

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 221 No. 4599 • 9 - 22 November 2018

MODEL ENGINEER



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**ROTARY
BROACH**

Grinding
Tools

COVER FEATURE

6 inch Fowler B6



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2MT arbor Item No. 8139A £12



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Fixed and travelling steadies
2 dead centres
Calibrated compound slide
Thread dial indicator
4 way indexing toolpost
Interlock chuck guard



Milling slide
Item No. 9628 £130



Centre drill set
Item No. 9053M £10



Indexable
lathe tools 12mm
Item No. 8947 £79

SPECIFICATION

Centre height.....	140mm	Tailstock taper.....	2MT
Maximum swing.....	280mm	Tailstock quill travel.....	60mm
Swing over cross slide.....	158mm	Top slide travel.....	65mm
Distance between centres	600mm	Cross slide travel.....	130mm
Bed width.....	150mm	Headstock bearings.....	Taper roller
Longitudinal travel	560mm	Compound slide swivel.....	360°
Spindle taper	4MT	Chuck mounting.....	Flange
Spindle bore	26mm	Motor	1.1kw
Maximum tool size.....	12mm	Power supply	240v
Range of spindle speeds rpm (12)	45 - 2000	Dimensions L x W x H to end of handle grips	
Range of metric threads	0.25 – 5.0mm	1260 x 580 x 600mm	Weight..... 160kg
Range of imperial threads	4 – 96 tpi	£2,150 including VAT and UK mainland delivery	

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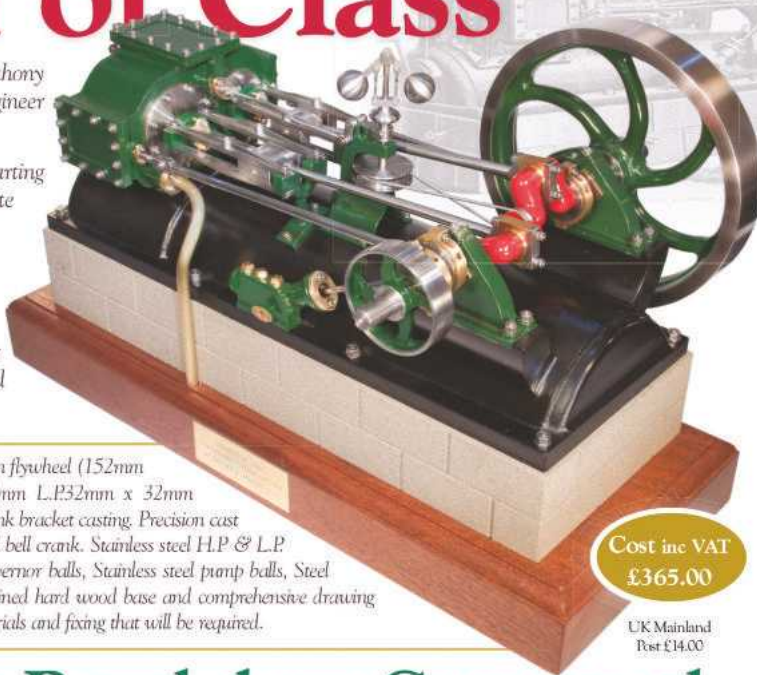
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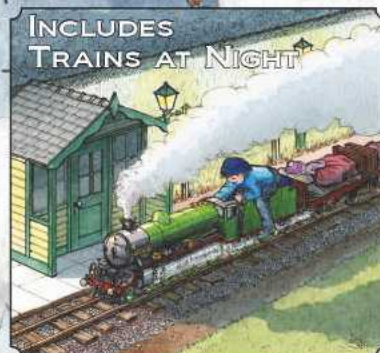
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A Time for Reflection

This Sunday sees the centenary of the end of the First World War on the 11th November 1918 and it is right that we should pause to remember the significance of this event.

The war was the most destructive so far in human history and the first in which modern technology played a decisive role.

About ten million altogether died fighting the war and the civilian death toll was almost as high. Losses in the UK approached a million and a significant proportion of an entire generation of young men never returned from the war. Wives lost their husbands, young women lost their fiancés and families lost their sons. In some cases, entire families were destroyed. One only has to look at some village war memorials to realise that, as the same name occurs over and over again. A similar story is repeated in Germany, France and Russia, and no doubt in all the other countries drawn into the conflict.

