

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 225 No. 4652 • 20 November - 3 December 2020

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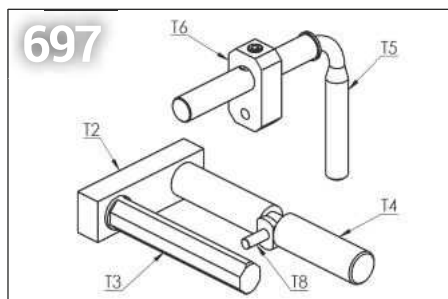


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ON THE COVER...

A pair of 'Molly Anns' - Helen Hale (left) tends to Helen of Troy and Hilary Smith (right) is in charge of Hilary Jane (photograph: Peter Smith).



With darker days approaching, it is a good time to review lighting in the workshop. Good lighting will avoid eye strain. Warco's new range of LED lighting complements the existing range and offers new features, sizes and prices. Lights have an inbuilt transformer and low energy consumption

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Lockdown II

Just when you thought it was safe to come out of the workshop... Well, here we are in lockdown again.

At least you have some consolation in knowing that, as you read this, we are probably about halfway through our one month incarceration. As I write this, though, we have just started.

Being British, we have of course celebrated this in the usual way – by rushing into the shops and buying all the toilet rolls (why??). Does this happen in Australia or is it just us Brits? As Yuletide is nigh I suppose we should buy coloured toilet rolls as they are rather more festive. Come to think of it though, can you get coloured toilet rolls anymore? I only ever see white these days. I remember a student friend of mine years ago used to change the colour according to the liturgical season – yellow for Easter and so on – but he was in training for the priesthood so he's excused. Black for Good Friday was a problem but as he was fasting anyway it didn't matter.

So – let's look on the bright side, turn around and head straight back into that now very familiar workshop. Even if our current project is complete as a result of Lockdown I we can still spend our time profitably making little trinkets and ornaments to inflict on our friends and relatives at Christmas. A month well spent.

Mystery Object

There may be a solution to last time's mystery object. Noel Shelley writes to say 'Whilst the picture does not show the diamond shape to best advantage, my first thought is that it is one half of a crude universal joint! The mating part would have a pin through it and be circular or square. It would allow a small amount of axial misalignment and also longitudinal movement, it would rotate slowly, maybe by hand, made before precision grinding and needle rollers

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
mrevans@cantab.net



Christmas!

Yes, it's that time of year again, although clearly the festive season this year may well be a little less festive than usual. So here is the usual 'plug' for the Welshpool and Llanfair Light Railway Christmas card. Andrew Charman, my opposite number at *Engineering in Miniature*, who also happens to be the railway's press officer, has sent me a sample of this year's card, reproduced here. It features U-class 0-6-2T locomotive *Zillertal*, visiting from the Zillertalbahn in Austria, arriving at Llanfair Caereinion station. The proceeds from the card help to raise much-needed funds for the railway, of particular importance in the current situation. The card, as before, is based on a painting commissioned from renowned railway artist Jonathan Clay. There is the usual snow but still – I regret to say – no festive robin.

Cards are available in various quantities, from £4.75 for 5, £7.75 for 12, £12.75 for 25, £16.50 for 36 or £21 for 50. They may be ordered on www.wllr.org.uk or by post to W&LLR Christmas Cards (ME), 12 Maes Gwyn, Llanfair Caereinion, Powys ST21 0BD. Cheques should be made payable to 'W&L Sales'. The 2018 and 2019 cards are also still available.

were common or cheap. This type of simple joint was common on agricultural machines before the days of tractor cabs with air con and stereo. Enlarging on Noel's theme I suspect that something rather like a car starting handle (remember those?) could be inserted into the diamond shaped socket to adjust some part of an agricultural machine.

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1



Pete's Polly bearing his wife's name – HILARY JANE.

PART 1

The Making of Hilary Jane

Pete Smith fulfils a life-long dream of building his own locomotive, with Polly's help.



Like many of us, and as long ago as I can remember, I had a fascination for model steam engines and miniature locomotives. My first venture into model steam locomotive building commenced some thirty years ago when I started a 5 inch gauge Simplex by Martin Evans. Unsurprisingly I shelved the project and effectively abandoned it due to the complexity of machining the parts, a young family, and the consequences of a demanding job.

During retirement I had various other interests but eventually I re-started the Simplex. After a few months it was becoming increasingly obvious that, due to the amount of work involved, I would not find the time to complete the project so

reluctantly I shelved it once again (**photo 2**). Nevertheless, I still had that deep passion to build a working steam locomotive and run it on a track but I felt time was running out and I would not realise my dream.

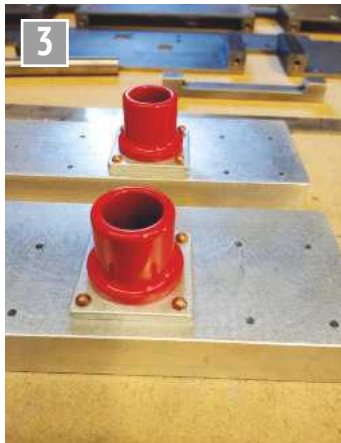
Time flies, as they say. It was now late 2018 and by chance I stumbled on an advert in the magazine *Model Engineer*. It itemised kit-built coal fired steam locomotives in 5 inch gauge supplied by Polly Model Engineering who are based in Nottingham UK. Their advert sparked a ray of hope that this could be an opportunity to resolve my dream of wanting to build a working steam locomotive. The build could also be in a time span of months rather than years. Indeed, my interest was growing; could this be



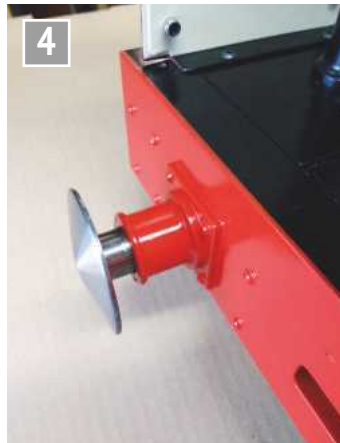
Showing the frames on my abandoned Simplex.

something I can run on a track and hopefully enjoy while I was still active?

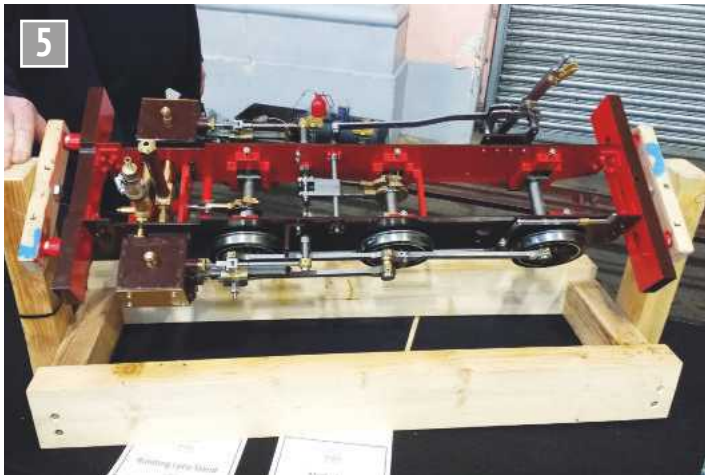
But I had a nagging thought that it was cheating somehow, and that just assembling a kit would not



Hexagon head screws changed for rivets.



Completed buffer body with modification.



Dr. Helen Hale's assembly jig displayed at Alexandra Palace January 2019.

satisfy my self-proclaimed machining and fitting skills. Negative thoughts turned into positive and I realised that I could incorporate some improvements to the design and hand finish each part to a high degree. This would provide me with the satisfaction that I was not just 'bolting' the parts together. I ended up visiting Polly Model Engineering Ltd. and placing an order for their latest offering - a saddle tank locomotive in 5 inch gauge that they had named *Molly Ann*.

After studying the design and having a close look at their locomotive on display, I realised that I could indeed make a few subtle changes to the overall look, thereby adding a few twists to an otherwise good-looking model. I had acquired a reasonable workshop and tools over the years, I could also add a few small aesthetic changes in the design which would provide

an element of individuality to what was to be 'My Loco'.

The first kit arrived during early November 2018 and I began preparing the frames, buffer beams and buffer bodies with enthusiasm. At this early stage I would make a few subtle changes to these parts. Taking the buffer beams for example, they were

supplied with small cosmetic hex screws on the front of the beams. For me it would be much easier to polish out the machining marks if the small hexagon screws were removed. Whilst doing so, I decided to drill out the threaded holes and change the screws for dummy rivets. As a result, this was the first simple alteration from the original Polly design and a rivet head was easier to keep clean than a hex headed bolt (photo 3).

The second alteration came when I looked at the buffer bodies, and to provide me with a small machining job, I used the supplied buffer bodies and added a flange against the beam and a lip pressed onto the front of the bodies. This made them look quite different from the original design and, possibly, more authentic (photo 4).

January 2019 arrived and I visited the London Model Engineering Exhibition at Alexandra Palace. I met up with the Polly Owners Group, where they had a series of working Polly locomotives and a few others in the process of being built. One of these caught my attention, a Molly Ann being built by Dr Helen Hale. Her Molly Ann was built up to Kit 7 and painted and it included all working motion and the pole reversing lever. However, the other interesting point was that it was mounted in a simple but strong wooden assembly frame or jig (photo

5) which could be revolved to aid assembly. This seemed an extremely good idea which was something that I had not considered. It would be so useful during construction, I decided to make one.

Months later I had the pleasure of meeting Helen at my local Riverside Miniature Railway (RMR) in St Neots, Cambridgeshire, both completely unaware of each other and that we were both building a Polly model, a Molly Ann. We exchanged notes and it was interesting to see that we had many of the same difficulties during the build. It proved to be a valuable opportunity to see how we resolved some of these issues. I was introduced to Helen by her colleague who I did not recognise at the time. He introduced himself as Tim Coles but I didn't twig that he was the author of a book called *A Beginner's Guide to Model Steam Locomotives*, a book that I had purchased many years ago when I started work on my Simplex locomotive.

Tim was exhibiting at our local track two fabulous 7¼ inch gauge steam locomotives, one of which was an unfinished 0-6-0 Jinty tank locomotive which my wife, Hilary Jane and myself were admiring (photo 6). When I got home it dawned on me where I had seen Tim Coles' name and photograph. Since our initial meeting we have collaborated over the weeks and months



Tim Coles's Jinty.



Modified regulator handle to Tim Coles' drawing.



Component parts sprayed with acid etch paint.



Chassis mounted in assembly jig.

concerning progress on our two Polly builds. In fact, at the end of building my Molly Ann, I incorporated an idea from Tim, that of a replacement regulator handle. I fabricated mine from a drawing that Tim provided (**photo 7**).

Back to the progress on my Polly build and things were taking shape. After thoroughly degreasing each finished part, I decided to spray paint each part as the build progressed, using a good acid etch primer first (**photo 8**). I then used a satin black paint from Halfords for the frames and buffer beams with gloss red on the front of the beams and buffer bodies. Painting at each stage obviously eliminated the need to strip the locomotive down after it was complete. This was not entirely successful as some damage occurred throughout the build. Paint touch up here and there was inevitable.

Kit 2 arrived quite swiftly, which contained the wheel sets and suspension parts. This was an opportunity for me to improve the look of the inner wheel rims, that part being unmachined. Mounting each set between centres on my lathe, I carefully machined the inside rim creating a groove between the counterweight and inside edge of the rim. This produced a distinctive improvement to the appearance of the wheels (**photo 9**). Hand filing between the spokes completed the preparation.

Assembling the axle springs into their pockets was a little daunting as they were a very

tight fit and, from my past engineering experience, more likely to get stuck rather than act as suspension. I increased the hole sizes slightly so that they would compress easily in their pockets.

The build was now getting a bit tricky to manipulate so I constructed a building jig like the one that I had previously seen at the London exhibition. Then it was a simple matter of supporting the locomotive frames in the building jig, using the empty buffer bodies with dowels in the buffer housing for support (**photo 10**).

Kit 3 arrived and it was mid-January 2019. This kit included the connecting rods, which were extremely well made; a big improvement on the flame cut rods for my Simplex. The Polly rods looked as if they were made from lost wax castings. However, I wanted a machined finish on all surfaces, so I devised an aid to help match the machining on the respective bosses. To accomplish this, I



Linished connecting rods.

made up a revolving finishing tool to fit onto my lathe made from an eight inch length of 1½ inch diameter wooden dowelling. Using double sided tape, I wrapped some wet and dry abrasive paper around it, placed one end in the lathe chuck and supported the other end with a running centre. I suggest that you do not try this at home but it was a simple matter of hand drawing the rod over the revolving finishing tool against the direction of rotation. The resultant finish obtained was like fine grinding which looked very impressive (**photo 11**). After carrying out this operation on all the connecting rods, they could now be fully assembled along with the axle pump and eccentric straps (**photo 12**).

Kit 4 required the instructions to be followed precisely which prevented a multitude of possible errors of incorrect assembly. Careful filing and shaping skills on the expansion links

was worthwhile and hand finishing the parts really made a difference to their appearance. I had already obtained a blacking kit for another project so I decided to use it here on the ferrous parts. Protecting each part after blacking with a coating of oil also added a lustre to the hand finished components (**photo 13**).

Kit 5 and Kit 6 followed and my enthusiasm continued. This was a chance to use some wrinkle paint on the cylinders, steam chest, covers and the guide bar brackets (**photo 14**). I had previously used this type of spray paint on another project and I was therefore familiar with its use and the requirement to cure the paint in an oven. Whilst not a traditional paint for locomotives, it adds a certain amount of interest to that area of the locomotive. Fitting the cylinders and steam chest was relatively straightforward. The steam chest covers could go on after the valves were set.



Assembled frames.

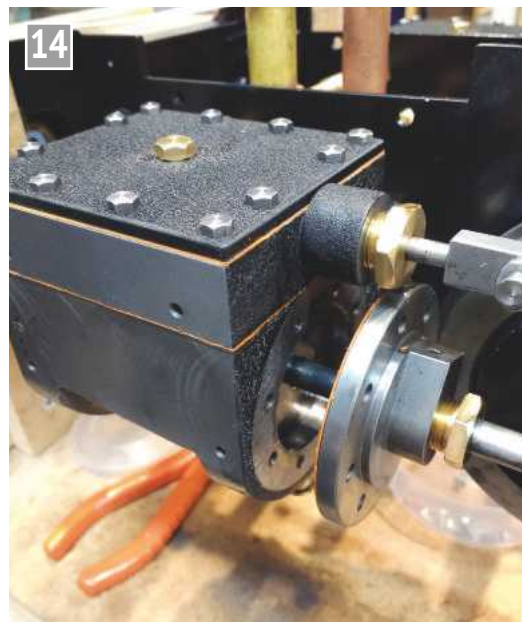
It was now time to fit the draincocks. I decided to include some extended pipework to the cocks so that the steam would discharge forward from the cylinders instead of downward onto the track (**photo 15**). Furthermore, it would provide a fascinating blast of steam to intrigue the onlooker. It then dawned on me that the drainpipes were now dangerously close to the track and a potential derailment would almost certainly destroy the new arrangement. Scratching my head for a solution, I decided to incorporate a derailment bar suspended from the front of the frames (**photo 16**) so that if a derailment occurred the locomotive would drop no further than the bar, which would support the locomotive. Theoretically this would solve the problem. These items amounted to a few more design changes which were somewhat experimental but gave me the opportunity to manufacture a few parts.

On to Kit 7. It was now April 2019 and these parts required quite a lot of hand finishing before fitting. The kit contained the reverser pole lever, latch plates, draincocks operating lever and several other associated parts. Again, I used chemical blacking on many of the steel components (**photo 17**).

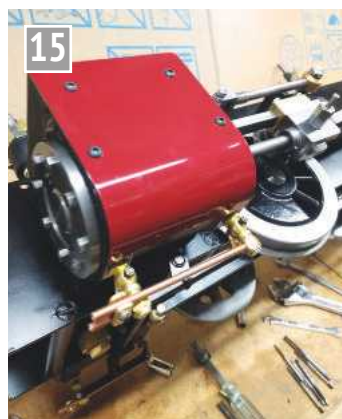
At this stage of the build it was time to set the slide



Completed expansion links.



Wrinkle paint on face of cylinder and steam chest cover.



Extended drainpipes.



Derailment support bar.

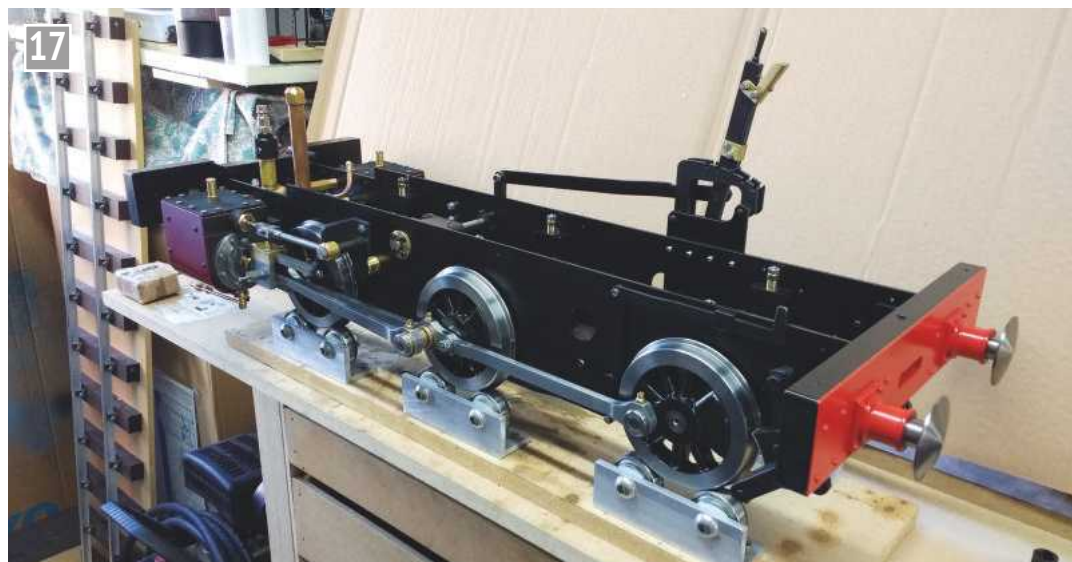
valves which took me through another learning curve and turned out to be a very fiddly procedure. I am glad that I had previously made a supporting jig because it would otherwise

have been a much slower process to adjust the setting (**photo 18**).

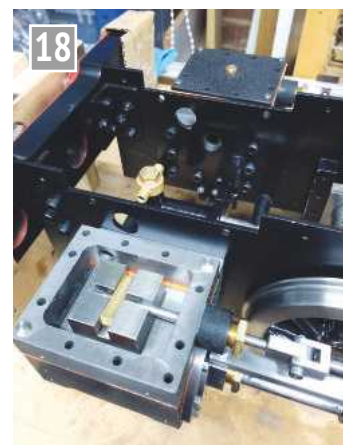
●To be continued.

NEXT TIME

We continue with kit 8, which supplies the axle driven water pump, and then go on to the smokebox and boiler.



Chemical blacking on reverser pole and associated components.



Slide valve in position.

Garrett 4CD Tractor

in 6 inch scale

PART 76

Chris Gunn splits the canopy and adds a seat and a pair of footrests.



Continued from p.544
M.E. 4650, 23 October 2020



Completed engine.

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.

It was then time to set up for the splitting of the two sections of the canopy. The canopy was supported at the rear by the original supports and at the joint line by the four studs holding the as yet un-split joint. I decided to use my jigsaw to make the cut as it was pretty controllable, so I started with the two side rails and had cut up to the roof and partly around to the top when I hit a problem. The jigsaw was bouncing about crazily and I could not make the cut. It dawned on me that the end of the saw blade was striking the packing I had put

in the joint which I could not remove at this stage. After a short rethink, I tried the angle grinder with a thin disc fitted and this went through it like the proverbial knife through butter but produced clouds of blue smoke in the process. Thankfully it was a breezy day and blowing in the right direction from where I was standing, so I was kept clear of the noxious smoke. I cut right across the roof and then when I was sure the joint was cut fully through, I released the joining studs and separated the two sections. The joint was not too bad but did need

some cleaning up, so I started with the section still attached to the engine and cleaned the sawn slats back to the original stretcher using a disc in my angle grinder. This was another job best done outside and with a face mask on, as hardwood dust can be carcinogenic. Once the joint was cleaned up I turned my attention to the shorter removable section. I removed the packing which was partly stuck to the new stretcher and then cleaned the roof ends back. This took a while to get right so the joint was tight and the side joints closed up as well. I had

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

to sand off the ends of the drip rails as well and when I was happy with it all on the section on the engine, I stuck the canvas back down and tapped the drip rails back into position with a dollop of glue in the joint. I took the loose section into the workshop and filled the new screw head holes with domestic filler. When dry I sanded the ends smooth again, then applied more glue and stuck the canvas back down, using an old rule as a clamp backed up by steel blocks held in place by loads of G-clamps (**photo 656**).

I left it overnight to set then cleaned up the drips of glue from the joint and fitted a couple of the steel reinforcing angles. I had made spares

when making the canopy in the first place, so that did not take long. I repainted the areas that had been damaged in the process. The canopy end went back on and the lettering matched up nicely. Once I was happy with that, I turned my attention to re-jigging the seat.

I went to our local car parts scrapyards and bought a front seat from an old Kia and took it back and tried to get it into a position with which I was comfortable but found this quite difficult.

I tried it low behind the tender so I could see under the canopy, as I had seen on Adrian Nutting's showman's engine. However my arms were not long enough to reach the controls, so I tried

perching it on top of the tender like Chris d'Alquen's engine but I was too close and too high and found it difficult to get up there. I also found when running the engine that I was continually banging my head when I got underneath to oil up or check something and in the end I decided that whilst the canopy looked good, it seemed too much aggravation. I suppose if one were on the engine all the time one would get used to it, but when rallying maybe 12 times a year, there isn't enough time to get that familiar.

Much later I found a better seat for the purpose from a mobility scooter; this had thinner upholstery and also arm rests which could be

raised and lowered, so I have retained it in case I have another try.

Anyway, as already mentioned I took the canopy off and reverted to Plan B, which was to copy the seats I had seen on another 4CD. These consisted of two pillars supported off the drawbar with stiffeners attached to the tender, each surmounted by a round upholstered seat.

The pillars were fitted to the two outer holes in the drawbar leaving the centre hole for a trailer. **Photograph 657** shows the seat supports under construction. I made a foot rail and also the dropped towing eye can be seen which allows me to use my 4 inch scale trailer in the short term.



Glueing canvas.



Seat supports.



Debut.



Bracket upright.

I got as far as making the round discs for the seats just in time for my first rally with the 4CD at Cranford in September 2015. I had to borrow a trailer to take the engine to the show and **photo 658** shows the engine on its rally debut.

These seats allowed me to have a good run around and I used these for a couple of rallies in 2016, but I did not feel secure on the seats as they lacked any sideways support. My foot rail was not too comfy either, so I decided to have another try.

Ideally, I wanted to be able to carry a passenger on the footplate, so I looked at a bench type seat, which many owners of 6 inch scale engines have fitted. I was aware that carrying two passengers who were supported off the tender could lead to 'wheelies' on start up, but the fact that the 4CD is a compound and the smokebox is quite long means that it is less prone and this has proved to be the case.

I had a good look round at the seating arrangements on some 6 inch scale engines and was quite impressed with the seat and supports I saw on a half size Burrell at the Spalding show in 2016. The seat supports were designed so the seat could be tipped up to reduce the length of the engine.

With the benefit of having a bit more time to get it right - I was able to rally the engine with my temporary seats - I decided to have a look at what could be done and I was able to scrounge some offcuts of 19mm ply, mocked up a seat and propped it up in place. It seemed much better. Then I had a look at the seat supports and I realised I would be able to attach them to the rear canopy support bolts on the inside of the tender.

The supports would locate on the bolts with the weight being taken on the top of the tender back. I made the supports to fit on the existing bolts and this provided two angles to which I could attach the seat by two M8 bolts each side. These were duly fabricated and tried



Brackets down.



Left-hand footrest.



New seat.

in position but at this stage they did not pivot upwards. At a later stage the brackets were modified by slotting the bottom holes so if the nuts were loosened, the bracket could be raised up to shorten the length of the engine (**photo 659**). **Photograph 660** shows the brackets in the lowered position ready to receive the seat.

I made the ply for the seats and spotted the holes through. I used spire nuts pulled into the holes in the ply to hold the seat to the supports.

I made three supports from 25 x 6mm steel bar to hold the back of the seat in place. The supports were also held in place by M8 screws and spire nuts. I decide to give this a try at the next rally and I felt much more secure sitting on the new seat with some support behind me. I was still not happy with the footrest but decided to test it for a few more rallies and in fact this took me through to the end of the 2016 season. During the winter period I made a couple of modifications.

