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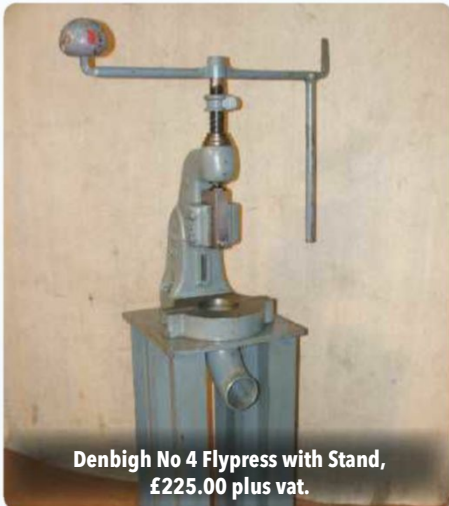
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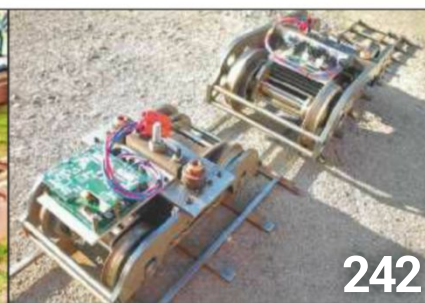


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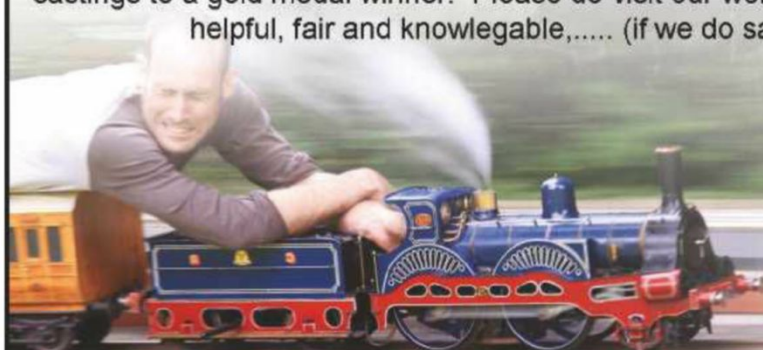
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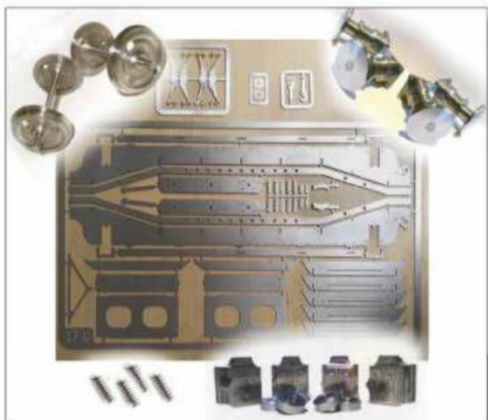
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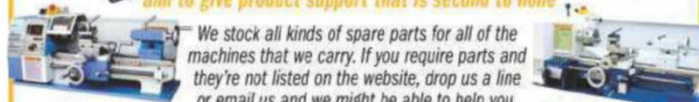
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LBSC Rally

This year's *Model Engineer* sponsored LBSC competition/rally will be hosted by the Southport Model Engineering Society on Saturday 31st August and Sunday 1st September. Due to the success of the last LBSC open rally the Saturday will be an open event for any LBSC engine to run and the Sunday will be the competition on their small track and open running on their main track but restricted to 3½ and 5 inch gauges.

Entries are now invited and are open to any LBSC designed/derived engine in 2½, 3½ or 5 inch gauge that have not won the event before. Please apply to lbscrally-entry@yahoo.co.uk

WARCO and the Midlands Show

After long and serious consideration, Warco have decided not to attend this year. This difficult decision has been made based on costs and major disruption in preparing the counters and machines for presentation at the exhibition, setting up and attendance over the exhibition days and re-stocking the stores and showroom after the event. This combined effort, involving many staff in multiple departments, is at least five weeks out of an already stretched work schedule.

Warco has been attending the Midlands exhibition since its inception in Birmingham some thirty years ago, through to the moves to the Royal Showground, Donnington and then to the Warwickshire Event Centre.

Warco would like express their thanks and apologies to their many regular visitors and loyal friends.

To compensate for not attending, we will have some very special offers to coincide with the week of the show. Warco will continue to organise their Open Days throughout the year.



Crich Tramway Exhibition

A model tram, trolleybus and railway Exhibition will be held on Saturday 17th and Sunday 18th August 2019, 10am to 5pm both days at the National Tramway Museum, Crich Tramway Village, Crich, Derbyshire, DE4 5DP. A total of 12 layouts will be present at the exhibition.

The Manchester Model Railway Society tramway layout will be the main feature of the exhibition and will extend to a total length of over 80 feet in the main exhibition hall. The track gauge is 27/16 inch and the track is standard coarse 0 gauge rail and chairs, mounted on a hardboard base, many pieces of which are over 50 years old. In the reverse of full-size practice, the track is LIVE at 24V DC, and is divided into sections, so the trams can be controlled, with earth return by the overhead.

The late Ray Williams of Belper scratch built this fine scale trolleybus layout in the late 1980s (photo 1). The layout is constructed of plaster, wood and plastic sheet, and all the stonework on the layout is hand painted. The castle and the various shops on the layout represent the architecture of the Brittany region of France. The model trolleybuses represent the systems: Limoges, Grenoble and St. Etienne.

Normal museum entry charges apply. For details visit: www.tramway.co.uk or telephone: 01773 854321.

Staines Open Day

The Staines Society of Model Engineers is hosting an Open/Invitation Day on Saturday, August 10th 2019. Anyone with any locomotive, irrespective of means of propulsion, is welcome to attend. Gates open at 10am and remain so until everyone has had enough. Light refreshments will be provided by demand and tea/coffee will be a continuous supply. Boiler certificates for live steam are required and membership cards will also be asked for. See their web site for track/contact details:

www.stainessocietyofmodelengineers.co.uk

Gilling Main Line Rally

Lastly, if you would like the chance to run your scale BR prototype locomotive to correct railway working standards, correct signalling and a proper scale timetable you need to take a trip to the Ryedale main line rally at Gilling, near York, over the August bank holiday weekend (24th-26th August). This event is open to 5 inch gauge locomotives based on BR prototypes, both steam and Diesel, and the usual boiler certificate (where relevant) will be required. Further information may be had by contacting Peter Layfield on 01406-365472.

Sweet Pea Rally 2019

John Arrowsmith reports from Sheffield on this year's friendly get-together.



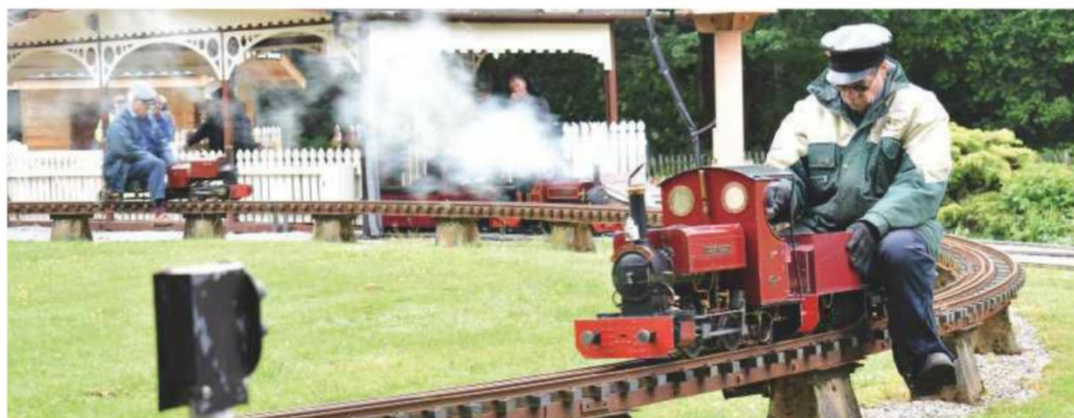
This year's rally was held on 8/9 June at the excellent Abbeydale track site of the Sheffield & District Society of Model Engineers. It was a weekend of weather contrasts with Saturday being damp and quite cold compared to Sunday which was a pleasant, reasonably warm day but both days saw some good operations on all the tracks with a number of Sweet Pea locomotive variants being put through their paces. This rally is all about relaxation and enjoying the facilities of the host club and everyone was really well looked after by the Sheffield club and its members.



The reason for it all, the original Jack Buckler built Sweet Pea, circa 1982.

The many variants of the basic Sweet Pea - that was first designed by Jack Buckler way back in 1981 - were operating this weekend. The usual ritual of who can be first in steam and running is always a close thing between Dave Dick and Malcolm High, but this year I think it was Nigel Ball who just edged Dave out of the first run, closely followed by Malcolm. It doesn't matter really, it's just a bit of fun and adds to the general good humoured banter. Of course the main trophy awarded

during the rally is the June Drake Memorial trophy which is presented to the locomotive considered to be the best of the weekend, for both engineering and presentation. This year it was made to Brian Holland from the City of Oxford Society for his excellent 7¼ inch gauge Sweet William 0-4-2 locomotive, *Susan Margaret*. Resplendent in its dark red livery it looked a superb example of the design. Nigel Ball owns a different version of the model with an 0-6-2 version, *Sweet Rocket* and



Malcolm High has got his 5 inch gauge Adele Marie going well as he starts the climb to the top end of the site.



The winning locomotive and Brian Holland with the trophy.



Chris Ball starts the long climb to the top of the site with the 0-6-2, Wild Rocket, 713.



John Ollerenshaw climbs the incline with his Sweet Sue.



The Southworth (Weir) Pump in action in the clubhouse.



A delighted Brain Holland after receiving the June Drake Trophy from Ron Drake.



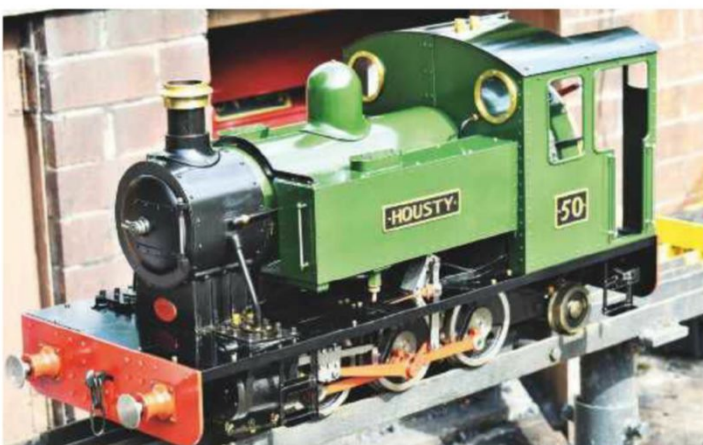
Chairman Bob Potter with Henry, Nathan and Sophie after they received their Signalling Certificates.



Phil Owen and his 7 1/4 inch gauge Jacquie O climbs up from the shed road onto the main line.



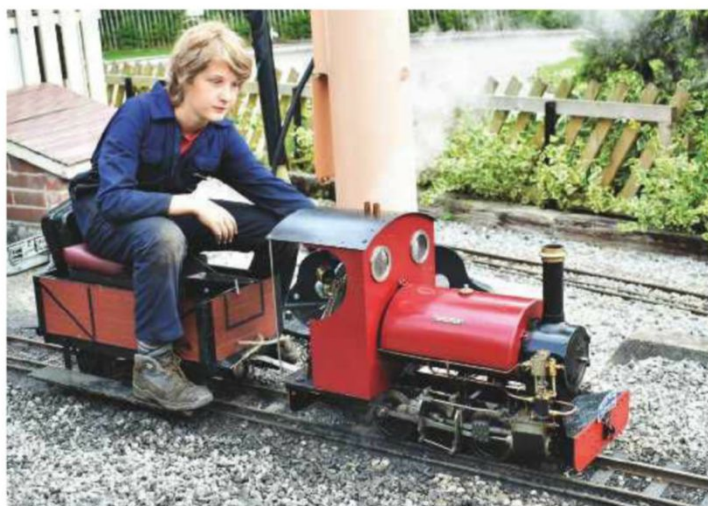
Sophie Price-Stuart, one of Sheffield's Young Engineers, in action in the sophisticated signal box.



Paul Godin's 5 inch gauge Housty from North London waits to be steamed on the elevated track.



The Stand By rescue locomotive was this 75cc Scamp owned and driven by 14 year old Ben Marks who had built it from the kit.



Fourteen year old Henry McDonald starts the club's 5 inch gauge Hobgoblin, with Joy valve gear, away from the station.



The three gauges together: 3 1/2, 5 and 7 1/4 inch, all waiting in the steaming bays.



Another of Sheffield's young engineers, Dave Griffiths coasts down the 1 in 37 gradient with one of the club's locomotives.



Jim Alderman from Worthing about to leave the steaming bays.

this engine really does go well. I think Nigel told me the engine was in continual steam for over seven hours on Saturday. One aspect of the line which keeps drivers on their toes is the steep incline from the top end of the site back towards the station and shed area. At 1 in 37 the incline certainly tested the drivers' control as they descended with a full train. Conversely, on the other side of the site the climb up to the summit made the drivers work hard to keep their steam pressure on the mark, all making for good driving experience. The Sheffield club have recently installed a new, heavy duty turntable into their shed layout and it really looked a first class installation. It had a positive locking system which was easy to use and is capable of taking the heaviest of locomotives. In the club house there was an interesting demonstration of a 12 inch Southworth (Weir type) Steam

Powered Water Pump, built by John Marriage from an available kit. It was quietly working away and would be a very useful addition to suitable larger scale locomotives or boats, which is what this one has been designed for. The Gauge 1 Garden Railway was also in operation over the whole weekend with some interesting locomotives and rolling stock.

Of course the main presentation of the weekend was the award of the June Drake Trophy, as mentioned above, and this year Ron Drake chose the 7 1/4 inch gauge locomotive, built and owned by Brian Holland from the Oxford Society as the winner. Brian was duly presented with the trophy to the acclaim of the assembled members and guests. The club also had a little presentation of their own to make, to three of their young engineers who had been on the final day of



Adam Diskin from Sheffield starts the 7 1/4 inch gauge version on its way round the elevated track.

training in the signal box. Chairman, Bob Potter awarded the three youngsters with their certificates to the delight of the club members and their families.

ME

Next year's rally will be held at the Hereford Society of Model Engineers over the weekend of the 6/7th June 2020. Further information will be available in these pages nearer the time.

The N.A.M.E Editor's Cup 2018

Richard Guthrie invites entries for this year's N.A.M.E. Editor's Cup.



The officers of N.A.M.E. (the Northern Association of Model Engineers) have announced that the first recipient of the N.A.M.E. Editor's award is David Barlow of the Furness Model Railway Club with *Turntable*, their newsletter. As well as a cup, he also receives a cheque for £50.

Whilst Dave has only been editor for a very short period, as an ex-submariner he was also involved in the production of the Submariner's Association magazine *In Depth* – so not quite a tyro.

The N.A.M.E. Editor's Cup was created on the death of Alan Bibby, a prolific model engineer who left a sum of money which was to be used 'to provide a suitably engraved trophy to be known as The Editor's Cup with a cash prize, to be awarded annually to the editor of the best model engineering club newsletter as determined by the officers of N.A.M.E.'.

The N.A.M.E. Editor's Cup is an annual award and editors wishing to enter for 2019 should send a copy of their newsletter to the N.A.M.E. Chairman, Frank Cooper, either by email to yorkhouse.flyer@btinternet.com or by



snail-mail to him at 47 Holmes Road, Stickney, BOSTON PE22 8AZ. The 2019 entries will close on 30th November 2019.



Dave Fuller, N.A.M.E.'s model engineering section leader, presents the first Editor's Cup to David Barlow.

ME

No.283

MODEL ENGINEERS' WORKSHOP

Pick Up Your Copy Today!

August's issue, number 283, is once again packed to the gills with more great workshop articles:



Brian Wood makes a drill over 2m long!



Peter Barker on mounting chucks on taper arbours



Eric Clarke cuts metric screws on a very Imperial Drummond Lathe

Steam Turbines

Large and Miniature

PART 16

More on Tesla Turbines

Mike Tilby explores the technology, history and modelling of steam turbines.



Continued from p.101
M.E. 4616, 5 July 2019

The previous article in this series started the discussion of what happens inside Tesla turbines. The present instalment deals with some additional complications and then moves on to describe what is actually known about the efficiencies of these turbines.

Nozzles

Tesla turbines are similar to impulse turbines in that they rely on accelerating steam (or other working fluid) in one or more nozzles so as to convert its internal energy into kinetic energy. If the turbine consists of a single stage, then it is generally necessary to expand the steam in De Laval-type nozzles. Many descriptions of Tesla turbines pay little attention to the nozzle design yet this constitutes a key part of the energy conversion process. As discussed in part 12, De Laval nozzles need to be designed correctly and it is possible that, in miniature sizes, they have very poor efficiency such that supersonic velocity might not actually be attained, at least under circumstances of modest steam pressures.

There is also the question of what angle the nozzle should be oriented at relative to the periphery of the rotor. Ideally the steam flow should be tangential so all the resulting frictional forces acting on the rotor are in the ideal direction for generating torque. However, this would result in steam rapidly exiting the rotor and impinging on the casing, with associated frictional losses (**fig 59A**). As the nozzle angle is increased (**fig 59B**) then the steam shows less tendency to exit the periphery of the rotor but the overall frictional force will no longer be purely tangential.

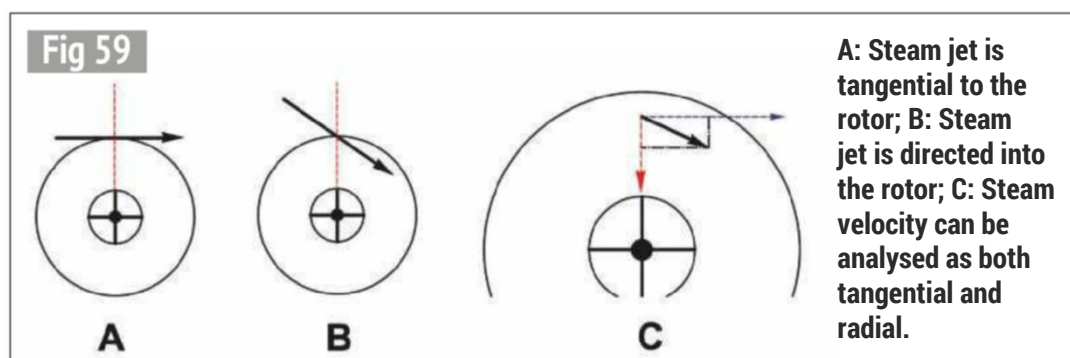
Steam flow through the rotor

Steam leaving a nozzle will be affected by a considerable number of factors. There will be friction between this steam and a) slower moving steam already present between the discs, b) the discs themselves and c) the casing. After leaving the nozzle(s) the steam will tend to travel in a straight line but will be forced to follow a circular path because of the presence of the turbine casing.

The tendency to continue in a straight line is the basis of what is commonly known as centrifugal force. This effect results in pressure of steam at the periphery of the turbine being higher than at the central exhaust hole. This is potentially significant for reasons discussed below.

At any point along the flow path between the discs, steam will be moving both **tangentially** and **radially** inwards (**fig 59C**). As discussed above, all friction causes dissipation of kinetic energy as heat but only the frictional drag resulting from **tangential** movement contributes to power output by causing torque on the rotor. In contrast, frictional drag resulting from **radial** movement causes energy loss without any contribution to power output.

Frictional loss resulting from steam flow in the radial direction depends on the velocity of the steam in that direction and the surface area past which it must flow. These values are determined by the volume of steam passing through the rotor per minute, the number and diameter of the discs and the width of the gaps between them. In order to maximise frictional force in the tangential direction Tesla turbine rotors have multiple discs with narrow gaps but this also maximizes friction from movement in the radial direction. It is essential that steam flows radially inwards but, in addition to overcoming the frictional drag in the radial direction, it is necessary to



overcome the centrifugal force that tends to move the steam outwards. So, for there to be inward radial flow it is necessary that steam pressure drops as it moves towards the centre and that this exceeds the effects of centrifugal force on the steam.

As steam moves inwards through the rotor, the circumference across which it moves decreases. This means the cross-sectional area for flow decreases and hence velocity must increase. Because there is acceleration in the radial direction, there must be a pressure gradient to supply the required energy which means the increase in pressure towards the outside of the rotor is even greater than is needed to overcome the effects of centrifugal force acting on the steam. However, if pressure decreases as steam moves inwards, its density and hence the volume per pound of steam increases which means the steam must accelerate even more in order to allow the same mass to flow per minute.

Percent reaction

The fact that pressure at the periphery of the rotor is higher than in the central exhaust passage means that pressure at the outlet of the nozzle(s) is higher than the final exhaust pressure. This means that in the nozzle(s) the steam cannot expand over the full pressure range

between inlet and exhaust so the resulting velocity (and hence the amount of usable kinetic energy in the steam) is less than ideal. The remaining expansion occurs in the rotor.

When a significant amount of expansion and acceleration of steam occurs in the rotor of a turbine, the turbine is said to operate partly by reaction, as was described in parts 2 and 8. In a conventional reaction turbine, expansion in the rotor is guided by the blades which cause the acceleration to be mainly tangential, thereby ensuring that the reaction force contributes to the output torque (**fig 60**). However, the expansion of steam that occurs in the rotor of Tesla turbines is undirected but mainly leads to acceleration in the radial direction. Therefore, this expansion does not contribute to shaft power and so the energy is wasted.

Tesla turbine exit losses

When discussing bladed turbines, we saw that the ideal situation is for steam to leave the rotor with a low velocity relative to the turbine case so that waste of kinetic energy in the exhaust is minimised. With bladed turbines, low exit loss can be achieved because the blades cause the steam to leave the rotor in a direction opposite to that of the rotation (**fig 60**). In a Tesla rotor, as steam moves into the central exhaust passage, its radial

velocity will be determined by the factors discussed above. However, in addition, the exhaust steam will be moving with the tangential velocity of the discs at their inner radius. Of course, this will depend upon the diameter of the exhaust passage and the turbine rpm. However, Tesla turbines generally rotate at high speeds and this means the steam exits with a high velocity.

Rotor discs

The number, thickness, diameter and inter-disc gaps of the rotor are all key design decisions. In principle, the discs are not subjected to lateral forces and so they can be very thin. However, they need to be sufficiently thick to remain flat so as to maintain the correct gaps. It has been proposed that the gap between two discs should be no greater than twice the thickness of the boundary layer but this may be more relevant to hydraulic turbines. With steam, boundary layer thickness will vary with properties such as density of the steam and its velocity relative to the rotor. These values all change as the steam moves through the rotor. The quantity of steam flowing per second is an important consideration in deciding on the rotor design since increased steam throughput for a given rotor size results in increased radial flow velocity and hence increased frictional loss. How, though, to calculate the optimum number, diameter and spacing of the discs is unclear.

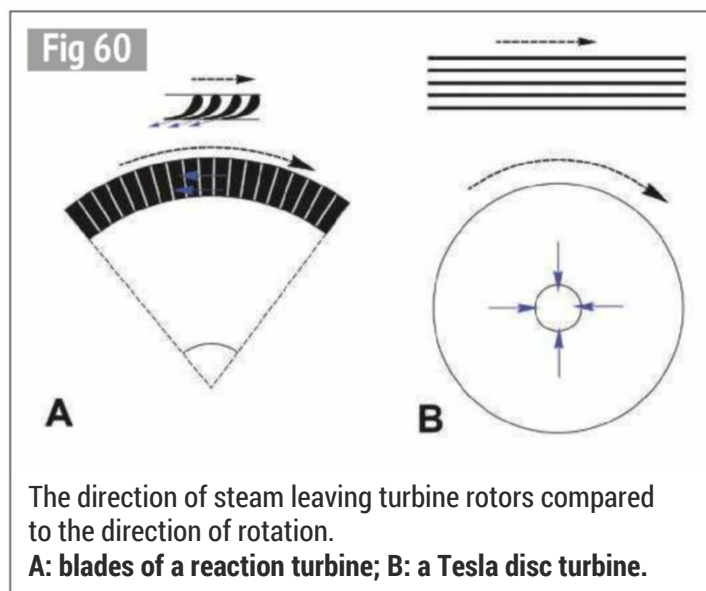
Tesla versus bladed turbines?