There's a rather poignant sequence in the 1939 film adaptation of James Hilton's novel *Goodbye Mr Chips* in which Mr Chipping, as headmaster, reads out the names of Old Boys killed in the Great War. He includes the name of Herr Staefel, the German master who, naturally enough, fought and died for the 'other side'. Was Chips right to do so? Yes, of course, as all those who died, whichever side they were on, died for their country and for what they believed in.

Fifty years later, as a careless teenager, it didn't occur to me to think very much about the disproportionate

number of elderly spinsters around me – I simply accepted it as the natural order of things. I didn't really understand how their hopes of marriage and children had been snatched away from them by the war or why that lady had to be helped out of the church one Remembrance Sunday. Half a century on, for so many people, war wounds and loss were still very raw.

My family were lucky; none died, although for my grandfather, my father's father, it was a very close thing. He lost an arm, and his friends, at Passchendaele and was lucky to survive. He spent the rest of his life mostly sitting, smoking, drinking and watching the world go by. He never spoke about his experiences until he was near the end of his life, sixty three years later. It is rather sobering for me to ponder, in retrospect, on how fragile a thread my own existence hangs. The same must be true for so many of us.

Part of the tragedy of the war is that, ultimately, nothing worth having was gained. It was going to be 'the war that will end war' (H. G. Wells). The irony is, of course, that the seeds of the second great conflict of the twentieth century, which was even more - far more - destructive, were sown by the Treaty of Versailles, intended to ensure peace in the aftermath of the first. It seems we learned nothing from the horrors of the First World War; waging war appears to be a deeply ingrained human habit and a hard one to shake off.

A hundred years on, no-one alive now remembers the war, so perhaps those wounds are closed at last. Even as



memories of the war fade into history though we should never forget those who were robbed of their futures. If we, as a race, can, in time, consign the very concept of war to the past then perhaps their sacrifice will not have been in vain.

*Why was I born into this age
In which mankind
has exiled God?
With God departed Man,
with rage,
now sits upon the throne of God.
And when man knew
that God had gone,
To spill his brother's
blood he bore
His eager sword, and cast upon
Our homes the
shadow of the war.
The harps to which
we sang are hung
On willow boughs,
and their refrain
Drowned by the anguish
of the young
Whose blood is mingled
with the rain.*

Hedd Wyn
(killed in action, 1917)

ERRATUM

Alert readers will have spotted that the captions in Club News last time (M.E. 4598, 12th October) didn't match the photographs. Unfortunately, one photograph got 'lost' and the captions slipped by one place.

My apologies for this; we shall try our best to be more vigilant in future.

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
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L&NWR 0-8-2T Heavy Shunting Tank Locomotive PART 2

Chris Rayward describes the construction of his 'D' tank locomotive.



Continued from p.581
M.E. 4597, 12 October 2018

The cylinder assemblies, crossheads and slidebars

With the adoption of the wider frame spacing, a slightly revised cylinder block has been produced to fit this change and it allows the full $1\frac{1}{8}$ inch diameter cylinder bore to be used or even increased to be a scale $1\frac{1}{16}$ inches if preferred. I just added a $\frac{1}{16}$ inch or so to each side of the existing pattern. Rough machining was carried out on my milling machine to obtain a flat face for the valves and then the remaining surfaces were machined by fly-cutting whilst clamping the block to the cross slide of my trusty Myford Super 7. In particular, of course, the facing of the rear of the block and the boring of the cylinders with a bar between centres could be easily done at one set-up, to ensure the necessary dimensional accuracy and squareness was achieved. It is very easy to check the axial truth of the bores with this method.

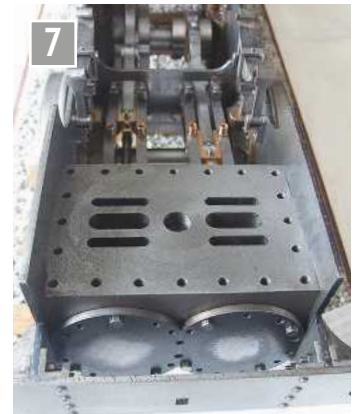
From my pictures you will note that the sealing joint for the front and rear covers is a figure of 8 with common fastenings in the centre. I had support from my friend Peter Wood for the laser cutting of the joints for the outline and the position of the holes and, while he was at it, he cut the two joints for the steam chest as well.