I bought some foam and black leatherette material and upholstered my seat and seat back. The seat can be removed for transport as it tends to

get in the way when winching the engine into the van. This involves removing the four M8 screws and tipping the seat brackets up out of the way.

Photograph 661 shows the new seat in its working position.

I also made some new deluxe footrests from a steel grid type step. We used these for the steps to get to the gantry on our nailing machines and, luckily, I had squirreled one away as I just knew it would come in handy. I made some brackets that located on the outer drawbar holes, using some welded on strips to keep the bracket aligned so just one bolt could be used to hold them in place.

I cut the step in half and made a round stretcher to close the open ends of the grid. I used one piece for each side of the engine.

The footrests are big enough to place both feet on the footrest and help me climb on to the engine as well. **Photograph 662** shows the left-hand or driver's side footrest in position.

I leave the footrests in place but they can easily be removed and the engine restored to its original condition if required. I used the new set of footrests

throughout the 2017 season and also carried passengers on the other end of the seat. I was quite happy with the driving position and the feeling of security.

I leave the canopy off unless the engine is to be exhibited, as it does impede visibility, whatever the seating position.

I feel that it is important to be comfortable and secure and to be able to see when the engine is used in public. Anyone who rallies their engine and takes it from its parking spot to the ring will have a tale to tell of the public walking in front, expecting us to stop dead, or of children running alongside the engine when one needs to see what is going on in a crowd.

The final instalments to follow this will cover a number of items that have occurred as the engine was run in and how these were dealt with in the two full rally seasons that have taken place since the engine made its debut at the Cranford Rally at the end of 2015. This does affect how some parts were made and fitted and these notes will help builders avoid my mistakes.

●To be continued.

A New GWR Pannier

PART 25

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



Continued from p.562
M.E.4650, 23 October 2020

The next thing I thought that it would be good to make is the water gauge, correctly called the 'Gauge Frame' (fig 45).

Right, hands up all of those who think you are reasonably observant. Now, without looking at the photographs, how many studs are used to fix a water gauge fitting to a boiler back plate bush? Yes, I would have said four as well until I was looking at the photographs here and wondered why the studs were all out of alignment until I realised that there were five. I have probably said before (many times) that the first thing I look at on a locomotive in an exhibition is inside the cab and if the fittings do not represent what is there full size then I immediately lose interest in the rest of the locomotive and these days there is no reason for fittings not being made reasonably to scale and working properly.

The other thing is that I cannot stand seeing blue line gauge glass on what is supposed to be a scale locomotive. I much prefer to see a dummy gauge glass protector with a plate at the back with diagonal black and white stripes. This makes the water level very clear to the

eye and also, when the glass is empty, it shows the lines diagonally. When there is water in the glass the refraction through the glass tube turns the lines to horizontal, which gives a good clear indication of the water level.

Photograph 200 shows the gauge frame and the two test cocks on the side. I have not included these but there is no reason why they can't be included. On the left-hand side there is the gauge lamp glass. I have shown one from my Y4 in **photo 201**. This is operated from a switch in the top of one of my tanks but I am sure that we can find somewhere to hide it on the pannier. If you care to thumb back a few years to the very first article 'wot I wrote' (in *Engineering in Miniature*) you will find details of how to make a working gauge glass lamp.

I have already had one builder comment on the fact that there is only $\frac{5}{8}$ inch of glass visible when the gauge frame is complete, but I just wondered how much glass he actually did want to see. One inch or perhaps two? No, on a boiler of this size where the water level is relatively stable $\frac{5}{8}$ inch is plenty and it keeps the fittings to within a reasonably scale size. In fact,

the only thing which is slightly over scale is the diameter of the glass itself which can be disguised by using the gauge glass protector. If the glass were to be placed any lower all it would tell you was that the firebox crown was uncovered and any higher, that you had overfilled the boiler!

The next thing I looked at was the actual water gauge fittings or, to give them their correct terms, the gauge frame fittings. As you will see from the full-size photographs, the fittings are predominantly square. The other thing that you will notice from the photographs is that the gauge glass protector is painted black and there is a very good reason for this. When working at night you do not want anything glinting which can be mistaken for the water level in the glass.

The fittings which screw into the boiler are made from phosphor bronze and I started with a piece of $\frac{1}{4}$ inch bar and threaded this $\frac{1}{4}$ inch x 40 for $\frac{5}{32}$ inch. I then turned off the first thread down to the core diameter so that when the nut retaining the glass is screwed on it would screw down to the bottom of the thread ensuring that the 'O' ring would nip onto the glass properly. Centre and



The water gauge, or 'gauge frame'.



Water gauge lamp.

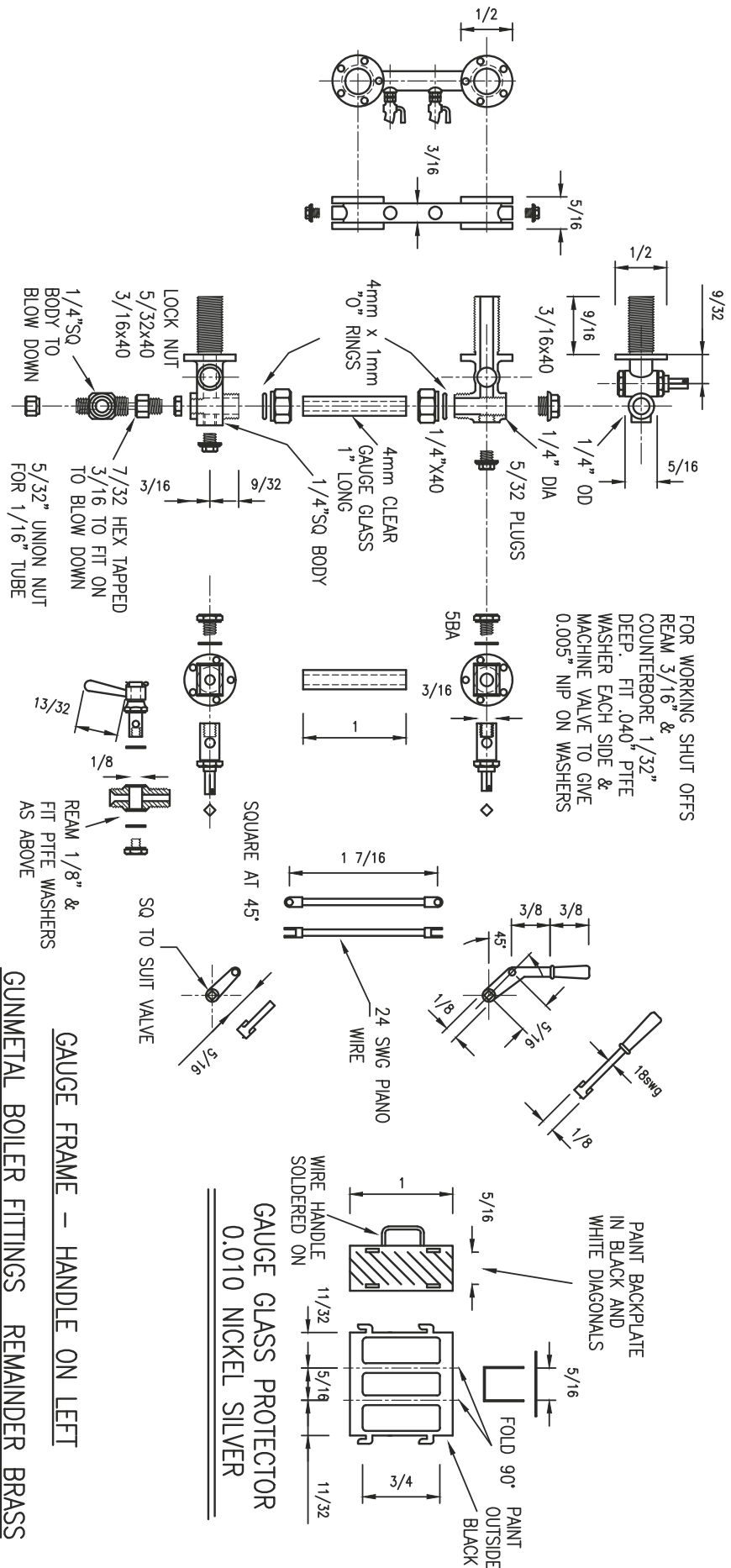
Fig 45

drill No. 30 to a depth of about $\frac{5}{8}$ inch. Turn the bar round and do the same at the other end and then, before parting anything off, remove the bar from the lathe to a 'V' block and pop mark $\frac{7}{32}$ inch from the thread. You can then cross drill this with a No. 30 drill and because you have already drilled down the bore the same size you will find, as if by magic, the cross hole will go straight through the middle without any fancy setting up rigs.

This hole now needs opening up with a $\frac{3}{16}$ inch drill. Once you have done both ends you can then return the bar to the lathe and you can open up the bore with a No. 19 drill which will just nicely clear the glass and part them off $\frac{1}{2}$ inch long.

Now a similar exercise can be carried out on the part which forms the shut off cock although the way you tackle this will depend upon whether or not you want to make the cocks working. In my case I made them as dummies, (a) because I have never had a gauge glass break in my life (apart from one glass which broke when I levered against it when one of my fire hole doors jammed) and (b) because the only person whose gauge glass I have seen break could not get anywhere near the cab to shut the cocks off in any event so he just dropped the fire.

So, use the $\frac{1}{4}$ inch bronze bar again, centre, drill down No. 40 for about $\frac{1}{2}$ inch depth and then, again, do the same at the other end of the bar. The bar can now be removed from the lathe and transferred to the 'V' block where a pop mark can be made $\frac{5}{32}$ inch from each end and the first drilling needs to be the same size as the pilot on your $\frac{7}{32}$ inch 'D' bit. In my case this was No. 40. Drill right through and, again, because of the small bore you will find that the No. 40 drill will find its way straight through the centre, and then 'D' bit down until you get a full $\frac{7}{32}$ inch circle. This hole can be then opened up right through with a $\frac{3}{16}$ inch drill. You can then return to the lathe and drill right through with a $\frac{3}{16}$ inch drill or, if you



GUNMETAL BOILER FITTINGS REMAINDER BRASS

GAUGE FRAME - HANDLE ON LEFT



Drilling the five holes for the water gauge studs.

are making working shut-off cocks, then a No. 14.

The next piece is made from $\frac{1}{2}$ inch bronze bar. Turn down to $\frac{1}{4}$ inch diameter for $\frac{5}{16}$ inch long and thread this $\frac{1}{4}$ inch x 40 and then, with a $\frac{1}{32}$ inch parting tool, undercut the threads at the flange face to the core diameter. Centre and drill down $\frac{1}{8}$ inch for $\frac{7}{8}$ inch long. Reverse and hold the threaded portion in a tapped bush and turn down to $\frac{7}{32}$ inch diameter to leave a 0.040 inch flange.

Now turn down to $\frac{3}{16}$ inch diameter to leave a $\frac{5}{32}$ inch long shoulder. The simple way to do this is to use a $\frac{5}{32}$ inch drill shank as a guide just held against the flange and stop turning when you get there. Before you remove anything from the chuck just try on part two made above and it should slide on up to the counter bore. Remove any sharp edges with a fine file, particularly the outer edge of the flange, and when you have made two you can then transfer the tapped bush to the rotary table and drill five No. 54 holes around the flange.

You can now silver solder the three parts of each one together and you will find that the counter-bored shut off cock fitting should fit tight up to the shoulder as described and the glass fitting will nest into the cock fitting to leave just a small protrusion for the cleaning plug on the outside face. Make sure everything lines up properly and, importantly, the one hole of

the five which is on a vertical orientation is the one which will be behind the glass. In other words, the bottom hole on the top fitting and the top hole on the bottom fitting. The fitting can now be held in the tapped bush again, but this time by the gland for the glass so that the centre piece can be centred and drilled through No. 19 for the glass. Whilst in this position you can also tap the top end $\frac{3}{16}$ inch x 40 for about five threads to fit the plug.

Photographs 202, 203 and 204 show the various stages in making the gauge frames for my BR Class 4MT.

For the bottom fitting you do not need the $\frac{7}{32}$ inch shoulder and I made the outer part of the fitting from $\frac{1}{4}$ inch square brass. Centre a piece in the four jaw and centre and drill down No. 30 for $1\frac{1}{16}$ inch depth. Now, using a round nosed tool, turn down the end to $\frac{7}{32}$ inch diameter. Reverse the bar and do the same on the other end and then again transfer to the bench. Pop mark one of the faces $\frac{7}{32}$ inch from the tapered end and then make another pop mark on one of the side faces 90 degrees round, $1\frac{1}{32}$ inch from the end. Drill both of these through with a No. 30 drill and, again, if you start off right you will find that because of the bore they will go dead through the centre. These two holes can then be opened out to $\frac{3}{16}$ inch diameter and then the bar returned to the four jaw chuck



Fabricating parts for the water gauge.

where they can be drilled out and reamed $\frac{3}{16}$ inch and then parted off $\frac{5}{16}$ inch long.

The gauge glass fitting can be made the same as described above except in this case you will need to hold it in a small tapped bush and turn a shoulder on it to a light press fit in the bod. You will also need another shouldered bush (making it from $\frac{1}{4}$ inch rod tapped $\frac{5}{32}$ inch) to silver solder in the underside of the fitting for the blow down fixing. When silver soldered together the outer end can be tapped $\frac{5}{32}$ inch x 40 for the cleaning plug.

The two $\frac{1}{4}$ inch x 40 gland nuts for the glass need to be made from 2BA or $\frac{5}{16}$ inch hexagon brass or, better still, 9/32 inch if you can find some and they only need to be four threads deep with a $\frac{1}{32}$ inch thick shoulder to the end of the nut otherwise you will only see $\frac{3}{8}$ inch of gauge glass.

If you are intending making working shut off cocks, then the holes for these can now

be drilled out and reamed $\frac{3}{16}$ inch and the fittings made as shown. If you make the valve out of stainless steel as shown the 5 thou nip on the PTFE washers will just ensure that it doesn't leak to the outside world, though it doesn't really matter if it weeps slightly when it is shut off as 99% of the time you won't want it like that anyway.

The gauge glass protectors can be folded up from 10 thou nickel silver or tin plate sheet and, as you will see from the full-size photographs, they just slot together. Again, I have had one of these on my Y4 for some years now though I added the little wire handle to make it easier to remove so that it can just be unhooked for cleaning. I did not put any glass in the protector although it looks the part. We now have some etched brass ones which should be on sale from The Steam Workshop.

●To be continued.



Some of the key parts.



A trilogy of engines.

Stewart Hart completes his trilogy of stationary engines with a grasshopper haulage engine.



PART 7 - ECCENTRIC

Grasshopper Haulage Engine

Continued from p.638
M.E. 4651, 6 November 2020



Parting off an eccentric sheath.

Eccentric assembly

This is shown in **fig 11**. I've pushed another boat out with this part in that I've continued the interlocking ring theme. It is manufactured in the same way as the vertical beam, except that the rings reduce in size, the largest ring being the eccentric sheath, and is connected to the eccentric valve link. The drawing (Part 51) shows an alternative simpler arrangement

Eccentric sheath

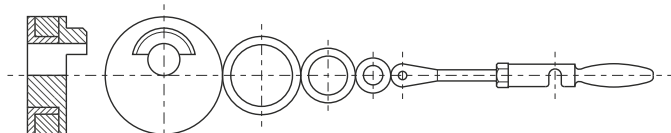
I was lucky to have some 28mm outside diameter x 20mm inside diameter 70/30 brass tube in my scrap box

that was ideal for the job. It was a little under drawing size on the outside diameter but this could be tolerated. It was a simple matter of parting the tube off to length and drilling and tapping M3 (**photo 62**). If you are making it from solid bar you will have to face, skim up the diameter to size, centre drill and drill and finally bore out to size before parting off and drilling and tapping the M3 hole.

Eccentric outer

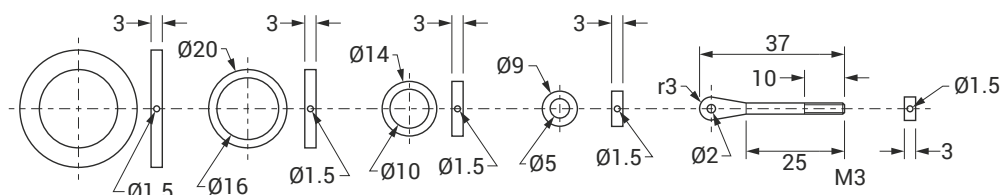
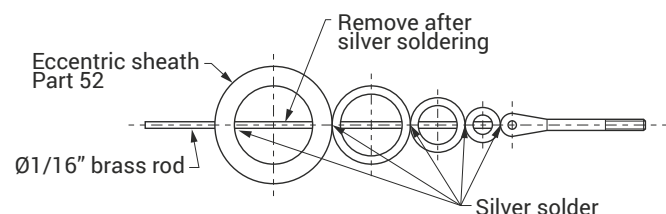
It's best to make the eccentric outer (Part 54) first as it is easier to fit a shaft to a bore than a bore to a shaft. The

Fig 11



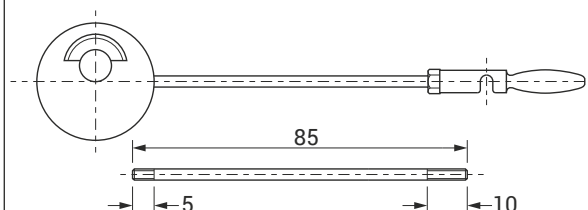
Part 48: Eccentric Assembly

Note: Assemble eccentric sheath inner & outer with high strength Loctite after silver soldering

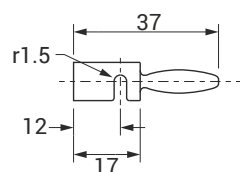


Part 49: Method Of Fabrication

Mat'l: Brass, 1 off

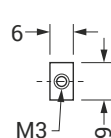


Part 51: Alternative Eccentric Assembly



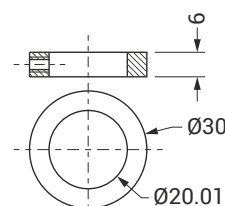
Part 50: Eccentric Valve Link

Mat'l: Mild steel, 1 off



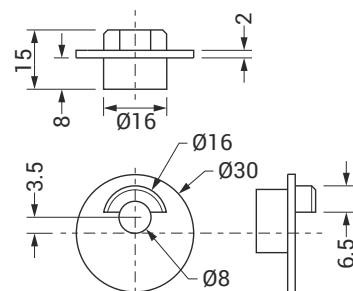
Part 54: Eccentric Outer

Mat'l: Mild steel, 1 off



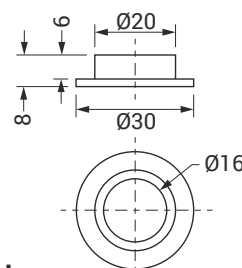
Part 52: Eccentric Sheath

Mat'l: Mild steel, 1 off



Part 53: Eccentric Inner

Mat'l: Mild steel, 1 off



63 Boring the eccentric outer.

part is made from a stub end of 32mm diameter mild steel. Face off, centre drill then put down a couple of roughing drills, then, with a boring bar, bore out to 16mm diameter

(photo 63). You can measure the bore with your digital callipers but remember the legs of the callipers have flats on them so you will get a false reading; the bore will



64 Turning a running fit in the sheath.

be actually bigger than the callipers are telling you so aim for a calliper reading of about 15.8mm. Next turn the 20mm diameter to give a nice running fit on the bore of the sheath

(photo 64). Make the 6mm length about 0.1mm longer than the width of the sheath, swap it round in the chuck and face the other end off to length (photo 65).



65 Facing off the eccentric outer.



66 Eccentric trial fit.



67 Marking off the throw.



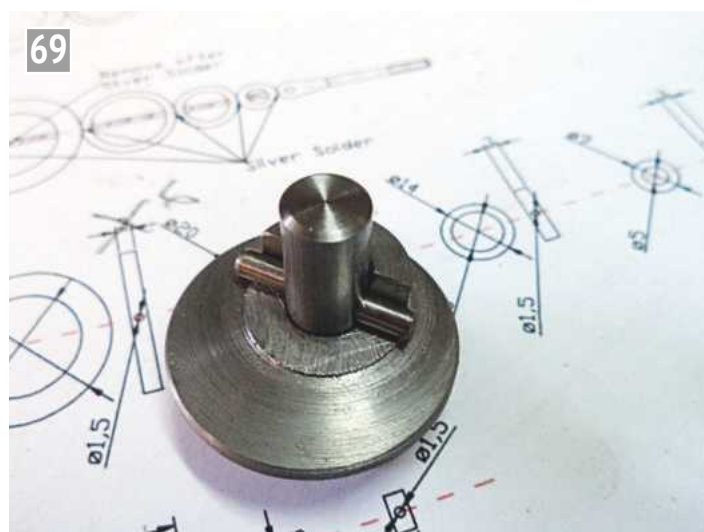
68 Setting the throw in the lathe.

To avoid contaminating the sleeve with adhesive, stopping it rotating, put the adhesive into the bore.

Eccentric inner

Again, this is made from a stub end of 32mm mild steel. Start by facing off and skimming up the outside diameter, then turn the 16mm diameter for a nice push fit on the eccentric outer. **Photograph 66** shows a trial assembly of the part on the lathe. Swap it round in the lathe, face off to length and put in a small centre mark. Using the centre mark scribe a 7mm diameter arc and on this diameter put a small centre pop to mark the throw of the eccentric (**photo 67**). Using the four jaw chuck and the wobble bar trick clock the throw up, centre drill followed by a roughing drill then an 8mm reamer or if no reamer available an 8mm drill (**photo 68**).

The eccentric drive flat has to be correctly oriented and accurately produced as this will affect the valve events. This is best done with the aid of a simple gauge (**photo 69**). This is made from a short stub of $\frac{5}{16}$ inch diameter bar taken off the same length of bar you will make the crank shaft from. To accurately drill through the centreline of the bar you will have to make yourself a drill bush. Again using the same $\frac{5}{16}$ inch bar, centre drill and drill 3mm and part a small 4mm wide bush, then gripping the stub of bar and the bush in the drill vice, using the bush to guide the drill, drill through 3mm. The hole will then be perfectly on the centreline. Fix a short length of 3mm silver



69 Eccentric gauge in the eccentric inner.

steel with super glue in the hole to make the gauge. Use this gauge to cut the flat in the correct orientation in the eccentric.

The whole assembly is put together with high strength Loctite 603 (**photo 70**). Don't forget to put the eccentric sleeve in place and, to avoid

contaminating the sleeve with adhesive, stopping it rotating, put a few drops of the adhesive into the bore. That way any surplus is pushed to the outside out of harm's way. If you do have a disaster, 'keep calm and don't panic' - the adhesive bond is easily broken by applying a little heat and



Completed eccentric.



Eccentric parts prepared for soldering.



Drilled and tapped M3.



Handle nicely shaped.



Cross drill 3mm.



File slot to fit 3mm rod.

this is best done with one of those hot air paint stripping guns.

Method of fabrication

Turn up the four rings and drill the $\frac{1}{16}$ inch cross hole in each ring and the M3 threaded end, thread them onto the $\frac{1}{16}$ inch brass rod and silver solder them together as for the vertical beam (photo 71).

Eccentric valve link

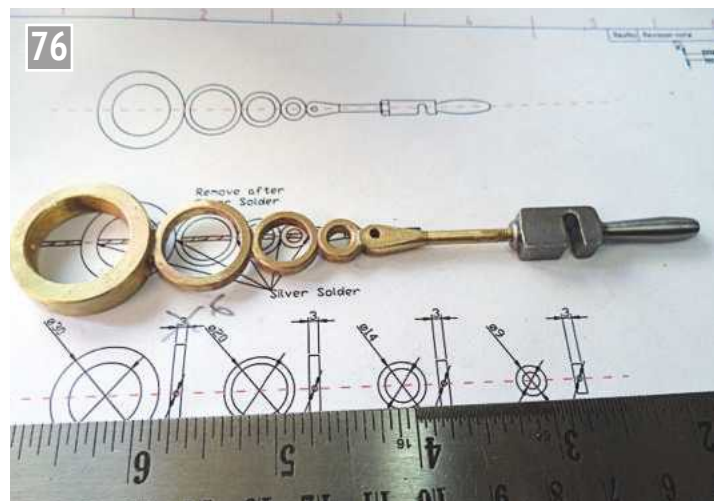
This is made from $\frac{3}{8}$ inch square mild steel. Cut off a 40mm length and in the self centring four jaw drill and tap

one end M3 (photo 72), swap it round in the chuck and form a nice handle shape (photo 73). Then drill a 3mm cross hole and cut and file it into a slot, a nice fit on a piece of 3mm rod (photos 74 and 75) and file down the width to 6mm (photo 76).