Previous parts of this series have described how, in a bladed turbine, we aim to minimize frictional losses since they cause kinetic energy to be converted to thermal energy and this leads to inefficiency. In an ideal bladed turbine friction would be zero and isentropic efficiencies as high as nearly 90% have been claimed for modern large steam turbines. By contrast, a

Tesla turbine completely relies on the occurrence of friction and so there must always be loss of kinetic energy into thermal energy. It was described previously (part 13) that, *to a strictly limited extent*, thermal energy resulting from friction can be reused in later stages of a pressure-compounded turbine. However, although proposals for multi-stage Tesla turbines have been described, I have not seen anything to indicate that any have actually been built. Such a machine would be rather bulky since the rotors are wide and the steam would have to be redirected from the central exhaust hole of one stage to nozzles at the periphery of the next. Such a flow path would entail yet further losses.

In addition to the losses discussed above there are other losses that are common to both bladed and Tesla turbines, namely friction in bearings and gearing plus disc losses on the outer faces of the rotor resulting from induced circulation of steam as was discussed in part 13.

Listing the potential causes of energy loss in Tesla turbines certainly shows that these machines may not be the marvellous simple panacea that some people might imagine. However, the really difficult task is to assess the magnitude of each of these losses and then to use that information to estimate the efficiency of turbines of different sizes. It has been proposed that some of the losses in Tesla turbines will remain relatively constant as size of the turbine is decreased. In contrast, in bladed turbines, many losses are known to increase with decrease in size. So - the key question is, which design will give the best efficiency in the sizes and power outputs relevant to our models? Of course, the only reliable result is that obtained by building a turbine and testing it but with so many design variables, some sort of accessible theoretical basis for a design would help to narrow down the design options.



It is of interest to mention one type of application where Tesla turbomachinery may have a clear advantage and that is in the pumping of viscous liquids and liquids containing suspended particles. At one extreme, this could be pumping suspensions of rock particles by which blades of a conventional turbo-pump might soon become abraded. At the other extreme, Tesla pumps have been proposed for pumping blood which is viscous and where it was proposed that damage to the suspended cells would be less than with a bladed turbo-pump or a reciprocating pump.

Efficiencies of Tesla turbines

Early examples of theoretical and practical research into Tesla turbines and pumps focused on incompressible fluids, (e.g. water) because theoretical analysis is far simpler than for compressible fluids. Since then a number of studies have been published where the working fluid used was compressed air or nitrogen. Presumably these gases were chosen because steam is less convenient to use in a laboratory. Also, much interest in Tesla turbines is aimed at developing small-scale gas turbines. Of course, using air or nitrogen means that one cannot calculate efficiency in terms of steam used per hp.hr and so we need to use isentropic efficiency. This topic was described in part 14 which attempted to explain that isentropic efficiency of a turbine is the amount of shaft energy produced divided by the amount of energy that is theoretically available from the working fluid for a perfect turbine operating with the same inlet and outlet conditions.

One of the earlier workers in this field was Professor Rice at Arizona State University. In one paper he claimed that theory predicted efficiencies of over 95% for Tesla turbines running on incompressible fluids. However, such claims

Ref.	Working Fluid	Inlet Pressure (psig)	Rotor Diam. (in)	rpm	Inter-disc Gaps (in)	No. of Discs	Isentropic Efficiency (%)
38	Air	10-40	6	4,000 to 18,000	0.06 – 0.5	?	7-25 ¹
39	Air	100-125	7	8,000 to 10,000	0.0625	9	16-23
39	Air	40-140	7	6,300 to 12,500	0.04	11	19-26
39	Air	55-104	8	8,000 to 19,000	0.02	24	23-35
40	Steam	101	12	6,500	0.03 & 0.06	45	14
40	Air	34	12	1,100	0.03 & 0.06	45	16
40	Gasses ²	40	12	6,284	0.03 & 0.06	45	11

1 Best efficiency was with closest disc spacing and lowest supply pressure.
2 Gases from the combustion of biomass.

are not echoed in research on Tesla turbines running on compressible fluids where measured efficiencies were generally around 20% as detailed in **table 7**.

A particularly interesting paper (**ref 37**) reported the results of theoretical studies using computational fluid dynamic analyses carried out on a supercomputer. These analyses concerned two different rotor diameters (100 and 300mm), two speeds (9,000 and 18,000rpm), variable numbers of nozzles (4, 6 or 8) located around the circumference with nozzle angles of 10° or 15° relative to a tangent to the rotor periphery. The authors conducted a wide range of analyses using a simplified calculation model and this indicated that for the 100mm diameter rotor, the highest efficiency was 30%. This was achieved at the higher speed using 4 nozzles at the 10° angle. Using the larger rotor diameter they obtained theoretical efficiencies of over 50% with the best result being predicted for 9,000rpm using two nozzles at 10° angle.

This does not support the view that efficiency can be maintained whilst reducing rotor diameter but this effect of size reduction is only valid for the conditions tested and I guess it is possible that conditions might be found that give good results with a

very small rotor. However, it is possible that the results from the simplified calculations are misleading because when they repeated the calculations on the 100mm diameter rotor using more complex and more realistic calculation methods, they found the maximum efficiency was only 16% which is in much closer agreement with the available experimental data (see the table).

Should I build a Tesla turbine?

It is easy to make a list of all the causes of energy loss in a Tesla steam turbine but the really important thing is to predict their overall impact. Also, it could be that, even if such turbines have poor efficiency, they could provide a better option than bladed turbines since the latter have given a fairly low bar to be exceeded.

The challenge for a model engineer is that, without access to expert knowledge and a supercomputer, it seems there is no way to find out if an efficient miniature Tesla turbine could be developed apart from by building one or more of the huge number of possible design variations and testing them. As far as I know, the only example of a model Tesla steam turbine that has actually been tested is the one built by Werner Jeggli. As mentioned in the previous article, his results showed low

efficiency for the particular design of Tesla turbine that he tried (**ref 41**). My own decision has been to build a bladed turbine and the next article will start discussing the reasons for this and the challenges facing attempts to design a more efficient model steam turbine.

●To be continued.

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The author tests the load-bearing qualities of his C38 tender.

An NSWGR C38 Pacific Locomotive PART 2

Les Phillips builds a pair – 3807 and 3808 – of C38 locomotives in 5 inch gauge.



Continued from p.185
M.E. 4617, 19 July 2019

The choice

To begin the story of my 'long' project... The following is not meant to be a detailed constructional account but some thoughts on the 'ins and outs' of tackling a project of this size and giving an outline of how I proceeded in bringing this project to a successful conclusion.

Approaching the completion of my Adams radial tank, around 1988, my thoughts turned to - and consideration was given - as to what to build next? Then things outside my control took over. Rupert Murdoch closed our printing plant, we were all made redundant and I was faced, at age 55, with being out of a job and having to build locomotives for the rest of my life - **I was grief stricken!!** Then I had what I thought at the

time was an inspiration. Why not build two locomotives, one to sell to augment our income? Little did I know how long a project all this was going to turn into and you may well ask the question - why the C38s? The choice, as it turned out, was relatively easy because of the reasons stated and also, if I am to sell one, N.S.W. was by far the largest market and in addition I believed the C38 was the most popular by a substantial margin. And so the seed was sown - two 5 inch gauge C38s it was to be. A factor that then came into consideration was that if this was to go ahead, what was the availability of drawings and castings to expedite things? How naïve not to think of that before!

Having made my choice, I was all fired up to proceed.

Drawings and castings

Drawings and castings were available. There was one supplier in 1 1/16 inch scale with both drawings and castings and another in 1 1/8 inch scale basically with just castings. It was simply (actually it wasn't 'simply' at all as you will read) a case of choosing which scale I wanted to build to. After due consideration I chose 1 1/16 inch scale as both drawings and castings were available and, as a first step, I purchased the drawings. Then, convincing a friend to come with me, we headed north and proceeded deep into N.S.W. to purchase the castings but first stopping off in Sydney to catch up with a mutual friend. Over a cup of tea he quite firmly and succinctly told me I was 'nuts' and if I did not build to 1 1/8 inch scale I should be certified! Or

words to that effect. His advice was good as from a purely commercial point of view 1 1/8 inch scale was by far and away the most popular in N.S.W.

Taking on board this sage advice my friend and I re-plotted our course to proceed to the 1 1/8 inch scale supplier where we loaded into my vehicle TWO sets of castings and returned with the back of the vehicle down at the rear!

Having previously purchased the 1 1/16 inch set of drawings, every measurement had to be multiplied by the factor of 1.059 - time consuming at first but it soon became matter of fact. With the castings I was given frame and wheel drawings so that at least helped me to get started.

After that long preamble the project was about to begin and a decision was taken to build the tenders (plural) first.

TENDERS

In choosing to build in the larger scale I found that as an offset to the 1.059 correction, the conversion from the full-size works drawings to 1 1/8 inch scale worked beautifully, so that was a bonus. It was my intention to sit on the rear of the tender to drive it as shown in this picture (photo 9) of the author at Orange Society of Engineers in N.S.W. In model size the tender is amply big and strong enough to enable this - ideal in fact for a height impaired bloke like me!

Frames

The underframe is of simple black bar construction with four longitudinal bars, comprising the two outside frames and two inside. The bogie bolsters, front drag beam and rear buffer beams are flame cuttings and, after cleaning up, the whole lot was arc welded together (see photo 10 - also showing my friend Martin's excellent pipe work).

I made up a simple fixture to set up the pieces of the frame to carry out the welding, being as careful as possible to minimise the stresses. I basically followed the tender drawing as provided by the

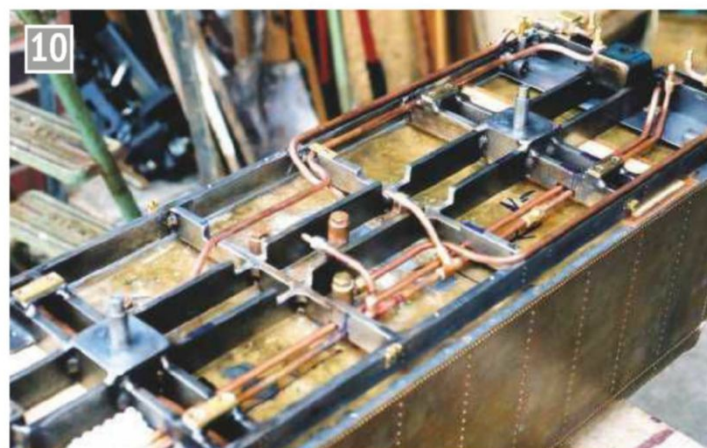
original supplier, multiplying by 1.059 of course, but then I made what turned out to be an important decision - to purchase the full size General Arrangement for both locomotive and tender. At that time prints for nearly all the various components of the original full-size locomotive were readily available from the State Rail Authority of N.S.W. They also supplied printed sheets listing the drawings that were available.

Bogies

I was very pleased with the way the fabricated main frames had turned out with very little distortion. My efforts now turned to the bogies and, with the full-size drawings to hand, I opted to make them as closely detailed as I could.

The bogies are a relatively simple arrangement but comprising several components. There is a main frame carrying the axleboxes and two equalising beams which were laser cut. These are bolted together and 'straddle' either side of the main frame, resting on the top of the axleboxes, and between the two are the four coil springs (photo 11). Between the main coil springs are the side control leaf springs - in the model's case imitation castings.

Once again full advantage was taken to produce drawings plans for all of those components that could be produced by flame cutting or laser. Taken to the same local flame and laser cutting service they were further intrigued and interested by



Martin's rather neat pipework underneath the tender.

what I was building. You see, I had taken pictures of my Adams! My philosophy is 'get them interested' - and they were very helpful.

Some simple machining on the mill put me in a position to 'jig' pieces together using socket head cap screws and combined, where applicable, with arc welding. The springs on the rear bogie were beefed up a fair bit to carry the additional weight of the driver whilst the wheels are to the AALS standards.

It was decided to adopt sealed ball bearings for the axleboxes.

Brakes

I adopted vacuum brakes for the tender and car vacuum cylinders were adapted to provide the operating cylinders, one on each bogie. This has worked exceptionally well with smooth operation, excellent control and operates from the brake stand in the cab, which also operates the engine brake.

At this point the aforementioned Martin decided he wanted to buy the

locomotive but wanted to do his own tender. Consequently, work on the second tender ceased.

Tank

In a roundabout way, Martin - there are so many of them! - was then coerced into doing my tender tank and detailing it. He was a trade school plumbing teacher so I felt things were working out beautifully! He was given a rolling chassis and it came back finished. QED! It was made of 1/16 inch brass as a contribution to strength and a removable section at the front was made to provide ease of firing and access to the controls.

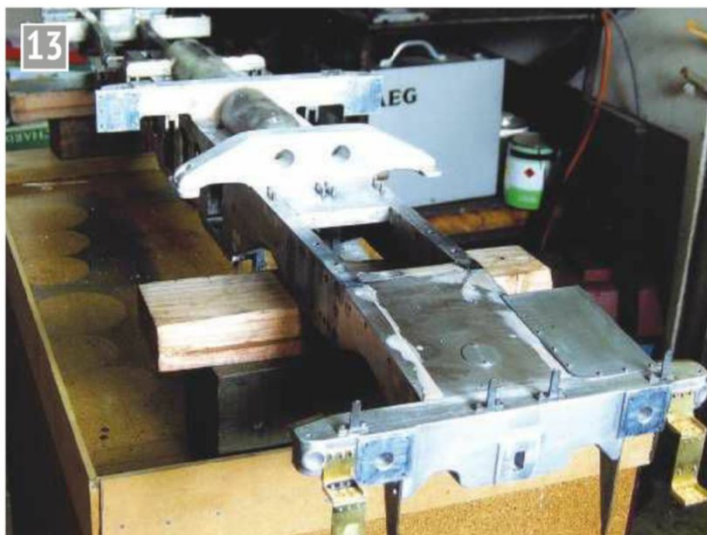
We estimated that there were approximately 3,000 3/64 inch rivets and they look fantastic and close to scale. The inner space is compartmented both for strength to take the weight of the driver and to prevent 'sloshing'. The 'rounded' tops give a nice finish. A finished but unpainted tender is shown (photo 12) on the turntable at my home club Wandong Live Steamers.



Tender bogie.



A completed tender.



The very solid fabricated main frames.

LOCOMOTIVES

Whilst waiting for the tender to come back I switched to tackling the locomotives. With a view to the close scale approach, further works drawings were obtained. I just loved receiving these drawings and poring over them; what a mine of information they presented and it was like turning the clock back.

Frames

As mentioned previously, along with the castings the supplier provided frame and wheel drawings. In fabricating the frames the aim was to end up with a reasonable facsimile of the full size cast frames when assembled. The main frames were flame cut (when I started this project laser cutting could not handle the thicknesses I needed) from $\frac{1}{2}$ inch thick black steel, normalised and then ground both sides to give a finished thickness a bit under $\frac{1}{2}$ inch. They taper inwards behind the trailing wheels to accommodate the movement of the trailing truck but then straighten again for a drag box. This taper was accomplished by cutting each frame partly through in the power hacksaw and bending to a fixture I made. There was plenty of strength left and the saw cuts were simply filled.

Stretchers were plain bright steel whilst the buffer beam, slide bar support beam and expansion link support beam were all castings. There is

one long stretcher which incorporates the imitation compressed air reservoir, which is solid to provide some weight low down. This is in the form of two semicircle cast iron

I was faced at age 55 with being out of a job and having to build locomotives for the rest of my life - I was grief stricken!! Then I had what I thought at the time was an inspiration. Why not build two locomotives, one to sell to augment our income?

castings which are attached to the top and bottom of the stretcher. Tracings for the flame cuttings were produced for those components not made from bright mild or castings and when machined the whole was bolted together with M5 capheads. The drag box was fabricated and bolted in, again with capheads. Assembled on a flat surface, when bolted together it provided a very solid and true foundation (**photo 13**) for what was ahead. Setting the whole frame up on the milling machine - a bit of a major thing in itself - it was trued longitudinally and the horn openings machined - CAREFULLY! Happily, this all went well. All the cap head holes were then filled to present a smooth surface and the final product looked like what I felt was a reasonable facsimile of the original cast frames.

Running gear

The main drivers are of the Boxpok type whilst it was decided that all springs would be leaf springs as in the original. After some consideration the conclusion was reached to compensate the main driver springs but this would not carry through to the rear pony truck as on the full-size locomotives. Calculations indicated the leaves should be 1mm thick by 10mm wide. I was fortunate to obtain a roll of annealed spring steel of fractionally wider material. Several lengths were then formed in rollers, cut to the various lengths, drilled for the centre pin, then hardened in the usual way. However, the tempering was done in a sand bath which I constructed, the thought being that I wanted

rods fluting has a radius in the bottom corner which gives a curved finish and a nice taper at the ends. I had a Woodruff key cutter specially ground with a radius at the corners to provide the required finish. I feel the side rods of a locomotive are particularly noticeable and consequently a fair bit of time was spent with reducing grades of Metalite cloth achieving the desired finish. All holes are bronze bushed.

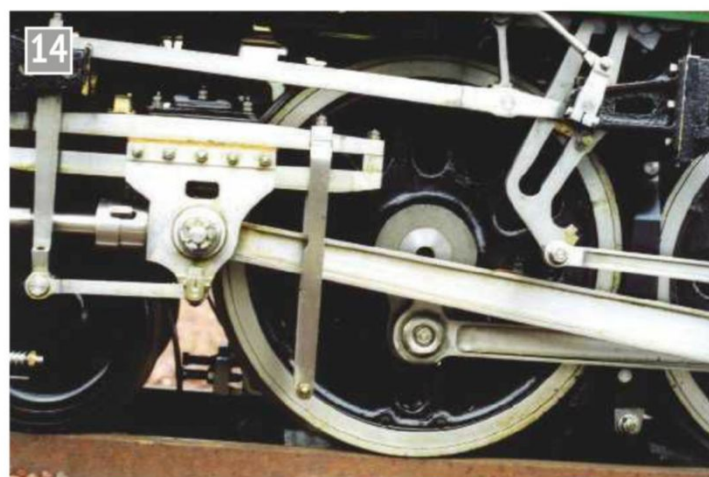
The axleboxes are of the cannon type and the castings were 'jigged' in the lathe to obtain perfect alignment.

Valve gear

I was fortunate with the valve gear as the friend in Sydney who I spoke to said 'build it exactly to full size' and sent me the works drawing! I was in clover! All I had to do now was to produce the components. Drawings were produced for flame cuttings to be done. After machining to the appropriate outlines, as for the coupling rods, a lot of time was also spent on their finish. Thirteen years on and an estimated sixteen hundred kilometres run (I have kept a log) I still feel it was time well spent (**photo 14**).

Cylinders

The cylinders are of cast iron and incorporated cast in passages, a huge bonus. Cylinder bore is $1\frac{1}{8}$ inch diameter whilst the valve chests are $\frac{7}{8}$ inch diameter. The stroke is $2\frac{1}{2}$ inches and,



Motion work - still looking good after 13 years and a thousand miles!



Cylinder components for two C38s.

all things considered, I felt this would give a pretty good performance and so it has proved. Both the cylinders and the valve liners were bored to within I think two thou' and then honed to a smooth finish. The hone was home-made and may be of interest to readers 'down the track'.

The decision to hone the cylinder and valve chest bores was because I had to! I had decided to use O-rings on the piston, a decision I have never regretted. All this is as outlined by Arnold Trop in his excellent articles in *Model Engineer* many years ago and, as LBSC used to say, 'the proof of the pudding is in the eating'. There may be some 'doubting Thomases' out there but I have replaced them once in 1,600km, not because of wear but simply because I had the pistons out for another reason and decided to replace them.

The valve chest liners are a close-grained cast iron and, when I indicated what it was to be used for, the supplier recommended car valve stem guides cast iron and I went with it - beautiful material to machine. The valve rings are of the cliplock type and are car automatic transmission rings. However, with the trick porting they had to be thinned fractionally to fit them in, which was fiddly.

The various cylinder components for the two locomotives are shown in **photo 15**, although I see the valve bobbins are not there. They are almost a story in themselves with the trick porting!

As stated, wheel flanges are not fine scale as I am a firm believer that if you intend operating at ground level they need a bit of added strength to withstand traversing points, some of which are not quite as they should be, especially on dual gauge tracks!

Brakes

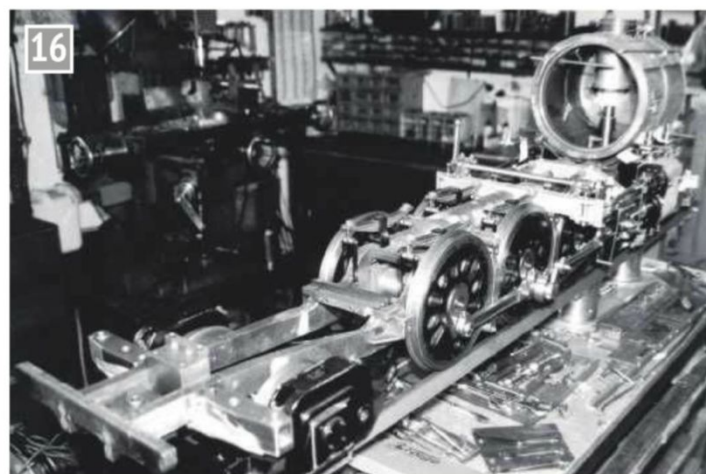
The engine brakes are operated by two steam cylinders mounted on a stretcher on the top of the chassis which act on two large vertical beams, which are pivoted part way down and act on the cross beams and cross beams of the brake gear. They are extremely effective and on the odd occasion when I have opened the regulator without releasing the brake I can assure readers she really does not want to move! A black and white picture (**photo 16**) shows a well advanced 3808 chassis and I hope this gives a good idea of some of the detail and layout of components mentioned previously.

Front bogie

The frames once again were flame cut. The axleboxes again have sealed ball races and leaf springs and **photo 17** shows the disassembled bogie on the marking out bench.

Trailing truck

The trailing truck is an aluminium casting and has a fair bit of detail. The castings really did not require too much machining after cleaning up. The bearings are sealed ball races and the springs are leaf springs.



A virtually complete chassis for locomotive 3808.

Smokebox and chimney

The smokebox is of ¼ inch thick black steel rolled into a shell approximately 7½ inches outside diameter, welded and, unlike the Adams, there is plenty of room for the various connections. The company who did this did a fantastic job and when I set it up in the lathe it ran almost perfectly true. The front and rear boiler rings were riveted in place and the blast pipe steam pipe access holes machined. The full-size version was insulated and clad which has also been applied

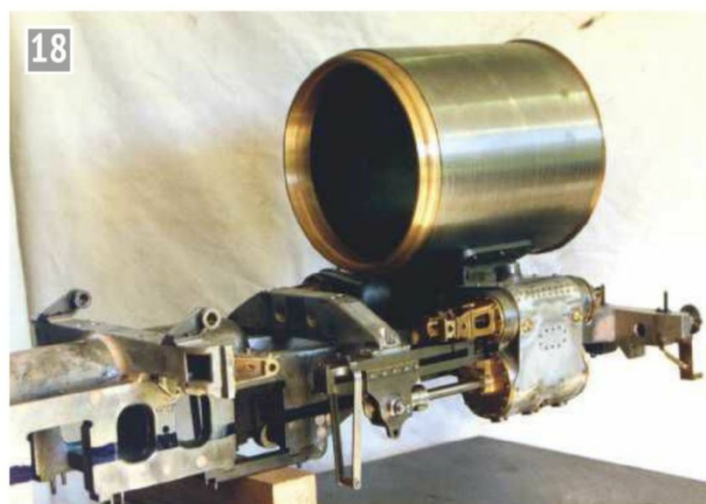
on the models. There is a front 'closing' angle which proved a bit of a challenge and was finally turned from a bronze ring I had cast. A view of the 'front end' is shown in **photo 18**.

