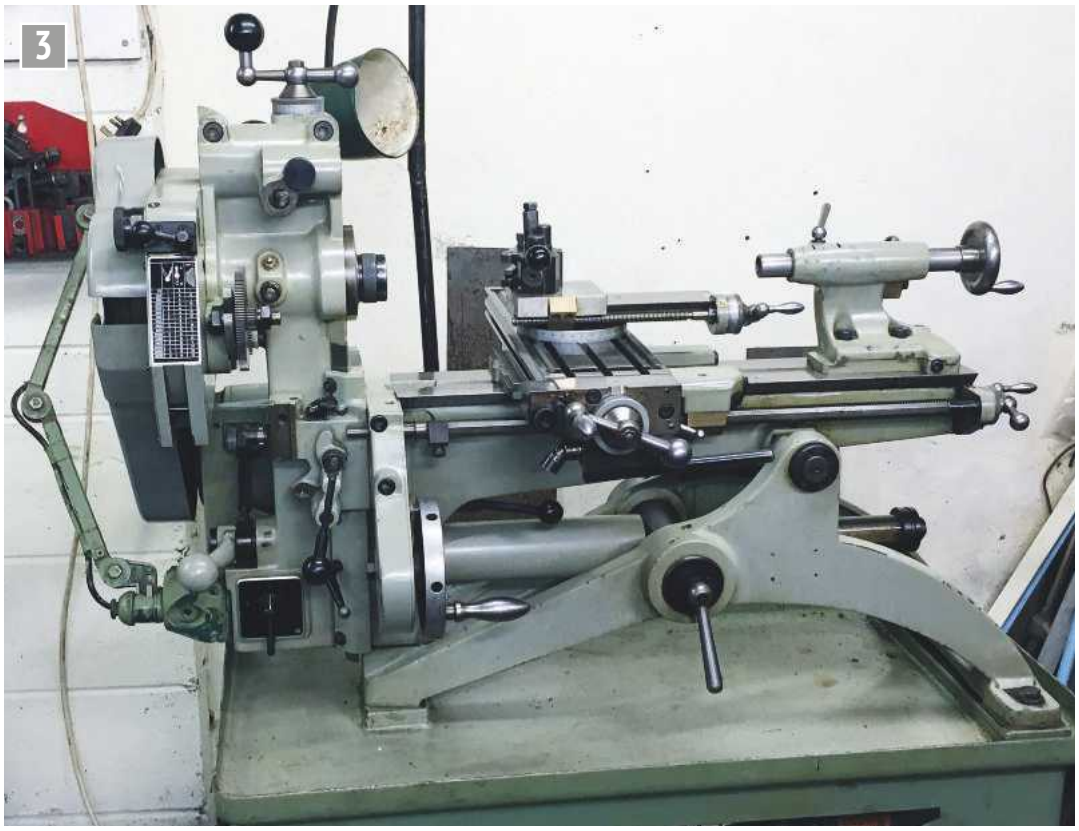
The Oily Rag, April, from **City of Sunderland Model Engineering Society,** in which Editor, Peter Russell, spotted at a member's workshop, a combined centre lathe/mill by Meyer & Burger (**photos 3** and **4**). For all Meccano fans, try this: https://www.youtube.com/watch?v=ahigXrWicog

Reading Society of Model Engineers' *Prospectus*, April, in which '61249' explains why the franchising system works and the cost to a profitable company is to take all the brickbats from uncomprehending critics. He says that the non-appearance of ThamesLink on the London Underground map was a political decision, as it might have led to people using it, thus reducing TfL's income. Peter Jennings writes on restoring a 50 Ton crane. Having detailed the sorry story, he neatly introduces a plea for funding so that we might enjoy this behemoth for many years to come. In the expression of 'Experimental' which adorns the name of several societies, Denis Packman has designed and built a gas burner for his 3½ inch gauge Pacific. The temperature in the clubroom rose considerably as this was discussed, centering on whether it was 'man enough' for the job. (Hot air, not tempers - the very idea...!) Leigh Challis brought a 2 inch scale Fowler BB1 ploughing engine to be steam tested. It was made by his Grandfather, Joe, who was one of the last men to earn his living by the steam plough.