Alternative eccentric assembly

This is a far simpler arrangement, the interlocking rings being replaced with a length of round bar.

●To be continued.



Trial assembly.

An Engineer's Day Out

Manx Steam Railways

PART 2

Roger Backhouse takes a trip across the Irish Sea to see the Isle Of Man Steam Railway and the Groulle Glen Railway.



Continued from p.635
M.E. 4651, 6 November 2020

All photographs: Alan Dawes 2018 (except where otherwise stated).

Diesels

The first non-steam power came in 1961 when the railway bought two Country Donegal railcars when that line closed (**photo 11**). Built by Walker Brothers of Wigan in 1949 and 1950, they had bus type bodies with a driving compartment as a separate unit. In service they swayed independently which made for a strange sight (**photo 12**). Walker Brothers constructed several railcars for Irish narrow gauge lines. On the Donegal Railway units were turned on turntables but on the Isle of Man, cars ran back to back with one engine out of use. For a time they ran with a parcels van in between.

Running costs were lower and they helped keep winter services going that might otherwise have ceased. Unfortunately, a full rebuild begun in the 1990s stopped due to costs overrunning but some work has been carried out more recently with a suggestion the units be loaned back to the Fintown Railway in Donegal.

Subsequently the railway added several Diesel locomotives. The first, a German 1958 built Schoma named *Viking* was bought in 1992 (**photo 13**). The railway added a Hunslet Channel Tunnel construction locomotive named *Ailsa* (**photo 14**) and then an American built

bogie diesel to replace *Viking*. Wickham trolleys and Simplex Diesels have also been used.

Goods traffic and wagons

Up until the 1950s the line carried a considerable freight traffic with a variety of rolling stock. There were wagons of different sorts, mostly supplied by the Metropolitan Carriage and Wagon Co., including covered goods vans, three plank open wagons, cattle wagons, two plank wagons originally used for ballast, bolster wagons for carrying timber and even a well wagon introduced in 1936.

The railway was largely self-sufficient with considerable recycling taking place. Fish



Former County Donegal Joint Railway railcars built by Walker Brothers of Wigan. Seen at Port Erin in 1980. Cars were used back to back, sometimes with a parcel van between. (Photo: Roger Backhouse 1980.)



CDJR Railcar interior. The driver's cab swayed independently from the rest of the car. (Photo: Roger Backhouse 1980.)



The line's first German Diesel built by Schoma in 1958, *Viking*. No longer in operation.



1994 built former Channel Tunnel and Jubilee Line extension Hunslet locomotive, renamed *Ailsa* stands at Douglas semaphore signals. Restricted vision limits it to shunting and works duties.

wagons were open wagons built on underframes from four wheeled coaches. Other four wheel coach frames were converted into bogie vehicles for carrying long loads such as lengths of rail (**photo 15**). When the line was operated by the Marquess of Ailsa oil tank wagons worked from Peel to the Milntown power station near Ramsey. At one time the railway had three travelling cranes (**photo 16**) including a steam crane, now restored to working order (**photo 17**).

Passenger coaches

Early coaches were four wheeled compartment vehicles but the railway later ran these as paired, close-coupled stock. The first bogie coaches came in 1909 and were open saloons. About this time Metropolitan began delivering steel bogie underframes on which bodies from former four wheelers were placed (**photo 18**).

Vacuum brakes were not fitted until 1925 following a fatal runaway at Douglas Station, though engines often had trouble supplying sufficient steam for the ejector. Carriages had steam heating fitted from 1936; passengers had previously resorted to footwarmers! However, heating was not needed in summer months and is no longer operational. Electric lighting replaced oil lamps from 1904.

Sheds and workshops

Douglas had the main running shed with smaller sheds at Port Erin and Ramsey. The workshops were at Douglas (**photo 19**) and many items of early equipment survive including a wheel lathe, screw cutting lathe and shaping machines (**photo 20**).

A unique single cylinder horizontal steam engine built by John Chadwick of Manchester survives, one of only two survivors built by this company. It once powered an Accrington cotton mill but was installed here, second-hand, in 1920. Steam was provided by an old locomotive boiler. Some other equipment is now in the Port Erin railway museum.



No. 4 Loch ready for departure at Douglas with a permanent way train seen behind.



Steam crane demonstrated at Douglas. Built by Taylor and Hubbard in 1902.

Signalling

Although signalling did not closely follow mainland practice, the line was well signalled with a more complex signal box at Douglas Station (**photo 21**). This station had four platform faces and several sidings plus lines into the locomotive and goods sheds (**photo 22**). The single lines used a train staff system. Unusually, many signals were operated by a windlass.

Models of Isle of Man locomotives and rolling stock

Isle of Man locomotives are popular with model engineers - their engines make attractive models. Richard Gibbon of York Model Engineers

has made models of No. 1, *Sutherland* and a passenger guard's van which doubles as a driving trolley (**photo 23**).

Groudle Glen Railway

Following the completion of the Manx Electric Railway, the Groudle Glen Railway was built in 1896 by local businessmen, led by Richard Maltby-Broadbent, as a tourist attraction just to the north of Douglas. It ran as such until the early 1960s when it fell into disrepair. The 1970s even saw the track scrapped and the rolling stock sold. The railway was eventually saved from total extinction some 20 years later by a band of enthusiastic volunteers from the Isle of Man Steam Railway



Travelling crane seen in 1980. Built by Richard C. Gibbins and Co. in 1893, now preserved at former Union Mills station. (Photo: Roger Backhouse 1980.)



Typical carriage with Guard's side look out. Built by Metropolitan Carriage and Wagon Co. in 1913. The railway adopted bogie carriages early on.

Supporters Association and others, beginning in 1982 and finally reopening to passengers in 1986.

This short but picturesque 2 foot gauge cliff top line runs from the M.E.R. Groudle Glen station, 'uphill' to the sea cliffs (**photo 24**) where there were once sea lions kept in a 'sea pen'. The line originally had two Bagnall locomotives, *Polar Bear* and *Sea Lion* (**photos 25 and 26**).

Services now run regularly in the summer. *Sea Lion* resides at Groudle Glen and *Polar Bear* was preserved at the Brookham Museum, Surrey and it runs at the Amberley Chalk Pits museum, though it has made occasional visits back to the Isle of Man.



Model of the Douglas railway workshops made by Robin C Winter. The railway was largely self-sufficient.



Wheel lathe in the workshops.

Thanks

Thanks to my fellow SMEE member, Alan Dawes for allowing me to use his pictures of the Isle of Man Railway and Groudle Glen Railway taken at various times. In lieu of payment a donation has been made to the Railway Children charity.

Thanks also to Wikipedia contributors; entries for Isle of Man Railways are particularly detailed.

Bibliography

R. Preston Hendry and R. Powell Hendry: *Isle of Man Railway Album*. David and Charles, 1976.

James I.C. Boyd: *The Isle of Man Railway*. Oakwood Press. Third edition, 1973. (Later editions available.)

Thomas Middlemass: *Encyclopaedia of Narrow Gauge Railways of Great Britain and Ireland*. Patrick Stephens Ltd., 1991.



Douglas signal box seen in 1999.



1878 Siemens signalling equipment at Douglas.



Sea Lion with train at Sea Lion Rocks station. The line's two Diesels and a battery electric engine stand nearby. (Photo: Alan Dawes, 2006.)

Isle of Man locomotives make popular models. Richard Gibbon's excellent No. 1 Sutherland and passenger guards van was displayed on York Model Engineers' stand at the 2018 Doncaster Exhibition. (Photo: Richard Gibbon, 2018.) ➤

25



Polar Bear of 1896 now runs at Amberley Chalk Pits Museum in Sussex but seen here on loan to its original home (Photo; Alan Dawes, 2016.)

26



Original 1896 engine Sea Lion seen at Groudle Glen terminus. This engine has recently returned following extensive restoration by North Bay Engineering Services in Yorkshire. (Photo; Alan Dawes, 2003.)

Important notice about COVID-19 and visiting the I.O.M.

At the time of going to press, the Isle of Man requires all visitors (with the exception of residents of Guernsey) to quarantine for 14 days upon arrival on the island. Rules are very strictly enforced.

Further information about the Steam Railway and other public transport is available from :
Public Transport Headquarters,
Banks Circus
Douglas, Isle of Man
IM1 5PT
Tel: 01624 662525.

W. www.iombusandrail.im
(This comprehensive website also covers the Manx Electric and Snaefell Mountain Railways.)

Supporters Group

An active supporters association acts as a pressure group and carries out restoration projects. New members are always welcome. Isle of Man Steam Railway Supporters Association

Thornhill, Bayrauyr Road,
Ballamodha
Isle of Man IM9 3AT
W. www.iomrsa.org
Email iomsrsa@manx.net
Tel: 01624 823682

Groudle Glen Railway

W. www.ggr.org.uk

Operation

At the time of writing:
Sundays from May to September and Wednesday evenings June to August (subject to confirmation).
Talking Timetable
Tel: 01624 670453

Museums

Port Erin Railway Museum at Port Erin Station
Open when the Steam Railway runs.
W. www.iomguide.com

Jurby Transport Museum (road transport)
Hangar 230
Jurby Industrial Estate.
Open Easter to October on Saturdays, Sundays, Bank Holidays and Tuesdays.
W. www.jtiom.im

ME

ISSUE NEXT ISSUE NEXT ISSUE NEXT ISSUE NEXT IS
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- **Britannia**
Norm Norton makes a new ashpan and grate for his Modelworks 'Britannia' locomotive.
- **Lister Engine**
David Churchman builds a half size model of a Lister 'D' stationary engine.
- **Tree Tops**
John Arrowsmith recalls a very hot August day spent at the Tree Tops Railway in rural Buckinghamshire.
- **Wenford**
Hotspur completes a set of lamp brackets for his 7¼ inch gauge Beattie well tank.

Content may be subject to change.



ON SALE 4 DECEMBER 2020

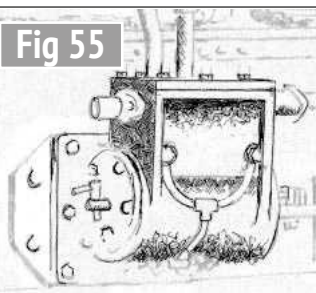
The Barclay Well Tanks of the Great War PART 68

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



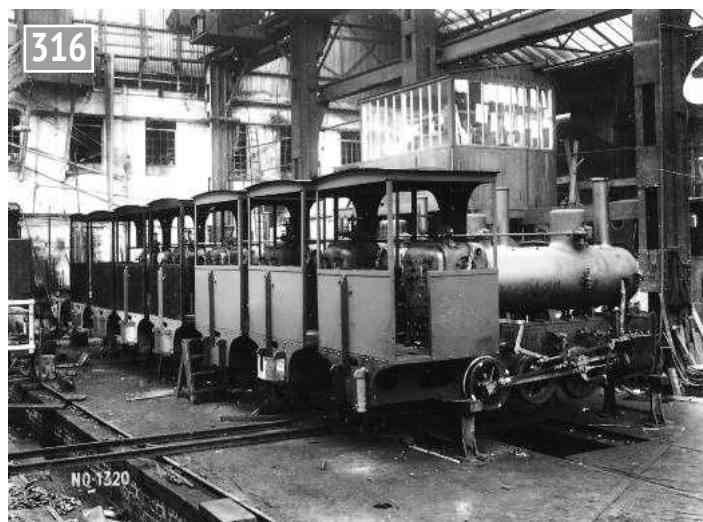
Continued from p.589
M.E. 4650, 23 October 2020

Fig 55



Sketch of steam drain pipework.

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.



Rear view of engines at the works (author's collection).

The rear view of a line-up of seven engines in the works at Kilmarnock is shown in **photo 316**. This picture, referred to previously, shows the rear coupling arrangement in various stages of completion and is the one that gave me a few clues to how the buffer/coupling arrangements were connected up. Note also the white paint marks on the rear wheel of the locomotive in the foreground and the open valve chest, which show that the valve gear is being set up.

An omission

I was checking through paperwork recently and noticed that **fig 55** was omitted from part 16 (M.E.4543, September 2016). I have, therefore, included that figure here; a sketch showing how the steam chest drains are arranged on *Douglas*, and presumably, the 0-6-0 engines. This is a view that is rarely seen, as the pipework is hidden behind the cylinder cladding. Note the all-in-one casting of the cylinder and valve chest.

Whilst on the subject of drain cocks I've been thinking about my new-build 0-6-0 and have decided to reconfigure the six-cock arrangement. The original design, which included the steam chest drains, was dealt with for the cylinders of brother *Douglas* in parts 17 and 18 (M.E.s 4543 and 4547). However, the centre drain

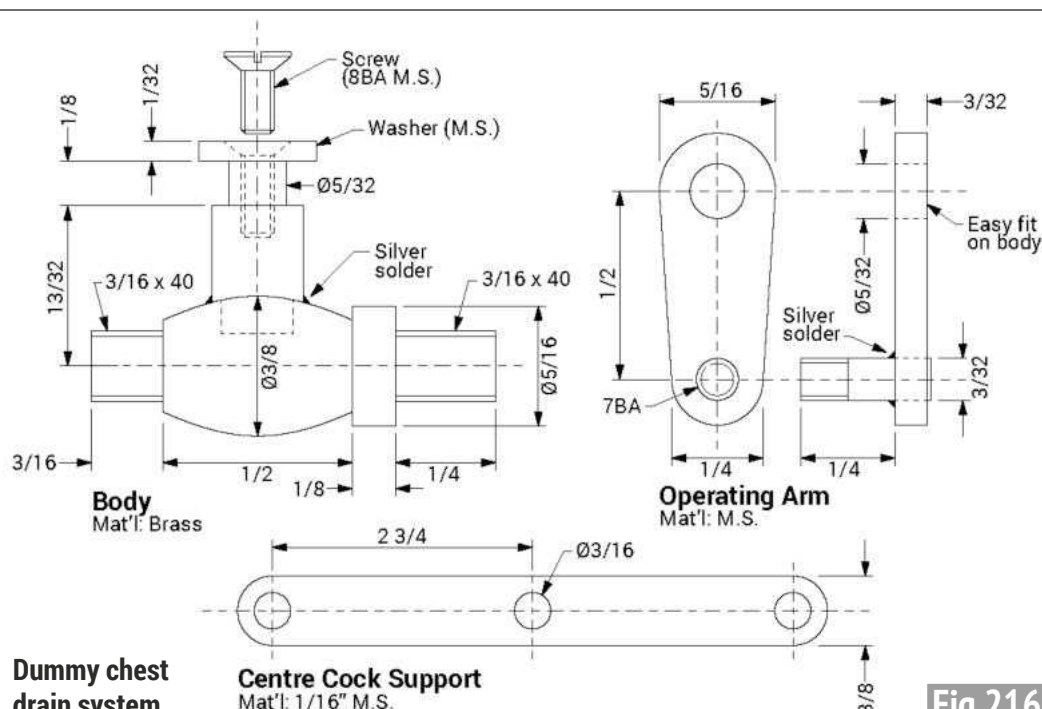
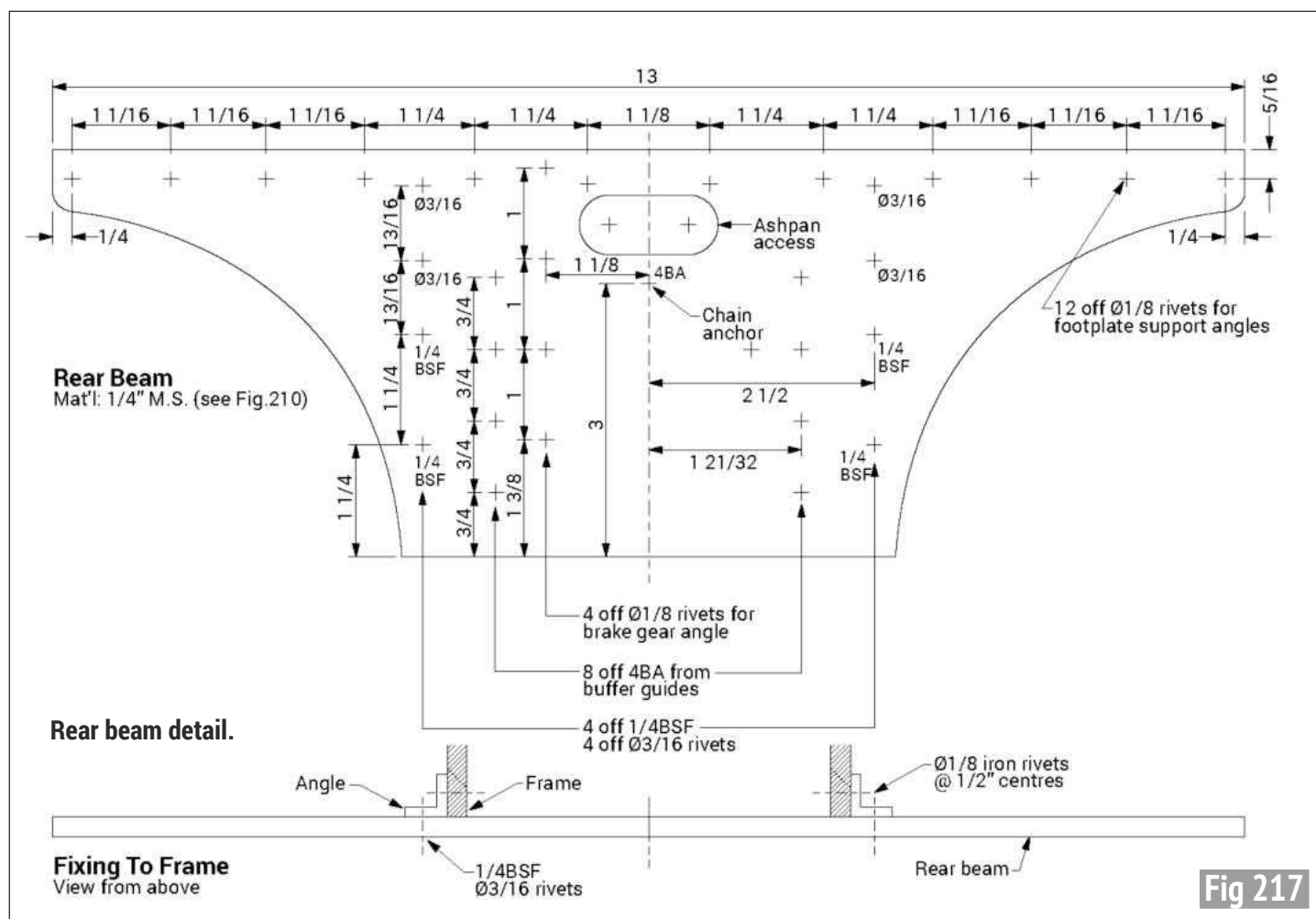


Fig 216



doesn't do much at our scales and is not really necessary for normal operation. Therefore, fitting the conventional, four-cock system (along with a central dummy cock) is another, easier option. So,

having successfully fitted six working cocks on my rebuild of *Douglas*, I intend to adopt four working cocks along with two dummies for my 0-6-0 that is currently under construction - as they say 'bin there, done

that!'. I will detail the working/dummy cock system here, which will be applicable to either engine design; the 0-4-0 or 0-6-0 (**fig 216**).

Note that the four working cocks (fig 57 in M.E. 4543) will need slightly longer screwed stubs to allow for the additional 1/4 inch thickness of the support plate.

Whilst on the subjects of omissions, alterations, errors, and corrections I note a small correction, which needs to be applied to the sandbox drawing; fig 120 - the height of the box, marked on the drawing as 2 1/4 inch, should be 2 1/8 inch.

I also note that fig 207 - 'Frame Side Plates' has an error; the well tank top dimension should be 18 7/8 inch, NOT 18 1/2 inch.

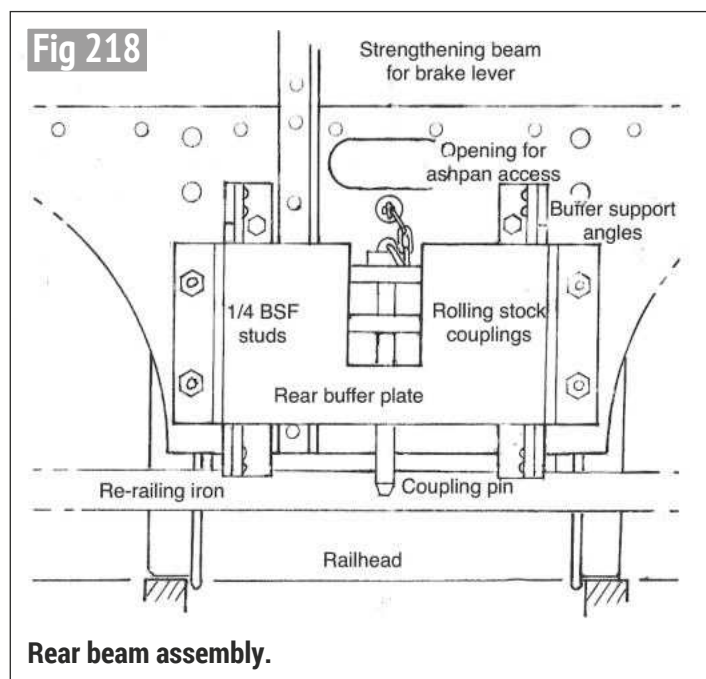
Detailed frame and rear beam drawings

Figure 217 shows the rear beam details. From the original drawings the beam scales to

1/8 inch thick, but as is often the case, a more substantial size is preferable at the current scale. This at 1/4 inch is thicker than the 3/16 inch frame plates. The overall beam dimensions were given in fig 210 (M.E. 4646, September 2020).

The beam does not fit in the conventional fashion, i.e. two pairs of steel angles, one each side of the frame plate. On the original, utility locomotives the rear beam was fitted with two substantial angles, fitted one each side on the outside of each frame plate and this is the arrangement adopted here. It is fitted to the two angles with two heavy rivets each side at the top, along with 1/4 inch BSF bolts which also attach the sprung buffer plate - the construction of which will be dealt with later. The two 1/2 x 1/2 x 1/8 inch angles are the same as those fitted to the front of the well tank etc.