The chimneys are quite large on the C38s and came as an aluminium casting and the mounting frame incorporates a mounting for the 'scale' whistle. A pipe from the main whistle, mounted under the running board and behind the valance, runs to the scale one so that it emits a jet of steam.

● To be continued.



Disassembled front bogie.



The C38 'front end'.

Garrett 4CD Tractor

in 6 inch scale

PART 59

Chris Gunn
completes
the lubricator.



Continued from p.93
M.E. 4616, 5 July 2019

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



I had a steel blank with a small stud in the centre that long ago had been used to turn some Simplex locomotive wheels so I decided to use this as a backing/ drive plate. All I had to do was drill a hole for a roll pin to drive the plates as I could not rely on the small nut holding it against the intermittent cut. That was drilled and I made a couple of small locating bushes to fit

the holes in the side and end plates, which were all larger than the stud in the middle of the blank. Then the blank was held in the three jaw using the reverse jaws and I took a skim off the face to make sure it was true, then drove in the roll pin and clamped a plate in place. I then started turning the thickness down. I ran the lathe on the slow side and traversed along the bed using a knife

tool rather than a facing cut. I was able to take a substantial cut this way and went down until I approached the finished diameter of the boss. I switched to my button tool and finished the boss to size with a nice radius in the corner and then reversed the feed direction and used the button tool to face off the tank side, working from the boss outwards.

This probably sounds as if it took a long while to make each side of the tank but it didn't and, in fact, I was able to machine the sides of the blanks on one set on the miller while the lathe was doing its stuff on the other pair of plates. **Photograph 503** shows a side plate being machined.

The tank could be made by folding up brass sheet and silver soldering the bearings in place, but personally I was happier doing it my way as sheet metal work has never been my strong point. It is debatable which would be the quicker way.

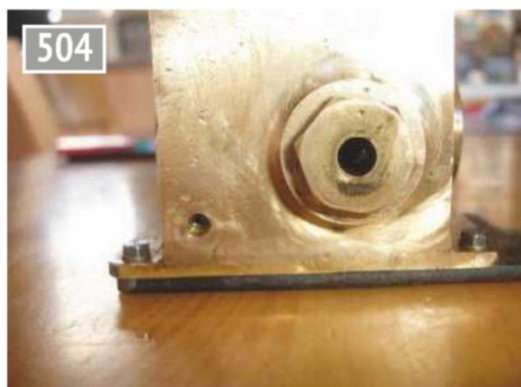


Turning the lubricator side plate.

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

I made the two bearings - a simple turning job. I left the bore at $\frac{1}{16}$ inch and threaded the outside $\frac{1}{2}$ inch BSB to match the sides; I cut an undercut so the thread could run out without leaving a land and to ensure the bearings would screw right up to the face of the boss. Once cleaned up, the bearings were fitted to the sides and then the base and the four sides were given a good polish. I then set up the four sides and the base so I could silver solder the whole thing together. I used an old $\frac{1}{16}$ inch drill to locate the sides in line. In addition I found a couple of long M3 screws and I made a long nut from a scrap of brass and was able to use the screws and nut to hold the top of the sides together without using a G-clamp. I got it all clamped together around the base using my small G-clamps, with the base clamped to a piece of flat bar held in the bench vice. I used a scrap of steel to span the top and hold the sides down to the base - the hope was that the clamps would not draw too much heat away from the job - and all the joints were fluxed. I must admit I was so anxious to get some heat on the job and unite it all together that I pressed on without taking a picture. I used my biggest burner and it soon got to red heat, the solder was applied and it finished up looking pretty good. Once it had cooled down, I polished it all up and also put a $\frac{1}{4}$ inch reamer through the bearings after making sure they were screwed in tight. I marked these with a centre punch to show which went where, so they could be replaced in the same orientation. **Photograph 504** shows a finished bearing in position.

I cut the tank lid from a scrap of 3mm or $\frac{1}{8}$ inch brass sheet and I made the pivot tube from a piece of $\frac{1}{4}$ inch brass drilled $\frac{3}{32}$ inch right through, fitted the tube in place on the lubricator and slid the lid up to the tube, sticking them all together with some silver solder. That was soon done, with the lid sitting



The shaft bearing.

perfectly flat on the top of the tank.

The pump element was screwed into position and a thin locknut made, whilst I still had the use of the M12 fine tap. It should be said that these taps are readily available from the usual suppliers and a carbon steel one would be fine for the materials used. It should be noted that most CETOP air cylinders use these fine threads for attaching accessories to the piston rods, so if you know anyone working with pneumatics, you could perhaps borrow a tap from them.

I made the shaft next and, as mentioned earlier, I intended to use a sprag clutch instead of a ratchet to operate the pump cam. For anyone not familiar with sprag clutches, they are very compact and look like a needle roller bearing, however the 'needles' are not round, but a parallelogram shape with the corners knocked off and rotation of the bearing outer will allow rotation in one direction but not the other, so it acts like a ratchet. (Type 'sprag clutch' into a search engine, as I did! - Ass. Ed.) The drive to the lubricator is much simpler using the sprag clutch, as there is no need for small ratchets or pawls. These are hard to make and harden in small scales, as evidenced by the broken one I

found when disassembling my old lubricator.

I had discussed the use of these small clutches with some fellow miniature traction engine builders around the camp fire at various rallies and some folk had used them with mixed results. It should perhaps be noted, at this point, that the very small clutches that are likely to be used in an application like this, are supplied without an inner race and are designed to be used on a hardened and ground shaft which acts as an inner race. The larger clutches are

supplied as a complete unit, with inner and outer races, looking like a normal bearing, and are installed basically as a normal bearing.

One of the contributors to the discussion had used a $\frac{1}{16}$ inch bore clutch on a silver steel shaft and this had eventually worn the shaft until it would no longer drive it. Bearing in mind how small these sprags are in the $\frac{1}{16}$ inch bore units, I felt it would not take a lot of wear to stop them working. I intended to use the two bearings I had saved, which were $\frac{1}{4}$ inch bore, and I felt I had a reasonable chance with these if I hardened the shaft. If they lasted two or three seasons I would be happy as they are easy to



Ratchet and pawl.

replace. It would also be easy to revert back to a ratchet drive, apart from the need to make or buy the ratchets.

The drawings of the details show the dimensions that need to be changed to suit sprag clutches, with either a 6mm or $\frac{1}{4}$ inch bore. It may be a good idea to use metric versions as one would expect that the imperial ones might, possibly, become unobtainable.

As I was using my old imperial clutches I selected a piece of $\frac{1}{4}$ inch diameter silver steel, cut it to length and chamfered the ends and put a couple of very shallow Vee-grooves in the diameter to run in the bearings and act as oil grooves. As I sit and write this up a year later, I do wonder if I have created a stress raiser there, bearing in mind the shaft was to be hardened and left rock hard. I did not want to temper it as I wanted the surface on which the clutch would run to be as hard as possible. Anyway ... once the shaft was finished and polished, I got it to cherry red heat balanced over my oil quench and dropped it in as quickly as I could and it was hard when it came out - as far as I could tell - so I gave it another polish and when I tried the clutch on the shaft it did what it should.

Next, I made the cam and I made this to the pattern described in the article by Eric Lindsay. This was not an eccentric but a lobed cam. I had some off-cuts of gauge plate flat section, $\frac{5}{8} \times \frac{1}{2}$ inch so I marked out the cam on this, drilled and reamed the $\frac{1}{4}$ inch hole on the Bridgeport and

Limits and fits meant that everything
was a press fit and when machined true,
as it usually was, it ran true.

then drilled and tapped a hole for an M4 grub screw to hold the cam to the shaft. The cam lobe was brought to shape by a combination of milling the flanks and rounding the ends on the finisher; I took care to make sure all the faces were square. This was hardened as well, using the same procedure as described above. When it was tried on the shaft all seemed well so I removed the shaft and ground a small flat where the grub screw would bear down on the shaft and moved on to the next parts. I made a pair of brass collars that fitted each side of the cam, just to keep it central.

The next item was the lever to contain the clutch and the outside diameter of the clutch was, thankfully, $\frac{7}{16}$ inch and I had a reamer to suit. If you are using a 6mm bore clutch you will need to ream the hole 10mm. The lever was marked out on a piece of $\frac{5}{8} \times \frac{1}{2}$ inch mild steel bar and the bearing hole drilled and reamed, but I used a hand reamer and only entered the hole a short way, as I wanted the clutch to be a tight fit in the lever. Call me old fashioned, but I prefer this to sticking the bearing in with an engineering adhesive. Bear in mind that the lubricator tank would be sitting on top of a hot cylinder and heat will cause a glued joint to deteriorate. I sometimes think that some of the joints in small scale models are just not big enough for adequate strength joints to

be achieved this way. Perhaps this is a throwback to my apprenticeship where I was involved in the manufacture of printing machines where geared shafts ran at high speed and everything had to run true; the limits and fits meant that everything was a press fit and when machined true, as it usually was, it ran true!

The majority of the waste was removed on the miller and the edges and radius on the end were cleaned up, then the lever was mounted on a mandrel and the boss turned round. The clutch was then pressed in the lever, making sure that it was pressed in the right way round, with the boss on the outside.

I made a $\frac{1}{4}$ inch bore brass knurled knob to go on the end of the shaft on the outside so that the shaft could be turned manually to give a shot of oil when laying the engine up between steamings. Then I dealt with the other end of the shaft and here I fitted my ex-Leo computer ratchet. I had to make a brass hub for this, complete with a grub screw to hold it to the shaft, as the bore was way over the $\frac{1}{4}$ inch mark. The ratchet is used to stop the shaft turning back, once the clutch had advanced it. I could have used another clutch to do this job but I only had two and I had two lubricators to make. Once the ratchet was fitted I made a pawl, again along the lines of that shown in the Eric Lindsay article, and a hexagon



The lubricator components.

pillar to support the pawl. **Photograph 505** shows the ratchet and pawl in position.

I made a spring anchor from an M3 screw and I found a suitable spring in my 'odd springs' tin. I drilled the outside face of the tank for the drain screw and the inside face was drilled and tapped for the pawl and spring anchor.

The drain screw was made from a piece of $\frac{5}{16}$ inch diameter stainless steel and cross drilled the end $\frac{3}{32}$ inch for a pin to form the handle.

The only thing remaining now was to make the dummy spring housing, which was turned up from some 0.705 inch A/F brass hexagon.

This was made to screw into the boss on the back of the

tank and the job was done.

Photograph 506 shows the small components that make up the lubricator.

I tested this with some oil and it pumped fine. The Interlube pump I was given was fitted with a push-in tube fitting for 4mm tube, but I used some $\frac{5}{32}$ inch that I had, which is 1 thou smaller and this was fine. If buying the pumps, $\frac{3}{16}$ inch and 6mm push-in fittings can be had instead.

Photograph 507 shows the lubricator fitted to the 4CD and **photo 508** shows the tank and its entrails looking from the top, with the pump piston uncompressed.

●To be continued.



The lubricator mounted on the engine.



Top view of the lubricator with the pump piston uncompressed.

SHOWCASE

Lancashire and Yorkshire 2-4-2T 50850



When 'Lanky Tank' 50850 was withdrawn from service in October 1961, it brought down the curtain not only on the 2-4-2 wheel arrangement for British Railways but also on one of the most successful classes of railway locomotives ever to have graced UK metals. 50850 was built by the Lancashire and Yorkshire Railway at Horwich in September 1899. Initially numbered 675, this medium sized radial-tank was just one of a class that would eventually total 330.

In the early years of their long lives, these engines did a tremendous amount of hard work with heavy trains over some of the steepest graded lines of northern England.

In L & Y days they were regularly seen handling ten coach expresses between Manchester and the coastal resorts of the northwest. Other routes included the Pennine hills, with trains from Manchester to Leeds, Hellifield and Colne.

In spite of their enviable reputation for punching above their weight, these locomotives were generally ignored by performance journalists of the period and also by the commercial designers within the model-engineering fraternity.

In the mid 1970's however, Don Young produced designs and castings for 5-inch gauge versions of the 0-6-0 'A' class tender

locomotive and the 2-4-2 tank, marketing them as *Aspinall* and *Lanky* respectively. It was a part-built version of the latter that I acquired in the autumn of 2013.

This was basically a rolling chassis with cylinders and motion parts which Leyland SME member Tommy Withnell had commenced building in the late 1970's. Abandoned, presumably due to ill health, the parts had been stored and kept together by successive Leyland SME members during an interim period of 30 plus years. My first observation was that Tommy had set out to build a long-bunkered version of the 2-4-2T. This fell in line with my proposed choice for the identity of the model. I also had a preference for the Belpaire boilered version, although this would mean considerable deviation from the published design. Eventually I settled on 50850 as it ticked all the boxes - allocated to my hometown of Bolton for much of its life and a celebrity by the time of withdrawal in 1961.

For the model engineer, Victorian era locomotives have a reputation for being more difficult to build than those from the later periods of steam. The reason (in my opinion) is not normally due to the manufacture of individual components but to the frustrations encountered during the process of their assembly. Poor

accessibility to confined areas usually becomes more acute as the job progresses and this proved to be the case with 50850.

I recommenced the build process by designing and producing the Belpaire boiler. Three years later and the locomotive was steam tested at Worden Park, prior to an afternoon's shift of hauling passengers. In this latter role the model has exceeded my expectations, being both sure footed and easy steaming. However, due to my having fitted the authentic L & Y firehole door (opens inwards) it is not the easiest of locomotives to fire.

The choice of livery was greatly influenced by nostalgia, as it was the one carried by almost every engine that came through my hometown from the early 1950's until the end of steam. Applied nationally at the time to all mixed traffic and secondary passenger locomotives, I think the livery sits rather well on the 'Lanky Tank'.

The photograph was setup on the shores of Morecambe bay and reminds me of a particular piece of social history, when locomotives like 50850 brought thousands of holiday makers to the coastal resorts of the northwest during the period of their annual holiday (wakes) week – happy days.

Alan Crossfield

If you would like to see your model in the 'Showcase' please send a photograph and a brief description to the editor.

Lathes and More

PART 45

Graham Sadler explains a procedure for removing the wear from your lathe.



Continued from p.177
M.E. 4617, 19 July 2019

Levelling the lathe bed

Unless the bed is correctly levelled it can twist and accurate work will be almost impossible. 'Levelling' here does not mean setting the bed level but refers to setting the machine to turn accurately. The notes below apply to the Myford but similar setting up can be applied to other lathes.

The best tool to use to achieve this is an engineer's level, which has an accuracy in the order of under 1mm per metre. My example is shown in **photos 237** and **238**. I purchased this for a silly price at an auto jumble and it is really a bit big. It is only rarely used but it's a cracking tool.

However, firstly we need to examine how the Myford is mounted. It should be on the Myford raising blocks - these are a casting with a tapped hole carrying a sleeve nut on a coarse thread acting as a jacking point. The lathe actually sits on these and screwing them up or down will obviously lift or lower one corner of the bed. There is actually a $\frac{5}{16}$ inch BSF stud which is used to hold the machine down. Some people

use a welded fabrication or a piece of rectangular box section rather than the correct parts. Without the jackscrews you will have to use shims, preferably as rectangles with a slot to pass round the holding down studs. When levelling we level the lathe, not the bench it is mounted on.

To level the machine, first slacken the holding down nuts on the bed feet. Next put your spirit level at the headstock end. Lightly tighten the nuts, front and back. With the level along the bed, adjust the height of the front jacking screw at the tailstock end to set the bed level along its length. Then set the level across the bed and check it is level, adjusting the back screw. Tighten down, check again and adjust.

Even with a precision level this is only the first stage. We now need to do a turning test, which should be periodically repeated, especially if your lathe is not on a concrete floor. Ensure the holding down nuts are fully tightened. Mount a bar in the four jaw chuck about 25mm diameter and 100 to 150mm long, without tailstock support. The centre

should be relieved by a couple of millimetres and both ends similar to leave a bobbin at each end. **Photograph 239** shows an example.

Take a very light skim over both bobbins without touching the cross slide. Even moving your feet on a wooden floor can cause a surprising difference. Measure the diameter of each with a micrometer. Of course, they should be the same size but won't be! If the tailstock end is larger, the height of the front foot should be increased. Fully tighten the nuts, ideally to the same torque on each trial. The number of attempts this takes and the accuracy you can obtain is debatable; mine was only a few microns out on the test bar three years after the previous alignment.

Setting the tailstock

The next stage is to set the tailstock so that it is perfectly aligned with the headstock. It is pointless doing this without having successfully completing the levelling. Start by checking the adjustment of the tailstock gib. This is a square bar mounted against the inside of the bed front shear. It is fixed by a socket screw at each end of the tailstock base located in a scalloped cut out. The adjusting thrust screws are at the back and front of the body (**photo 240**). Slacken the fixing screws and just nip them and adjust the thrust screws in order to get a smooth fit all along the bed without any trace of binding or play.

In order to set the tailstock another test bar is needed,



237 Spirit levels to set the bed horizontal - note removed leadscrew.



238 A comparison of the bubbles from photo 237.

this time the longer the better - about 300mm long would be ideal and again about 25mm diameter. We will turn this between centres. Note - this is one type of turning in which the work can be removed from the lathe without losing concentricity.

The bar needs a centre hole in each end and it is not an easy task to get them in line. If you have a fixed steady this can be used to support the bar to drill from the tailstock. Mount the bar in the four jaw chuck and set it approximately true. Check the outer end is free from orbiting, tapping with a soft hammer to set it before adjusting the bar true. Now set up the fixed three point steady close to the chuck and adjust the fingers so they just grip the bar (**photo 241**).

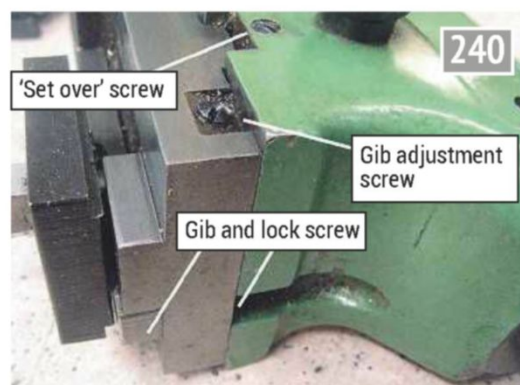
My three point fixed steady is a bit of a bodge. I obtained the casting but it was several years before I got around to machining it. Having made all the top parts, it came to machining the base to fit the bed. Only then did I find that I had been supplied with a casting for a 4 inch centre height not $3\frac{1}{2}$ inches for the Myford. So, the fingers had to have the odd end shapes to work in any reasonable way. It is however, for me, good enough for most jobs so nothing will be done with it.

Now the steady can be put at the outer end with the knowledge that it is on centre. The lathe is started, steady points lubricated and the centre hole drilled.

If a steady is not available, an angle plate can be clamped to the cross slide, set parallel to act as a back fence. Then the bar is packed up to the correct height and clamped to the angle plate. Put a sharp point in the chuck, move the cross slide to get the point on the edge of the bar and move it half the diameter, taking into account the backlash by only feeding in one direction, before centre drilling from the chuck by pushing the bar with the tailstock. Repeat for the other end but this time insert the already formed hole on to the



Turning the bobbins for the levelling of the lathe bed.



Tailstock adjustment points. I thought I had cleaned it for this photograph!



Setting up a three point steady to enable centre drilling the tailstock set-over.



Checking the alignment with an accurate test bar, also showing the use of a catch plate and carrier to turn the bobbins on your test bar. The clearance between the bobbins is needed so a very fine cut at the same setting can be made on the ends. Once made, and with the ends at an identical diameter, it can be used in the same way as my ground version.

tailstock centre which will help alignment. Take care not to rotate the bar when switching ends to keep the centres exactly in line if the packing is not exactly perfect.

It's time to fit the catch plate, although a faceplate will do the same job if you don't have one. Clean the Morse taper in the spindle and fit a centre. The bar will need drilling and tapping close to the end for a peg which will provide the drive, although for smaller work a carrier will do the job nicely. Fit the tailstock centre and lubricate this end if it's a solid variety then tighten the work so it rotates without binding. Once again, we produce bobbins at each end and once again take a very fine cut over the bobbins and measure them - it is unlikely that they will be the same.

Now the frustrating and fiddly bit! Make up a table to show the adjustments you make and the resulting effect

on the bobbin diameters. You will get a long list as you hunt back and forward either side of the elusive, exactly equal diameters. Loosen one of the adjusting screws situated directly above the tenon slot in the tailstock body then just nip it up. Now release the main clamp lever. These screws are $\frac{1}{4}$ inch BSF X 26tpi. This has a pitch of 38 thou, very close to 1mm so one full turn will move the centre over enough to make 2mm difference to the bobbin diameter. The adjustment needed is tiny. One clock face minute of adjustment or 6 degrees - tiny to judge with a screwdriver - will cause a change in diameter of 1.3 thou or 0.33mm. So, what is needed is merely a trace of additional pressure or slackening on the adjusting screws. Lock the clamp lever, tighten the one you loosened and finally take a fine cut over both bobbins again. Repeat the process until you fluke a very small

difference or you belt it with a sledge hammer in frustration!

Once the bobbins are the same diameter, future checking of the tailstock setting will be easier as the test bar can be used with your lever DTI. One dodge could be to actually turn the bobbins to get them the same size then use this to adjust the tailstock - at least then you will have a reading to work to. I don't have to do this, as on a teachers' workshop practice refresher course I was able to make a parallel test bar on the cylinder grinder and at my club I picked up a lever type test indicator with a scale graduated in 0.002mm making this setting task somewhat less frustrating. **Photograph 242** should give you some idea. My lathe was last checked when I extended the workshop three years ago and when checked now in May 2019 it was out by just two divisions!

●To be continued.

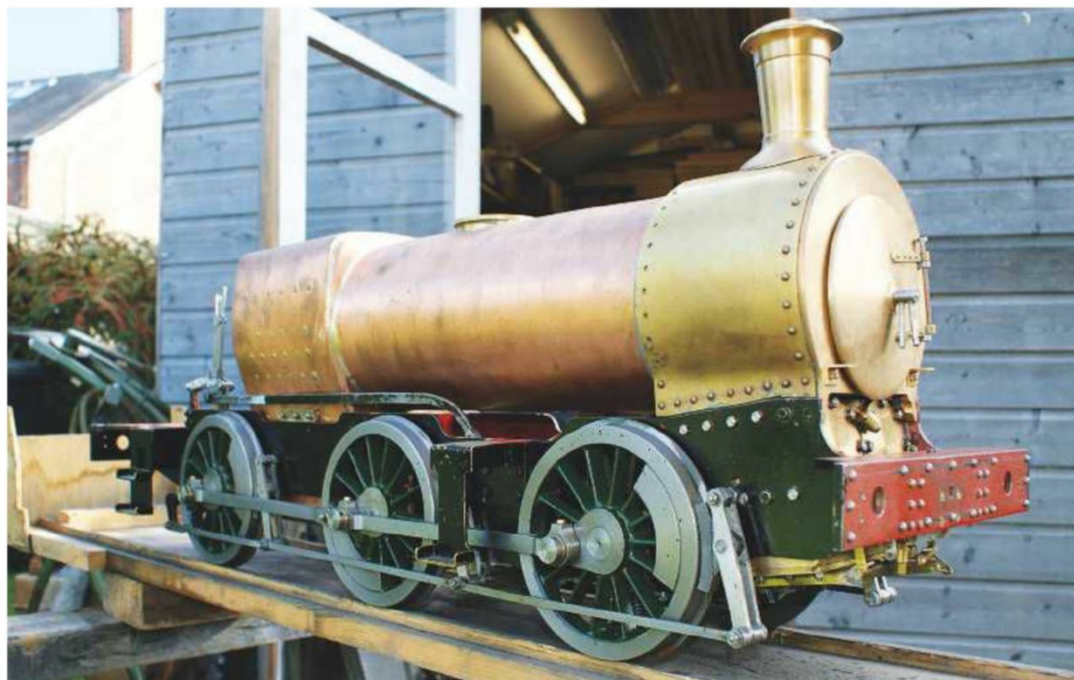
A New GWR Pannier

PART 8

Doug Hewson decides that LBSC's well-known GWR pannier tank design needs a make-over.