The machining of the steam and exhaust ports was carried out on my milling machine so I could see what I was doing. Here again the advantage of the wider cylinder block meant that I could extend the width of the ports from $\frac{3}{4}$ inch to 1 inch and still allow sufficient land width for the slide valves to seal (**photo 7**). There is a central pillar that

takes the exhaust steam out of the block directly under the chimney so the passageways are very straightforward. The fastenings for the steam chest assembly are 3BA Allen cap head screws, which may be frowned upon but they are simple to fit and I have in mind using angles on the steam chest cover to secure the smokebox. When the time comes the screws will be easy to get at inside the smokebox.

Making the pairs of cylinder covers was an interesting exercise. They started as discs of steel plate and the front ones were just soft soldered to a plain flat brass block held in a four-jaw chuck and centred to machine them to size and add the register for the bore. The rear ones needed a bit more thought as they had to provide the housings that hold the two sets of four slide bars. I decided I would accurately machine some mild steel to act as the housings and add a central drilling that would take a close-fitting pin to match an identical drilling in the slightly over-sized cover discs. Once the two pairs of parts were ready with their location pins, I simply silver soldered them together.

After cleaning up, the fabrications were re-mounted in a four-jaw chuck by the housings and centred using a long probe under the top slide and using my cross slide dial readings. Once set I could machine the covers to size as per the fronts, then reversing them and re-centring the set-up allowed me to machine the piston rod bores and the gland and thread. This all had to be done extremely carefully but later when the pistons and rods and the stuffing gland nuts were added all seemed to be very smooth.



A front view of the cylinder block positioned in the chassis showing the fit of the covers which have common fastenings in the centre as on the prototype. The ample nature of the ports is also clear.

Adding the sets of slide bars was a different matter. The scale thickness of material needed for the bars was not available and I chose not to machine them down from mild steel but to have them water-jet cut from gauge plate. Making them all the same size also helped with the machining just described so, after carefully adding chamfers to the inside corners, I numbered and drilled them for special long 6BA hexagon headed bolts to attach them to the housings.

At this point I realised that I needed the two crossheads to ensure all was sensibly aligned, so I stopped and milled the two bronze parts and centred them to fit the piston rods. This stage also meant that I needed the motion plate so that the outer ends of the slide bars could be held on their fixing brackets. I do not mean to suggest that the task was difficult; it was just that so much work had to be undertaken before anything could properly be assembled. ➤

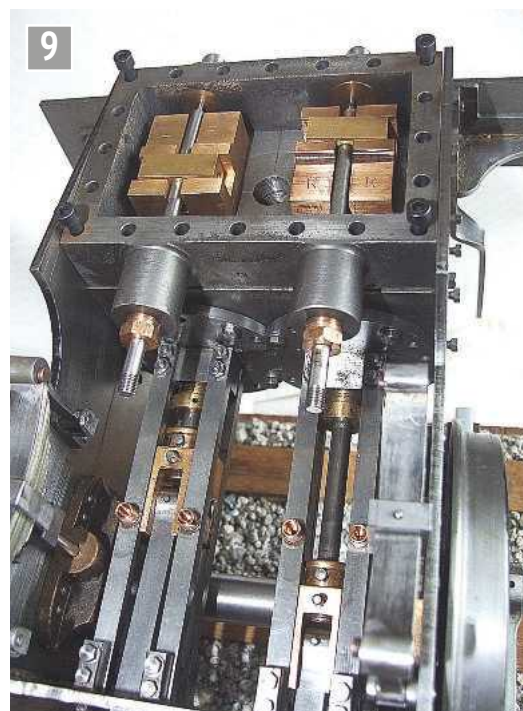
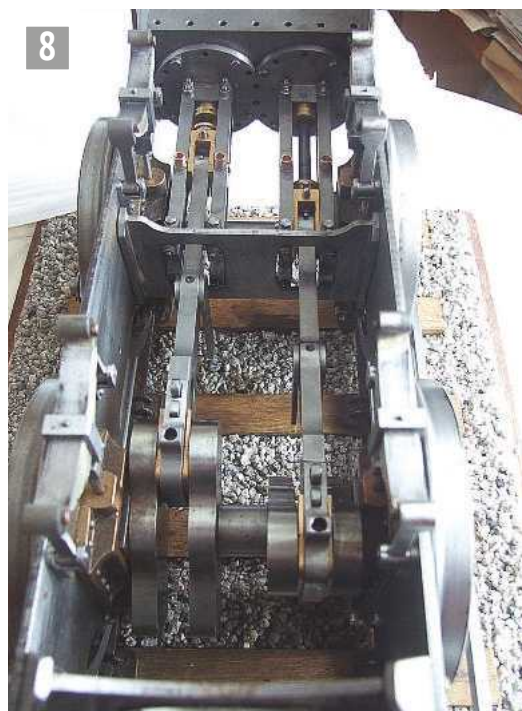
In the end the result worked out quite well but two very small shims were needed to give the slide bars the clearances they required. At this point I also decided to add the two taper pin cotters that attached the crossheads to the piston rods and I know that this does not usually take place at this stage. However, I could determine where the piston travel limits were and what position the crossheads should be in when the whole cylinder assembly was fitted in to the chassis, so I did the task and my pictures should show the result (**photos 8 and 9**).