Without wishing to be labelled a 'rivet counter', I note that the rivets on the



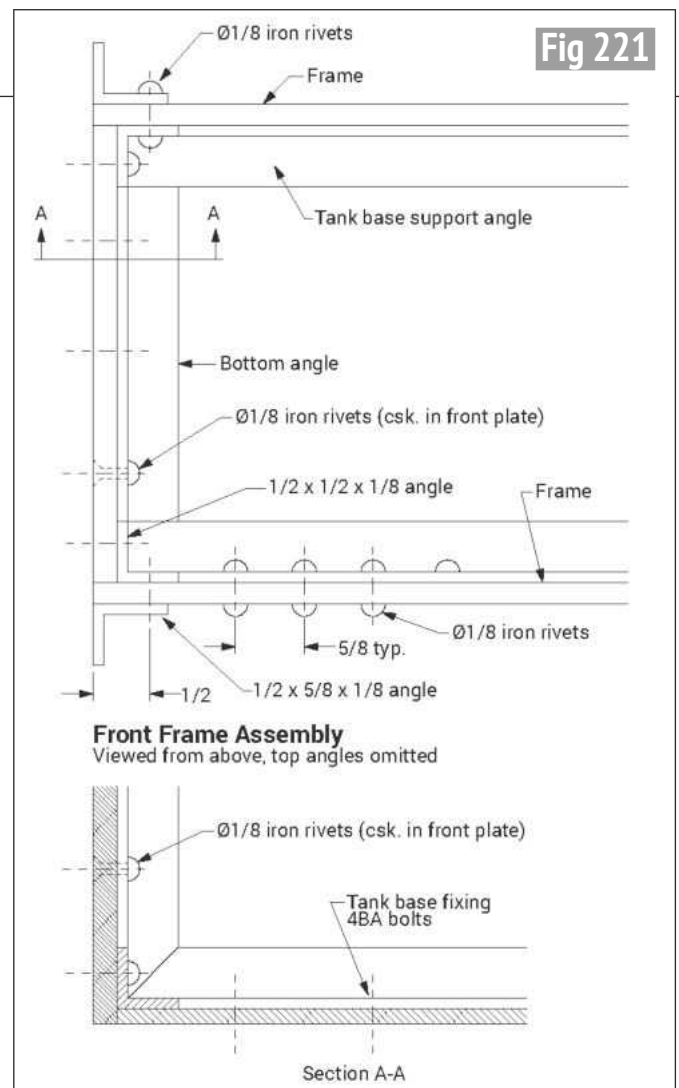
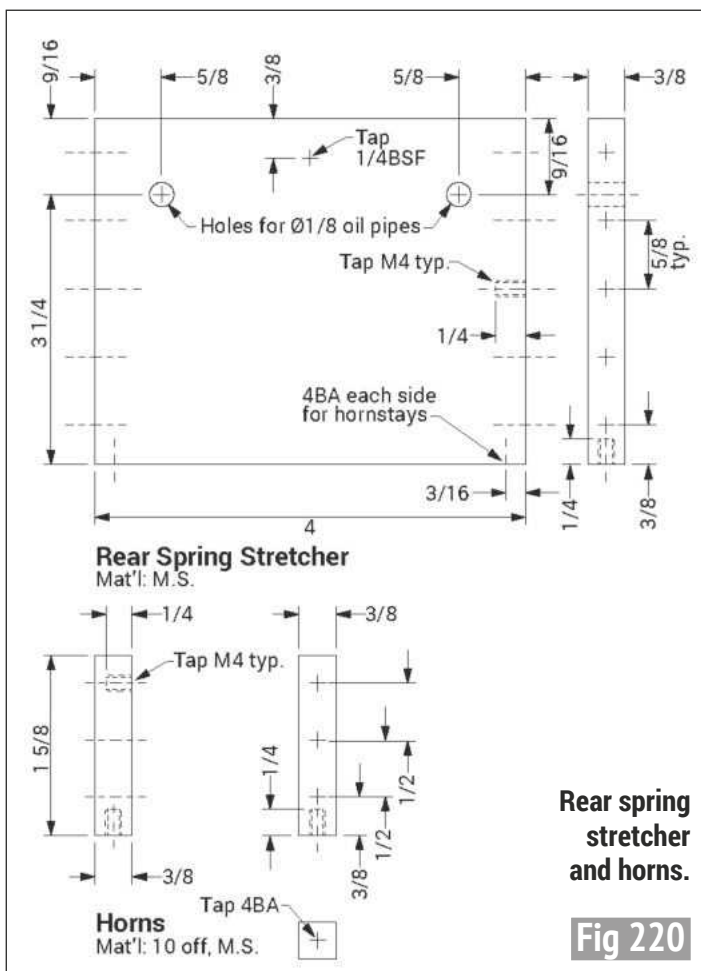
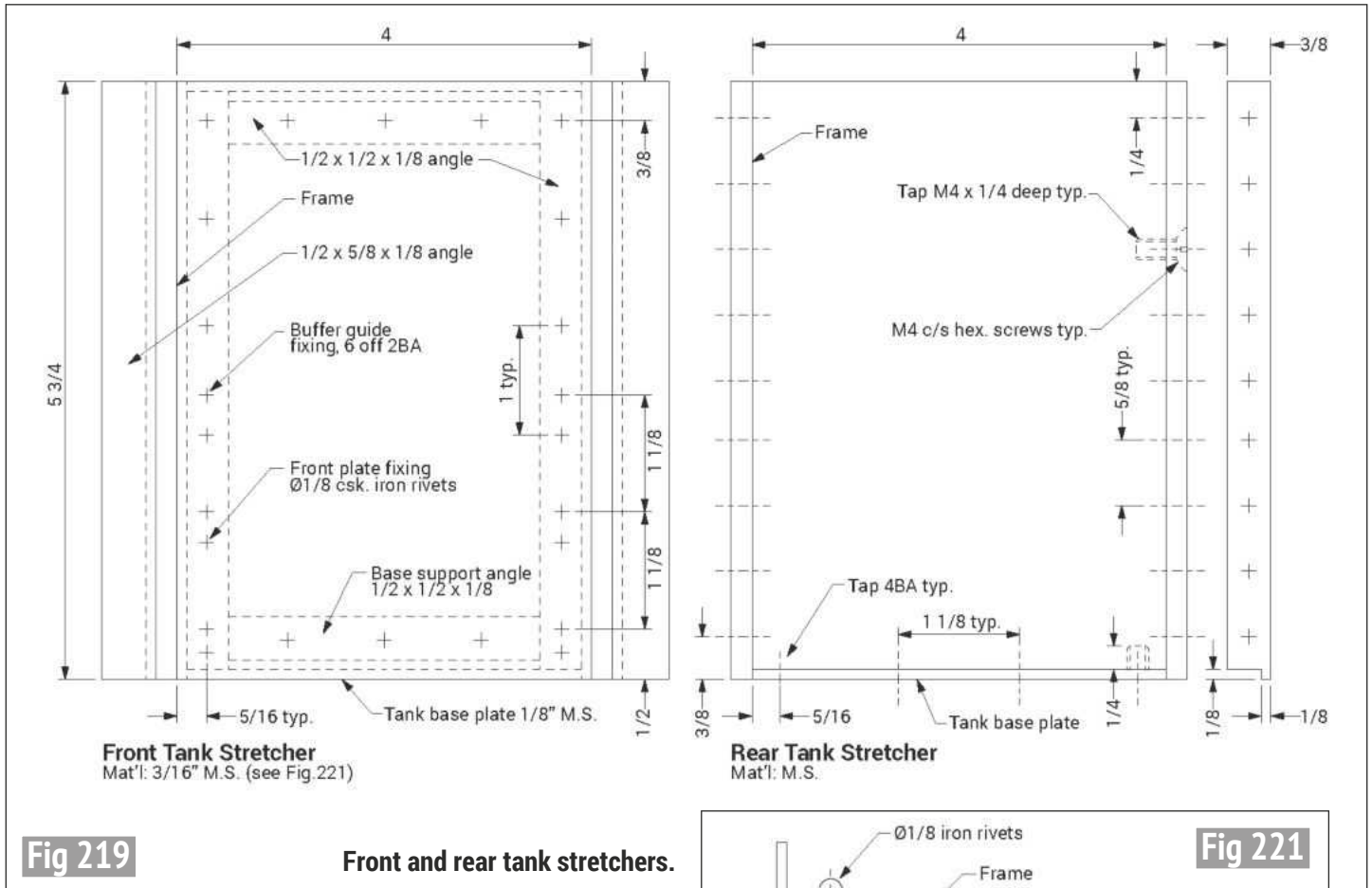
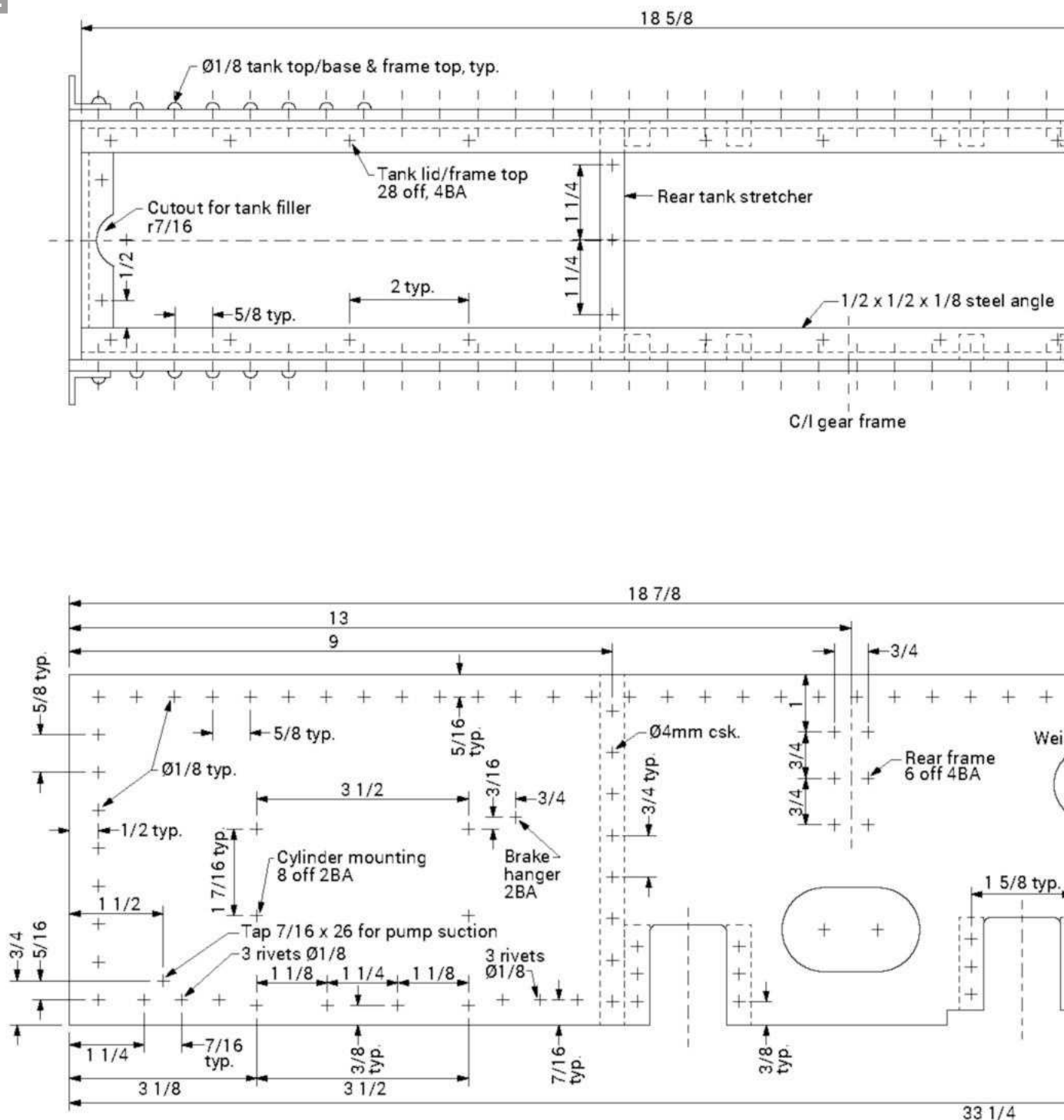


Fig 222



rear of the engine are visually significant (see photo 303, M.E. 4644, August 2020), if only because there's not much else 'going on'. So, I have tried to obtain a reasonable representation of the various fixings. See **fig 218**, which illustrates the main components. Obtaining a satisfactory 'look' is not

an easy task because, on a model, bolts are often more 'user friendly' than plain rivets for assembly and, additionally, most components at this scale tend to be oversize.

The front and rear general arrangement drawings, figs 204 and 205 (M.E. 4644, August 2020), certainly show that these little engines were

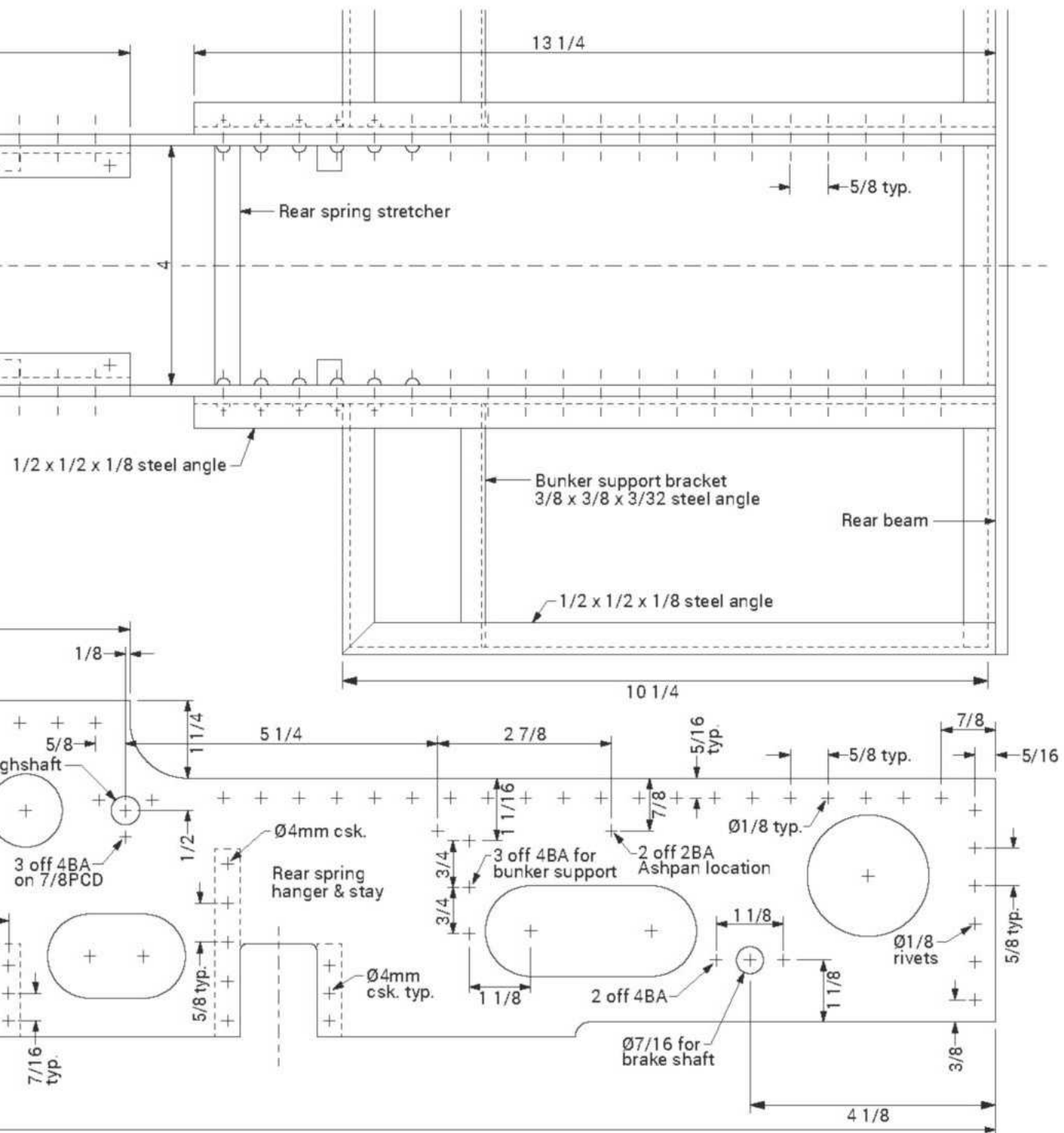
unique and delicate in their own way – partially due to the lack of fancy bits. But they are definitely an acquired taste!

Stretchers/stays and axlebox horns

Figures 219, 220 and 221 provide further details of the stretchers. The basic dimensions of these were

illustrated in figs 208 and 209 (M.E. 4646, August 2020).

The $\frac{3}{16}$ inch thickness of the frame is somewhat unusual for a 5 inch gauge engine. However, as mentioned earlier, this provides an extra degree of stability due to the lower centre of gravity, a good corrosion allowance for the well tank, and the additional strength that



The main frame.

the well tank base and the top cover plate provide by forming a box section. As far as I can see from the original Barclay drawings, they specified no rear rod stretcher for the 0-6-0 frame, unlike that of the 0-4-0, but, again, the $\frac{3}{16}$ inch thickness and the $\frac{1}{4}$ inch thick rear beam will provide suitable stiffness. Simple horns are required

each side of the axlebox openings where there are no stretchers. These are pieces of $\frac{3}{8} \times \frac{3}{8}$ inch mild steel and are fixed in place using M4 hexagon, countersunk head screws. See fig 220. I've specified M4 because it's likely to be almost impossible to get countersunk BA screws with cap heads.

Figure 221 shows how the front stretcher of the well tank (which is also the front of the engine to which the buffer plate is fixed) interfaces with the frame plates, the top cover and the tank base.

I note that the making and erection of the 0-4-0 frames was addressed in this magazine during August and

September 2015 and the same methodology also applies to the 0-6-0 (fig 222).

● To be continued.

NEXT TIME

We go on to talk about the well tank.



Oliver Cromwell on the GCR, Loughborough in 2014.

Britannia Class 7 Locomotive in 5 Inch Gauge A Modelworks Rebuild

PART 3 - SPRINGS
AND SPRING RATES

Norm Norton takes a renewed look at this popular, kit-built BR Standard Pacific.



Continued from p.617
M.E. 4651, 6 November 2020

This article will describe changes I made to the locomotive springing. Clearly, this was completed before the air test described in the last article but jobs don't always finish in a linear order that matches their best description in reasonably clear write-ups.

Design principles

If a locomotive is going to grip the track then all the driven wheels need to be in contact with equal loads applied and those evenly spread weights should be as high as possible. This is simple to arrange in an 0-6-0 configuration. However, if there is a leading bogie and a rear pony truck in a Pacific 4-6-2 configuration then sufficient weights must

be applied to the bogie and pony truck in order to keep them on the track – but too much and they will reduce the driven wheel pressures. If you are going to make springs for a locomotive then you have to first design them to take the weights predicted and at a specified rate of deflection per applied mass. Once made they should be tested to see if they perform anywhere near the required specification.

I suspect that a lot of model engineering spring manufacture is guesswork or simple 'hope for the best'. I have read one renowned model locomotive designer say in writing something along the lines of: 'you could try a few Tufnol leaves in place of the steel ones;

perhaps someone could write in to say how they get on'.

The Modelworks main springs on this Britannia were made with mostly Tufnol leaves and looked to be almost flat and slightly concave. If I pushed down on the frames there was barely any movement; the springs were 'dead' and some of the horns were binding. Removing the bogie and pony truck and testing those gave the same, dead and un-springy effect. In my view it is essential that each sprung component does its job according to design or wheels will derail and the driven ones will slip more readily.

Four designs of spring

I had previously undertaken some experiments on main

leaf springs to help in the build of a Don Young 5 inch 'Black 5' that I am making. Those results helped me make decisions regarding the rebuilding of these 'Britannia' springs so I will describe those findings here.

The common view is that model locomotive springs, if prototypically made to scale from spring steel, will be too firm. This is broadly true and so there have been alternative designs to give springs with greater compliance, that is, more movement per unit of applied force. A more compliant spring might be described as a 'softer' spring or as having a lower 'rate'. Previously described designs for achieving this have been a) to use leaves made of Tufnol, b) to use leaves made of bronze and c) to cut slots in the steel leaves.

Tufnol is a trade name for a material made from paper, cotton fabric or glass fibre impregnated with phenolic resin. It was in common use before modern plastics and can still be obtained today in sheet form and, conveniently, in $\frac{7}{16}$ inch wide x $\frac{1}{32}$ inch thick strip. It can be thermo set, that is, bent to a shape and heated; when cooled it will retain that shape. I set some by bending it around in a coil, tying with wire and placing that in the domestic oven at 150 degrees C for ten minutes.

The four spring types made are shown in **photo 11**. The nearest used leaves of EN42 spring steel, the second is made from Tufnol, the third from bronze (PB106 20 swg sheet guillotined to 7/16 inch strips by M-Machine suppliers) and the fourth from EN42 steel that has had the centres of the leaves removed by milling before hardening.

Each spring has the same top leaf with shoes intended for the 'Black 5'. These shoes are silver soldered the top leaf cannot be hardened. The springs are held together temporarily with a slotted screw, rather than the buckles, only to keep them assembled during testing.



Leaf springs with leaves of four different types for test.

Table 1. Spring test results		
Material	Spring Rate kgf/mm	
EN42 Solid	5.8	100%
Bronze	3.6	64%
EN42 slitted	3.3	61%
Tufnol	2.1	40%



Leaf spring test frame.

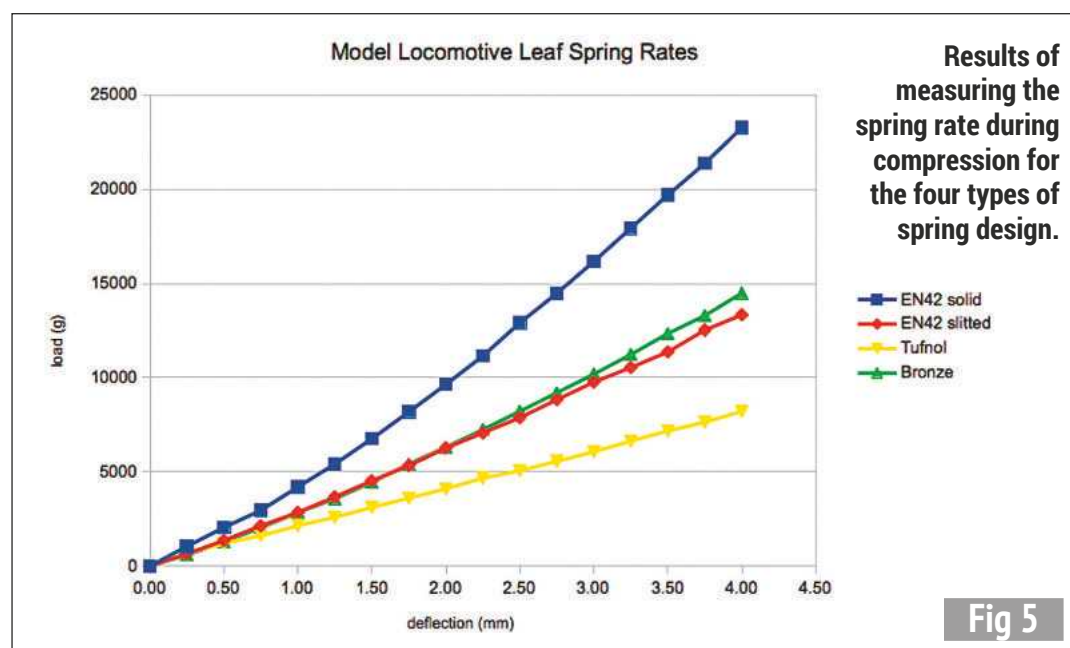


Fig 5

Test frame and results

The test frame I made from angle steel and pillars (**photo 12**). It carries a wooden block to support a set of 40kg electronic postal scales. A simple press has pegs for alignment and a small digital calliper is held by screws. The spring under test simply rests on its shoes and the nut on the retaining screw transmits pressure from the upper jaw as the screw jack is turned. In use, the apparatus gives very repeatable results. It is interesting to see that when

the spring is gradually relaxed in the frame the sprung force is less than in compression, because of the frictional forces between the leaves. Before the tests, all leaves were cleaned and lubricated with a light mineral oil.

The graph in **fig 5** shows the load resulting for spring deflections up to 4.0mm. Note that these are curves and not straight lines. Each spring was preloaded slightly to close any gaps before starting and the scales and calliper zeroed. The non-linearity

is perhaps a result of the changing blade curvature.

Table 1 shows the spring rate in kgf/mm determined from the greatest deflection. Taking an average of all readings for each spring the relative strength of each has been calculated. Bronze and slotted EN42 give a similar 61-64% rating while Tufnol gives an appreciably softer spring at 40%. Considering how much metal has been removed from the slotted springs it is somewhat surprising that they still give 61% of the un-slotted

rate. The slots are $\frac{5}{16}$ inch wide, leaving $\frac{1}{16}$ inch sides. The top two leaves though are un-slotted and these must be taking a proportion of the load.

Design and manufacture of Britannia main springs

For the Britannia, my plan was to make a solid EN42 leaf spring, then to test it and decide if it was acceptable or if it needed Tufnol inclusion at some proportion. The Britannia springs would be longer at 4.4 inch between hanger centres, compared with the Black 5's 3.75 inch, and contain just eleven leaves compared with thirteen. Fewer leaves and at a greater length will result in a lower spring rate.

In the following text I shall continue to use metric units; it keeps all the numbers for spring rates consistent with the tests and the units are convenient when making comparisons

I first had to find out what spring rate I wanted for the locomotive. I weighed all the component parts that were going to comprise the finished engine, added 7kg for a boiler water fill, and it came to 109kg. From this total the un-sprung weight of wheels, axles and axle blocks should be subtracted. I nominally took the adjusted figure to be 105kg.

My design principles were to say that if the all-up locomotive weight was 105kg then you might have 25kg on each of the three driving axles, 15kg on the front bogie and 15kg on the pony truck (fig 6). These are a distribution of weights that will hopefully be sufficient on the bogie and truck to keep them on the track during loading bay ramp movements and when crossing ground level points. But the bogie and truck will only move and stay on the track if those sprung items have sufficient compliance, that is an ability to deflect a reasonable distance with a small change in load. The main driver wheel springs however can be stiffer (lower compliance or greater spring rate) to give stability to the locomotive.

25kg per axle is 12.5kg per spring and if that one-sided load is doubled to 25kg, i.e. the locomotive is badly deflected so that all the mass is bearing on one side, a spring displacement of no more than 4mm is perhaps a target; any more and the locomotive risks 'wallowing'. The main axle blocks have a maximum of 10mm of total movement in the horns. However, there is a bit less available in the bogie and truck so I was looking for perhaps 8mm of maximum total movement in use. This means a spring compliance of 12.5kgf/4mm, or 3.1kgf/mm (to one decimal place).