Continued from p.97
M.E. 4616, 5 July 2019



Once you have got the first wheel to size, set the dial on the top slide to zero. Just wind the top slide back, put the next wheel on the faceplate and do them all to the same stage in one cut each. You can apply the rear radius to the flange with a medium cut or smooth file though I like to do this with the lathe running a little faster, something like mid gear without the back gear engaged. The top slide can now be set over to 30 degrees and you need to go back to your normal cast iron turning tool to machine the outer chamfer onto the tread but do not be tempted to use a chamfering tool and do this in one cut as it is bound to chatter. I have a very nice chamfering tool to do this.

The final operation on the face of the wheel is to cut the groove to show the inner edge of the tyre and this can be done with a small parting tool or left handed knife tool set parallel to the lathe bed though you will need to unlock the cross slide for this operation and when you have finished

one groove, set the dials on both the cross slide and the top slide to zero and turn all the others to the same setting. You then need to reverse the wheels on the faceplate and turn a similar (but larger) step on the backs of the wheels (to seat the balance weights flush both sides). For these finishing operations it is as well to put your chuck key on the bench rather than keep it on the lathe so that you remember to take the wheels off using the nut on the faceplate rather than undoing the chuck jaws by mistake as you do not want to disturb the faceplate at all during these operations.

It is very important to turn all locomotive wheels to this profile, particularly if you are running on a ground level railway where there is usually some pointwork. The small chamfer on the outer edge of the tread gives a smooth run across crossing noses and switch blades and the taper on the tread gives the differential action on curves. Apart from anything else it makes for a much freer running and more efficient locomotive than if

the treads are turned parallel. In fact, if the treads on your wheels are not turned to this profile you will be turned away from most railways as they will be checked by the running foreman before you are allowed to run. Once you have mastered the wheel turning like this you will be able to use the same method for turning any wheels.

Once you have completed all the finishing operations, do not remove the plate from the chuck as we need to mark out a mounting for boring and facing the crank pin holes and bosses. With a pointed tool in the tool holder, scribe a line from the centre outwards across the radius of the faceplate and then go back to the centre, set your cross slide reading to zero and wind the tool back $\frac{7}{8}$ inch. At this point, hold the tool against the faceplate and turn the faceplate by hand just to make a mark across your first scribed line and there you have the marking out for the crank pin boss. You will now need to remove the faceplate from the chuck and drill and tap for the crank pin marking with your

$\frac{3}{8}$ inch thread (**photo 69**). The spigot from the middle of the faceplate now needs removing and screwing into this new hole and then the faceplate can be returned to the same position in the three jaw chuck. Just check to see that it runs truly but if not, you may be able to true it up with the use of a leather mallet before fully tightening the chuck jaws. A few gentle taps here and there generally does the trick. Mark the centreline on each wheel boss and then mount each wheel in turn on the newly positioned off-set centre and turn the wheel so that the centreline marked on the boss aligns with the centre of the lathe. You can check this by offering up the tail stock centre or a small centre drill and pulling the

chuck round and moving the wheel by hand until it does line up. Drill and ream all the crank pin holes $\frac{5}{16}$ inch. **Photograph 70** shows the crank in its new position on the faceplate and ready for centring. **Photographs 71 and 72** show this set-up being used for drilling and reaming the crank pin holes in the Y4 wheels. This way you can guarantee they are all square with the face of the wheel. When I built my first Y4 I didn't do this as I just drilled them on a block of wood and regretted it. I had to bore the crank pin holes to a new size and then make them with an odd size to press the pins in so that they were square. Another lesson learned.

The crank pins are all turned from $\frac{3}{8}$ inch silver steel. The

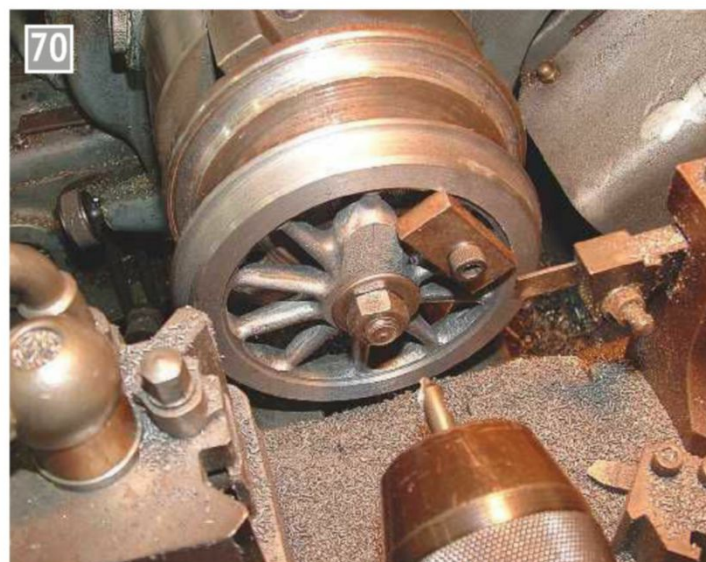
ground finish is used for the bearing surface. Turn the shanks for a length of $\frac{5}{8}$ inch to about 4 thou over $\frac{5}{16}$ inch diameter and then turn the first $\frac{1}{8}$ inch just so that it just fits the crank pin hole in the wheel with a bit of a twist and make a note of the dial reading on the cross slide. Then wind it back and re-set the slide to half a thou short of where it was before and turn a further $\frac{1}{8}$ inch, then make sure that the pin will not go in the hole this time. If the pin will not go in then you can turn the rest of your $\frac{5}{16}$ inch spigot to that setting. This should give you a 1 thou interference fit. You can also use Loctite 601 for this job if you turn another couple of thou off the pin. Anyway, part off to a length

beyond the shoulder of $\frac{5}{8}$ inch. Grip the pin the other way round and you can now turn the step for the retaining collar. This should be $\frac{1}{4}$ inch diameter and $\frac{5}{32}$ inch long. To make the collars you need to chuck a piece of $\frac{1}{2}$ inch bar in the three jaw and part off six lengths $\frac{1}{8}$ inch long. Now, mill or file a couple of spanner flats to suit a spanner of your choice and drill a No. 50 hole though it - dead centre or it will look awful - for a 10BA bolt. The 10BA bolt needs the threads removing from where it sticks through, and a 1mm hole drilling through it so that you can pop a little split pin through ... and that will do for this time.

● To be continued.



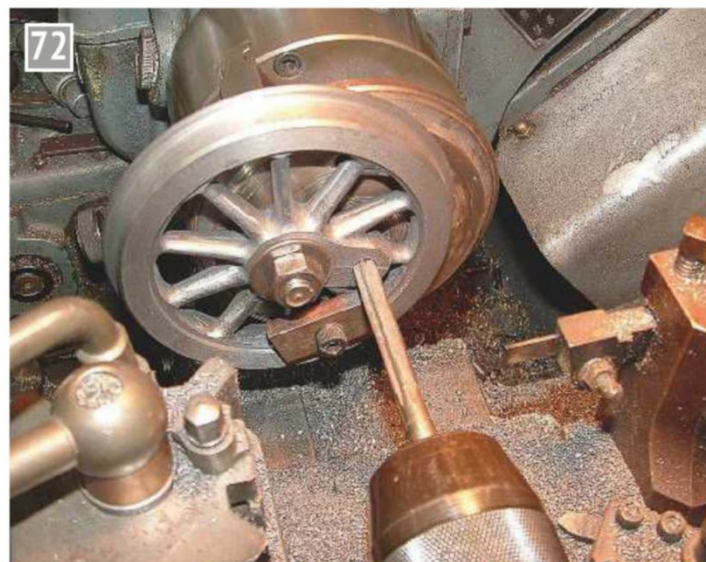
69 Drilling the offset spigot for locating the crank pins.



70 Lining up the wheel for drilling the crank pin.



71 Drilling the crank pin.



72 Reaming the crank pin.



Write to us

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Responses to published letters are forwarded as appropriate.

EMCO

Dear Mr. Evans, The vertical axis leadscrew nut on my vertical milling machine recently stripped, and the original supplier was unable to help. On the internet I discovered that my miller FV-320T from Warco has also been distributed as FB6 from EMCO. Acting on their advice I downloaded the parts list for the FB2 from the EMCO website, identified and ordered the correct part number which arrived safely.

As my miller is 26 years old I found this service from EMCO (with whom I have no connection) to be excellent and worth praising.

Yours sincerely, Patrick Williams (Germany)

Ford Museum

Dear Martin, I have just read the article about the Ford Museum in the USA that has appeared in a recent *Model Engineer* (M.E.4614, 7th June).

One of the photograph captions describes the 2-6-6 locomotive as a 'Triplex'. It most certainly is not! The locomotive in the museum is an 'Allegheny' (not 'Alleghany' as mentioned in the text of the article). The locomotive in the museum is a simple expansion four-cylinder articulated locomotive, similar to a Union Pacific *Big Boy* or *Challenger* (but using a different wheel arrangement).

The Erie Railroad tried a 'Triplex' design with two locomotive chassis under the boiler and a third under the tender but the boiler couldn't keep up the required steam output for the six cylinders. The design was not a success and none were preserved.

Regards, Bill Read

Dear Martin, The locomotive in the Ford Museum is a 'Duplex' (not 'Triplex') Chesapeake & Ohio Railroad H8 2-6-6 (number 1604, the only one preserved).

45 of them were built by Lima locomotive works

between 1941 and 1944 and 15 built in 1948. Eight similar locomotives were built for the Virginian Railroad in 1945.

For the first 22 years C&O used the locomotives to lug coal over the mountains, developing 5000hp pulling 16,000 tons at 20mph.

The locomotives were transferred to the Ohio flat lands and the C&O discovered a very powerful 'racehorse' pulling 13,000 tons at 60-70mph, developing 7500hp.

No 'Triplex' locomotives were successful due to lack of boiler capacity.

Regards, P. W. Collier
(Tunbridge Wells)

US/UK Lexicon

Dear Martin, With reference to *Model Engineer*, Vol 222, No. 4604, 18th January, the article entitled 'British and American terms for *Model Engineering*' by Gregory P. Widin.

Special railroad terms: the British 'buffer stop' is the American 'bumping post' as regards to purpose, though not appearance.

All American trains were required to be 'fitted' with automatic air brakes (usually Westinghouse) and automatic couplers (Janney, MCB/Master Car Builders, commonly known in Britain as 'Buckeye', which is a manufacturer) with the passage by the US Congress of the Railroad Safety Appliances Act 1893, which applied to all inter-state traffic from 1900.

In British parlance, 'fitted' meant an automatic brake of either vacuum or air, which was not universally achieved on British freight trains until the 1990s, and a standard automatic coupler still does not apply in either Britain or Continental Europe at this point in time.

The British 'guard' is the American 'conductor'. American steam era freight trains ('goods' trains in Britain) had a crew of five, consisting of the (locomotive) engineer, (locomotive) fireman, conductor, and two brakemen, who rode with the conductor in

the 'caboose' (British guards or brake/break van).

In this instance, 'engineer' was a generic term for a person who operated machinery and, again in railway terms, originated in Britain where, with the passage of time, 'driver' became the more common descriptor.

This is in contrast to locomotive engineers in pre-Bolshevik Russia, where locomotive driver/engineers were (and still are) actually qualified fitters and turners/machinists due to the necessity for them to undertake running repairs in case of a breakdown in remote areas. Most former communist bloc countries retain this requirement and China Rail has extended this practice to railways in Africa where it has funded a number of new and rebuilt railways over the last few decades (the TanZam Railway – Tanzania/Zambia – being a case in point).

The brakemen used the wooden walkways on the roof of 'boxcars' ('vans' in Britain) to apply the handbrake by means of a wheel attached to a vertical post on the ends of each freight vehicle. The purpose of this 'pinning down' was to hold a long, heavy train on a falling grade to prevent it from running away.

British and American sidings are one and the same thing, meaning a section of track intended for the storage of railway vehicles. A 'storage road' is a particular purpose siding, e.g. for storing brake vans or cabooses. A siding does not necessarily need to be a dead end – it may be a loop siding.

A British 'shunter' can be either a locomotive or a person; likewise the equivalent is an American 'switcher', which can either be a locomotive or a person. A British 'signalman' is an American 'pointsman' or 'towerman'.

By the way, at one time both British and American ties were the same. It was only later in the 19th century that Britain referred to ties as 'sleepers'. This was most likely done to

prevent confusion with 'tierods' or 'tiebars', which hold movable switch blades at the correct distance apart.

A railway 'fishplate', being the metal castings that are used to join one rail to another, is the same in both Britain and America. An American 'tieplate' or (British) 'baseplate' is the interface between flatbottom (Vignoles) rail section and the tie or sleeper. Its purpose is both to spread the weight of the rail over a wider portion of the tie or sleeper and also to hold the flatbottom rail at the correct 1:20 inclination. (Where a baseplate is not provided, the sleeper needs to be adzed to 1:20 to hold the flatbottom rail at the correct inclination.)

The term 'railroad' also originated in Britain and is most likely derived from its predecessors 'wagonroad' and 'tramroad'; likewise, 'railway' is probably a derivative of 'wagonway'. With the passage of time, 'railway' became the accepted British term, whilst the Americans generally retained 'railroad'. However, there were, and are, American railroads which use the term 'railway' in their legal title.

(As an aside, locomotives and railway vehicles are 'stabled', as were the horses which were the original railway motive power.)

As an Australian, it is noticeable how frequently trade names in Britain become generic descriptors, e.g. 'Hoover' for vacuum cleaner, whereas in Australia and America, descriptors are the more common, even allowing for the exceptions!

The article's various lists give some, from my perspective, interesting examples of this. For instance, I was unaware that nickel silver was 'German' silver, that bakelite was 'tufnol', emery cloth or paper was 'Aloxite', that a miniature hacksaw was necessarily an 'Eclipse' (even though I own one!), that a gasket was 'Hallite', that vice grip pliers were a 'Mole' wrench, or that 'marigolds', which I know to be flowers, are

actually yellow dishwashing gloves! (We have a choice of yellow, blue or pink here!)

In relation to soldering fluxes, if you asked for 'Baker's Fluid', that was what you got - it was not a descriptor here. With regards to trade names, in both America and Australia, local suppliers tended to get supplies from relatively local suppliers, hence trade names rarely became a generic descriptor. An exception to this was Araldite, which for years was the only two part epoxy generally available in the local hardware (former ironmonger) stores, and thereby became a generic descriptor by default.

The Americans have long used natural gas from oil fields for domestic and industrial use and in Australia the Esso (now Exxon Mobil) BHP joint venture natural gas supply from the Bass strait dates to the mid-1960's, well before Britain's North Sea gas. I understood the American equivalent of British 'town gas' was 'coal gas'. Both the Americans and Australians also use propane gas, a derivative of crude oil refining for domestic use.

Congratulations to Mr Widin for an excellent article.

Best wishes and regards, Philip Miller (Victoria, Australia)

Dear Martin,
In reference to the correspondence regarding the English and American engineering Languages, I have the following observations:

- A 'C' Spanner has a 'dog' to engage in radial slots on the rim of special 'nuts'. Most only 'fit' one size of nut with any efficiency.
- 'Verdict' - this was once (and may still be) the 'trademark' on a small, very short range lever action 'Dial Test Indicator', of southern English manufacture (a long time ago) - as far as I know. Once very commonly used by model engineers and heavily advertised in *Model Engineer* magazine.
- 'Clock', better known as a 'Clock Gauge' - there is much

confusion between these and DTI's. A 'clock gauge' has a range of about $\frac{1}{2}$ - $\frac{3}{4}$ inch or more depending on the manufacturer - a 'dial test indicator' has a range of about 0.010 - 0.025 inch, depending on the manufacturer.

- A 'lorry' was originally a small, flat deck unit, heavily built with wheels to match - a horse drawn vehicle for heavy loads. Depending on where in England they were built, in the mid (?) Victorian era there are variations of design and name, viz. 'Lorrie'/'Laurrie' etc. and heavily used by the railway companies - most 'lorrys' could carry the old form of railway container.
- I have never known a 'feeler gauge' to be called a 'slip gauge' in over 65 years of using them... To me, 'slip gauges' come in sets of small extremely high precision blocks that will 'wring together'.
- 'Zerk' was the name of or trademark of the American manufacturer of grease nipples, a long time ago. There were about 20 different types of grease gun connection - mostly obsolete now.
- 'Jubilee clip' - after the trademark of the original manufacturer.
- 'Upsetting' - originally an operation of a blacksmith - heat end of iron/steel bar to bright yellow/red, bang the end of it on the anvil to shorten and expand the end - repeat until desired size is reached.
- 'Gunmetal' is in the brass to bronze group of alloys - there are many hundreds varying in colour from a faint

yellow/white to a distinct red. Some are called 'brasses' and are not and some are called 'bronzes' and are not. Some at the 'red-ish' end are soft and easily machined, some are 'as hard as the 'hobs o' hell' and are at the 'white' end. I have a piece somewhere from the 'white' end - it is un-machinable to the extent of taking the edge off tungsten carbide tipped tools. There is also a vast range of 'Admiralty brasses' - most of which are - or are debatably - 'bronze'. Some of my 'gunmetal' that has stood on a rack for years has attained a peculiar 'blue/grey' patina of oxide(?) but NOT on the ends where it was cut (?) which remain of a yellow colour.

I hope the above will introduce some clarity - but will also probably produce still further confusion. The basic problem is that 'we English' speak English and 'the Americans' speak American with peculiar spellings.

Further, alas, America has 'peculiar' pints and gallons - this is due to William Penn not consulting his wife Juliema Maria Posthuma Springett (a distant direct relative on my mother's side of the family) when he purchased fluid measures for his Quaker colonies. He bought 'wine measures' (smaller) NOT 'water/milk/spirit' measures and all were different at the time - 'our' now obsolete bulk fluid 'Imperial' measures are all 'water measures'.

Regards, Peter King (Christchurch NZ)

Albula

Dear Martin.

Did John Olsen, in his Albula Pass article, realize that there is another museum in Bergun? It is in the town, about 10 minutes stroll from the station. Their website www.albula-bahn-club.ch will give you a far better picture than my waffle. Suffice to say, there is an excellent HO model of the line which gives a good idea of the local terrain.

My visit was many years ago and I think that they were then on their first complete rebuild. Language was a problem then so we didn't get much information.

Richard Pool



1
Les brought family and friends for support, starting at the left: baby Archie and Les's daughter Phillipa, then Carolyn and Gill, daughters of the builder Alan Hall, grandson Liam, Les himself and wife Liz.



2
Les about to start his first run with Mona.

Chris Chugg

reports from the Bracknell Railway Society, hosts of this year's LittleLEC competition.



LittleLEC 2019

When Peter Langridge established the LittleLEC competition in 2006 he had in mind a different sort of contest between men and their locomotives than had been previously been the case. Aimed at small and light locomotives, under 50lb dry weight and from 2½ inch gauge upwards, it appealed to those who wanted something a bit more light hearted than mixing with the bigger sized locomotives that compete in IMLEC. Many people had smaller models tucked away somewhere which could now be brought into use and also perhaps it may encourage the younger, less experienced drivers to try their hand. The competition prospered and has moved between different host clubs arriving in June 2019 at the Bracknell Railway Society Jocks Lane track.

Run over two days, the competition attracted a small but very competent field of drivers with interesting and well prepared locomotives. Most had previous experience of LittleLEC and knew the likely challenges of competing.

Drivers are given a timed slot on the track with a 20 minute window to complete their run. Runs lasting less than 15 minutes or more than 20 minutes are disqualified on a time basis. So, they have 15 minutes to clock up as many laps as they can. If they are still going well and can complete further laps after 15 minutes but before the 20 minute deadline then those laps will count towards the

each run. The driver can elect to change the load between runs and the best run will count for the final results. The Bracknell track is 351.8m long and has a number of gradients to test driver ability and is set in a public park with attractive surroundings. Weather on the first day was at first wet but improved considerably over the day and was dry, warm and sunny on the second day.

So - what happened?

Saturday running was tricky for all competitors, who had to contend with a wet track, giving some adhesion problems for all locomotives.

results. Each driver is allowed two runs and also has to meet the basic competition rules which use an efficiency formula dependant on the track length and its gradients, number of laps completed, the weight carried and fuel used. Sounds complicated but in fact it is a straightforward way to produce an efficiency rating for

Saturday Running

At 10.00am precisely, Les Pritchard of the Harlington club took to the track in his *Mona* locomotive with a payload of two passengers, his daughter and grandson from his extended family that came to support him on the day. Les completed five good laps on his first run and with a slightly



Beautifully turned out Rob Roy run by Peter Wardropper.



Peter concentrates on the driving on his winning run in rather poor conditions.



Young Liam Pritchard did rather well driving Grandpa's locomotive to finish third.



Peter Wardropper drove a splendidly turned out Jenny Lind.

heavier load finished six laps on his second run. His LBSC designed 0-6-2T locomotive *Mona* was actually built by his close friend Alan Hall in the early 1970s. Alan, who died at a tragically young age some 23 years ago, was represented by his two daughters, Carolyn and Gill, who had come to support Les and to witness his excellent run (photo 1). Les is a LittleLEC veteran and a previous winner. He had nothing but praise for the locomotive which is certainly a lively performer, being very easy to drive (photo 2).

Next up on the track was Peter Wardropper of SMEE on his self-built *Rob Roy*, a Martin Evans design, completed between 1968-75 and first steamed in his schooldays (photo 3)! A beautiful little engine too. This first run for

Peter was eight laps with no issues emerging. He then chose to carry his son Steve as a passenger on the second run, Steve is a strapping six-footer but Peter still managed seven full laps for an amazing efficiency rating almost twice that achieved by anyone else (photo 4).

Liam Pritchard, grandson of Les, then took over Les's *Mona* to see if he could record a run. Liam at 16 was the youngest driver at LittleLEC this year and drove with Les as a passenger. Liam, although an inexperienced driver, took the locomotive round for five laps. Understandably Liam was a bit lower on efficiency but in this competition finishing is everything. Unfortunately Liam had to leave before he could do a second run but this was a very creditable effort which

put him amongst the leaders (photo 5).

The first day's running was rounded off with another immaculate run from Peter Wardropper, this time with his 2-2-2 *Jenny Lind*, another splendidly turned out locomotive. Peter completed two runs for six and seven laps respectively again without difficulty - an excellent performance. This little *Jenny Lind*, to the 3½ inch gauge LBSC design, was built by Peter over a 30 year period being completed in 2016. It is a beautifully turned out and super detailed, decorative engine enhanced further by careful study of the original drawings (photo 6). This locomotive too was a very effective performer.

Saturday running was tricky for all competitors who had to

contend with a wet track giving some adhesion problems for all locomotives. The track dried out later and by the following day the weather was fine, dry and sunny.

Sunday Running

There were three competitors today: Stephen Harrison of the Birmingham SME, William Powell from the Bournemouth Club and Neil Furze of the Worthing and District SME.

William took the first run on a dry track, driving a unique little locomotive based on a 2½ inch gauge *Southern Maid* chassis with a *Canterbury Lamb* boiler. Valve gear is slip eccentric and he uses a Rosebud grate. He finishes off this eclectic mix with a delightful purple livery, a colour chosen by his five-year-old daughter (photo 7)! ➤



7 William Powell entered this intriguing little locomotive made up from parts liberated from donor locomotives.



8 Neil Furze looks determined to complete a good run.



9 Stephen Harrison going well before his fire died on the last lap.



10 Overall winner Peter Wardropper, together with Mike Chrisp who presented the prizes. David Mayall looks on.

Running with a separate water tank William did complete a single lap on his first run but had trouble maintaining steam pressure on both his runs and on the second run he had to retire. Overall you have to compliment William for experimenting and he did produce a truly small locomotive in line with the LittleLEC spirit. He has to be applauded for his novel approach and if you don't experiment then you don't learn.