W. www.rsme.org

And finally, I don't have grey hair. I have 'wisdom highlights'.

Contact:
geofftheasby@gmail.com



Meyer & Burger convertible lathe. (Photo courtesy of Peter Russell.)

Meyer & Burger convertible lathe, converted. (Photo courtesy of Peter Russell.)

MAY

24 **Sutton MEC.** Afternoon run from noon. Contact Paul Harding 0208 2544749.

24 **Worthing & District SME.** EGM, followed by 'Looking Forward to LittleLEC'. 7.30pm. Contact Geoff Bashall: 01903 722973.

26 **Romney Marsh MES.** Track meeting, noon. Contact Adrian Parker: 01303 894187.

27 **Grimsby & Cleethorpes MES.** Public running and car boot sale, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

27 **Oxford (City of) SME.** Running Day. Contact: secretary@cosme.org.uk

27 **Pimlico Light Railway.** Public running 3-5pm. Contact John Roberts: 01280 850378

27 **Romney Marsh MES.** 2½ inch Gauge Association rally. Contact Adrian Parker: 01303 894187.

27 **Worthing & District SME.** Public running 2pm – 5pm. Contact Geoff Bashall: 01903 722973.

27/28 **Cardiff MES.** Open days. Contact Rob Matthews: 02920 255000.

27/28 **Chingford DMEC.** Public running at Ridgeway Park. Contact secretarycdmec@gmail.com. Website: www.cdmec.co.uk

27/28 **GL5MLA.** Ryedale main line rally at Gilling. Contact Peter Layfield: 01406 365472.

27/28 **Lancaster & Morecambe MES.** Public running at Cinderbarrow. Contact David Wilson: 07721 020489 or secretary@lmmes.co.uk.

27/28 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

27/28 **Portsmouth MES.** Public running, Bransbury Park, weather/participant dependant, 2-5pm. Contact Roger Doyle: doyle.roger@sky.com

28 **Bracknell Railway Society.** Public running 2-4.30pm. Contact Paul Archer: 07543 679256.

28 **Grimsby & Cleethorpes MES.** Bank holiday public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

28 **Northampton SME.** Bank holiday club run 10am – 4pm. Contact: secretary@nsme.co.uk 07907 051388.

29 **Romney Marsh MES.** Track meeting, 1pm visitors/spectators. Contact Adrian Parker: 01303 894187.

29 **Wigan DMES.** Bits & Pieces evening. Contact Kevin Grundy: 01942 522303.

JUNE

1 **North London SME.** Talk: 'First Aid at Colney Heath' – Verity Maclachlan. Contact Ian Johnston: 0208 4490693.

1 **Rochdale SMEE.** Models Competition Night, at Castleton Community Centre, 7.30pm. Contact Rod Hartley 07801 705193.

2 **SMEE.** Talk - 'Monorails of the Early 20th Century', 2.30pm. Booking essential (chairman@sm-ee.co.uk).

2 **Southport Model Engineering Club.** Diesel day, 10am-4pm. Contact Gwen Baguley: 01704 568456.

2 **Tiverton & District MES.** Summer Open Day at Rackenford track. Contact Bob Evenett: 01884 252691.

2/3 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

3 **Chingford DMEC.** Public running at Ridgeway Park. Contact secretarycdmec@gmail.com.

3 **Grimsby & Cleethorpes MES.** Public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

3 **Lancaster & Morecambe MES.** Public running at Cinderbarrow. Contact David Wilson: 07721 020489

3 **Northampton SME.** Open to the public 2 - 5pm. Contact: secretary@nsme.co.uk 07907 051388.

3 **Oxford (City of) SME.** Running Day. Contact: secretary@cosme.org.uk

3 **Portsmouth MES.** Public running, Bransbury Park, weather/participant dependant, 2-5pm. Contact Roger Doyle: doyle.roger@sky.com

3 **Plymouth Miniature Steam.** Public running, Goodwin Park (PL6 6RE), 2 – 4.30pm. Contact Malcolm Preen: 01752 778083.

3 **Welling DMES.** Public running at Falconwood 2-5pm. Contact Martin Thompson: 01689 851413.

4 **Peterborough SME.** Bits & Pieces, 7.30pm. Contact Terry Midgley: 01733 348385.