The numbers in fig 6 are based on an assumption that the centre of gravity (COG) of the locomotive sprung mass is exactly over the centre driven axle and that the bogie centre and truck axle are equidistant from that same centre axle. This is unlikely to be exactly true. We have to accept that if the front is heavy because of the cylinder blocks then more load will be applied to the leading axle and the bogie. However, if the big firebox brings the COG to the rear then the trailing axle and the truck will bear more weight. Suspending the locomotive in a balance frame to measure exactly where the COG lies is possible but difficult. It will be easiest to observe by how much each axle box has moved when the full load is applied. Even better to roll the locomotive over a track weighbridge.

I drew a design for the main driving axle springs with a new mounting pillar and spring hangers – this gave me a curvature for the springs that was similar to the prototype and lengths for the eleven blades (note that the prototype in fact has thirteen blades, and shoes on the top blade to accept the spring hanger pins, but I have chosen not to copy this). A roll of $\frac{7}{16}$ inch x 20g EN42 spring steel comes in its annealed state, if that is what you order. One spring was made by cutting the blades to length, drilling the centre fixing

Idealised, target weight distribution.

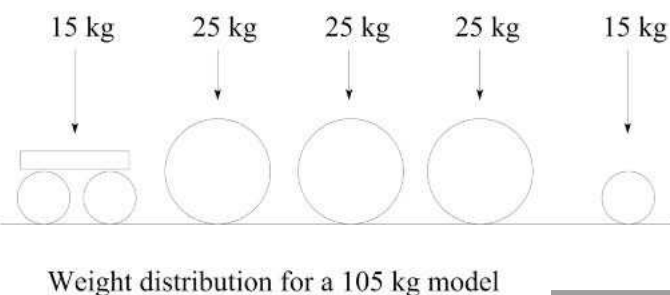


Fig 6

hole, cutting spring hanger slots in the two top leaves, and then running each through a rolling machine to finish with the desired curvature from the drawing.

The blades were then placed in a small industrial oven (small oven sold for hobby jewellery work) set at 820°C for 15 minutes when they were a light cherry colour. One at a time, each blade was quickly removed with tongs and plunged vertically in light mineral oil (Neatcut) keeping it moving for five seconds and then dropping it in the oil container. When removed, each blade had a layer of black scale and burnt oil but this was easily removed with a rotary abrasive pad. The clean blades were then assembled into spring sets and tempered with the furnace now set at 310 degrees C, leaving them for 30 minutes. This gave a light blue colour which is correct for locomotive springs. It is further up the tempering scale from the yellow-browns of cutting tools and blues of punches.

Some writers advocate heating the whole, assembled spring for hardening and plunging that in oil. But I tried it and took the spring apart and found a lot of scale between the leaves. It means they will have to be disassembled for cleaning anyway. I am also not convinced that the blades will harden to the same evenness. If you have not got an oven then they will have to be hardened by gas torch as an assembly in this way, cleaned up, then tempered by laying

the assembly on a bed of sand (or brass fine turnings) in a tin tray and over a gas ring.

After tempering, each blade was cleaned by lightly wiping and oiling. I tested this first spring and it had a rate of 3.3kgf/mm. I had struck lucky as this was acceptably near enough to the design target of 3.1kgf/mm. Clearly the additional length and two less blades had a large effect in reducing the rate from the 5.8kgf/mm obtained for the Black 5 design. I therefore made five more springs in exactly the same way and assembled them in simple, wrapped buckles drilled through for the mounting pillars. I tested all six springs to see how similar they might be and all fell in the range 3.26 – 3.44kgf/mm; a pleasingly consistent result.

It is interesting to note that the unresponsive Modelworks Tufnol springs, when measured, gave a spring rate of 6.3kgf/mm. This high figure is because they were collapsed.

Before re-fitting the axle blocks I wanted to ensure they were all moving freely within the horns. I had to ease three of the six horn pairs with careful filing, scraping and emery to achieve this, and then they needed rechecking when the coupling rods were attached. I would guess that the horns had not been machined in the frames after being fitted.

The hangers are studs that screw into small pieces of round bar to bear upon the two top leaves; the slots in the

leaves ensure that the hangers have some freedom for angular movement. Similarly, I put slots in the hanger brackets. I have assembled it with nyloc nuts to allow ease of ride-height adjustment but these could be replaced with a nut and locknut (**photo 13**).

Front bogie

To achieve the load design, the front bogie (**photo 14**) and pony truck both needed more compliant springs than those fitted to the main axles. The rate will be in proportion to the desired load. A few calculations will tell us what number we are after.

1. If a main spring's rate is 3.3kgf/mm, then each axle has an effective rate of 6.6kgf/mm
2. If each axle is loaded to 25kg it will deflect 3.8mm (25kg/6.6kgf/mm)
3. The whole bogie needs to move the same distance of 3.8mm when supporting 15kg.
4. This is a bogie effective rate of 4.0kgf/mm (15kgf/3.8mm)
5. The same rate of 4.0kgf/mm will be wanted for the whole of the truck.

The Modelworks bogie springs are a dummy leaf and a pair of small coil springs hidden each side. When tested, the whole bogie was far too stiff at 12kgf/mm. I rebuilt it by moving the dummy leaf in its supports to give more room and fitting new, thinner wire gauge and longer coil springs. I experimented with spring length until I had a total bogie compliance of 4.0kgf/mm.

The Modelworks bogie had no limit to its amount

of rotation – well, actually the limit was set by the draincocks. This meant that as soon as the bogie derailed, or was mishandled during loading, it would very likely destroy one or more of these draincocks. I silver soldered a brass limit plate onto the rear of the main bearing block, and cut a slot, and this engages with a limit pin screwed into the bogie frame stretcher (**photos 15 and 16**). Movement has been limited to plus/minus 5 degrees which will be more than adequate for a sharply curved track.

Pony truck

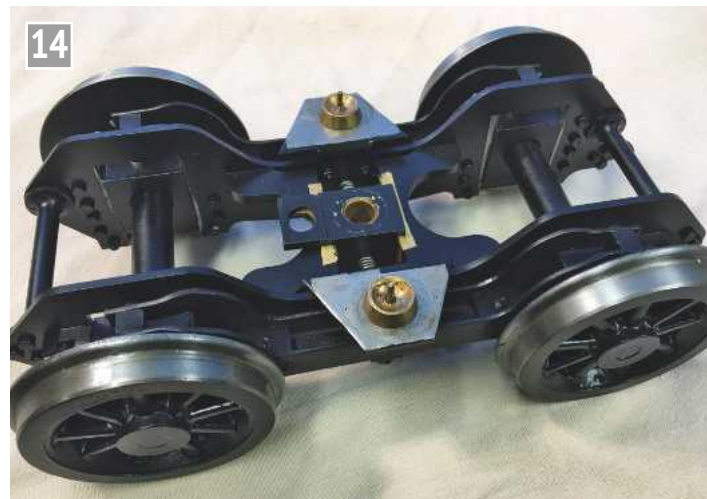
The pony truck springs are inverted on the prototype, curved with the centres upper-most, and I built two new springs to replicate this (**photos 17 and 18**). I made one using five top steel leaves

and four Tufnol below as a trial and the rate of this individual spring was 4.6kgf/mm - too high. Using two top steel leaves and seven Tufnol gave a rate of 2.6kgf/mm. Most of the spring is hidden anyway and you can only see the top edges in the photograph. Because the truck load-bearing pads sit behind the axle, and it is pivoting on the swivel pin at the front, the effective truck spring rate is less than the sum of these two individual springs because of leverage. When measured, it was close to 4.0kgf/mm total, the same as the bogie so exactly where it was wanted.

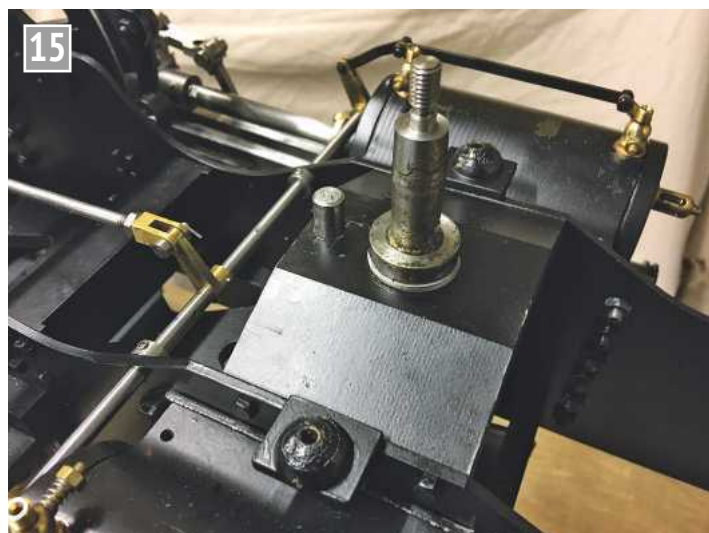
Before the work on the springs was done, the truck itself had to be strengthened. The Modelworks design used two setscrews to affix the sideplate to the main cast iron swivel. This was already



13 A main spring fixed to the axle block by a pillar and supported by spring hangers.



14 Front bogie.



15 Front bogie bearing pin and swivel limit pin in the bogie support frame stretcher.



16 Swivel limit pin located in the limit plate.



Pony truck.

coming loose and the casting flanges broken. I added a substantial piece of steel angle to the rear and a plate to the front of the casting. The same repair was made each side and cannot be seen when the truck is under the locomotive (**photo 19**).

Doug Hewson did note in his articles that the Winson truck had limited side movement and he had to cut away part of the brackets that affixed the drag beam. On this engine either Modelworks, or the previous owner, had already cut them and it now had 1½ inches total side to side movement.

Wheel and axle alignment in the frames

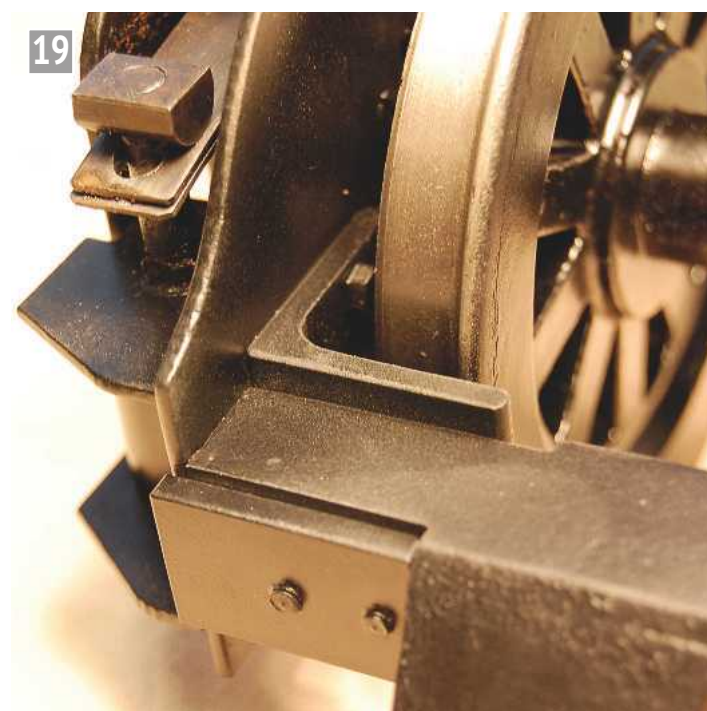
I am fortunate in having a rotating engine support and it is a simple matter to flip the frames upside down. Each axle (bogie, main and truck) had been mounted with its springs so that with no load applied the box sat just a fraction above its lowest limit of movement, which was the keep. I now made new main swivel pins for the bogie and truck and set their length so that when mounted I could put a straight edge (metre rule) along the treads of all six wheels (bogie, main and truck) for each side. Then, when the locomotive sits on rails and is fully built each axle box will hopefully deflect 3.8mm, sit in the centre of its horn movement, and be supporting the designed loads of 15, 25, 25, 25 and 15kg.

However, if the pony truck and trailing axle, for example, have deflected by more or less than 3.8mm then that might indicate that the COG is not in the centre. I shall have to wait until all the heavy parts are added before I can find out what happens. If changes are needed, I can adjust the spring hanger nuts on the leading and trailing driven axles to rebalance the loads by a kilogram or so. Also, the height of the bogie mounting pin could be adjusted so that it took more or less than the designed 15kg. The bogie height would be best adjusted by resizing the rear bearing pads. Significant adjustment anywhere would mean that the spring rates would have to be reset but I have fingers crossed that this will not be required.

There is a very simple test of the springing for any large model and that is to put a finger and thumb on the steam dome and attempt to rock it from side to side. With a decent push and pull it should move freely



Pony truck top two leaves visible with semi-circular spring hangers. These tops could be replaced with the more prototypical pin through the vertical shaft.



Strengthening brackets to pony truck frame swivel casting.

an inch or so each way – if it doesn't then the springing is too stiff or the horns are sticking. With either defect it will not have the best traction.

●To be continued.

NEXT TIME

We shall look at the ashpan and the grate.

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Drill Press Improvements

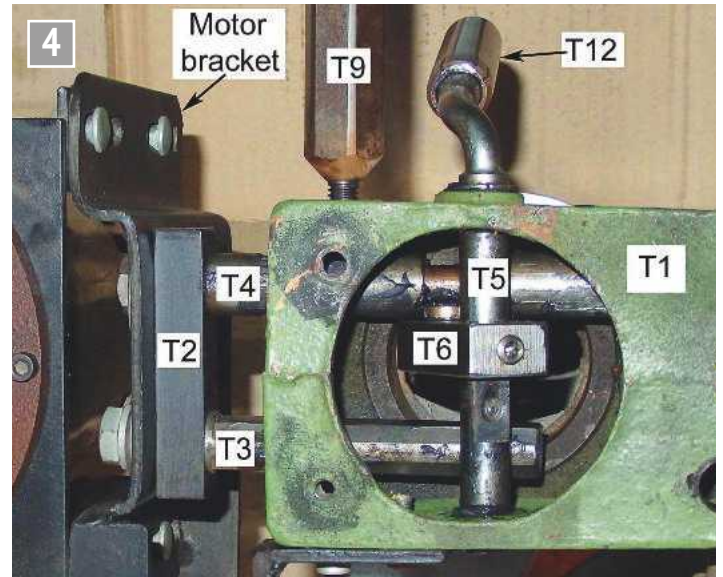
Jacques
Maurel
upgrades his
drill press.



Continued from p.628
M.E. 4651, 6 November 2020

The tensioning system

With new pulleys we need a revised tensioning system (photo 4 and figs 10 and 11). The motor bracket is guided on two cylindrical bars. This is an over-constrained system which can work only if the two bars are perfectly parallel. There must also be the same distance between the bar axes and the bore axes. The bars are unlikely to be parallel though as they are screwed (one end only) into a (not very flat) sheet iron plate. This is a bad solution and very often self-locking.



Tensioning system.



Wear in the tensioning system.

The tensioning force is provided by an internal lever, which moves a button along a groove machined in one of the guiding bars. The button and the groove were both scored, caused by an inaccurate centre distance, a small contact area and the rubbing of the button

in the groove (photo 5). The internal lever was moved back and forth by an external handle (T12 in photo 4).

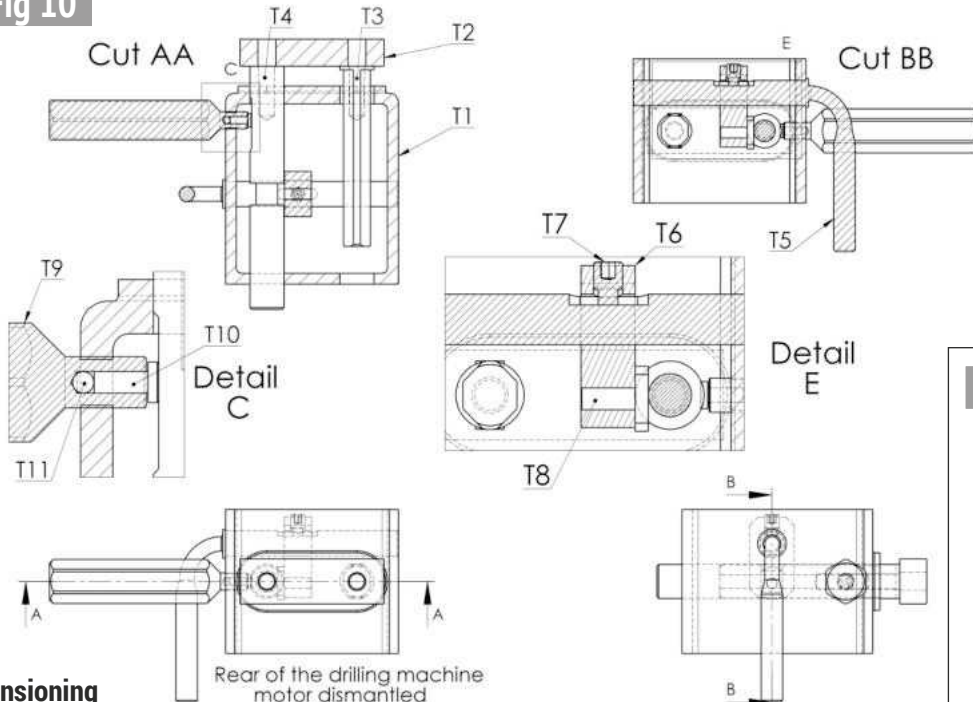
The locking of the motor bracket after tensioning was achieved by two wing nuts (one on each side of the machine) acting on flats machined on the guiding bars.

Three improvements were made.

Improvement of the bracket guiding

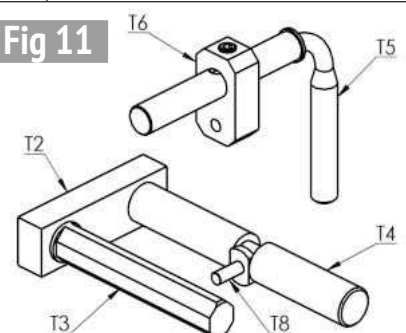
Only one bar (T4) now has full cylindrical contact (the one receiving the tensioning force). The other bar (T3) has only a point contact with its bore (by shortening and milling the cylinder and by filing inside

Fig 10

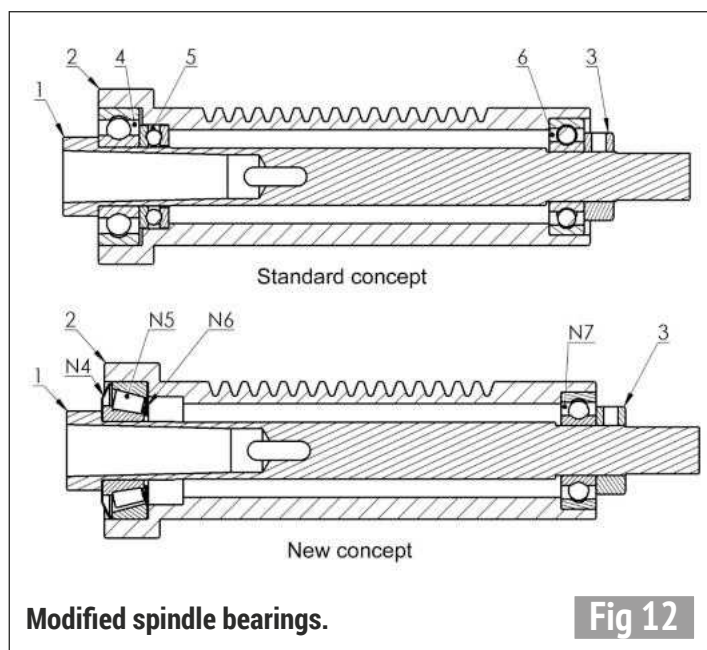


Tensioning improvements.

Fig 11



Isometric view of new tensioning parts.

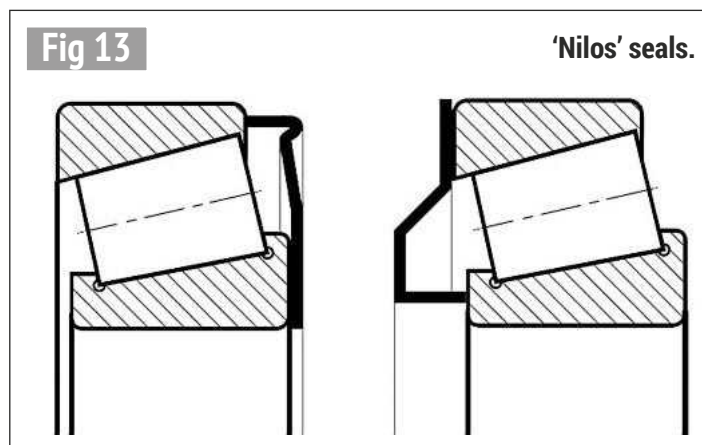


the bore). This results in an isostatic guiding arrangement that works well and won't lock, but is slightly more flexible. The point contact takes half the motor and bracket weight, as before, but the tensioning forces are all taken by the other bar. The two bars T3 and T4 are attached to T2 (15 x 25mm CRS). T2 is now welded onto the motor holding plate (not shown in photo 4).

Improvement of the tensioning force

The T4 bar was turned one half turn around on its axis to get an unworn part of the groove

and a new flat was machined for the locking screw. The lever T6 (made of 15 x 25mm CRS) is now equipped with a bronze pad T8 (set at the right centre distance) resulting in a more convenient plane contact with the T4 groove. The external lever T5 is extended (to make it easier to grip) by part T12 (see photo 4). The centre distance on T6 is 22mm and the T12 length is about 110mm, so the 'hand' force is multiplied by 5. As the average tensioning force is about 40N/tooth from the belt documentation (so 200N for the five teeth) a hand force of 40N will be sufficient.



Improvement of the bracket locking

One locking handle T9 is used in place of the two wing screws. A pressure pad T10 and a ball T11 (see fig 10) are used to increase the locking force. With this arrangement it's possible to tension with the left hand and to lock with the right one.

Spindle bearings

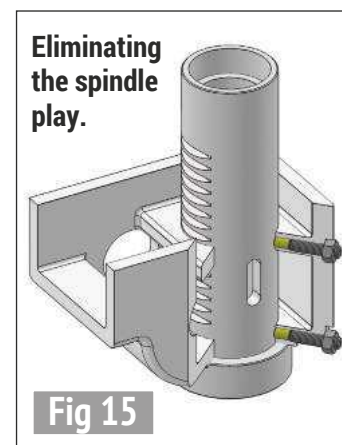
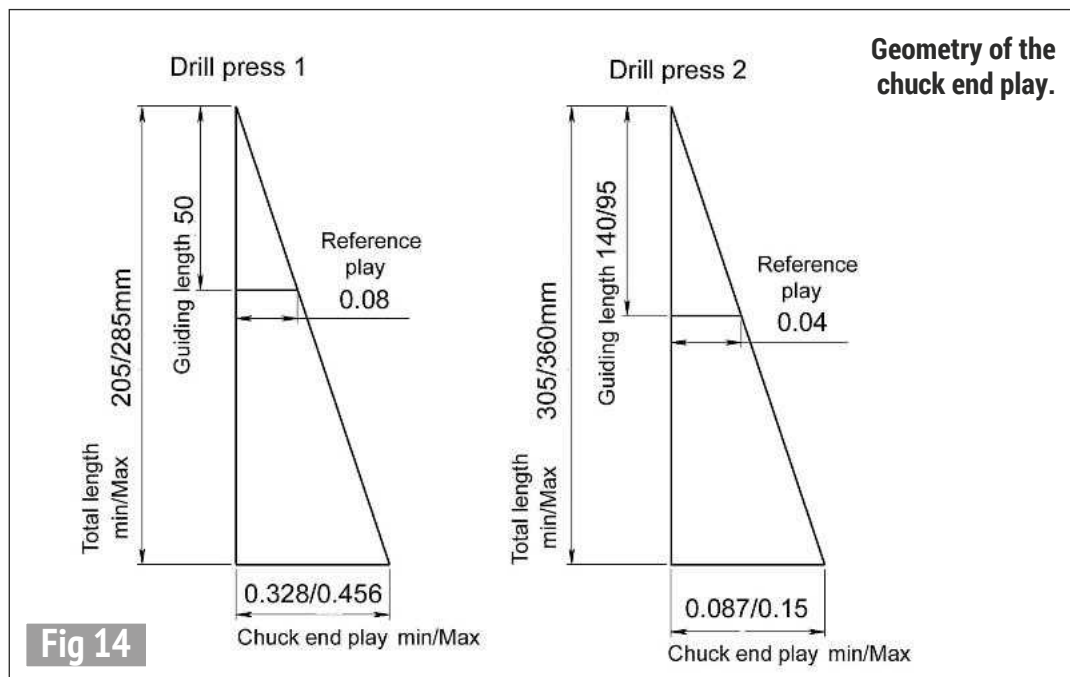
I decided to change the spindle bearings. **Figure 12** ('Standard concept') shows the usual roller bearing set up for a drill press using 2 radial ball bearings, parts 4 and 6 (sealed type) and one thrust ball bearing (part 5). While dismantling the spindle I discovered that the thrust bearing was missing! Clearly it had never been fitted – perhaps because it wouldn't

fit in the bore. I decided instead to use a single taper roller bearing N5 (see fig 12 – 'New concept') as the front bearing for the spindle (diameters 20mm, 47mm, thickness 15.25; SKF ref: 33204). The endplay is taken by the rear ball bearing N7, the inner race of which is pushed by the nut 3 (a grub screw and brass pad are used to lock the nut after adjustment).