Neil Furze with his *Rob Roy* produced some very good laps. On his first run he only managed two laps but on his second attempt he had completed seven laps in his allotted 15 minutes and went for another last lap only to run

out of steam just yards from the finish. Rules are rules and he got time disqualified. A shame really because he was doing well.

Neil's locomotive (**photo 8**) was built in 1965 and has never been modified. Still running with its unpainted brass work, it nevertheless looks good and is in excellent shape.

Last to run on the second day was Stephen Harrison in another *Rob Roy* built by Trevor Martin in the 1990s and passed to Stephen's family in 2002 (**photo 9**). Stephen has competed in this competition several times, managing second place in 2018. Here though, after completing six laps on his first run, he ran out of time and was disqualified.

On his second run, his fire died and couldn't be revived and he retired without finishing the lap. This was very unfortunate for Stephen because his efficiencies were otherwise looking good.

Results

By a large margin Peter Wardropper took the first place. On his second run with his *Rob Roy* 0-6-0T he recorded an amazing efficiency of 0.428% as the table shows. He was pleased to receive the Winner's Cup in the final presentation (**photo 10**).

Runner up was Les Pritchard who could not attend the prize giving. Of the remaining qualifying runs, the scrutineers considered that it was not in the spirit of the contest to

give two awards to the same person, leaving in third position the young Liam Pritchard.

The leader board table gives all the results (**table 1**).

Prizes to the top three were given out by Mike Chrisp, former editor of *Model Engineer* and now President of SMEE, at the end of a very successful two day event (**photo 11**).

The coordinators of the LittleLEC contest (now under the stewardship of Guildford MES) wish to thank *Model Engineer* magazine for their generous support in providing the prize money for the winner and runner-up and additionally Geoff Stait of GS Model Supplies who provided the third prize for this year's contest.

Table 1. Leader board

Driver	Loco	Run No.	Laps Run	Work Done	Coal Used	Energy Released	Average Speed	Eff	Status
				ft lb	lb	ft lb	mph	%	
Peter Wardropper	0-6-0T	2	7	29,919	281	6,984,966	4.2	0.428	Finished
Neil Furze	<i>Rob Roy</i>	2	7	19,453	250	6,214,383	3.5	0.313	Disqualified - Out of Time
Les Pritchard	0-6-2T <i>Mona</i>	1	5	17,536	245	6,090,095	3.5	0.288	Finished
Les Pritchard	0-6-2T <i>Mona</i>	2	6	22,301	314	7,805,265	3.7	0.286	Finished
Peter Wardropper	0-6-0T	1	8	17,244	250	6,214,383	4.6	0.277	Finished
Peter Wardropper	2-2-2	2	7	15,088	250	6,214,383	4.2	0.243	Finished
Stephen Harrison	<i>Rob Roy</i>	1	6	20,499	386	9,595,007	2.2	0.214	Disqualified - Out of Time
Peter Wardropper	2-2-2	1	6	12,933	250	6,214,383	3.7	0.208	Finished
Stephen Harrison	<i>Rob Roy</i>	2	4	12,455	250	6,214,383	4.4	0.2	Retired - less than 15 mins
Liam Pritchard	0-6-2T <i>Mona</i>	1	5	8,846	280	6,960,109	3	0.127	Finished
Neil Furze	<i>Rob Roy</i>	1	2	4,087	179	4,449,498	1.6	0.092	Finished
William Powell	2½ inch Hybrid	1	1	2,262	147	3,654,057	0.8	0.062	Finished
William Powell	2½ inch Hybrid	2	1	2,262	161	4,002,063	3.3	0.057	Retired - less than 15 mins
Liam Pritchard	0-6-2T <i>Mona</i>	2							Retired

Next year's LittleLEC will be hosted by Birmingham SME on 13th and 14th June 2020.

Special thanks from Mike Chrisp also went to all the

hardworking members of the Bracknell Club who laid on the event and in particular thanks to David Mayall, Ivan Hurst, Eddie Holland and Andrew

Day who worked tirelessly behind the scenes to make it run like clockwork (**photo 12**). Lastly, thanks to those lovely ladies in the kitchen who kept

us all fuelled and watered. Many thanks to the Bracknell Railway Society for putting on a splendid LittleLEC contest.

ME



Peter Wardropper shows off the winner's cup. From the left: Mike Chrisp, President of SMEE, Peter, Ivan Hurst and Jim Wilson of the Little LEC organising committee.



Peter with his fellow competitors and members of the Bracknell Club who organised the competition.

The Brushless Brute

Jon Freeman describes a powerful, dual gauge petrol-electric locomotive using brushless motors for tractive power.



Continued from p.191
M.E. 4617, 19 July 2019

Engineering design criteria – overview

At this stage 'The Spec' looked something like this :

- High efficiency – modern electric locomotive using brushless traction motors
 - Dual gauge using interchangeable 5 inch and 7¼ inch gauge bogies
 - Modular – for one person handling without lifting gear
 - Powerful enough for heavy duty public running use
 - Reliability – low maintenance
 - Versatility – wide operational voltage range/choice of motors/power source
 - Full four quadrant control – driving and regenerative braking in both directions
 - Length – to fit in the car!
- The following sections will expand on these.

Efficiency

Public running experience with 'The Wedge' has shown it to be a very efficient design, evidence being the number of times similarly sized and powered locomotives doing the same job on the same track on the same day have retired early with tired batteries, leaving 'The Wedge' to carry on 'til the end. Without any hard facts or figures, this is thought to be in part due to the greater efficiency of brushless motors but probably at least as much to do with the design philosophy behind the controller.

Developed further with experience gained, the STM3 dual brushless motor controller accepts a range of commands, including separate control over motor voltage and current limit. This allows precise control over maximum speed and tractive force within design limits, while design of the cycle-by-cycle current limit provides robust overload protection, as well as the option of torque



Two bogies of different gauges.

(tractive force) controlled driving. With this approach the motors can be individually controlled to operate within their rated operating areas where high efficiency is assured, with any overload being precisely applied by design, under total control.

Brushless motors offered for sale on popular web sites are often described as 'sensored' or 'sensor-less'. Sensored motors are used in this design for optimum control over the full range of speed and torque. Sensor-less motors are better suited to uses such as cooling fans, where the speed / torque relationship is predictable and where control at low speed is not important.

The 'Brushless DC', or BLDC motors used in building 'The Brute' are in fact three-phase synchronous AC motors, each fitted with triple Hall effect angular position sensors which provide information used by the controller to synchronise the AC drive to measured position change. This means the motors are more complicated to drive compared to brushed DC motors but not much more so in the scheme of things, although unlike brushed DC motors they cannot simply be wired

together in series or parallel. A separate electronic driver is required for each motor but these need not be expensive or bulky. The STM3 provides two controllers on a board sized 3.5 by 3.7 inches and, where efficiency and reliability are objectives, brushless motors are the perfect choice.

Dual gauge

The bogie design resembles that devised for 'The Wedge', the most significant difference being drive configuration. In the 'Wedge' design, the motors were too long to fit between the wheels. This led to adoption of a toothed belt drive with tensioning pulley. Motors selected for this new design fit snugly between the wheels enabling direct gear drive. The 5 inch gauge bogie was designed and drawn on 2D CAD first. The larger bogie is simply an up-scaled version with a few minor dimension tweaks. **Photograph 25** shows one of each size bogie completed.

Modularity

Modular design enables handling by one person without lifting gear or other aids. The roof panel is located using four dowels and easily lifts clear. With the roof off,

the side panels may be lifted out and clear, giving access to all within. The bogies have two plug and socket electrical connections, and the bogie is secured to the chassis by one locking nut or nut with 'R' clip. The petrol engine and electrical generator are combined as one compact sub-assembly. This is easily removed complete (having allowed time for cooling!) after unplugging two electrical connections and removing three 'nyloc' nuts. Having lifted out the power unit and disconnected the bogies, the chassis is liftable by one person if need be, although it is easier with one person at each end. The 5 inch bogies are an easy lift, although the 7¼ inch bogies are a bit of a struggle.

Power

Being the second electric locomotive out of this workshop, experience informed the power requirement. The first electric locomotive in 5 inch gauge, 'The Wedge', was designed 'to be at least as useful as a *Polly 1* steam locomotive' and has proved a success, having performed numerous passenger hauling duties over four years. This time the aim was 'to be at least as useful as any steam locomotive' or 'at least twice the power of The Wedge' in 5 inch gauge (considerably more again in 7¼).

For locomotive use, passenger hauling around the club track, assumptions could be made about what proportion of time is spent idle in the station or about variable loads negotiating gradients and so on. However, for reliability, the locomotive should be designed to withstand continuous use at full rated load. This suggests motors which need to be rated for continuous (industrial) and not intermittent (hobby) use. Time spent looking at motor data will be well spent.

The quality of data varies hugely, with much to be found that lacks credibility. Attempting to sort the wheat from the chaff, it was decided

only to consider motors whose specification came at least with dimensioned drawings and included rated voltage, full load speed, rated output power and rated load torque. Armed with full load speed and rated torque, output power can then be simply calculated and if the result deviated by more than a 'gnats' from the claimed power output, the motor was rejected.

The output power 'P' of a motor in watts is the product of torque (τ) in newton metres, and speed, or angular velocity, (ω) in radians per second:
 $P = \tau \cdot \omega$ [Eqn.1]

There being by definition 2π radians per revolution and 60 seconds per minute, converting radians per second to revs per minute we get:
 $P = \tau \cdot 2\pi \cdot \text{RPM} / 60$ [Eqn.2]

'The Wedge' has four motors, continuously rated at 105 watts each. A new search found a choice of motors continuously rated at 220 watts output for the 5 inch bogies, giving a choice of 24 or 48 volt operation. A 660 watt output, 48 volt continuously rated motor was found for the larger 7¼ inch bogies. **Photograph 26** shows the choice of motors found suitable for 5 inch use, both having a power rating of 220 watts; the smaller Nanotec motor is for 24 volt systems and the other for 48 volts. In **photo 27**, the smallest motor is the 42mm frame size 105 watt motor used in 'The Wedge'. The other two are the 86mm frame size motors rated at 220 and 660 watts. Just to double check, the motor claiming 660 watt output power rating claims a rated torque of 2.1Nm @ 3000rpm. Plugging these numbers into the formula Eqn.2 gave $P = 659.7$ watts. That'll do nicely.

Boost budget

With motors of these power ratings it seems unlikely extra power would ever be wanted, but it is interesting to note that the manufacturers data sheets quote 'peak' torque and current ratings at three times continuous ratings. What they don't state is for how long! The

limiting factor in continuous use is temperature. Much of the heat dissipated is due to I^2R losses in the stator windings. At full load for long periods the motors may get quite warm to the touch - this is normal and nothing to worry about - but a cool motor can run with a significant current and output torque overload for as long as it takes for anything within to approach maximum safe operating temperature. This thought led to building a deliberate overload capability into the motor controller drive boards.

Called the 'boost budget', the controller keeps a record of motor load over some immediately preceding interval. Running for some time at under full load allows the boost budget to accrue, increasingly quickly as the average load is reduced, until some 'Tank Full' limit is reached. Then, when high load is demanded, should there be any boost budget available, it may be spent providing

short term boost (up to 40%) to current and torque output (torque being close enough proportional to current). There is some maths behind all this, designed to make sure the motors don't get any hotter than they would have had they been run at 100% load continuously. This feature may be disabled in the STM3 board firmware setup for users of a nervous disposition.

Reliability

For reliability the wheel bearings use drawn cup type needle rollers packed with grease. Plain bronze bushed bearings support the motor mountings on the axles.

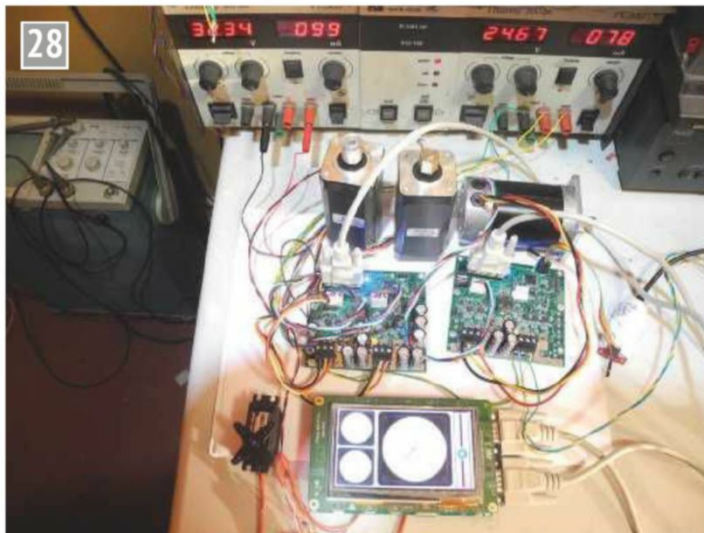
These are also greased and should enjoy long life as they only carry a proportion of the weight of the motor. The bogie frames were laser cut from steel sheet much thicker than it needed to be. This was to aid traction by adding weight, helping to keep the centre of gravity low down, aiding stability, and to allow simple



A pair of brushless motors.



Three different sizes of brushless motor.



The electronics on the testbench.

openings in the frame to serve as axle box horn bearing surfaces. Complementing the high reliability brushless motors, the STM3 intelligent drive board has been designed and built to drive two brushless motors, one board fitted to each bogie. These boards communicate with the touch-screen control computer mounted on the driver's control panel and ensure the motors never get driven into unintentional overload. The locomotive is controlled and driven by simply touching controls on this touch-screen. It is possible to connect a simple hand controller with a connecting lead but for a number of obvious reasons this compromises the 'reliability' design criterion.

Versatility of design

One early decision in the design of an electric locomotive is likely to be the system DC voltage. With this in mind, the electronics has all been designed to operate over a wide supply voltage range from 10 to 62 volts DC without any fuss or adjustment. Simply power-up and go. For systems powered by traction rated 12 volt lead-acid batteries, connecting a single battery, or connecting two, three or four batteries in series for 12, 24, 36 or 48 volt systems, are all sensible options. 48 volts is a sensible upper limit for battery systems, particularly where batteries are charged *in situ*, as the

voltage will rise to around 58 volts, close enough to the 62V limit. In general, higher voltage systems will be more efficient.

While it is possible to configure drives to safely control lower voltage motors from higher supply voltages, with supply voltages below rated motor voltage, full speeds will not be attainable. The controller electronics is capable of providing higher currents at lower voltages, but not the other way round.

There are a number of petrol-electric locomotive designs out there, most of which use a combination of engine, battery and vehicle type alternator - the familiar 'hybrid' configuration. Hybrid designs have been seen to work well but vehicle alternators are not designed for efficiency; their use is often problematic when driven by small engines and they require connection to a battery, so constraining system voltage. For good efficiency, versatility and reliability, the idea came to use an engine driving one large brushless motor used as a three-phase generator, with external rectifier. As this generator requires no 'excitation' to get started, batteries are not required and can be designed out.

With a permanent magnet generator, output voltage tracks engine speed. So long as the voltage remains within the wide 10 to 62 volt system working range, all will be well. Although the generator

could have been fitted with an electronic voltage regulator without too much trouble or expense, this was not necessary.

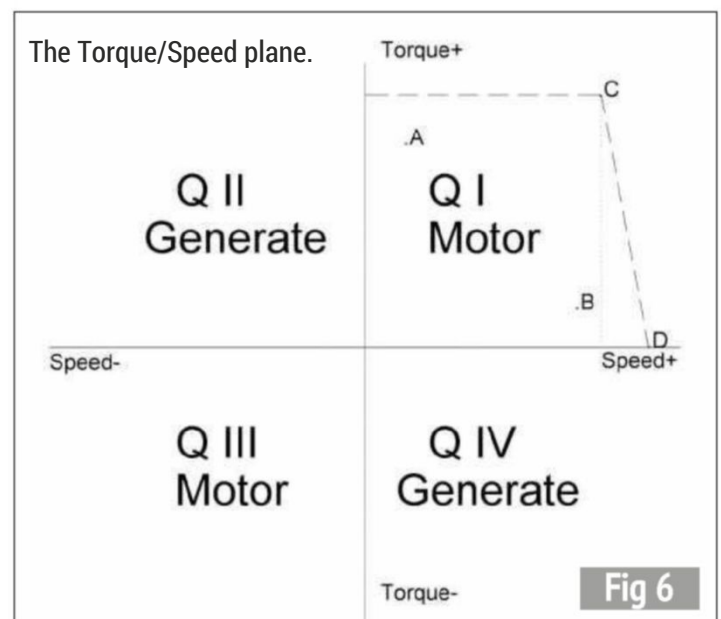
The STM3 controller board was designed for versatility with the thought of use in CNC machines, robots and more. To this end, the two motors are independently controllable, and the boards may additionally be controlled by hand controller or radio control. **Photograph 28** shows the main parts of the control kit on the bench powered from a lab power supply, a touch screen controller driving a servo and talking to a pair of STM3 boards driving a variety of motors.

Four quadrant control

With no mechanical brakes designed into 'The Brute', four quadrant control is highly desirable. The four quadrants refer to driving and braking in both directions - nothing more complex than that. Fortunately, like brushed DC motors, BLDC motors can be operated as a motor or a generator. The locomotive can accelerate the train by motoring - converting electrical power into the kinetic energy of motion - but it can also slow the train by using the traction motors as generators, taking kinetic energy out of the system and converting it back into electrical energy.

Figure 6 shows the 'Torque/Speed plane'. The right-hand half in the positive speed direction represents rotation in one direction and the left half, rotation in the opposite direction. The upper half represents rotational force, or torque, in one direction and the lower half the opposite direction. Motor mechanical power output (watts) is equal to the product of torque (units of newton metre) and speed (units of radians per second). In quadrants QI and QIII the torque · speed product is positive, therefore power flows through the machine from the electrical side to the mechanical - a motor. In the other two quadrants where the torque · speed product is negative, power flows in the opposite direction - a generator.

Looking at quadrant I motoring, the area enclosed by the axes and the dotted line indicates the operating area of a motor in one direction. Point 'A' represents a motor running slowly with high load torque, low voltage, high current. At Point 'B', a lightly loaded motor runs at close to full speed, high voltage, low current. At point 'C' the motor is powered at rated voltage, runs at full rated speed delivering rated torque, the maximum rated power state (high voltage, high current). At 'D' the motor runs at rated voltage with no load,



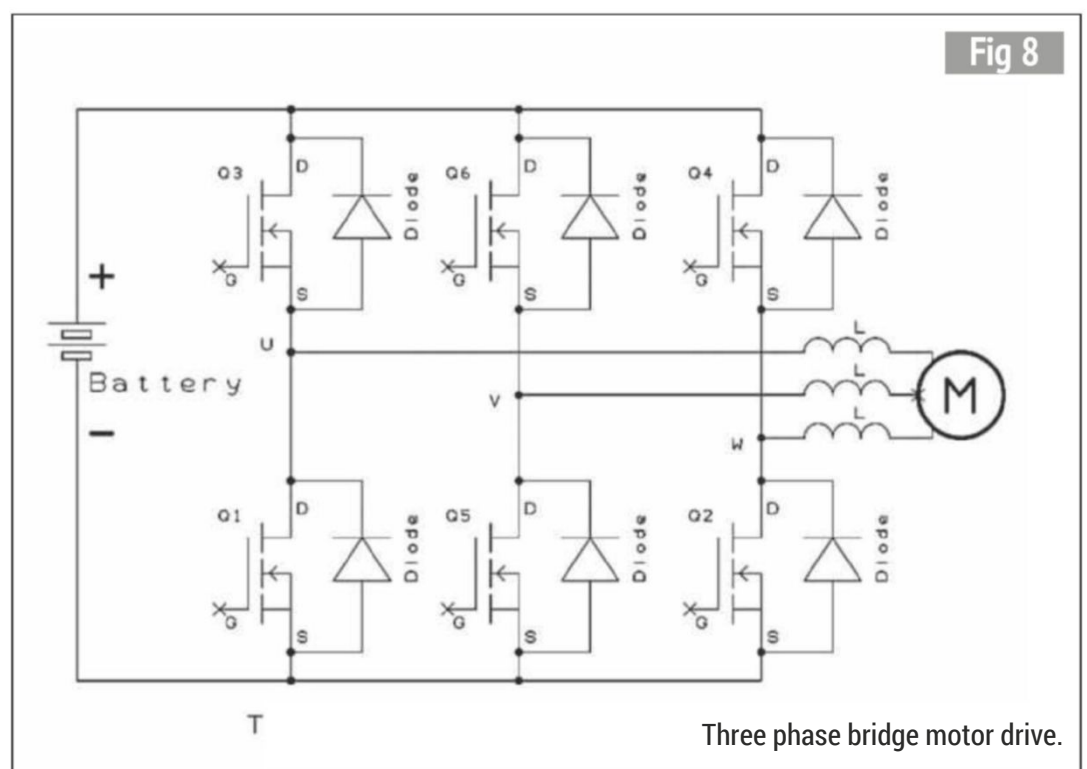
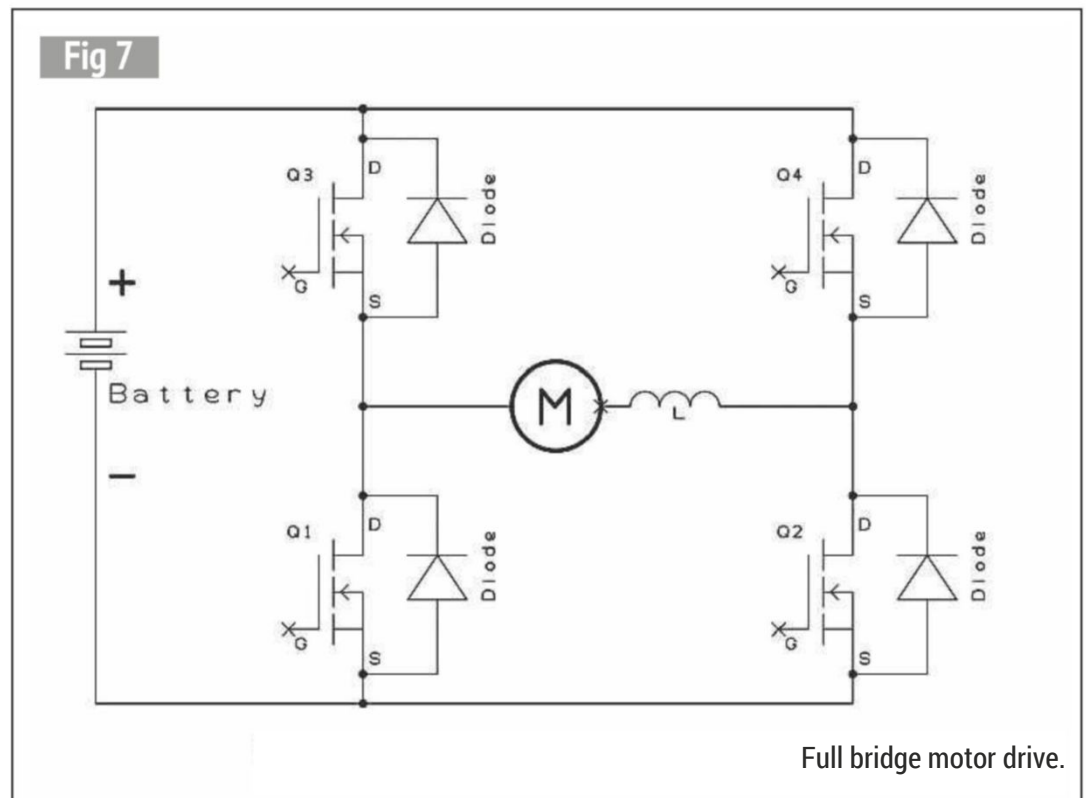
at the off-load speed (high voltage, minimal current).

A four quadrant controller for a brushed DC motor uses four power switching devices (power transistors of some type - the STM3 board uses MOSFET three phase bridge modules) in a 'full bridge' configuration (**fig 7**), connected to the two motor terminals.