5 **Romney Marsh MES.** Track meeting, 1pm visitors/spectators. Contact Adrian Parker: 01303 894187.

6 **Bradford MES.** Rubber powered loco competition. 7.30pm start, Saltaire Methodist Church. Contact: Russ Coppin, 07815 048999.

6 **Brandon DSME.** Meeting at The Ram Hotel, Brandon, 7.45pm. Contact: Mick Wickens, 01842 813707.

6 **Chingford DMEC.** Fish and chips. Contact secretarycdmec@gmail.com.

7 **Sutton MEC.** Bits and Pieces. Contact Paul Harding 0208 2544749.

8 **Tiverton & District MES.** Club meeting at Old Heathcoat Community Centre, Tiverton, 7.30pm. Contact: Chris Catley, 01884 798370.

9/10 **Cardiff MES.** 28th Welsh locomotive rally. Contact Rob Matthews: 02920 255000.

10 **Andover and District MES.** Rob Roy Rally. Contact Rex Hanman: 01980 846815.

10 **Bracknell Railway Society.** Public running 2-4.30pm. Contact Paul Archer: 07543 679256.

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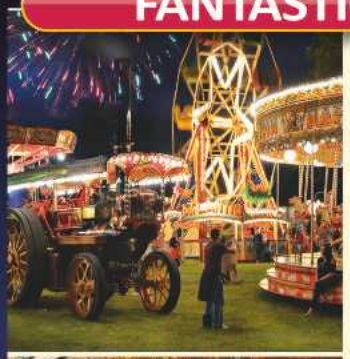

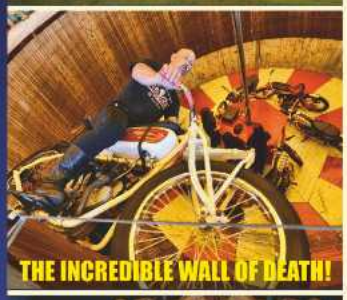
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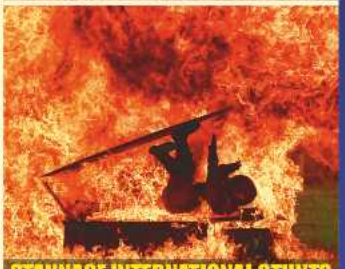
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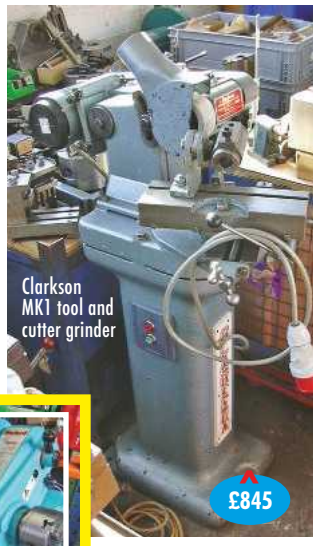

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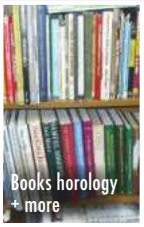

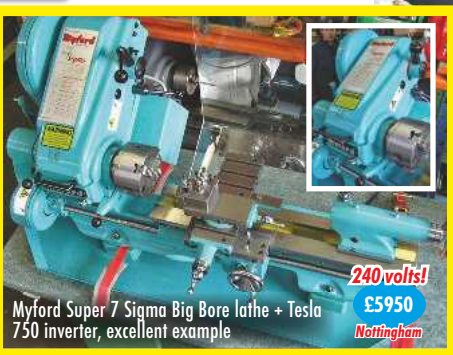

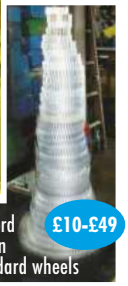

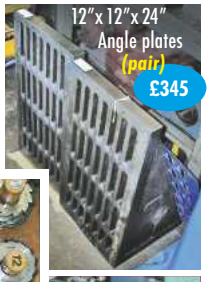

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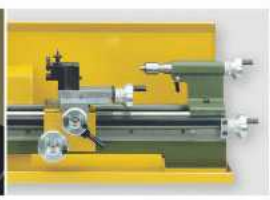

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