To protect the front bearing I've used 'Nilos' seals (**fig 13**), these being thin steel cups exerting a slight force against the bearing races thus providing a light duty sealing action in a narrow space.

Improvement of the spindle sleeve guiding

I felt that the play between sleeve and casting was too big - 0.08mm measured with a DTI. The DTI stem was touched against the lower part of the spindle sleeve and the sleeve was lowered slightly (say 1mm) to free it from the casting. The chuck was then moved back and



forth to measure the play (this is the reference play). Take care while doing this not to touch the machine table as the DTI's magnetic stand is set on it. This play is not too bad; for a comparison the same measure was taken on an old French made 'Adam' brand drill press from the sixties, giving 0.04mm play.

But on the basis of this play it would be interesting to know the corresponding drill-end radial throw!

This throw is of a great importance for example when drilling a hole through a cylindrical bar. It must be small to avoid the drill wandering, so for this type of work use the minimum spindle vertical throw and the shortest length for the drill bit. Ideally, a short centering drill set in a No. 2 MT shank (so no chuck) would be the way to go.

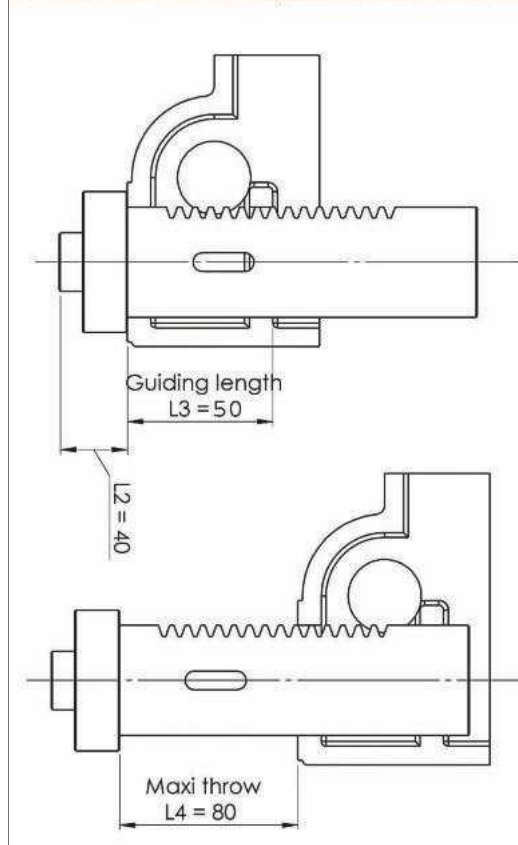
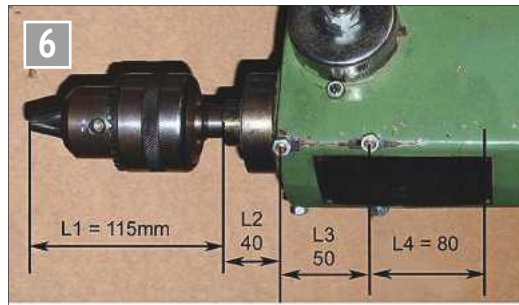
To calculate the radial throw, the guiding lengths are needed, and they are shown on **photo 6** (Taiwanese drill) and **photo 7** (Adam drill).

- L1 = Chuck length (out from the spindle bore) - identical for the two machines.
- L2 = Length between spindle bore opening and sleeve guiding bore opening (Taiwanese drill).
- L3 = Guiding length in the machine bore (Taiwanese drill).
- L4 = Spindle sleeve throw (Taiwanese drill).
- La2 = Same as L2 but for Adam drill.
- La3 = Same as L3 but for Adam drill (two values Max/Min here).
- La4 = Same as L4 but for Adam drill.

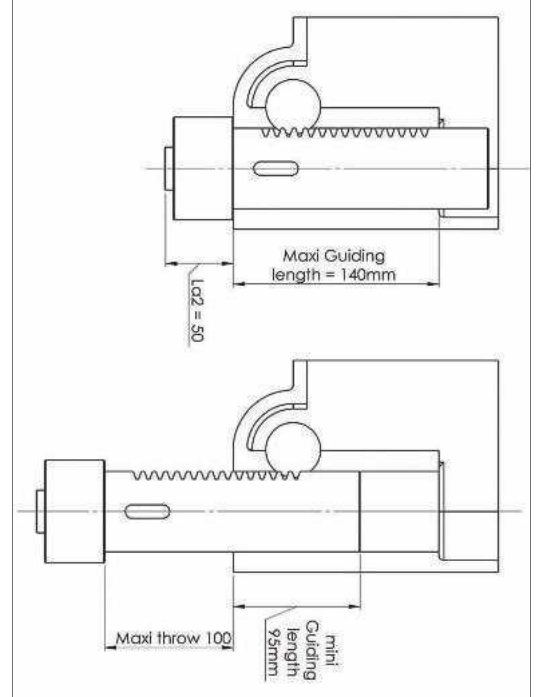
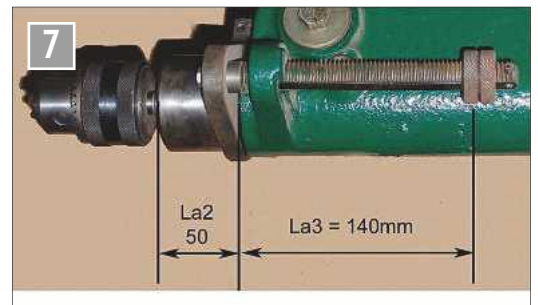
See **fig 14**, which uses the geometry of similar triangles to determine the radial throw at the end of the closed key chuck.

For the 'Taiwanese' drill press: Min = 0.358mm, Max = 0.456mm (for the full outside throw of the spindle sleeve).

For the 'Adam' drill press: Min = 0.087mm, Max = 0.17mm.



Guiding length (Taiwanese drill).



Guiding length (Adam drill).

The poor result of the Taiwanese drill is due to a small guiding length, which is only 50mm, while it was from 140mm to 95mm for the 'Adam' machine.

To take up this play I've used four brass pads pushed by M6 grub screws locked with a counter nut after play adjustment (**fig 15**). The problem here is to machine the threaded holes as the casting is somewhat cumbersome.



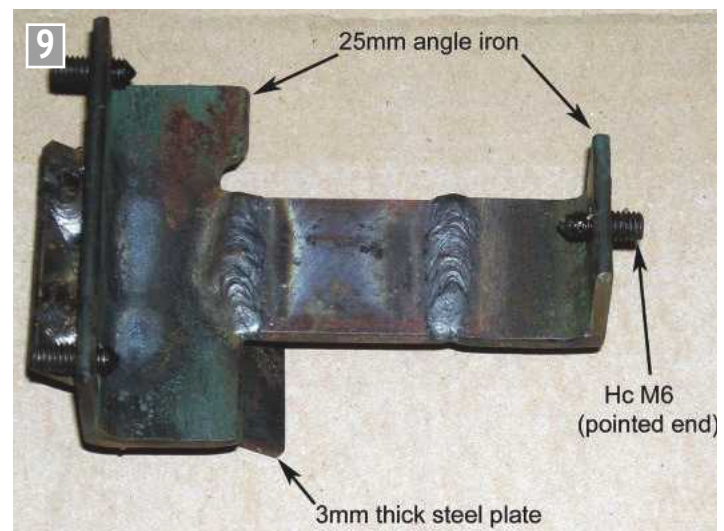
Marking out for the pressure pad screws.

I decided to drill and tap *in situ* with the help of a drilling mirror! Here's the method:

- * First step, file a 45 degree chamfer on the casting at

the right places, mark and strike a punch dot as seen on **photo 8**.

- * Make a jig (**photo 9** shows a fabricated one) to hold the mirror perpendicular to the



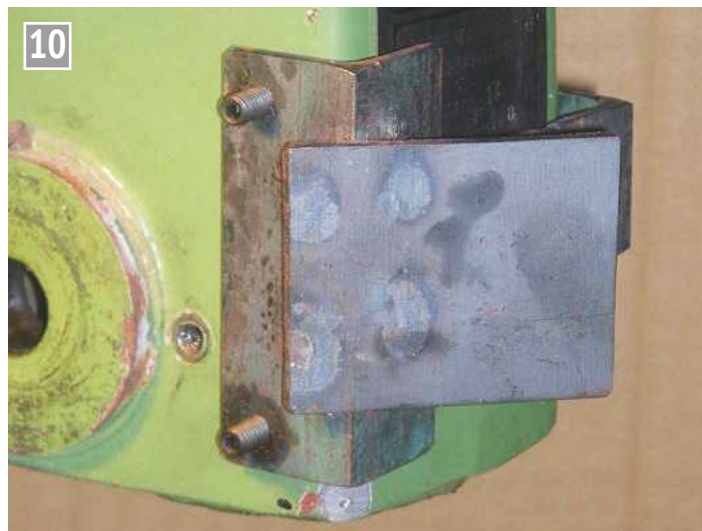
Drilling jig.

holes axis - **photo 10** shows the jig positioned for drilling the first hole.

* **Photograph 11** shows the mirror (a polished inox plate with a hole inside) fixed on the template with a locking plier. The alignment of the drill is good when the reflected image of the drill is in line with the drill itself. Drill first 2.5mm diameter (thinned pointed drill) then 5.1mm diameter, tap M6, use a 5mm diameter brass pad. **Photograph 12** shows the finished work.

Note about 'motor tribulations'

After all these improvements (and more, including changing all the ball bearings from the driving shaft and the motor) but still with the single phase genuine motor, the machine was switched on for a first test and - shame! Very strong vibrations appeared; so strong that they slackened the MT2 and the chuck fell out! The only way to use the machine was to tension slightly, so the vibrations were on the belt only. I made a video of these with a stroboscope (search on



YouTube for 'belt vibrations on a drill press') - they are quite impressive.

The culprit was discovered after many years - the single phase motor!

This motor, when dismantled to change the ball bearings, proved to be very badly made, but it was running quietly enough off-load. I tried another single phase 1425 rpm motor (French made, and fitted with bronze bushes) out of an old washing machine from the fifties. The vibrations still occurred but the motor was

far smaller, so it couldn't be used anyway as it was of insufficient power.

Another day I tried a three phase motor and - yes - here was 'nirvana'! After investigation, it appeared that single phase motors are unbalanced concerning the electromagnetic forces, hence the vibrations, due to irregular torque, this problem being amplified on the 'Taiwanese' motor by badly made windings.



Using the mirror to guide the drill.

Drilling jig in place.



ME Pressure pad screws installed.

No.299

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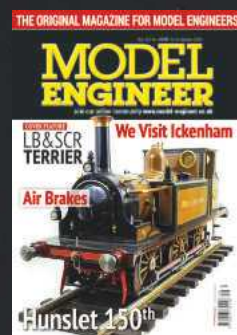
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Petrol Engine and Alternator Sets

PART 2

How to make them work well and why they often don't

Jon Freeman explains how to make petrol engines and electrical alternators work efficiently together.

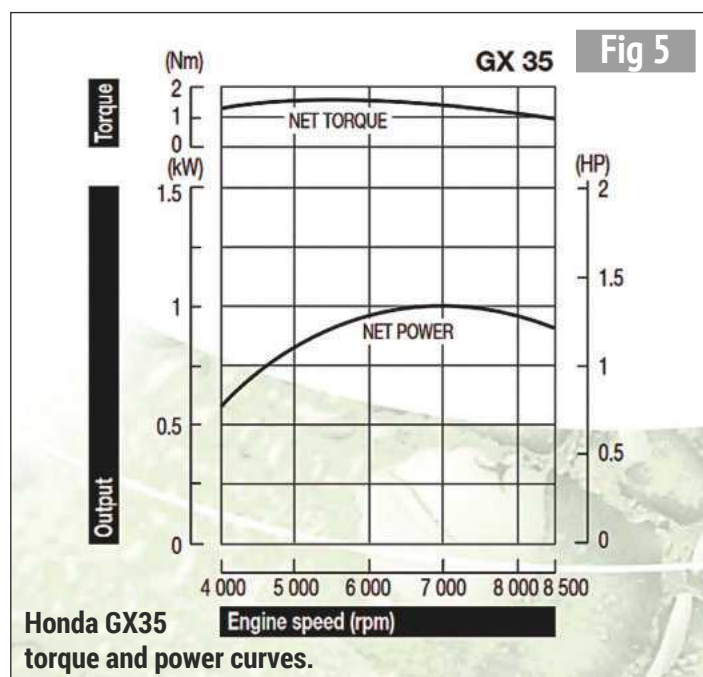


The torque characteristic mismatch problem

Rotary mechanical power may be calculated by multiplying torque by speed (or angular velocity, to use the proper term). It follows that if an alternator delivers some constant power 'P' at 6000 RPM, loading the engine with a torque of 't' Newton metres, the same power at 1000 RPM requires six times the input torque, '6t' Newton metres. In contrast, the upper trace, 'Net Torque' in **fig 5** from the Honda data sheet shows a substantially flat engine torque characteristic over the useful speed range. These hugely incompatible torque characteristics present a problem to be solved!

The lower trace of **fig 5** - 'Net Power' - represents the upper bound of the engine 'useable operating area'. At any instant, engine speed and power delivery to load can be represented by a point within the area, at or below the 'Net Power' trace level. Points close to and below the trace represent conditions where the engine capability and load are well matched. For points lower in the area, reducing speed improves utility by moving the point to the left, closer to the trace.

At all times the engine needs to be capable of delivering just a little more power than is being demanded of it, operating at a point below the Net Power upper bound. Too large a margin wastes fuel in over-revving but too small a margin risks



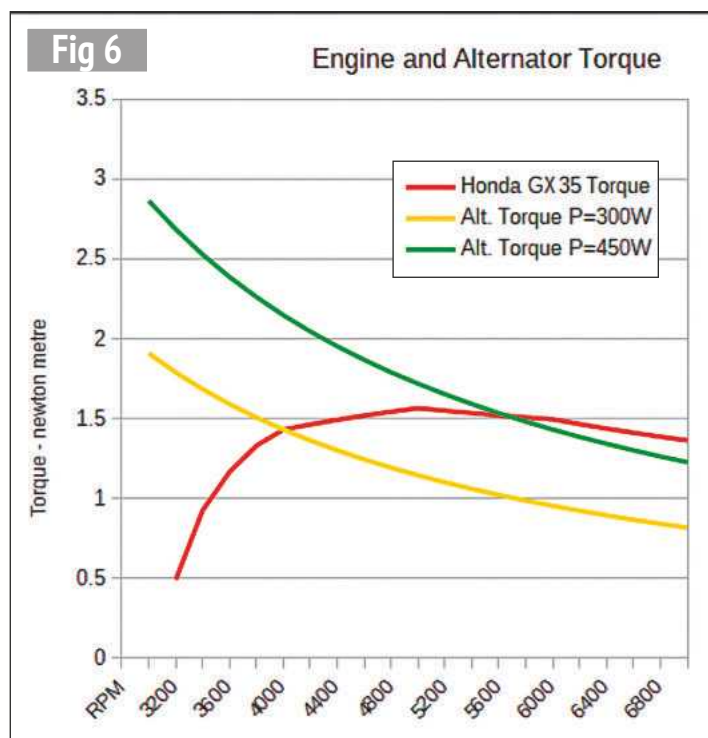
pushing the point above the line, taking the system out of the stable region, over a cliff-edge into a stall. For a power load point right on the trace, with zero margin, should the load increase at all, the now overloaded engine slows, lowering alternator output voltage. The alternator regulator responds by increasing the rotor field current and hence load torque, which slows the engine further – and the simple small-engine-alternator combo is seen to be an unstable system, perfectly designed to stall engines!

Figure 6 illustrates the torque characteristic mismatch. The engine torque trace is copied from 'Net Torque' of **fig 5** with some approximate extra data points at lower speeds. The alternator

torque traces are calculated assuming a constant 50% efficiency. Where the alternator torque trace in **fig 6** is below the engine torque trace, the engine will be working at a point within the usable area where it is capable of delivering more than the power demanded, and all is well. Once the alternator torque exceeds deliverable engine torque, moving the operating point outside the usable area envelope, stalling is inevitable.

The root of the stalling problem is explained by the crude action of the standard alternator regulator. Like a dog with a bone, it is concerned with only one thing, that of trying to maintain constant output voltage come what may. This is no good to us. A means of limiting input torque

Continued from p.645
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to avoid stalling engines must be found, the solution being to use a different regulator - a 'smart regulator'. This new smart regulator needs a little 'intelligence', using a microcontroller of some sort. That's quite handy as some intelligence is also required to control the engine. A well-chosen small microcontroller should be capable of supervising a smart alternator regulator and providing simple engine management functions at the same time.

There's much myth and mystery surrounding alternator regulators, so it's time for some debunking. Undoing two screws, the rear cover of the Lucas ACR alternator is removed revealing all the interesting stuff inside (**photo 10**). The two connections to

slip rings connecting to the field winding on the rotor are near the centre. Below is the rectifier stack, above centre is the regulator, a metal box about 40mm square with one black and one yellow wire. The metal box forms the only other regulator connection.

With only three electrical connections, we can be confident in identifying and naming all three. One has to be the 'Input' (IN), a sample of the voltage to be regulated. Another has to be the 'Output' (OUT), and the third can only be the variously named negative, chassis, earth, ground or common (COM), analogous to the mechanical bolt to the chassis. IN (yellow) connects to a rectifier output, an alternator output. COM (black) connects directly

to the chassis, ground, or negative output, and OUT (metal box) connects to a slip ring connecting one end of the rotor field winding. The other field slip ring connects to the same point as IN, where yellow and brown wires connect. That's all there is.

Experiment reveals alternator regulator is just a switch

The regulator gubbins are encapsulated, so a little detective work is called for. The design goes back to the 1960s. This tells us that whatever's in there, it isn't anything too clever! Rather than trying to take it apart, a simple experiment was conducted to discover what it does (**photo 11**). Using a 24 volt 60W filament bulb in place of the rotor field winding, and using a variable lab power supply in place of a car battery, the voltage was slowly increased. Above 4 volts the lamp begins to glow, dimly as you might expect from a low voltage. As the voltage rises so the lamp brightens. When the voltage reaches 14.5 volts the lamp abruptly turns off. Varying the voltage by a tiny amount either side of this threshold switches the lamp on and off. Thus, the alternator regulator is shown to be a voltage operated switch, nothing more than that. (A video of the experiment can be viewed at www.youtube.com/watch?v=KGXch0ABVVo)

How alternator regulator works

This is how it works. The regulator switch is 'on'

while the alternator output voltage is below threshold, allowing a rising current to flow through the rotor field winding. Assuming the rotor is spinning, rising rotor field current induces rising output voltage in the stator windings. Once the output voltage rises even a shade above threshold the switch opens, attempting to interrupt field current flow. This switching action repeats fast enough to keep the output voltage substantially constant.

Experience of circuits switching currents in coils suggests some filling in of the details. A diode is required, known by any of a number of names; the 'catch', 'flyback' 'flywheel' or 'freewheel' diode. An explanation of what it's for is beyond the scope of this article but it plays a crucial role. **Figure 7** summarises what we know about the Lucas regulator, and how it connects.

There's just a little more to regulation than this. Because the alternator generates DC voltage from rectified three phase AC, there is a 'ripple' on the DC, and this acts to operate the regulator switch at the ripple frequency (**fig 8**). This gives a primitive implementation of a useful technique known as PWM, Pulse Width Modulation. An electrical characteristic of coil windings, inductance, tends to smooth out the field current flow such that the average current is set by the ratio of switch 'on' to 'off' time, known as duty cycle, or duty ratio. **Figure 9** shows a PWM signal starting at time zero with a duty ratio of 0.7. Due to circuit resistance and inductance, the current rises and falls exponentially with switching but quickly settles to an average value close to 0.7 in this example.

A new 'Smart Regulator' is what we need

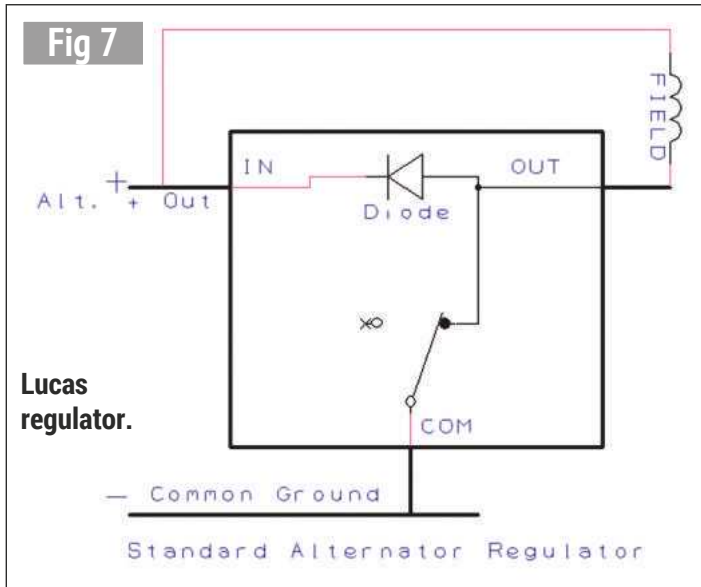
Starting the design of a new 'smart regulator' with a clean sheet opened the way to some further lateral thinking and questioning of conventionally assumed constraints.



In the back of the alternator.



Regulator bench test.



Using alternators at other voltages

The Lucas ACR series of alternators (**fig 10**) was designed for 12 volt systems. Having found a Lucas workshop manual from 1968, it appears these were designed to produce useful output at speeds from around 1000 RPM up. Knowing the Honda engine idles around 3000 RPM, surely the ACR would be good for 24 volt systems, with a suitable regulator? The rectifiers were tested and found good for up to at least 60 volts, but the rotor field winding is still rated for 12 volts. To keep within its current rating, with a few instructions

written into the smart regulator microcontroller code, the maximum PWM duty ratio can be scaled by 50%, this being a lot easier than the alternative of re-winding the rotor with twice as many turns of thinner wire!