A detailed explanation of electronic motor controllers is beyond the scope of this article but, briefly, here are some of the more interesting points. Controller data includes terms such as 'PWM', or pulse width modulation. This describes turning a switch on and off repeatedly, usually several thousand times per second (easy for electronic switches). The ratio of the 'on' time to the 'off' time is variously expressed as duty cycle, duty ratio, or mark to space ratio. Switching power to a motor using PWM can then supply an average voltage to the motor less than the supply voltage, the motor inductance tending to smooth current flow. This is how speed is controlled.

Figure 7 shows four MOSFET switches connected in a bridge configuration. The diodes shown are within the MOSFETs (known variously as the body, parasitic, or intrinsic diode). To drive a motor, two diagonally opposite switches must be held off, the other diagonal pair being used to switch power on to the motor. PWM switching can be applied to either of the 'on' switches to achieve PWM speed control. To run in the opposite direction, simply swap the function of the diagonal switch pairs.

Using the motors as generators involves doing something similar with the upper pair of switches with the lower pair 'off', or with the lower pair of switches with the upper pair 'off'. By using the PWM to rapidly and repeatedly short and open circuit the motor, voltages higher than the back emf are generated by the same principle used in engine ignition circuits and



Tesla coils. This higher voltage feeds current through two diagonally opposite diodes (**fig 7**) back into the battery (or other electrical) supply. That's about it, other than to say the one thing to avoid with switch bridges is turning on any pair of switches one above the other. This short-circuits the supply and tends to let the smoke out.

A brushless controller uses six devices connected to three terminals - the 'three phase bridge' configuration (**fig 8**). Some simple electronics drive the 'G' gate - input terminals of the switches to control the motor. The parts labelled 'L' in the figures represent the inductance of the motor windings, not external

components. Understanding the significance of 'L' and the diodes shown would require a deeper look at the subject. The same principles of control apply to both DC and three-phase motors, the driver electronics being only a little more complicated for the latter.

●To be continued.

Sieg SX2 Plus Miller CNC Conversion

Graham Sadler explains how he converted his Sieg milling machine to CNC operation.



Continued from p.107
M.E. 4616, 5 July 2019

Controlling the spindle

The next problem is to get the spindle running from Mach3. This is essential, as it will automatically be turned off when the E-stop is pressed, the stop button on the run screen clicked or the M30 (program end and go to first line) command executed. Again, it took many hours to find why the simple M3 (spindle clockwise on) and M5 (turn it off) commands just would not work. There is a tiny led mounted on the BOB to show when the relay is active so it was easy to see the M3/5 was working even without a power connection to the machine spindle, so it had nothing to do with the wiring of relay 1 or any of the mains connections. Trawling the forums shows this is a common problem.

I re-installed Mach3, fiddled with the connections on the BOB, tested, pulled hair, yet more hair out and couldn't sort the problem. Eventually I found a bit in the forums where a guy needed to be able to do something with the spindle start and ramp up the speed slowly. The solution he was told was to put some Visual Basic script into the M3 macro. Uh??? There's a macro?? Looking in the Mach3 folder on the computer revealed a macro sub folder and opening this revealed two more folders: 'Mach3 Mill' (the original profile with the program) and 'Sieg Mill' (my profile). Opening either shows a load of macros, some titled with the M codes, but they were all completely empty when clicked on especially the M3, M4 and M5 macros (the motor controls).

Why are mine empty? Well the problem is simple. When you start Mach3 installation the manual tells you to create a new profile. This means that the original profile setup is always there for you to go back to. The Sieg mill (profile) created by me holds all the machine settings slavishly

created when setting up, i.e. most of the entries you have made in the Config. section about motors, inputs, outputs etc. (Mach3 updates and saves copies of this very frequently.) So you make your own profile but there's information missing. Select the original Mach3 mill profile and view the M3 macro - it reads thus: DoSpinCW()

This is Visual Basic (VB) script with an obvious function. In English: 'Do (an action) turn on the spindle please and make it run clockwise'. M4 read - yes you guessed it - DoSpinCCW(). Okay in American...

These were put in to my Sieg Mill profile and **YES** it works! Only when you press the start button on the miller itself though.

A great feeling of satisfaction resulted and a good malt was called for! However, I got clever and added another line. The spindle on the Sieg takes a while to start up, about 2-3 seconds. As the program goes fast at the start while the G0 initial positioning takes place, the last thing we want is to have an almost stationary spindle running into the work piece so an extra bit of code was added, adapted from entries in the forum post indicated above, so both of my M3 and M4 read the same with an additional line: 'G4P3.7'. To do anything in Mach3 we need a G or M code. G4 is the dwell (pause) command while P is the parameter. In this case the program will wait 3.7 seconds before the next line is executed and so the spindle has time to wind up to full speed. Then the slides will move with the next command.

All this is now so simple but as you can see it was difficult to find. But you have the benefit of the hours I spent! (I have no knowledge of Visual Basic but did a

lot of programming of BBC computers in the late 80's.)

But we still ain't there. We have a signal from the BOB triggering Relay 1 but there isn't a direct connection to the motor and the original machine spindle ON button still has to be manually pressed. So, opening up the control box, I thought it would be an easy matter to just add the power wires direct onto the main control board. Ahem. An exploration of this box showed it was a big NO NO - lots of wires going between the main board and the motor, all black and not a single one of them marked! I was not under any circumstances going to mess with that.

However, the switch box was a different matter. This was opened and a careful examination of the push button switch showed which are the mains input to it and the ones which are the outputs - it's printed on the side of the switch. The wires were labelled so they could be replaced, photographs taken and the wires removed from the switch to enable them to be permanently jointed in yet another a connector block. There's only one strange wire - it's connected to the green lamp on the front of the switch box telling you the spindle is switched on to revolve.

After checking and re-checking, the M3 was put in at the MDI and - lo and behold - the green light came on and the spindle started. There is a small delay as the Sieg control board gives a ramped gentle acceleration. The connector block was then carefully wrapped in tape for protection, a small cover was fitted where the switch was removed and another task was completed.

Photograph 47 shows the switch itself.

One of the limitations is that the spindle speed still needs to be set manually but this is not a problem. I understand



The original discarded Sieg switch. All that has to be done is use a connector block to join Neutral, 23 and 24 together, Live 13 and 14. The current to the green ON lamp on the Sieg switch box is connected to 14. The symbol onto A1 from 14 is for the switches own internal relay latch, no longer needed as the mains current comes directly from the spindle relay in your control box. Important! Put a cover on the hole in the control box.

there is an add-on board to solve this problem but if your CAM software has the correct data for the material being worked on you can see the required speed in the Program Run screen.

Suds galore

The pump was connected and off it went, with both coolant and spindle working perfectly. Over time, you will need to stop the execution of a program by pressing the stop button on the Mach3 screen (here I am not talking about the emergency stop). Perhaps some small adjustment has to be made or the doorbell rings. To restart the program you cannot just press cycle start again, as the spindle will not be running but Mach3 doesn't know this so will move the slides as if it is running. Goodbye to another tool! There are two solutions.

1. Manually start the spindle but in this case there's no coolant and at the end of the program it will also have to be stopped manually.

2. Go to the MDI input line, click it, enter an M3 code, return to the 'Program Run' tab and then click cycle start. In this case you return full computer control and it

all stops at the end of the program (or pause, or tool change).

Question, for method 1, is this a good reason to have a three position switch for the pump, perhaps 'On with computer control', 'On with manual control' and 'Off'? Care would be needed here with the type of switch. A centre-off would be needed and the toggle type avoided which are easy to set off accidentally, which could give you a bath! A common trick in the school workshops was for the kids to leave the pump switched on and the coolant pipe pointing at where your head would be, ready for the next user switching on. The pump runs and ... splash! ... lots of giggling...

I am not giving blow by blow instructions for setting up. These were very well covered by Peter king from New Zealand, starting on 8 June 2016 M.E.4525, page 110, but I will show some worked examples (mainly graphical) at the end of the series. In addition, I am not detailing the motor covers, bellows and enclosure, all essential in the harsh environment of a self-acting machine.

To give you some idea of the capabilities of the machine the working envelope is big for a



The mock-up for the rejected front containment. The two central pieces fold back but access was poor due to the bench height of the machine and it dripped when stored open.

small CNC machine. The table movement is 137 x 318mm but this can be increased by 40mm if the bellows are removed. Spindle to table is 340mm, all of which is available. These dimensions are greater than the KX3 except for Z movement which ranges from 355 to 80mm, spindle maximum to minimum position. One of the great things is the ability to get the head fully down to the table, which is very useful when using tiny cutters in R8 collets.

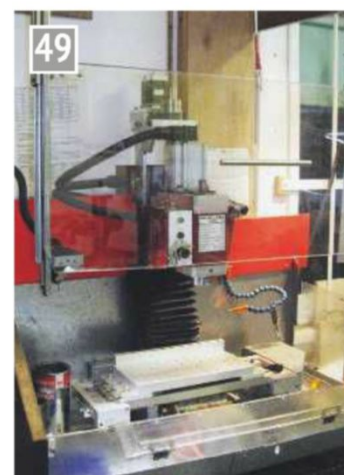
Putting a lid on it

This concludes the manufacture and setting up the machine. However, some details of motor covers and containment are called for. Originally, I was very pushed for space and arranged a self-acting spring loaded door for when at full X travel and used a folding door arrangement at the front, two hinges on the right, one on the left onto the end fixed parts. The mock-up is in **photo 48**. This worked well but coolant splashes from the underside when the doors were open ran down and dripped overnight onto the keyboard. In addition, the access to the machine table was restricted making setting up and cleaning difficult.

So, the design was changed for a pull-down screen which is held up with a simple DIY catch and a counterbalance

weight behind the machine. It runs on triple extending drawer runners hanging from the ceiling (**photo 49**) but the hinge down bit at the front works very well and was retained. The screen drops down on the inside of the front screen giving easy access and complete shielding from splashes.

The tray and back splash was made from available materials but had to be enlarged upwards with a sheet of Foamex board, Note all the screens are made from 6mm polycarbonate. **Under no circumstances should Acrylic or Polystyrene be used.** Polycarbonate is used as



The current containment screen. It is pulled down from the ceiling on ball bearing extension drawer runners. The plywood column contains the balance weight, working through simple pulleys to guide the cord.



50 My sprung double folding end door (tape on the top for clarity), arranged so that the linisher, which was originally on the right before the workshop was extended, had elbow room.



51 Forming the right-hand half of the upper drip tray, which drains into the oven tray shown earlier.

anti-vandal glazing and is virtually bullet proof so safe in a machine situation; this is not so with the others, which are extremely brittle.

Photograph 50 shows the space sharing right end arrangement. **Photograph 51** shows the forming of the left side of the drip tray (and gosh, wasn't my old workshop bench tight for space!). **Photographs 52** and **53** show the motor covers. The left one is built into the splash back and both are open at the bottom for ventilation.

Finally, **photo 54** shows the modified box spanner with built in hammer for releasing the R8 collet. It is stored in a tube mounted on the left of the miller head utilising holes left when the fine down feed was removed. The spindle lock used in conjunction with this tool is held in spring clips fixed onto the top of the original switch box. I try to be disciplined to put them back immediately after use. I stress the word try...



52 The X motor cover. Angled to clear the door shown earlier.



53 The Y motor cover built into the left-hand splash back, which is fixed to the back of the column.

NEXT TIME

I will cover the vexed question of tool offsets and inputting them into the tool table. I have devised a very simple system for this, enabling off machine tool setting.

●To be continued.



54 A modified box spanner for tooling release complete with a turned bobbin pressed in for a lightly weighted hammer.

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EVERY 3 MONTHS



SAVING 80%
3 ISSUES FOR £3
THEN £11.45
EVERY 3 MONTHS



SAVING 80%
3 ISSUES FOR £3
THEN £11.50
EVERY 3 MONTHS



SAVE 86%
5 ISSUES FOR £3
THEN £15.25
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SAVE 80%
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THEN £11.25
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The Barclay Well Tanks of the Great War PART 51

Terence Holland describes and constructs two appealing, century old locomotives.



Continued from p.113
M.E. 4616, 5 July 2019

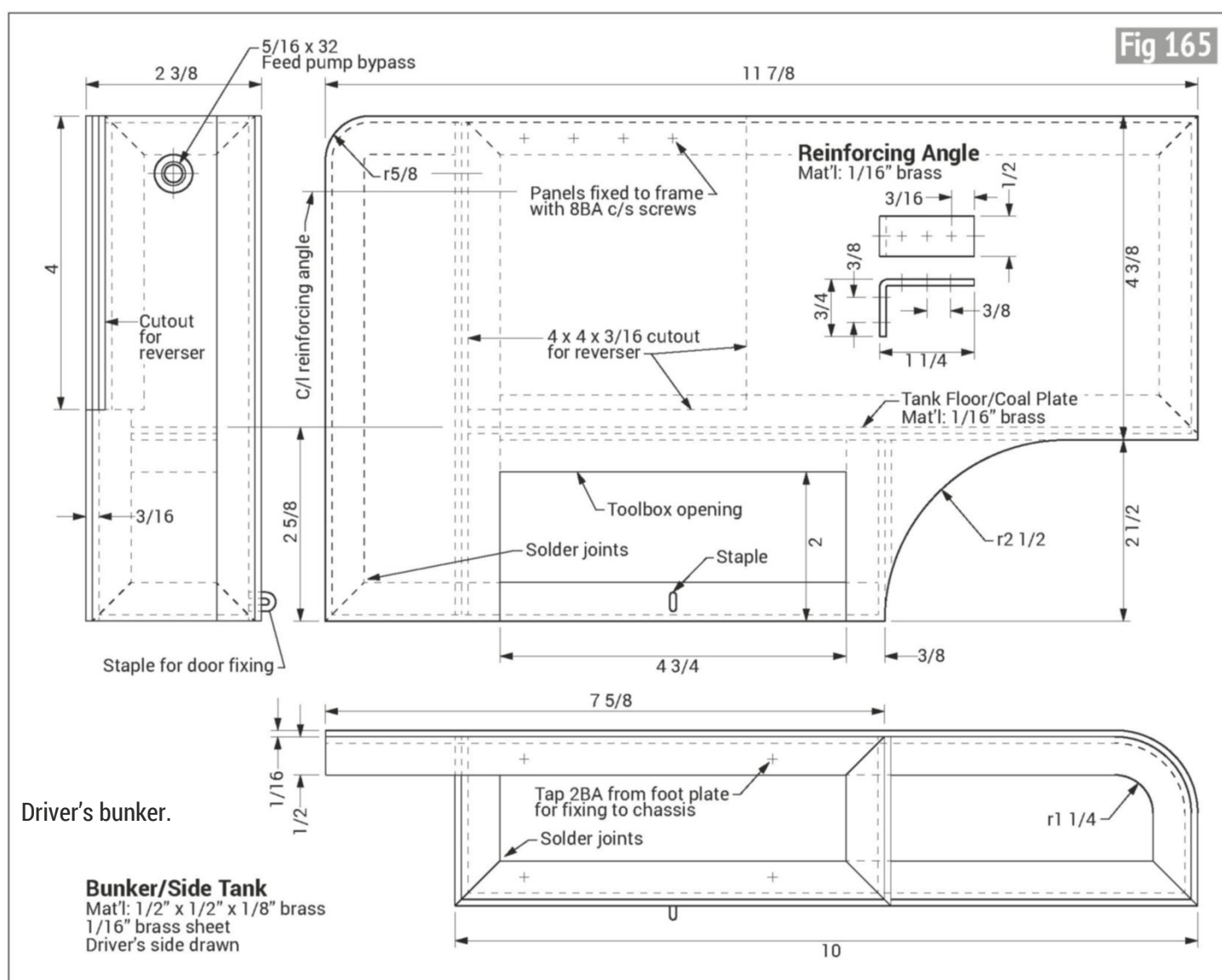
This constructional series addresses Andrew Barclay 0-4-0 and 0-6-0 narrow gauge locomotives supplied for use in the First World War. Built without the use of castings, the 0-4-0 design is described as two versions; as-built for the British Admiralty in 1918 and as rebuilt and currently running on the Talylyn Railway as their locomotive No.6, *Douglas*. The 0-6-0 engines described were built in 1917 and operated on 60 centimetre gauge track at the Western Front in France. These were small, spartan machines of which only 25 were supplied and none have survived into preservation.

Now that I have got those 'confessions of a loco cleaner' off my chest we can carry on with construction.

Bunkers/side tanks

These so-called side tanks for *Douglas* are actually bunkers on the prototype, which carry no water. As can be seen from

the drawings etc. the left hand bunker holds steam coal, whilst the right hand bunker on the full-sized engine is more or less empty, but is used to hold



the driver's oil cans and other various tools. Note that they are of fairly stout construction; $\frac{1}{16}$ inch thick brass sheet on a framework of $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{8}$ inch brass angle (figs 165, 166 and 168). The thickness of the cladding might seem a bit extreme but my recently refurbished tanks are still dent-free some 50 years after construction. And, of course, any extra weight with a steam locomotive will improve the traction between wheel and rail – although offsetting this is the fact that the locomotive will have to be lifted on occasion (notwithstanding the price of brass). The cladding could be reduced to $\frac{3}{64}$ or $\frac{1}{32}$ inch without causing a problem.

These tanks/ bunkers are complicated by the need to incorporate toolboxes and, on the driver's side, a cut-away for the reversing lever. The top of the toolbox provides the coal plate in the fireman's bunker and the base of the water tank on the driver's side. The opening for the toolbox

doors are cut slightly wider than the door panels which fit flush. The bottom of the door fits on the exposed $\frac{1}{2} \times \frac{1}{2}$ inch brass angle which is fitted with a staple made from $\frac{1}{16}$ inch stainless rod. A corresponding slot in the door panel allows the door to be closed in place using home-made retaining R-clips. The door hinges are commercially-

available brass items (as are those on the bunker lids), riveted in place with $\frac{1}{16}$ inch diameter copper rivets.

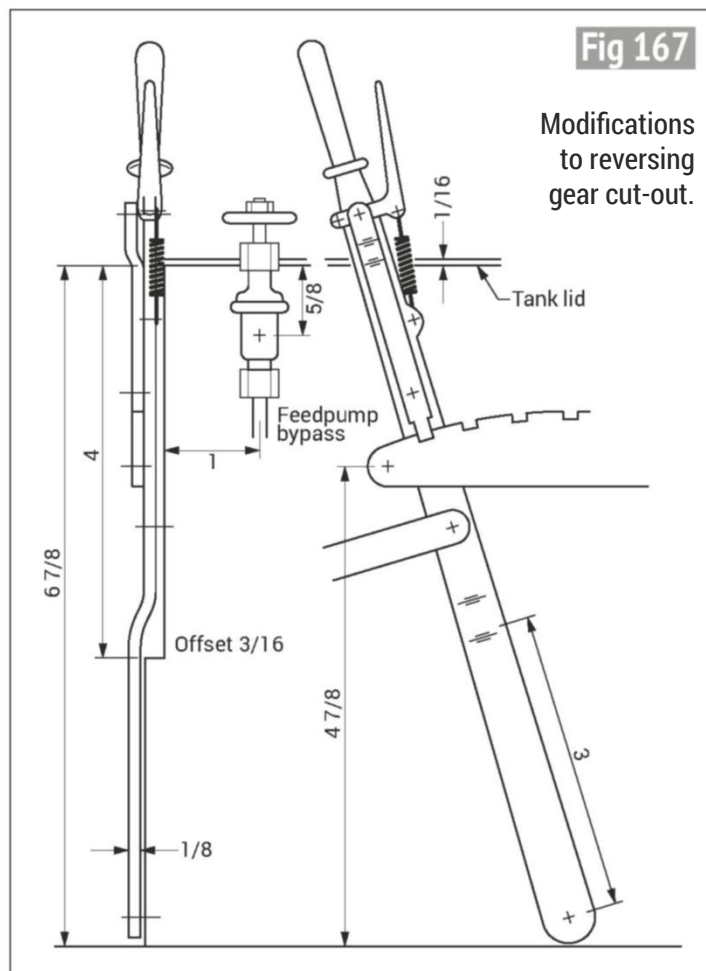
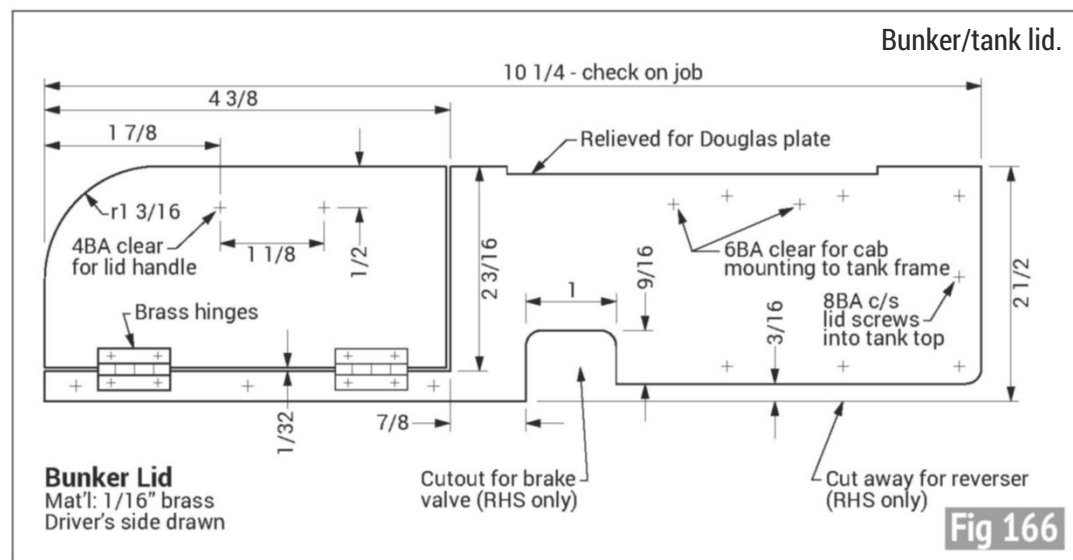
Once complete, the driver's bunker/ tank should be sealed with soft solder; this is only necessary on the right hand side, where the bunker is used as a water tank; i.e. the header tank for the driver's injector.

As an alternative material, galvanized steel sheet could be used, but it is unlikely to be so durable as brass. The zinc coating, of course, allows it to be soft soldered where sealing is required and the layer of zinc will give good corrosion protection.

The panels are fitted using 8BA brass countersunk screws at 1 inch centres. The heads are filled in with soft solder, prior to sanding flat and painting. The tank has a water capacity of 2 litres, which will enable the injector to add

about one third of a glass of water to the boiler. **Photograph 237** shows the driver's tank without the lid but fitted with the steam brake valve and its plumbing, complete with PTFE-lagged steam pipe. Note that the $\frac{1}{2} \times \frac{1}{2}$ inch brass angle is cut away under the bunker lid. For *Douglas* only, the left hand fireman's bunker is slightly wider than its opposite number. This is because extra width is required on the fireman's side to fit the sliding coal door. The right hand bunker is narrower to allow as much room as possible for the reversing lever and its fixing. The extra width on the left hand side (for the coal bunker door) is not necessary for *ACC No. 1* so, if preferred, that bunker can be made the same width as the driver's; i.e. $2\frac{3}{8}$ inch wide.

Figure 165 shows details of the driver's bunker, which, as mentioned earlier, is sealed



Driver's tank and steam brake valve.



238 Cut-out in driver's side tank.

to provide a head tank for the driver's injector. The cut-out shown on the inside of the tank is to allow room for the reversing lever as shown in fig 92 (M.E. 4575, 8th December 2017). The drawing got a bit complicated at this point but **photo 238** shows what is required.

In photo 238, the three copper rivets inside at the top fix a small angular piece of reinforcing brass. On the model most of these need to be cut away to allow fitting

of the coal bunker door (on *Douglas*) and to allow fitting of the brass bush for the pump by-pass valve (on *Douglas* and *ACC No. 1*) so they can be left out if desired. These reinforcing pieces do, however, result in rivets showing on the outside of the bunker.

Bunker lids

The bunker/lids are shown in **fig 166** (driver's side drawn). Note that both lids should be cut away to fit the nameplates. The lid on the driver's side also



239 Completed tanks.

has a cut-out for the steam brake valve and is relieved $\frac{3}{16}$ inch over the tank cut-out for the reversing lever. Only the cut-out for the regulator is required for *ACC No. 1*. The lids should overlap the tanks by $\frac{1}{16}$ inch on each side and at the ends – so check the actual dimensions on the job once the bunker is complete.

As mentioned above, there is a small correction required to fig 92 in that the height of the tank top was drawn incorrectly. The cut-out dimensions and

position of the bend in the reversing lever should be as shown in **fig 167**.

Photograph 239 shows the tanks after painting and lining complete with hand-painted Tallyllyn 'transfers' – more of which later.

● To be continued.

NEXT TIME

We look at the cab and spectacle plate.

ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE

● Steamy Weekend

Confession time for Geoff Theasby as he tells us all about his weekend in Sheffield.

● Muncaster Engine

Jason Ballamy creates a set of columns for his stationary engine.

● New Lanark

Roger Backhouse's latest Engineer's Day Out takes him to Arkwright's mill on the River Derwent.

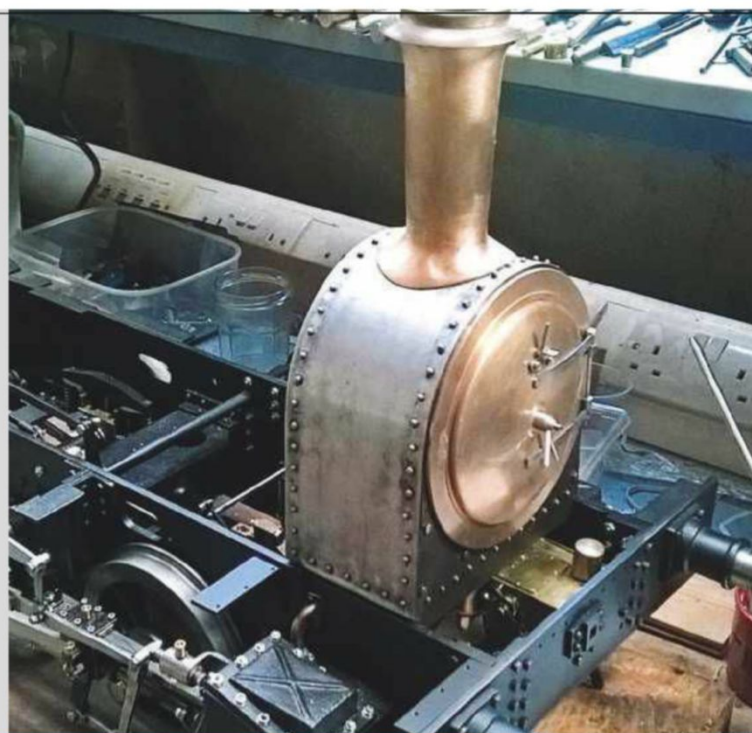
● Beam Compass

Stewart Hart needed to draw some large arcs and so made a beam compass to do the job.

● Bridget

Jon Edney constructs a $7\frac{1}{4}$ inch gauge Bridget, to Ken Swan's design.

Content may be subject to change.



ON SALE 16 AUGUST 2019

Muncaster's 'Simple' Entablature Engine PART 1

Jason Ballamy presents a rarely modelled engine suitable for a beginner.



Background

I remember driving over to Cherry's of Richmond some time in my late teens, I can't recall exactly what for but it must have been to get something for my first steam engine, a Stuart 10V that I was building at the time. Whilst there I bought a small booklet with the title 'Model Stationary Engines - Their Design & Construction' by H. Muncaster (ref 1).

There are some nice looking engines in the book but you seldom see any made even though copies of the book have been available on the internet for many years. I suspect that this is due to the lack of detail as most only have one or two elevations of the general arrangement and lack details for some of the individual parts. Recently some metric drawings have been posted on the net and a few engines from these have started to appear.

Back to my own tale. At the time I only had a small Emco Unimat 3 so most of the designs shown were outside its capacity but I was rather taken by a couple of general arrangement drawings of a 'simple' entablature engine. Well, I only got as far as blowing up the drawings on the photo copier at work to a size that would suit a Stuart 10V flywheel before a bigger lathe and other engines came along and the drawings just sat in a file.

Fast forward about 30 years and armed with a bit more experience under my belt and having recently completed the 'Jowitt MkII', details of which



3D rendering of the design.

can be found on the *Model Engineer* website, I fancied making something else of similar size that could be mostly done from bar stock but, like the Jowitt, have the appearance of an engine from castings without the costs or worries of a beginner about mucking up an expensive part.

The model

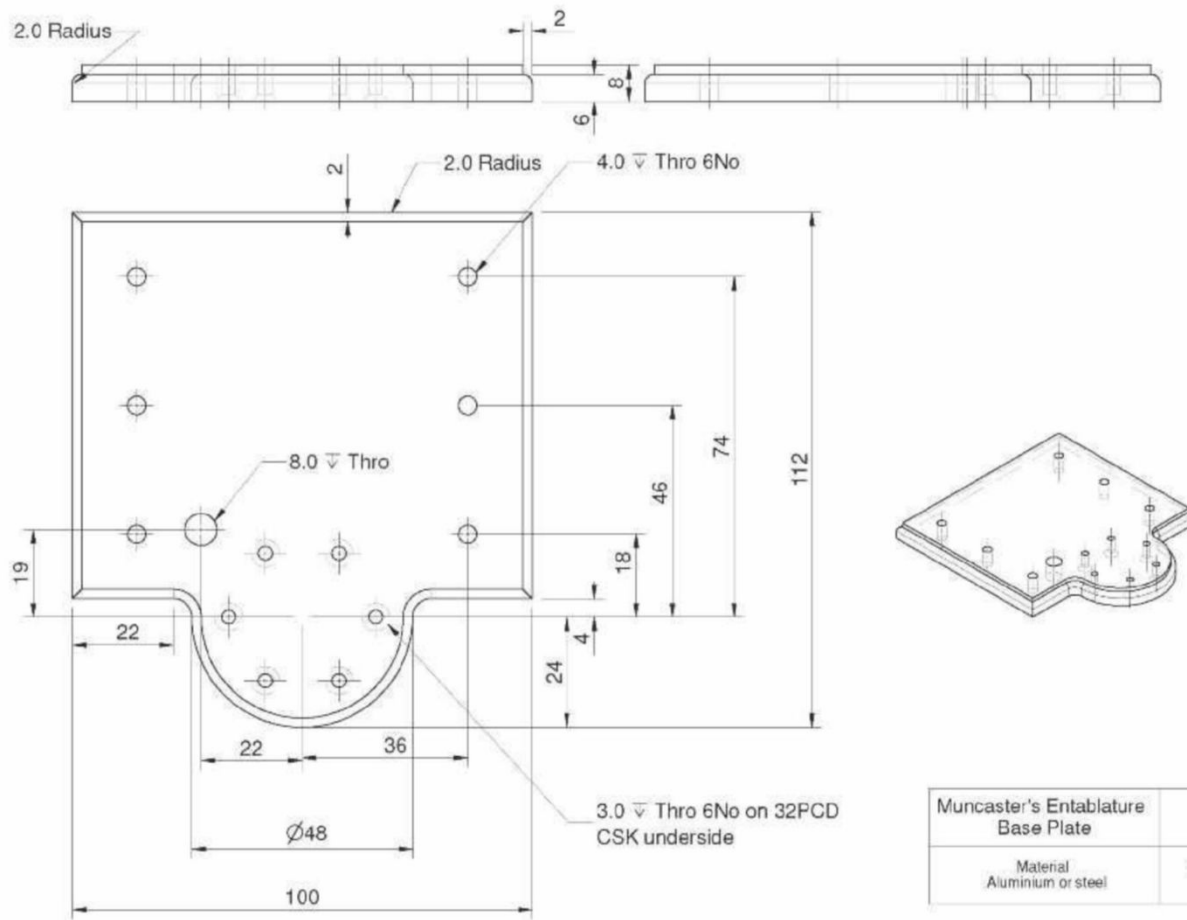
Looking at the old book again and bearing in mind that if I was going to aim my efforts at the beginner I should use metric rather than Imperial measurements, given that the average first lathe is now the ubiquitous 'Mini-Lathe'. I also

upped the bore from $\frac{3}{4}$ inch to 24mm. This makes it quite easy to scale the remaining few dimensions in the book using the ratio of $\frac{1}{32}$ inch equals 1mm. The resulting engine stands 147mm to the centre of the crankshaft and has a 114mm diameter flywheel.

It did not take too long to draw out the basic design in *Alibre*, which is the CAD package that I use. The main parts that took a few edits and alterations were the cross head guides, to ensure that the con-rod did not foul them. Once I was happy that all went around as it should, on the screen at

Additional content and discussion about this build can be found at www.model-engineer.co.uk/forums/postings.asp?th=139596

Fig 1



least, a set of 2D drawings was produced from the 3D modelled parts (**photo 1**) and some swarf made. As I went along any slight alterations were noted on the drawings for subsequent revisions.

Another engine has been built by a relative newcomer to the hobby to the drawings in this series to prove them and it runs very well on both air and steam.

I have not included all of the photographs taken during the build but will post these in a thread on the *Model Engineer* forum as the build series progresses. This thread can also be used to ask any questions and also hopefully to show your own progress. Also feel free to ask about alternative construction methods if you don't have some of the equipment that I have used, alternative materials, etc. A link to my engine running can be found at the end of this article (**ref 2**).

Base (fig 1)

I have specified 8mm thick material but this is not critical and if you don't feel up to milling the moulding around the top a sandwich of say 6mm and 2mm plate could be used with the top corner of the lower plate rounded over by filing. Cut out a piece a little over size and clamp to the mill table with some sacrificial packing underneath and mill to overall size; the clamps will have to be moved one at a time and repositioned to allow this.

Locate the position of the cylinder's centre point, which I have used as the datum for measurements, and zero your dials or DRO. The various holes can now be drilled plus a central drilled hole to aid later location (**photo 2**). Next, the decorative moulding can be added along three sides or all four if you don't want to include the 'D' shaped end to the base. This can either be



Squared up and drilled base.

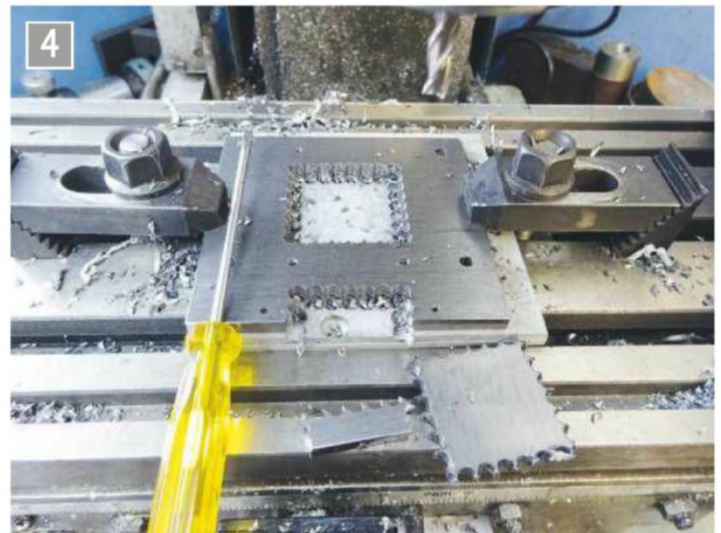
cut with a commercial round over bit or, as I have done here, by free hand grinding the corners of a blunt milling cutter to the desired profile.

To create the shaped end around where the cylinder will stand mount the base onto a rotary table and with an 8mm

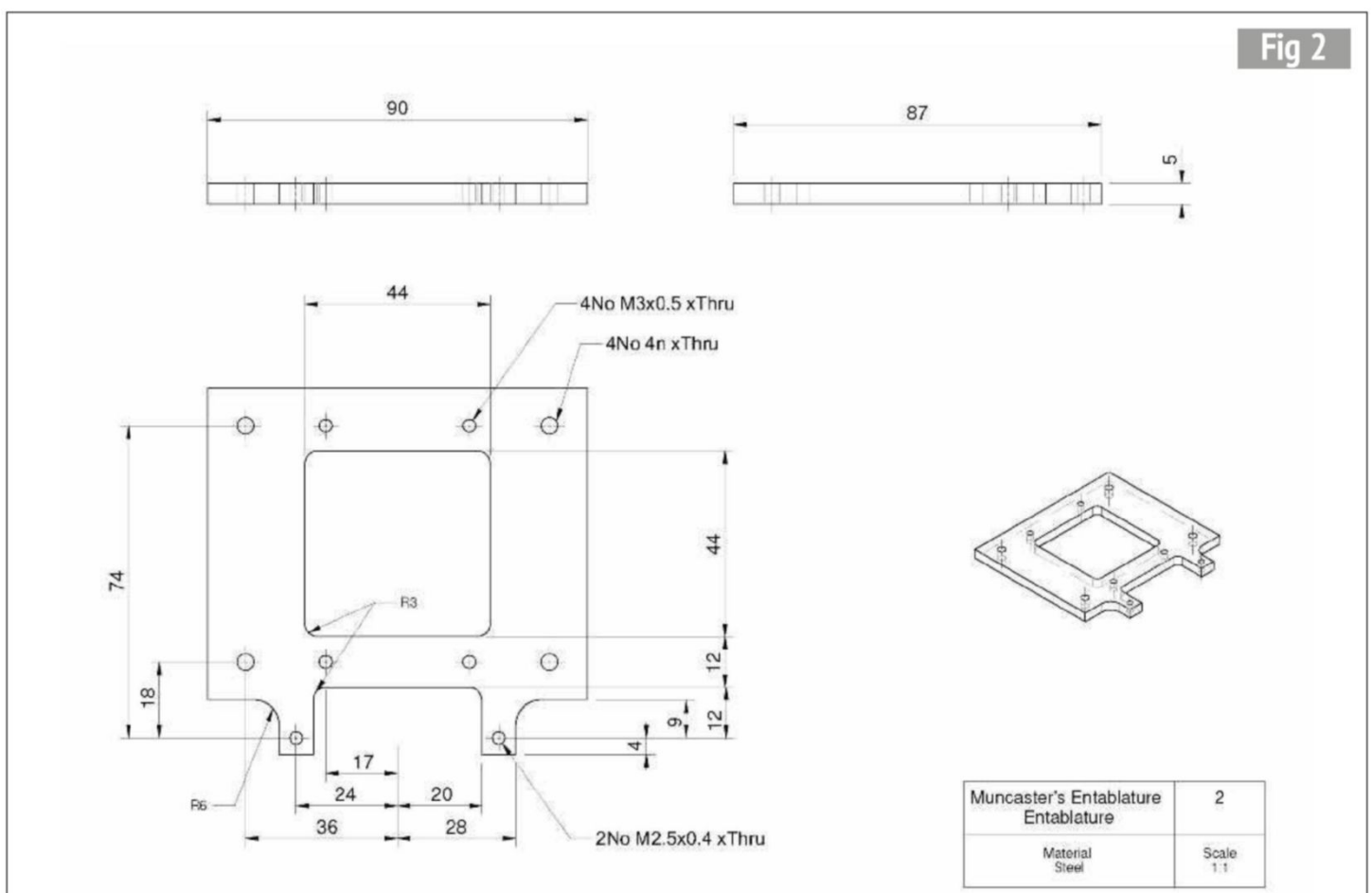
diameter cutter form two slots 22mm in from the edge, followed by the curved cut. Then pop the round over bit back in and mould the edge (**photo 3**). The final job on this part is to countersink the underside of the six cylinder mounting holes.



'D' shaped end machined and profiled on rotary table.



Entablature waste material removed by stitch drilling.



Entablature (fig 2)

This can be treated in much the same way as the base by milling to overall size then drilling and tapping the various holes. While you still have the drill chuck in the machine the two main areas of waste can be stitch drilled just shy of the line and flicked out with a screwdriver (**photo 4**). The final profile can then be cut with a 6mm bit for the two large cut

outs and a 12mm diameter one for the corner ones (**photo 5**).

●To be continued.

REFERENCES

1. Tee Publishing:
www.teepublishing.co.uk
2. Running engine:
www.youtube.com/watch?v=bHxmMZFXyOY



Entablature machining complete.

National Model Engineering Exhibition 2019

Club Stands Part 2

John Arrowsmith reports on the club stands and displays at the recent Doncaster exhibition.



Continued from p.181
M.E. 4617, 19 July 2019

Outside, the **Doncaster Steamers** were operating each day but their numbers were reduced from last year as apparently there was a clash of events which took its toll on the line up here. However, there were some nice models in action entertaining the visitors. It is always good to be able to get up close and talk to the drivers and owners and watch the steaming preparations etc. The little 3 inch scale Atkinson Uniflow Tractor (**photo 48**) built by Graham Sadler is always a good engine to see in action. Each day had a different selection of models to enjoy and the 4 inch Foster owned by D. Lidster was a well finished model which was steaming well (**photo 49**).

The smaller railway groups provided their usual regular operations with a variety of



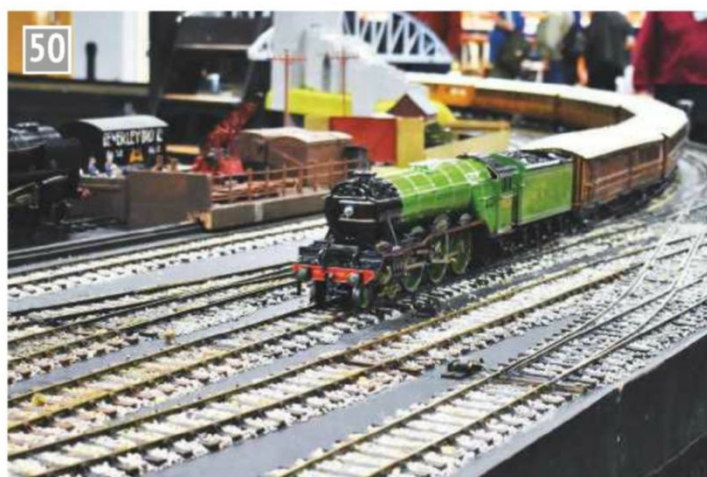
A contemplative Graham Sadler waits for the pressure to rise on his Atkinson Uniflow engine.

locomotives and rolling stock making up the trains. The **OO Live Steam Group** were again demonstrating these fascinating small steam powered locomotives providing lots of interest for visitors. The **Gauge 1 Model Railway**

Association had their portable layout 'Ridings' in operation and this had a veritable feast of locomotives of many of the different railways being put through their paces by the operators (**photo 50**). It was good to see on the



Plenty of atmosphere from the 4 inch scale Foster traction engine.



Flying Scotsman with a rake of teal coaches approaches the station at speed on the Gauge 1 MRA layout.



A first model for 9-year-old Jordan Allen from the Rotherham DMES.



Fourteen-year-old Elliot Boulton from Rotherham helped his dad build this Flower Class corvette.



Part of the large aircraft display by the Doncaster MFC.



The Avro Lancaster on the Doncaster MFC stand.



The large working layout from the Durham Model Truck & Construction Club.

Rotherham & District MES stand a contribution from the younger members of the club. Nine-year-old Jordan Allen had built, with help from the senior members, a nice little 5 inch gauge battery powered shunter (photo 51). If this young man carries on in this way he will become an excellent model

engineer. Another fourteen-year-old Elliot Boulton helped dad Trevor to build a nice example of a Flower Class corvette in 1/72 scale (photo 52). A wide selection of marine craft on the York MBC provided lots of interest for spectators with some classic models both motorised and wind powered.

The Doncaster Model Flying Club stand (photo 53) which was located on the upper floor area provided a very wide range of aircraft from large military types to small single seater planes. A large Avro Lancaster built by D. Burton was an impressive machine which looked good and ready to fly (photo 54). The Guild of Model Wheelwrights had their usual colourful display featuring many types of horse drawn wagons, carts and military vehicles, which does show how society's needs have changed over many years. The little field kitchen built by Brian Young illustrates this clearly when you see modern military vehicles.

The Durham Model Truck & Construction Club again provided a large working display of their r/c model trucks and assorted vehicles and showed just how

sophisticated some of these modern models have become (photo 55). Adjacent was the Kirklees MBC Military Vehicle Section with an array of many different military trucks, support vehicles and tanks (photo 56). An attractive display by the Erewash Valley MES (photo 57) showed off some excellent models in a number of different gauges all overlooked by a 1/4 scale Mustang aircraft. A popular display by the Stirling Engine Society showed off the tremendous variations and applications these machines can be used for, from cars to canoes and many other forms. Julian Woods displayed the three separate engines from his canoe (photo 58) which he was able to demonstrate with the use of a small camping gas bottle. Also on the stand was an intriguing spot welder which utilises an old micro



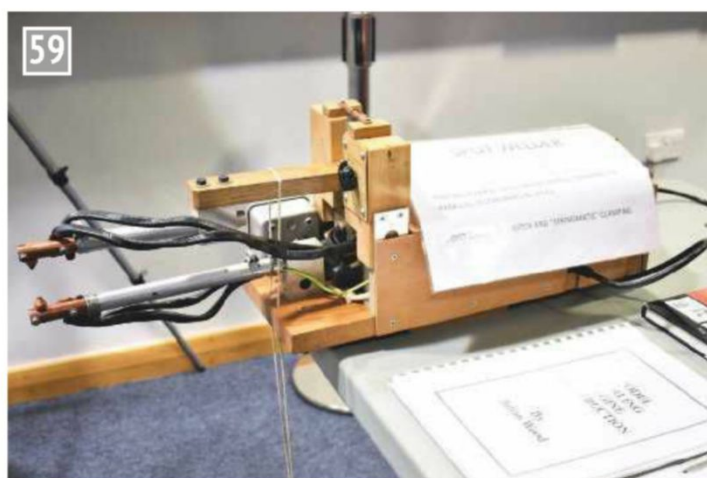
A fine line up of military vehicles from the Kirklees MBC Military Section.



Erewash Valley provided a compact and interesting display.



The three Stirling engines from Julian Wood's canoe.



A novel use for old micro wave oven electronics was this small spot welder.

wave oven system. Capable of welding 1mm metal it was an interesting use of recycled material (photo 59). The display by the **Spenborough Model & Experimental Engineers** (photo 60) contained a good variety of locomotives both complete and under construction in a number of different gauges.

Well that just about sums up this year's Doncaster Model Engineering and Modelling Exhibition, I hope this brief view gives you a flavour of what was on show and encourages you to attend next year. I must thank the organisers, Lou and Gavin Rex for their help and hospitality and to say – gentlemen, you organised another first class exhibition which covered just about every discipline you could think of. In addition to the model displays the traders deserve a big vote of thanks

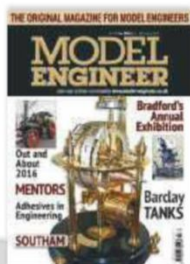
for providing a first-class selection of materials, models and accessories. Looking forward to 2020 and another great exhibition.

ME

Locomotives dominate on the Spenborough MES stand.



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CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.



I bought a defunct London Clock Company carriage clock for £2.50 at a model engineering club stall. The clock was quite clean and smart, run by an electronic movement, so it had possibilities. At home I investigated and found that the 'U11' or 'C' battery was still in it, though flat as a great big flat thing, bearing the legend 'Government property NSN 6135-99-117-3212', which was rather careless of the previous owner. The stock number revealed correctly that it was an MN1400 battery. Anyway, I replaced the movement (also £2.50) and it worked again! Piece of cake! It now resides in our dining room.

The Baltic Quiz League – or - a Moveable Fiesta... On our recent sojourn around the Baltic, aboard the good ship *Balmoral*, we entered the twice-daily quizzes, in a team varying from just me, to Debs, Bert, a Gurkha officer and the fragrant Kirsty, a knitter from Dunfermline. We got 1 First (that was just me!) about 9 Seconds and took it to a tie-breaker five times. Bert knew Major Lumley (Joanna's Dad). I think we left our mark (or kroner, rouble, euro etc.).