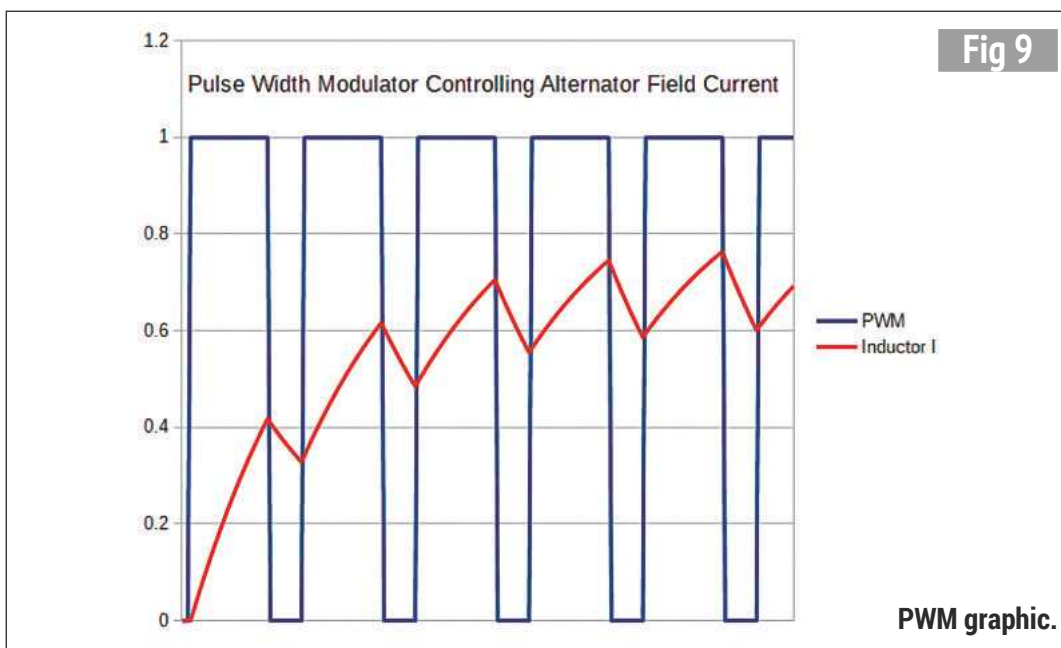
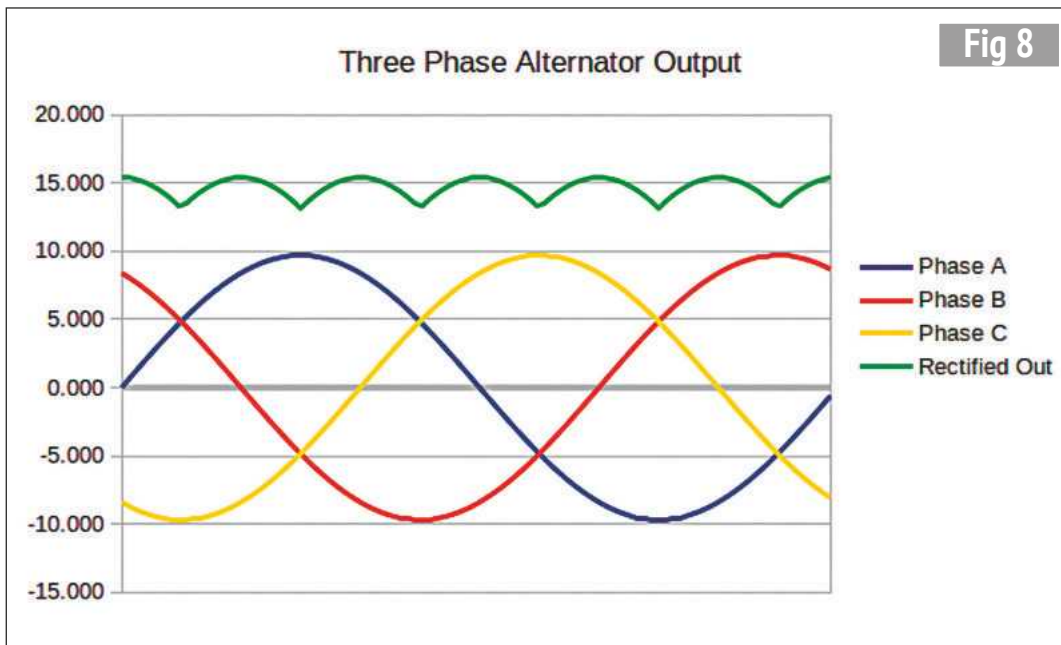
Anti-stalling strategy

The smart regulator needs to know about more than just the one thing - output voltage. With a second input, carrying engine speed information, the simplest anti-stalling strategy could be to switch rotor field current off when engine speed falls below tickover, for example. This would effectively switch the alternator off, and the load torque falls to just that due to bearing friction and fan drag. Stalling problem solved!

Taking this thought a stage further, the smart regulator could be designed to continuously apply an engine speed-related, variable upper limit on rotor field current. This would apply an engine speed-related limit to power output, hence load torque, and it becomes possible to tailor the alternator torque characteristic to a reasonable match with that of the engine (maybe with some trial and error).

To measure engine speed

How to measure engine speed? The Honda engine has just one wire coming out. This is intended to be switched to ground to stop the engine. (Other Honda engines have an 'On/Off' switch built in, but it's the same thing, and similar has been seen on other breeds.) This poses the interesting question, what exactly is it we are shorting to ground to stop the engine? Using an oscilloscope to look at what happens with this wire with the engine running (**photo 12**) shows this is the magneto output, probably the primary side of the ignition coil. A sample of this signal can be taken to fulfil two useful purposes. First, it is exactly the speed related signal needed to measure engine speed, and it is also useable to operate a micro-power switch to power



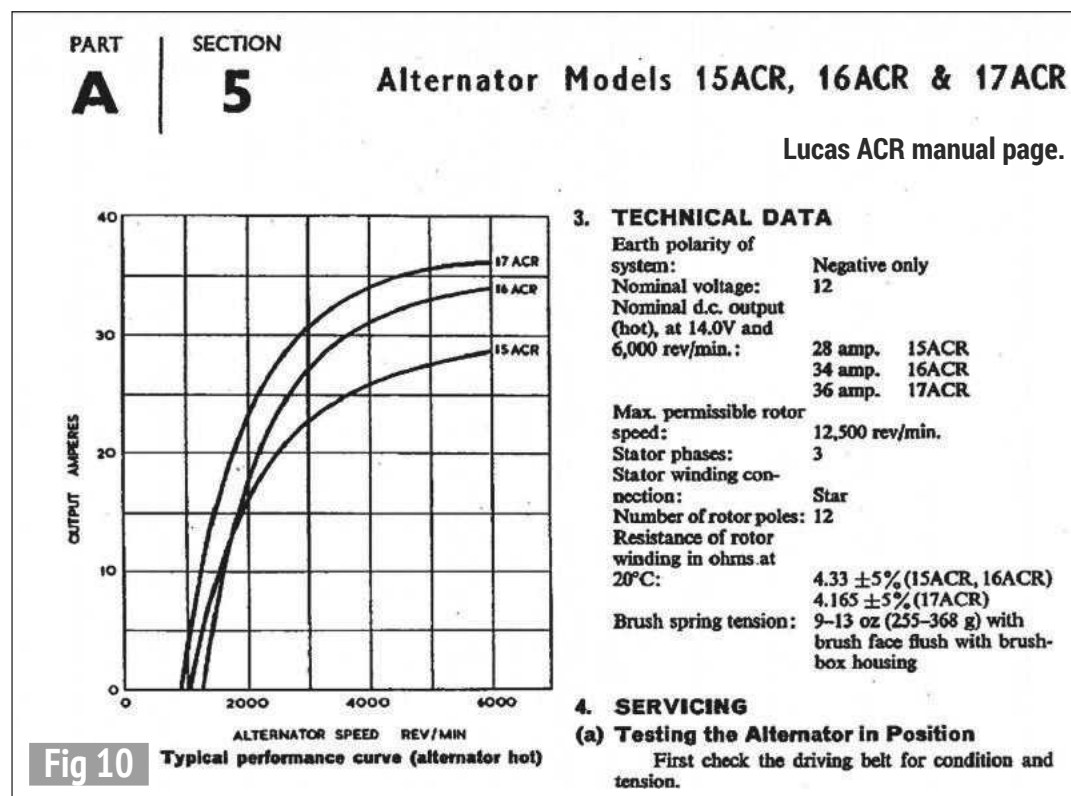
PWM graphic.

the electronics only when the engine runs. Auto power-down!

To include full engine control, a new output from the smart regulator is needed driving a model control servo (or some better actuator) to work the engine speed control. Another input, an analogue copy from the driver's locomotive control, might be useful. We now have a smart regulator controller with three inputs and two outputs. These new features, added to the original, are included in the revised smart regulator diagram (fig 11). Some 'intelligence' will be needed to make all this work - a microcontroller of some sort.

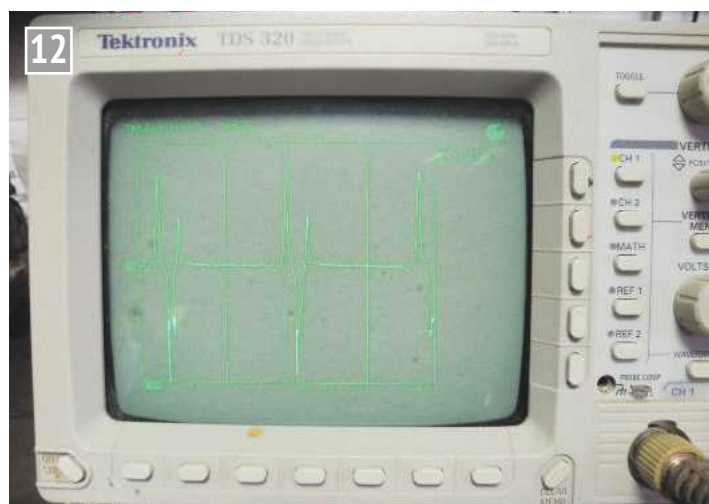
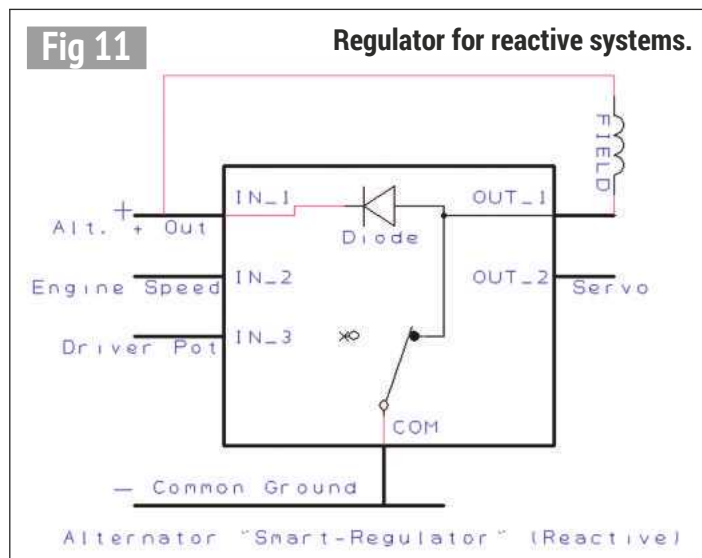
There are now two factors, either of which serves to limit rotor field current - output voltage and engine speed. This suggests a need for something rather better than the hit and miss style of PWM inherent in the old 1960s Lucas design. A search for a modern PWM controller chip identified a perfect candidate, the MCP1630 integrated circuit, described as a 'Microcontroller Adaptable Pulse Width Modulator'. This along with a microcontroller formed the basis of the new smart regulator.

Yet to be solved is the problem of how exactly to control engine speed and power. The ultimate control system would be able to setup the engine state before taking power - proactive control. This is after all how full size (non-steam) locomotives work. Inter

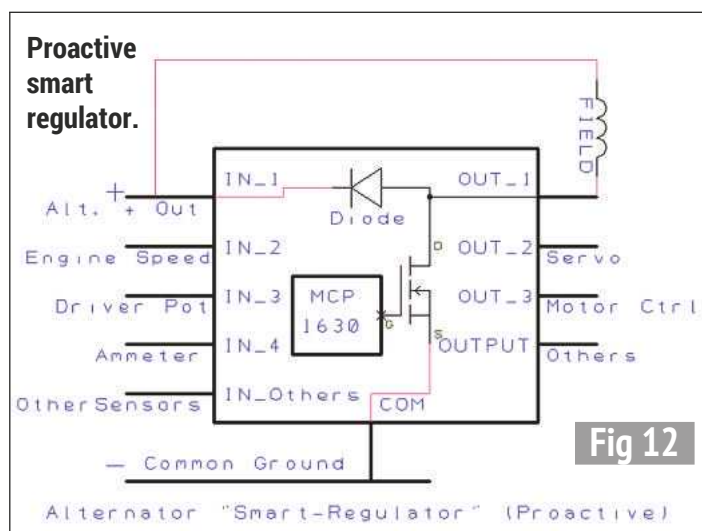


City 125 engine revs rise to high before any sign of movement. Similar applies to jet aircraft, cars etc. Adding this level of control involves taking the driver's control potentiometer signal, processing it and delaying any increased demand until after the engine state has been changed and verified in readiness. Designing the smart regulator and controller with sufficient resource to implement this top level proactive control ensures it would be good for all eventualities. Figure 12 shows these thoughts developing.

●To be continued.



Oscilloscope trace.



150 Years of the 'Quarry Hunslet' Dynasty

PART 4 - THE PENRHYN
'PORT' CLASS

Mark Smithers celebrates 150 years of the famous Leeds locomotive builder.



Continued from p.624
M.E. 4651, 6 November 2020



Penrhyn Railway 'Port' class 0-4-0ST Lilian is seen here at Canna Park on the Launceston Steam Railway in June 1990. The locomotive had first been restored to working order by Nigel Bowman in Surrey in 1968.



Following its return from the U.S.A., Winifred is seen restored to working order, but in final Penrhyn Railway condition, at Aberystwyth during the Vale of Rheidol 'Forgotten Engines' Gala of September 2015. Note the studded dome cover. This view is of vital importance for one particular reason: the survival of a similar Pearl-pattern studded dome cover from the Dinorwic-based Lady Madcap (now fitted to Sybil Mary at Statfold) has sometimes been used to support the view that Lady Madcap carried an ordinary Alice class boiler from 1931 for a short time on the grounds that the dome cover would still have been fitted and required modification with fixing studs for a tank designed for a domeless boiler. Given that both the 'parent' designs of Lady Madcap (originally Sextus), namely Winifred and Pearl, were built with studded dome covers, this line of argument does not stand up. In any case, if a domeless boiler was fitted along with a tank built to Alice class proportions, why would the dome cover be retained at all?

Charles having proved its worth on the Penrhyn Railway's 'Main Line', Hunslet's attention turned to providing a suitable design of locomotive for shunting work at Port Penrhyn. In coming up with a solution to the Penrhyn company's requirements, the makers turned to the 'dropped footplate' line of evolution pioneered with *Gem*. Utilising a 33-tube boiler cross-section but with an even longer wheelbase of 4 feet, the wheels were the earlier *E. Jago* standard dimension of 20 inches. The cylinders were 7 by 10 inch (apparently in line with *Huelva*) whilst the Salter safety valves of *Gem*-pattern were retained, in preference to following the lead set by *Charles* in using Ramsbottom valves. The same was true of the plain 'disc' smokebox doors. *Charles'* lead does appear to have been followed

in one important respect, however: contrary to usual Hunslet practice of the period in relation to narrow gauge locomotives in their size range, *Gem's* feed pump gave way to a second injector (mounted rather strangely on the right hand side as with the first) on the three class members: *Gwynedd*, *Lilian* and *Winifred* (respectively W/Ns 316-7 of 1883 and 364 of 1885). It therefore appears that the Penrhyn Quarry was going to have an injector-only policy on its Hunslet locomotives from day one - certainly no photographic evidence exists of these or any other of the Leeds firm's specific products for this customer having ever been fitted with a feed pump. One interesting constructional detail of this class was that the handbrake column was affixed to the firebox wrapper on the right



A view for modellers – Winifred's injectors, both on the right hand side. This feature did not find its way on to Pearl.

hand side as opposed to being free-standing. This peculiarity appears to have been inherited from the Manning Wardle '6 by 8 inch' locomotives where the 'Woolwich' variety utilised the former arrangement (albeit integral with the reversing quadrant mounting) and the 'Chatham' variant the latter. As we shall see, this dichotomy would persist further in the story of the 'Quarry Hunslet' dynasty. Be that as it may, the *Velinheli* and *Gwynedd* specifications (the latter represented today by a surviving General Arrangement of *Winifred*) were to have an influence upon events at Heaton Mersey Brick Co. which was to take delivery, in

1890, of its second Hunslet 0-4-0ST *Pearl* (W/N 513). This locomotive would be equipped with 7½ by 10 inch cylinders, a general styling similar to *Winifred* but with *Velinheli*'s smokebox configuration and water feed arrangements of an injector and a crosshead driven pump. It also had 2 foot wheels and a 3 foot 8 inch wheelbase; rail-washing gear and, for good measure, a classic 'colonial' plain canopy of a type similar to those found on the company's four-coupled products for wider narrow gauges. The significance of *Pearl*'s design was that it was influential in the choice of another industrial customer, Groby



A view of current reconstruction work on Lady Madcap in the Welsh Highland Heritage Museum in May 2018. Whilst several original components have been recovered, sadly the mainframes (which could have revealed much about the locomotive's career) were lost in the 1960s. Although it is likely that the engine will be restored to Dinorwic condition, my personal view is that it would be better if it were reconstructed to original pattern with the feed pump and canopy, if only to fully resurrect the 'Heaton Mersey' element of the dynasty. This view will be of interest to modellers as it shows the 'splasher mountings' for the brake hangers and the firebox stretcher.



This fine 5 inch gauge model of the basic Penrhyn 'Port' class locomotive by Steve Milns of Shropshire appeared at the Hunslet 125 Gala in May 2018. Despite being constructed substantially to Winifred's configuration (note the injector configuration and early pattern smokebox door with which this engine was built), the model has Dinorwic-pattern buffers and the name (and worksplate) of Lady Madcap.

Granite Co. of Leicestershire, to purchase 2 foot gauge locomotives, *Junior* (W/N 596 of 1893) and *Sextus* (W/N 652 of 1896). These locomotives followed *Pearl* in general styling (including canopy and water feed arrangements) and had the latter's 160 p.s.i. working pressure but reverted to *Winifred*'s 4 foot wheelbase and 7 by 10 inch cylinders. In 1910, following return to the makers for a trade-in, *Sextus* would be re-sold to the Dinorwic system as *Lady Madcap*, having dispensed with the canopy and feedpump (in favour of a second injector placed, unlike *Winifred* on the left hand side) and been fitted with revised drawgear and an amended 'back-to-back' measurement commensurate with the gauge.

The three Penrhyn 'Port' class locomotives all enjoyed long and successful lives, with *Gwynedd* working all of its life at the Port until withdrawal from service in 1954, having retained its original pattern smokebox with classic 'flat disc' door (albeit latterly without handles) all of this time. After a period in private storage, the locomotive was sold for use at its current home, Bressingham Gardens, where it has given good service, albeit aided by extensive maintenance work, for most of the intervening years. Sadly, construction of a new boiler with deeper firebox

by Washington Boiler Co. in 1976 subsequently resulted in the loss of the original smokebox and door when fitted in 1984, whilst the boiler pitch was raised by approximately 3½ inches in the process. *Lilian*, despite its wheelbase dimension, had spells of working in the Quarry itself and was withdrawn in 1955 with boiler trouble, gravitating to the infamous 'scrap line' outside Coed-y-Parc Workshops. At this stage, damage to the locomotive's right hand cylinder was very much in evidence, notably to the rear flange. In 1965, *Lilian* was sold for the princely sum of £60 to Nigel Bowman, then a resident of Shalford (near Guildford, Surrey) and I well remember the locomotive standing in his parents' driveway at this time, during which it was overhauled. Initially steamed at a farm near Hascombe, *Lilian* moved to the Launceston Steam Railway for operation from 1983 onwards, where it has remained a useful part of the fleet since, having been equipped with a Westinghouse brake. *Winifred* was transferred from Port to Quarry in 1955 and withdrawn from the William Parry gallery some nine years later. After a slot on the BBC 'Tonight' programme on 4 January 1965 reported on the end of steam haulage on the Penrhyn system, six ex-Penrhyn locomotives, including *Winifred*,

Penrhyn 'Small Quarry' locomotive Margaret passes through Minfordd on a shuttle working to Portmadoc Harbour Station during the Hunslet 125 Gala in 2018. Mechanically similar to the first generation Alice class, this locomotive differed in being fitted with Salter safety valves as built, along with Peep-o'-Day pattern mainframes, and Penrhyn-pattern drawgear with no block buffers. The radiused lower corners to the bufferbeams were retained. The enlarged, less angular saddle tank with which the engine ended its revenue-earning career can also be seen.

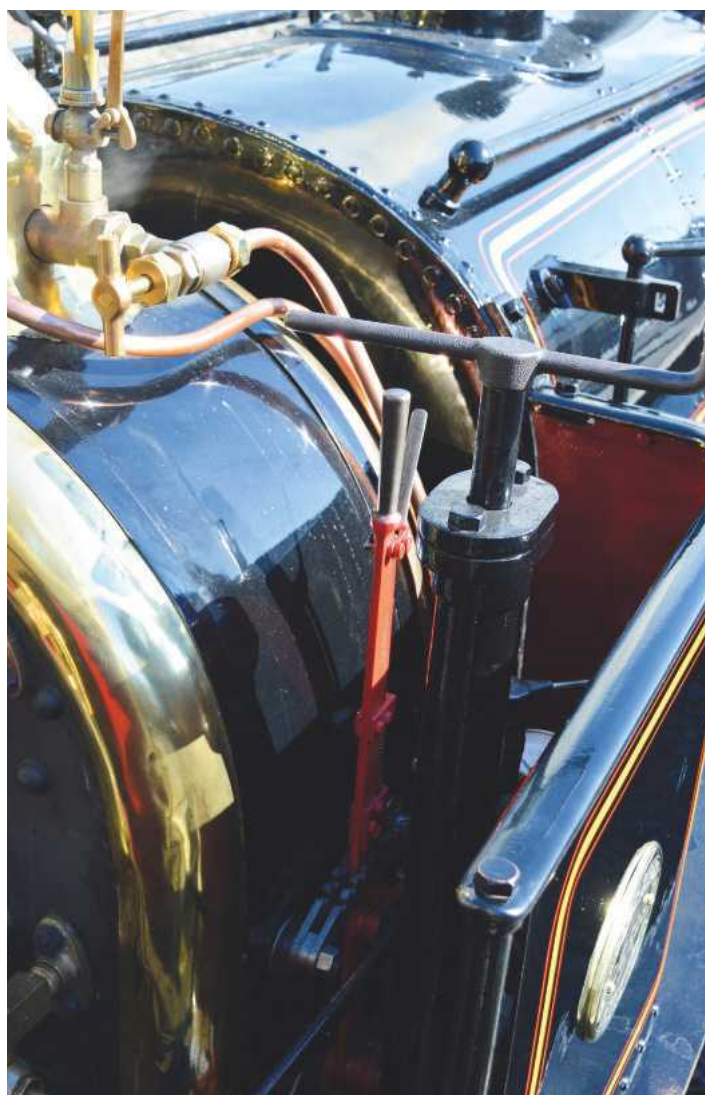


were sold to U.S.-based dealer Mr C. B. Annette and shipped across the Atlantic to Norfolk, Virginia on the S.S. *Manchester Progress*. Following an auction at the trip's final destination, Murfreesboro in Tennessee, *Winifred* was sold to a Mr. A. Hulman for his Early Wheels Museum some 80 miles west of Indianapolis. This proved to be a relatively short-lived venture and the locomotive subsequently spent a long period in storage, the last two decades of which were in a warehouse within the grounds of the 'Indianapolis 500' race track. Eventually, thanks to the efforts of Julian Birley and Graham Morris, *Winifred* began its return journey (once again via the port of Norfolk, Virginia) on 27 March 2012, finally arriving in Southampton the following 21 April. *Winifred* is currently based on the Bala Lake Railway, being a useful addition to its fleet of 'Quarry Hunslets'.

Playing catch-up: Penrhyn's 'Quarry' designs

The Penrhyn Quarry's owners were slow to follow the Dinorwic lead in ordering a Hunslet design with 3 foot 3 inch wheelbase for internal traffic, apparently finding the DeWinton products totally adequate for their needs

until 1894. In that year the first member of a new class, Hunslet W/N 605 *Margaret* appeared. The general design of the locomotive greatly resembled the 'tall chimney' first generation Alice class of the Dinorwic system and its leading dimensions were identical, save for a 10 p.s.i. reduction in the working boiler pressure. There were, however, three important differences: firstly, the rectangular versus chamfered mainframe dichotomy reared its head once again, with the former being preferred for *Margaret*, whilst Salter safety valves, as used on the 'Port' class were chosen in preference to the Ramsbottom pattern. *Margaret* was followed by three further locomotives of the same class: *Alan George* (W/N 606 of 1894); *Nesta* (W/N 704 of 1899) and *Elin* (W/N 705 of 1899). On the Penrhyn system, their history was fairly typical of the 'Quarry Hunslet' classes with the usual pattern of modifications undertaken to keep them running. *Margaret* and *Elin* received enlarged saddle tanks increasing their capacity by 20 gallons and producing a more curvaceous profile. Towards the end of 1938, it was decided to replace *Elin*'s life-expired boiler with a Marshall product (W/N 83501



A vital view of Margaret for modellers. Visible in the view are the cock and pipe for the right hand injector steam feed, with the blower pipe running underneath; the brass fairing for the backhead; the reversing lever supported (Manning Wardle fashion) by the firebox wrapper, and the free-standing handbrake column (as per Velinheli).

of 1928) previously used for portable stationary purposes. This necessitated the fitting of a lowermost extension to the smokebox and a new saddle tank, with a 'round' profile (the previous replacement tank being transferred to *Nesta*. With the general downturn in demand for slate in the mid-to-late twentieth century, all except *Nesta* were taken out of service by the end of the 1950s decade. *Margaret* was the first to go, in August 1950 and after the removal of various components was sold in 1966, passing initially into the ownership of the late Colin Pealing and Rev. Teddy Boston. Initially based at Cadeby Rectory, *Margaret* later passed through the hands of Mike Hart and the late Alistair Lamberton who intended to operate the locomotive on the Groudle Glen Railway. Sadly, his death prevented this scheme coming to fruition and in 1999, with restoration still far from complete, the locomotive was sold to the Phyllis Rampton Trust. By 2015 it had been beautifully restored in time for the Vale of Rheidol Railway's September 'Forgotten Engines' Gala. *Alan George* was withdrawn in November 1953 and joined the

line of 'derelicts' outside Coedy-Parc workshops. In March 1966 it was sold to Messrs J. Buckler and Roger Jackson of the private Howdenclough Light Railway, near Leeds. Over the ensuing years the engine would be restored to working condition but in July 1982 it was sold again, this time to the Teifi Valley Railway, Henllan, Dyfed, where it re-entered service on 12 April 1987, fitted with a Westinghouse brake. By the end of 1996, a cab had been fitted, but this has been removed in more recent years. *Elin* last saw Penrhyn service in November 1954, thereafter joining the line of 'derelicts'. The locomotive was sold in J.R. Burdett of Louth, Lincs in August 1962 and overhauled for use on the first Lincolnshire Coast Light Railway. Unfortunately, the locomotive's axle loading was in excess of three tons, rather heavy when compared with the 'Quasi-Fell' arrangement found on the line's other steam locomotive, Peckett 0-6-0ST *Jurassic*. There were also difficulties in adapting the engine's 1 foot 10 $\frac{3}{4}$ inch gauge tyre profile to suit nominal 2 foot gauge track. *Elin* therefore departed from the L.C.L.R. after relatively little use on



A right hand view of *Margaret* taken at Aberystwyth during the 'Forgotten Engines' Gala of 2016. Note the loss of the upper flared portion of the safety valve 'trumpet'.