In this issue: Latin homework, the HST, a new site, on declining flying, spring, smile, SPADs and a honeymoon.

I don't wish to steal John Arrowsmith's thunder, reporting on the Sweet Pea rally, but here is David Everingham in the post of St Peter at the recent Sheffield event (photo 1).

Worthing & District Society of Model Engineers' Newsletter, summer, says that their Chairman, Kevan Ayling (who likes them big) has built his first traction engine. It is a 4 inch scale Foster 7NHP, built from a set of drawings, complete with 72 dimensional errors, and took him over four years to build. Derek Betterton writes on the history of the Thomas Tilling empire, beginning with its hybrid petrol-electric buses built by Tilling Stevens. Mike Wheelwright discusses link motions by Allen, Stephenson and Gooch. John Stoton continues his life story, having been almost the only SKEFKO recruit who had visited Göteborg. Then he worked with Vauxhall who were designing a new small car when times were quiet. This eventually became the *Viva*. In wartime bearings were vital, so a 1000 bomber raid attacked

Schweinfurt. This delayed production by one week! Early in John's National Service, many of his young compatriots sobbed themselves to sleep. Enduring this period of adversity was easier if you did Latin homework at school, he says. Learning how to bayonet Russians had declined in his priorities by the time he worked with them in Helsinki.

W. www.worthingmodelengineers.co.uk

Port Bay Express, June, from **Portarlington Bayside Miniature Railway**, has a feature, 'Camera Corner', showing the shop staff, attired for some reason in Saturn Yellow hi-viz vests, ready to sell a comprehensive range of goodies. Shouldn't they have hard hats too? If you want more, they are on Facebook.

W. www.miniaturerailway.com.au

Ryedale Society of Model Engineers, Monthly Newsheet, April, discloses that Editor, Bill Putman drained the motor mower's gearbox, expecting 2½ litres to appear. Only 1 litre did so. Refilling was slow, as the oil viscosity is very high and it doesn't flow well down a funnel. Eleven mains plugs need replacing with 'shielded pin' types to conform with the latest regulations. Ex-junior member James Conway has passed out as a fireman on the NYMR. The May issue reports that Bill Putman cut the grass and redistributed the molehills to confuse the moles. A party of students (Seraphim, perhaps, but no Cherubim under 12) from Ampleforth college descended on them so the club Diesel was fired up and they were given rides (Widdershins? - Geoff). The May Rally went well, although Chairman, Bob Willis, who was signaller in Gilling box, had to be restrained from lynching the perpetrators of SPADs. Mike Earnshaw was shunting in the hump yard when the Class 13 master-slave locomotive pair failed and he had to make do with a Class 56. A column of thick black smoke to the north puzzled those present but it turned out to be an articulated



'St Peter' for the day at Sheffield SMEE.



J21 RSME (photo courtesy of Bill Putman).

lorry cab unit which burned out. Afterwards, an email of thanks was received, from one who would like to attend again, but cannot in August as he will be on honeymoon. At least he got to the railway first! This photograph of Graham's NER Class C (J21) No. 22 is rather nice (photo 2). Editor Bill Putman says "Graham is primarily a Gauge 1 producer who has a considerable following. His 7¼ inch gauge NER class 'C' is a regular and completely trouble free performer at Gilling each month, a definite Rolls Royce of a machine. I am eagerly awaiting his *Jumbo* 2-4-0 currently under construction in 7¼ inch gauge".

W. www.rsme.org.uk

The Link, May and June, from **Ottawa Valley Live Steamers & Model Engineers**, has arrived, in which Ken Round discusses his small 7¼ inch gauge Garratt locomotive. The use of aluminium for the platework was notable. Galvanic interaction 'twixt brass and aluminium was hopefully avoided by mounting the manual feed pump on a Tufnol block. Bowden cables for controlling the valves on the front engine were tried and abandoned. They were tricky to adjust and prone to damage when separating the units for transport.

Prospectus, June, from **Reading Society of Model Engineers**, begins with a fine photograph of Quinn driving the new club *Polly* on its first

outing. Mum, Jackie, does not seem impressed... '61249' was invited to travel on the last HST in GWR service. He delves into what made this train so successful. Following the failure of the APT, on which too little was spent, the HST put engineering first, especially the bogies. These were designed from scratch, rather than cobbled-up modifications to earlier designs. The complex kitchen and bar equipment worked well, apart from the tally counter tracking beer sales. Power cars put the big bits at the ends, which left the coach undersides free for plumbing and air conditioning. One mistake? Slam doors. John Spokes visited the French Railway Museum at Mulhouse. French philosophy, it seems to John, was 'if there is space, fill it with something complicated'. This is illustrated by the duplex feedwater pump on a 1952-built 241 P16 (photo 3).

W. www.prospectparkrailway.co.uk

Stockholes Farm Miniature Railway *Newssheet* for June, begins with some very sad news – the cement mixer has died. After providing sterling service for over 30 years, it has gone to that great builders' yard in the sky. It has ceased to be, it is an ex-... (stop that!). A video has been made of the Easter Day event, and can be seen on YouTube under 'Caroline Steam'. Select 'videos' then the railway name and 22 April. The Open Day in May was very busy and the tea

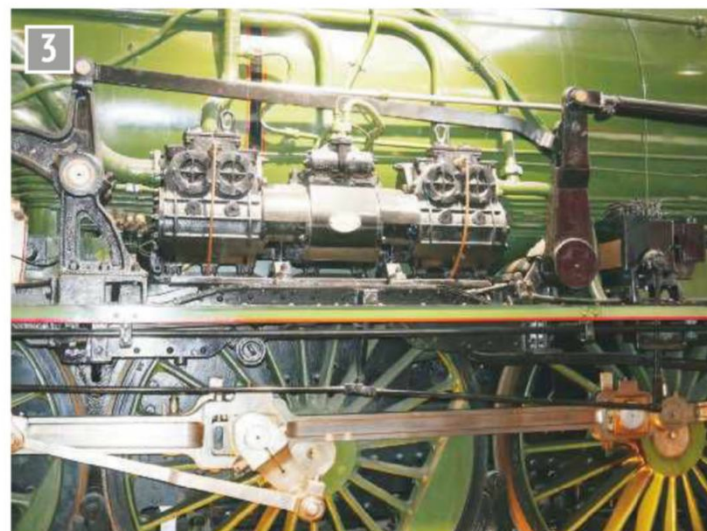
room sold out of everything by mid-afternoon!

W. www.sfmr.co.uk

Another picture from Chesterfield SME Open Day; this locomotive *Recuerdo* (trans. 'memories') is a *Juno* design, built by Derek Crookes and is available as a kit from Model Engineers Laser (photo 4).

The Oily Rag, spring, from **Taunton Model Engineers**, brings great tidings! They now have their own four acre site near West Buckland. Being made to feel unwelcome at Vivary Park, the quest began, eventually reaching 28 locations reviewed. Finance was a problem but after clandestine discussions with certain members, the money was pledged or raised without external negotiations. Planning permission was however refused. Oh no! It was thought that the villagers would not

approve such a development but a survey and publicity blitz, with neighbours closely consulted, brought a very positive response. Offers of construction help were made and, finally, in February the scheme was approved. BIG SIGH! Clearing the site meant removal of a pantechicon (?) and a 4wd vehicle, plus tons of logs. Now the work starts! Ray Rolt describes Project Mamod, the introduction of a new range of locomotives, which proved very popular amongst the 16mm people but less so in the 'O' gauge fraternity. Various modifications were made to the original design and Ray used the bits to make a 2-8-0 variant. Several other types were produced by third parties. Brian Groves gave up flying r/c model aircraft on emigrating from the East Midlands and took up railways, thus being



Something not understood, at Mulhouse (photo courtesy of John Spokes).

less likely to meet a premature fate. A GWR *Hinton Manor* was acquired and was taken to his new club, Northampton SME (an LMS/LNER stronghold) to be greeted with 'Nice engine, pity about the colour...'. Andy Cooke makes leaf springs, heartened by the hardening and tempering guidance in Doug Hewson's catalogue. He wondered if the cooking oil he used would catch fire. What a silly question! Of course it did! A lid to cover the conflagration effectively doused it. A little help from industry allowed him to temper the springs properly. Subsequently (in TOR!) Steve Gosling writes on making coil springs. Gosh! A Springfest! (Very appropriate for this issue – Geoff)

W. www.tauntonme.co.uk

Following Graham Astbury's idea (of a **Henley Solon Owners Club**) following M.E.4609, we have gained another recruit, Bruce Basson, who has a 25 watt and a 65 watt, which belonged to his grandfather in the 1960s. Any more and we shall have to form a real club, association, group, S.I.G., shed, chapter, tent, appreciation society or w.h.y. We could call it H. S. O. Association, but that gives fewer opportunities for silly rhymes. You've heard of the Iron Man challenge? Let us have a Soldering Iron Man Challenge! Build a leakproof tender from a brass kit. Last to finish is a cissy! "We have such fun down at the pub, with the Henley Solon Owners Club. If your iron needs a scrub, join the HSOC, good for Boy Scout and Wolf Cub, the HSOC" etc. ad tedium.

*"As we all grow older,
using up life's solder,
get a roll of Multicore
and you will feel
much bolder."*

(Enough! – Ed.)

Stamford Model Engineering Society's June Newsletter, mentions a recent talk about BRM of Bourne in Lincs. Editor, Joe Dobson has requested notes and pictures for this journal but in the meantime there's always Wikipedia...

The Men's Sheds

Association celebrates its 500th shed in the UK, with its own Isle of Wightfest, and Silver Sunday, 6 October, when the association gathers to combat loneliness. See <https://menssheds.org.uk/wp-content/uploads/Shoulder-to-Shoulder-052-June-2019.pdf> and check out the Haynes Manual of the Shed. Yes, really! (Not forgetting the Ladybird Book of the Shed, published by Michael Joseph, ISBN 978-0-718-18358-5.)

Grimsby & Cleethorpes Model Engineering Society's

The Blower, June, reports on the Immingham Museum Model Railway Show. The five inch gauge portable track was operating and the professionally printed banners did much to promote the club's image. Part of the permanent way in the cutting has been found to resemble a Swiss cheese! Replacement rails are being installed. The motors on the Class Eight have given sterling service over the years but failed recently. Three new motors would be very expensive, so a bigger, single motor has been installed, with chain drive to the other axles. In conclusion, the Society is



Recuerdo at Chesterfield Open Weekend.

now registered with Amazon Smile so, if you nominate GCMES as your chosen charity, every time you buy from Amazon, the club gains by 0.5% of your spend.

W. www.gcmes.com

Mention of the Sheffield Sweet Pea rally brings this fine example - *Adele Marie* (photo 5).

The Old Locomotive Committee advises that this year's Lionsmeet will be held at Bournemouth & District SME on 17th August. Anyone with a model of *Lion* or its contemporaries, or a part-built

work in progress, or even just an interest in the subject, is welcome to attend. Usual requirements - boiler certificate, insurance, etc., and there is a very local Travelodge.

W. www.lionlocomotive.org.uk

And finally, remember when plastic surgery was a taboo subject? Now when it is mentioned, nobody lifts an eyebrow.

Contact:
geofftheasby@gmail.com



Adele Marie at the Sweet Pea rally.

AUGUST

- 1 South Lakeland MES.**
Meeting in the pavilion, 7.30pm. Contact Adrian Dixon: 01229 869915.
- 2 North London SME.**
Edward the Compressor rides again – bring an engine! Contact Ian Johnston: 0208 4490693.
- 2 Portsmouth MES.**
Club night – 'Playing Trains', 6.30pm, Bransbury Park. Contact Roger Doyle: doyle.roger@sky.com
- 2 Rochdale SMEE.**
'Irene the White Engine at Elland Road' – David Pope, at Castleton Community Centre, 7.30pm. Contact Rod Hartley 07801 705193.
- 2-4 Gloucestershire Vintage and Country Extravaganza.** See www.glosvintageextravaganza.co.uk
- 3 Tiverton & District MES.** Running day at Rackenford track. Contact Chris Catley: 01884 798370.
- 3/4 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.
- 4 Guildford MES.** SMSEG open meeting, 2-5pm. Contact Mike Sleigh: pr@gmes.org.uk
- 4 Newton Abbot & District MES.** Running day at Lindridge Hill. Contact Ted Head: 07941 504498.
- 4 Oxford (City of) SME.** Running Day, 1.30-4.30pm. Contact: secretary@cosme.org.uk
- 4 Portsmouth MES.** Public running, 2-5pm, Bransbury Park. Contact Roger Doyle: doyle.roger@sky.com
- 6 Romney Marsh MES.** Track meeting, 11am onwards. Contact Adrian Parker: 01303 894187.
- 7 Bedford MES.** Public running, from 10.30am at Summerfields Miniature Railways. Contact Brian Walton: 07498 869902.
- 7 Bradford MES.** Evening running and social, 7:30-10pm, Saltaire Methodist Church. Contact: Russ Coppin, 07815 048999.
- 7 Brandon DSME.** Meeting at The Ram Hotel, Brandon, 7.45pm. Contact Mick Wickens: 01842 813707.
- 7 Bristol SMEE.** Talk: 'Restoring Fry's Lost Sentinel' – Eric Miles. Contact Dave Gray: 01275 857746.
- 7 Oxford (City of) SME.** Running Day, 1.30-4.30pm. Contact: secretary@cosme.org.uk
- 8 Cardiff MES.** Members' projects. Contact Rob Matthews: 02920 255000.
- 10 Staines SME.** Invitation day, 10am onwards. Contact Stan Bishop: 01784 241891.
- 10/11 Rugby MES.** Big Four event from 10am – overnight camping available. More info. at rugbymes.co.uk.
- 11 Cardiff MES.** Steam Up & Family Day. Contact Rob Matthews: 02920 255000.
- 11 Newton Abbot & District MES.** Running day at Lindridge Hill. Contact Ted Head: 07941 504498.
- 11 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.
- 11 Portsmouth MES.** Public running, 2-5pm, Bransbury Park. Contact Roger Doyle: doyle.roger@sky.com
- 11 Welling DMES.** Public running at Falconwood 2-5pm. Contact Martin Thompson: 01689 851413.
- 12 Bedford MES.** Talk: 'Finest Quality Boat Building' – Peter LeSeuer, 7.30pm Summerfields Miniature Railway MK45 3BH. Contact meetings@bedfordmes.co.uk.
- 13 Romney Marsh MES.** Track meeting, 11am onwards. Contact Adrian Parker: 01303 894187.
- 13 Tiverton & District MES.** Club meeting at Old Heathcoat Community Centre, Tiverton, 7.30pm. Contact Chris Catley: 01884 798370.
- 14 Bedford MES.** Public running, from 10.30am at Summerfields Miniature Railways. Contact Brian Walton: 07498 869902.
- 14 Oxford (City of) SME.** Running Day, 1.30-4.30pm. Contact: secretary@cosme.org.uk
- 17/18 Crich Tramway Museum.** Model Tram, Trolleybus, Bus and Railway Exhibition at the Crich Tramway Village, Crich, Derbyshire DE4 5DP 10am-5pm. Contact John Huddleston, huddlestonja8@hotmail.com
- 18 Guildford MES.** Public open afternoon 2-5pm. Contact Mike Sleigh: pr@gmes.org.uk
- 18 Newton Abbot & District MES.** Running day at Lindridge Hill. Contact Ted Head: 07941 504498.
- 18 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.
- 18 Oxford (City of) SME.** Running Day, 1.30-4.30pm. Contact: secretary@cosme.org.uk
- 18 Portsmouth MES.** Public running, 2-5pm, Bransbury Park. Contact Roger Doyle: doyle.roger@sky.com
- 18 Rugby MES.** Public running 2-5pm – visiting locos welcome with boiler certificate. More info. at rugbymes.co.uk.
- 18 Tiverton & District MES.** Running day at Rackenford track. Contact Chris Catley: 01884 798370.
- 20 Romney Marsh MES.** Track meeting, 11am onwards. Contact Adrian Parker: 01303 894187.
- 21 Oxford (City of) SME.** Running Day, 1.30-4.30pm. Contact: secretary@cosme.org.uk
- 23-26 GL5MLA.** Ryedale main line rally at Gilling. Contact Peter Layfield: 01406 365472.
- 25 Pimlico Light Railway.** Public running 2-5pm. Contact John Roberts: 01280 850378
- 25 Welling DMES.** Public running at Falconwood 2-5pm. Contact Martin Thompson: 01689 851413.
- 20 Westland & Yeovil DMES.** Track running day 11am – 4.30pm. Contact Bob Perkins: 07984 931993.
- 25/26 Bedford MES.** Public running, from 10.30am at Summerfields Miniature Railways. Contact Brian Walton: 07498 869902.



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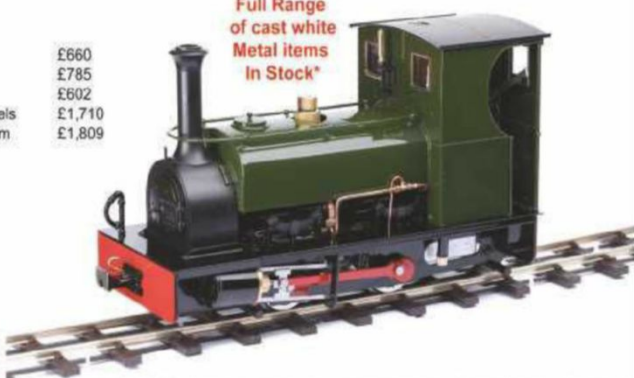
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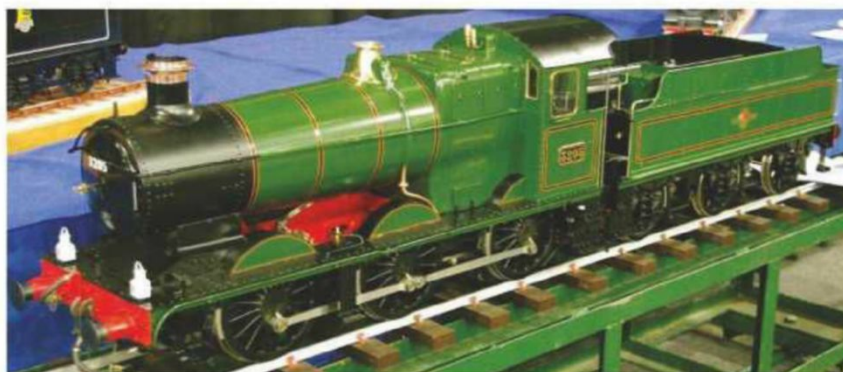
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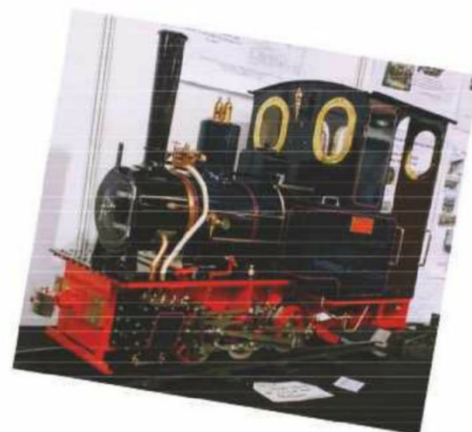


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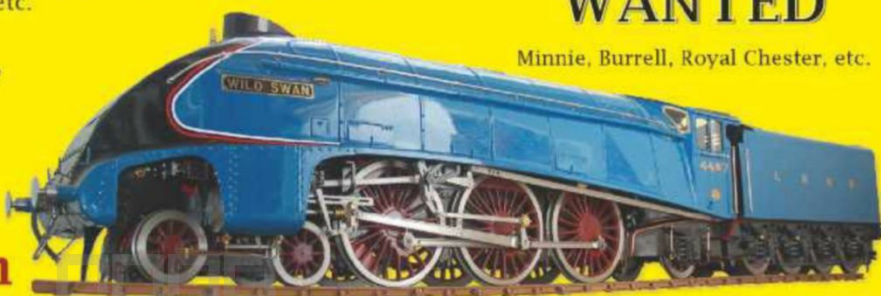
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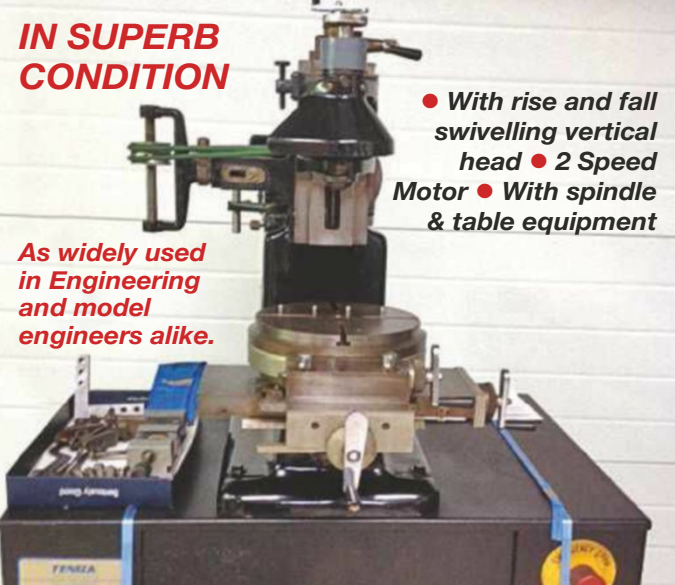
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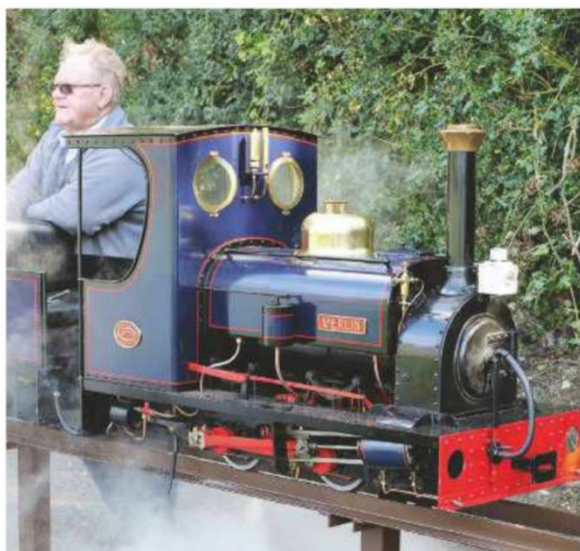
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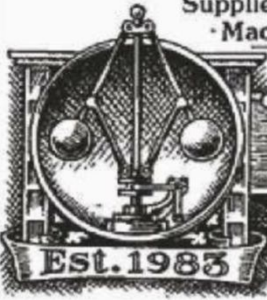
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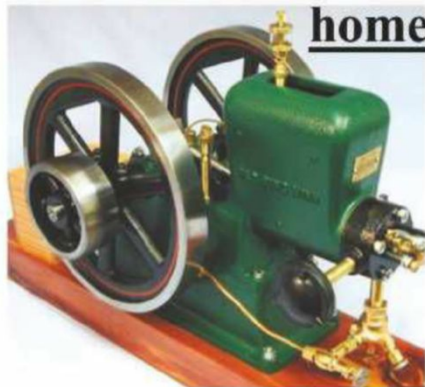
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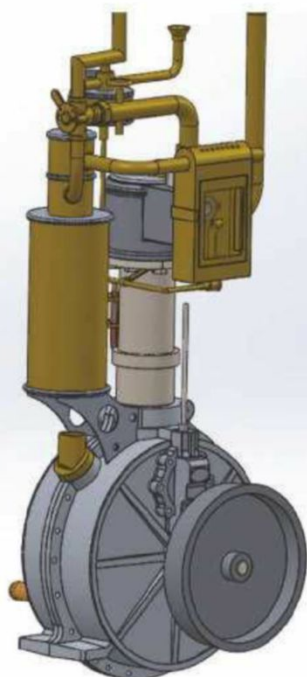
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