25 October 1986 following its closure the previous year. From 1986-2012, *Elin* was based on the Yaxham Light Railway, where a boiler overhaul was carried out and the rear of the frames extended by 14 inches to better accommodate the longer firebox wrapper of the Marshall boiler. In 2012, however, *Elin* passed to Jeremy Martin for use on his private Richmond Light Railway in Kent and further restoration work has been proceeding steadily ever since. When it re-enters service, *Elin* will retain most of its appearance brought about by the 1938-9 rebuild but will

have a new shorter firebox to allow removal of the frame extension. As previously mentioned, *Nesta* was the last operational member in Penrhyn service, still being active in 1961. Four years later, *Nesta* was one of the 'Annette' shipment, later being sold in the U.S.A. to a Mr. R. Johnson of Rossville, Georgia. Ultimately gravitating to a swamp in Puerto Rico, *Nesta* was eventually returned to the U.K. and now in the ownership of Robert Gambriel, it is on public display in the Bala Lake Railway's Heritage Centre.

●To be continued.



Ex-Penrhyn locomotive line-up at Minfordd during the Hunslet 125 Gala. From left to right we have Winifred; Gwynedd; Margaret, and Hugh Napier. The effect of the 1980s re-boiling on Gwynedd is very much in evidence, namely the higher pitched boiler (in comparison to Winifred) with later pattern smokebox and door, although Salter safety valves were retained.

Geoff Theasby reports on the latest news from the Clubs.



Two's company! (Photo courtesy of Peter Vincent.)

Consistent with the need to avoid generating scrap and waste and preventing goods going to landfill, I bought a defunct, valved KW202 amateur bands radio receiver dating from the 1960s for restoration. It is three times the size of my 'turn of the Millennium' station receiver (an Icom R-70) and the power consumption is 80 watts, as against 30 for the Icom. KW were a British company whose products were very popular at the time but superseded by the technically more sophisticated Yaesu FT101 from Japan. Having been brought up on valves rather than transistors, I am getting in touch with my 'Inner Vacuum' and thoroughly enjoying the process. It is made easier by the components being very common - and still cheap - and the large amount of space inside the case.

'Bolide' progress has accelerated of late, following my ignominious treatment detailed last time. I may have underestimated by how much the construction sagged under my weight and so I re-engineered the rear axle by moving the bearings inwards from the chassis runners on adaptor plates.

In this issue: failures, viaducts, sloth, more failure, Temperance, yet more failure and a cautionary tale.

A cornucopia of glossy newsletters has descended upon your scribe, making his job much easier, and he feels spoilt for choice. Reader, are you sitting comfortably? Then I'll begin...

Centurion Smokebox, September, from **Centurion Society of Model Engineers**, complains that everyone appears to be keeping *schtumm*, in that no items of lockdown work have been

declared and in visiting Nick Popovic, to see progress on his 'switcher' the editor, Jon Shaw failed to take any photographs...

W. www.centuriontrains.com

Grimsby & Cleethorpes Model Engineering Society's *The Blower*, September, has Graham Dumbleton submitting several old photographs of their site from the time of the Silver Jubilee and contrasts them with pictures taken today, to give a 'Then and Now' flavour. Fortunately, the 'Now' photos show a distinct, nay, spectacular improvement, as opposed to the usual T&N books. Editor, Neil Chamberlain, adds a downbeat ending in saying that members viewing these comparisons may not be best pleased on observing how young and handsome they once were...

W. www.gcmes.com

Gauge 1 North, Yorkshire Group, had a successful GTG in Derbyshire at which locomotives from each of the major train companies were represented, with good pictures but, for me, a lovely photograph of Steve Johnson's new 2F and the Group's Deeley Dock Tank beats them all, in its plain ordinariness. By which I mean (he added hastily) that such sights were so common as to pass unremarked, until they had almost all gone (photo 1).

W. www.g1mra.com



GWR 'Crocodile'. (Photo courtesy of Garth Bridgewood.)

The *Newsletter & Journal*, autumn, from The **Gauge 1 Model Railway Association**, in which editor, Rod Clarke notes that whilst overseas contributors are identified by their country of residence, UK contributors are not. He has therefore rectified this omission and now we see how truly international its readership is. (This legacy matter is not, one hopes, a reminder of 'First World White Privilege' as the saying goes, but reflects the fact that the UK was the first to develop so many things, which date from a time when the UK was pre-eminent in so many fields. So, the Automobile Association, the Royal Institution, the Royal Navy and many others felt that they needed no country identifiers. Now, the world is much more diverse and better for it, I feel – Geoff.) John Boyson designed and built an ornamental viaduct based on that at Craigenarden on the West Highland Railway. Richard Hill, in France, having written in the two previous issues of the N&J, held a GTG at his home between Covid-19 lockdowns, described by Chris Ludlow. Entitled, 'Charente chou chous', (Pardon me, boy? See me later... - Geoff.) Garth Bridgewood was given a 'Crocodile' by Peter Woodhouse as thanks for helping with Peter's garden railway. Garth buffed it up a little and it looks just fine

with its unusual load (**photo 2**). Quite coincidentally, after referring to six-wheeled milk tankers in *M.E.* 4649, here are two more by Geoff Clifford, scratch built this time. David Fletcher was involved in the design of the Accucraft Adams radial tank engine, a process not normally publicised. An item from the *Railway Magazine* of July 1906 featured 19-year old H. Fehlmann's wooden model of a Swiss railway, with stock from across Europe. Sadly, Herr Fehlmann died shortly after publication. Chris Sheldrake built a 1:24 scale Land Rover road-railer, based on a kit (**photo 3**). John Kershaw has built the Slater's Kirtley goods locomotive, a very detailed kit excellently photographed by Martyn Welch who also painted and 'weathered' it (**photo 4**).

W. www.g1mra.com

Whistlestop, September, from **Hereford Society of Model Engineers** opens with editor, Martin Burgess thanking his loyal readers for providing him with plenty of copy for this issue *and* the next. Of course, now those with a literary bent could find themselves commissioned to write more (on pain of ... what??? Answers on a postcard to J. K. Rowling). Withdrawal of coal allowance, 'Error 404', a declaration of *persona non grata*, etc...? The storm just before Martin began co-ordinating submissions for publication, exceeding



Road-rail Land Rover. (Photo courtesy of Chris Sheldrake.)

anything he experienced in the Far East with the RAF. This almost brought down an oak tree and the bridge by the carriage shed is now at risk. The Blasted Oak indeed! Trevor Carter cleaned and reset a pressure gauge from St. Ethelbert, completely submerged in last autumn's floods. The gauge was reading a few pounds with a cold boiler and he offers a possible explanation. Pete Fenn offers some philosophical thoughts on why certain vital components - denominators, perhaps - inexorably find their way to the floor, where they hide until just after you have made/bought/stolen a replacement. As the Young Engineers meetings are in abeyance, junior member, Matthew, was asked to attend to a nominally working 3½ inch gauge Tich and secondly, a 7¼

inch gauge Maggie (a.k.a. a late model Romulus).

W. www.hsme.co.uk

The **Gauge 3 Society Newsletter**, autumn, begins with a cautionary tale by Roger Marsh entitled *The wages of Sloth*. Having put off until tomorrow that which should have been attended to 'yonks' ago, he was faced with a garden railway that could no longer take the weight of a train. Trying to order waterproof plywood online failed, with his supplier's computer imagining ever more bizarre amounts, in quantity and quality, as yet unresolved. A more permanent structure was described by Tim Glead-Owen, in the shape of a brick arched viaduct, also curved (see above) but not from a Scottish railway. (A rolling English road, mayhap? _ Geoff.) Don Crouch reviews the varieties of buffer guides on the model market at the moment, whilst editor, Ashley Wattam builds a Slater's 8 ton open wagon. Somewhat daunted when first he set editorial eyes upon't, a thorough study of the notes within enabled him to make the body without any problems - until he came to the wheels and brakes, where conflicts arose. Mike Huddart built a rolling road for his manifold locomotives of multiple gauges. Then, just when I got to the last page, a beautifully atmospheric photograph of Ian Driver's LT pannier tank from 1914 (**photo 5**).

W. www.gauge3.org.uk



Kirtley Goods. (Photo courtesy of Martin Welch.)

City of Oxford Society of Model Engineers sends CoSME

Link, autumn, and claims a Royal connection. Seemingly the Queen and the Society use the same coal merchant. Well! In another shared experience, members visited two other railways recently. Chairman, Dennis Mulford went to the Lynton & Barnstaple, where he failed to see *Lyn* and Graham Toplis to the Severn Valley Railway where his party failed to ride behind GWR 2800. Dave Thorpe then concluded his series on making an horizontal mill engine from scrap and very fine it looks too. Josh Allen describes a novel method of straightening coiled copper tubing using brute force rather than engineering. (This may set back the cause of improving the public's concept of engineers always using large hammers – Geoff.) David Price then draws our attention to Vauxhall Bridge in London, the outward faces of which are adorned with eight statues of classically-draped young women representing industry, including one with an horizontal mill engine clasped to her. John Winn has entertainingly fitted his steam boat *Chimera* with a Cornish Pasty oven. Up and at 'em, Ginsters! (I found this newsletter a particularly good read, informative, entertaining and funny – Geoff.)

W. www.cosme.org.uk

Chingford (? I think) sent their club newsletter for September but it doesn't say from which club. Could the first page be a Page 2 with a cover missing? Anyway, we will struggle on in the hope that all becomes clear. A good start comes from junior member, Alex Bevins who achieved the top grade in every one of his 10 GCSEs. Well done! Brian Hinrin's funeral was held in September. The officiating minister, a railway enthusiast, hopes to arrange a memorial service next year and expressed a wish that the whistle from Brian's locomotive be blown in the church. What a nice thought! An item on early locomotives



Very atmospheric. (Photo courtesy of Ian Driver.)

at the club published in 1948, discussed a model of 'LBSC's 'Fayette' by A. D. Brown after an initial run in June 1945, when all present experienced the intoxicating smells of hot oil, steam and smoke. The following day the locomotive was demonstrated at a Temperance café. (I'm surprised the café let them in. Intoxicating conditions? The very idea! - Geoff.)

W. www.chingford-model-engineering.com

The Model & Experimental Engineers, Auckland

September Newsletter starts with Ken Pointon casting an aluminium inlet manifold for a Lea-Francis, for a car enthusiast (L-F?) using a pattern the enthusiast himself had made. This ties in with editor, Murray Lane's late business of designing and making wind turbines, recently resurrected. John Burnett tells another tale about his father and showed some items from Howick Historic Village, including a weighing device consisting of a steel bar pivoted at one extreme end, with a weight adjacent. An object hung from some point along the arm will balance the weight and the details can be read from a scale. (I believe it is known as a steelyard - Geoff.) Michael Cryns showed

a clockwork toy train from about 1880 and in good need of a sympathetic restoration. The clockwork motor is still operational and very strong for its work. Graham Quayle spent some time with the donated three-inch scale Foden steam wagon, which was rather poorly made. The flywheel was oversize to the crankshaft, which was itself a sloppy fit in its bearings. A keyway in one item was not provided with a keyway in the corresponding shaft and so on. (The keyway's not connected to the pulley, the pulleys not connected to the drive shaft, the drive shaft's not connected to the flywheel... - Geoff.) Richard Street has finished his tool box and very nice it is. Shame to put all those sharp and oily tools into it... Murray bought a new drill press and found that its self-assembly stand was one of the most dreadful items he has had the misfortune to assemble. He says, "There were no instructions; the frame is made of eight pieces of steel and an MDF plate. The longer spreaders were 25mm too long and had to be cut and re-drilled. All 40 holes were for 6mm bolts and nuts, but there were only 12 provided, all the rest were 5mm. The leg tops are flanged and drilled to allow the top to be screwed to the frame

base. None of the flanges were bent to the correct angle. The top was pre-drilled and none of the holes were in the correct position. The drill was placed on top of the stand when assembled and holes drilled through the wood and into the metal flanges. These all broke partially through the flanges. When drilling out these holes with a hole saw all the swarf melted the paint and stuck to the surface."

Referred to last time, the YEC 'Janus' is now pictured here after help from our 'esteamed' editor, Martin and with apologies to Evelyn Cole (photo 6).

And finally, engineering is like maths, but LOUDER!



YEC 'Janus'.

Contact:
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T. 01235 847516. Abingdon.

■ Denham Junior Mark 2 VGC. 5" 3 jaw and 8" 4 jaw, faceplate, full set change wheels, 4 way quick change toolpost,

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■ 1948 Myford ML7, with g'box, spares incl. headstock, re-ground bed, all bearings recon, stand, £500. 1956 Smart Brown Model Sabel toolroom lathe numerous attachments £200. **T. 01258 475219. Redruth Cornwall.**

■ Proxon mini lathe £225 ono and \ proxon Table top Saw £120.
T. 0129722661. East Devon.

Parts and Materials

■ Complete set of parts for 3 1/2" Gauge LBSC 'Heilan Lassie' loco, will require boiler materials, full original mags & documentation etc. from Kennions in

2010. £500.

T. 01258 475219. Redruth Cornwall.

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T. 01757 702437. Selby. N. Yorks.

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T. 01159 655881. Southwell.

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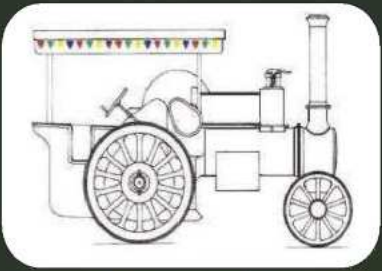
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Ceramic Burners for Model Steam Boilers • Weiss • £19.74

The follow-up to the same author's *Building Small Boilers for Gas Firing*, (available through our website as a 'DIGITAL EDITION') this is a comprehensive description of how to build a number of ceramic burners for small boilers, be they horizontal or vertical, water-tube or pot boilers of varying sizes, but all under the 3 bar limit of the UK Boiler Test Code. The burners are round, rectangular or oblong in one case. Very necessary information for all wanting to gas fire a smaller model's boiler. 111 pages, 209 colour drawings, layouts and photographs. Paperback.



The story of the "Scamp" - the little loco with a big heart • Edmondson • £8.69

"Scamp" is a 7 1/4" gauge ride-on, narrow gauge outline i/c locomotive, based on a 'Lister' prototype, usually built as a petrol-electric. It is a small locomotive, easy to transport, and kits of laser-cut or machined parts are available to expedite construction. 42 A4 format pages, full of colour photographs, and much to enjoy.



Old Codger's Cookbook • Curwen • £8.85

David Curwen was prolific designer of miniature railway locomotives; in his eighties he faced changed circumstances which meant that if he wanted to eat, he had to learn to cook. He thought, "I'm not a grumpy old codger, I'm a happy-go-lucky codger, and I'll face up to this in a practical way." You learn how he did this in this wonderful cookbook. Besides brief accounts of kitchen equipment, basic tools and recipes from tomato soup to beef stew with pigeon, David diverts to a wide range of topics such as cats and their behaviour, recalcitrant cookers and the joys of a good butcher. Full of zest for living until the end, David died a few years ago at the age of 97. Delightful reading, beautifully illustrated with 25 equally delightful drawings by Wendy McCleave. 74 pages. Paperback.



'I read "Old Codgers Cookbook" at a sitting, couldn't put it down, or read it sometimes, I was crying with laughter so much. Brilliant book and I have ordered three more copies.' Mr.A.B. UK

Memories of Steam Rallying • Hampshire • £10.70

The last of Jack Hampshire's trilogy on his life with road steam, this one covering his involvement with preservation from the mid 1950s, and the rallies of the 1960s and 1970s. Many long journeys in steam are described in detail, especially with Jack's own Foden steam wagon 'Peg' o My Heart. Adventures are frequent, and this is a real window into a time when many of the owners had, like Jack, been involved with steam all their lives. A wonderful read for any lover of road steam, highly amusing and full of great characters of the time, plus hints and tips on driving skills. 144 well illustrated pages. Paperback.



INJECTORS: their theory, construction & working • 1893 • Pullen • £14.60

Even if it is well over a hundred years old, this really is still a cracking book! It may not include the most modern injectors, but the science of injectors was well developed when it was published, and it does cover all injectors and ejectors of the period in considerable detail. More importantly for those wanting to build their own injector or ejector, it includes many formulae to help with designing one which will really work. Great book for the technically minded and those involved with steam preservation 210 pages. 109 drawings/illustrations. 10 tables. Paperback.



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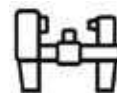
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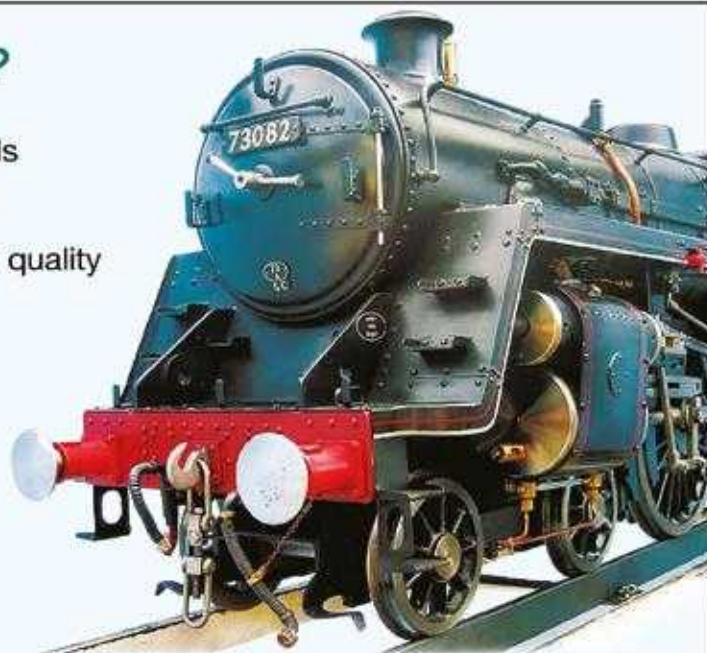
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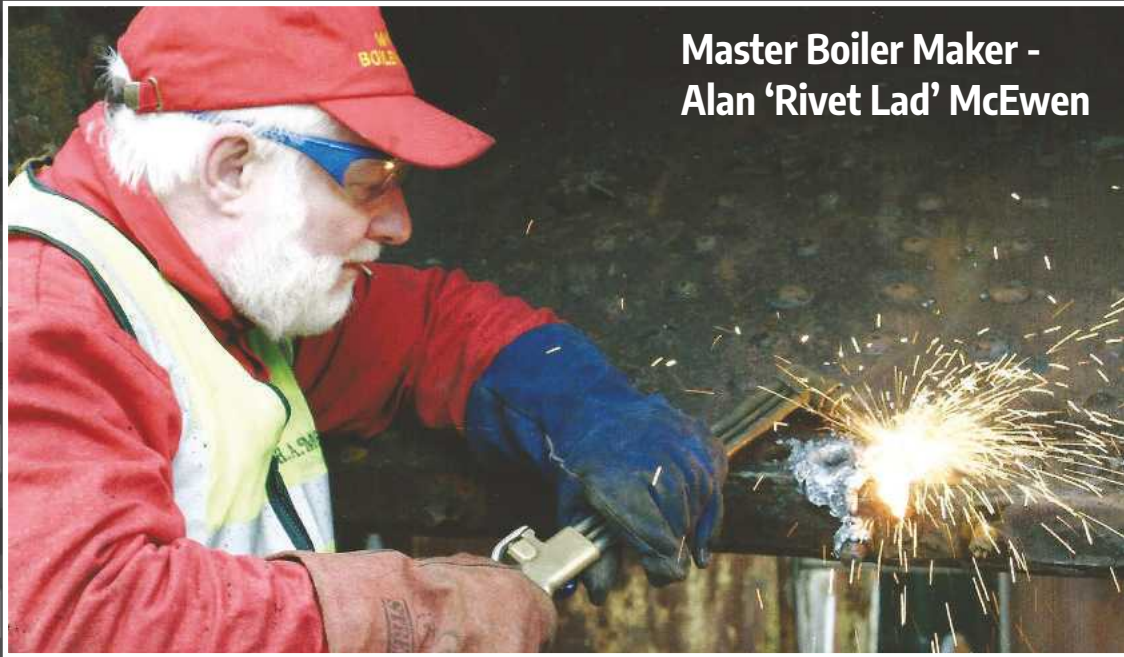
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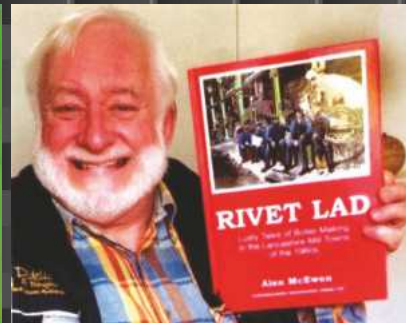
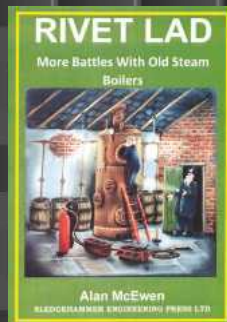


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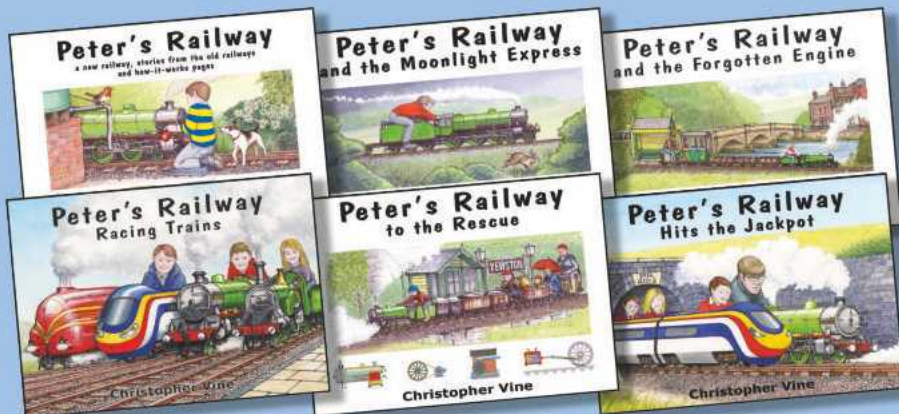
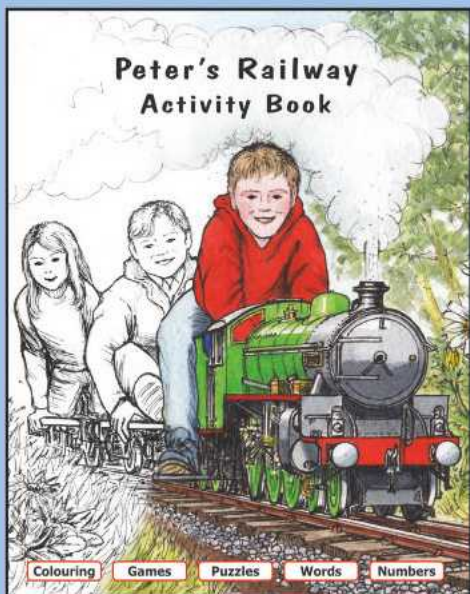
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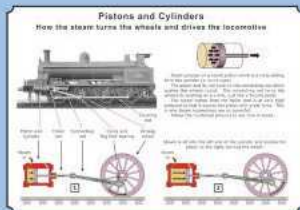
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