The crankshaft and connecting rods

Before I go on to the valve gear, I will just add a few words about the crankshaft and connecting rods. The advantage of the wider frame spacing is that a more generous crank design can be adopted; the same crank web parts are used but as they are made from 10mm material they are not machined down to the $\frac{3}{8}$ inch width originally specified for the 'Wessie'. The crank webs were soft soldered together in pairs to fine bore the holes for the shouldered axle parts and the crank pins, then they were lined up and Loctited together.

In addition, instead of using simple brass angle for the horn cheeks, a bronze casting is available to which can be added brass blocks underneath to give the necessary depth for the twin clamping bolts through the spacer blocks under the axleboxes.

Those of you who are familiar with the Joy valve gear will be aware that the connecting rod is the driver for the valve motion with its pivot hole near the centre for the combination of links. Basically though, the rod is the transmitter of the forces from the piston rod to the crankshaft. I have mentioned before that with a $4\frac{1}{4}$ inch frame spacing the crank webs are stronger (10mm thick) and at the same time the proportions of the connecting



Two views of the slide bars and crossheads with the gudgeon pin fixed in the front of the connecting rod with a taper pin. Lubrication is from the slide bar oiling points down a hole each side in the crossheads. The securing brackets on the motion plate were machined $\frac{1}{4}$ inch square blocks with a threaded end nutted in place and silver soldered. The second of these pictures also shows the way I added the drive nuts for the valves; they are off-set to allow easy sideways access to Allen grub screws securing the nuts to the valve rods. I never think simple grub screws on top are good enough as permanent fixings.



Two views of the connecting rod assemblies with their straps and bearing bronzes added and with the two pairs of taper keys fitted through the straps. The two pairs of jack links have also been added and lined up as described in the text.

rod can be increased from the original $\frac{1}{4}$ inch thickness to $\frac{5}{16}$ inch (or 6mm up to 8mm). This meant the width of the big end journals could be $\frac{7}{16}$ inch wide and thus the running journals would be more durable.

The more involved part about the construction however is the fitting of the big-end bearings into the connecting rod strap and the use of taper keys to hold the parts together. The rod material came as a laser cut blank which needed a fair amount of cleaning up to make it look the part. Laser cutting tends to leave quite a rough and slightly concave surface on thicker materials but with care the flame bite

marks can be filed away to leave an acceptable surface.

To start with I fitted each strap onto the blank end of the rod and also drilled a larger lightening hole in the rod adjacent to the holding keys. I used a small toolmaker's cramp to keep the strap and the rod end tight together and this enabled me to mark out the centres and make the drillings needed to start the slots for the taper keys. For this operation you need to keep in mind the fact that the strap should be forced forward into the angled seat on the rod, both top and bottom, and the taper key needs to bear against the rod on the

inside to make this happen. It is quite a protracted task to open out a hole to be in the centre of the rod/strap combination and also be tidy and square to accept the key. I used a combination of round and square needle files and then I used a key made from an old scrap of $\frac{3}{8}$ inch thick steel plate to maximise the size of the slot. With patience it comes together and is well worth the effort (**photo 10**).

Next, I needed to make the two bearing bronzes that have to be soft soldered together and bored for the crank pin diameter then milled around their edges to fit into the shape of the opening made by the

strap. The fit needs to be close to size to avoid any wobble in service, especially up and down, and the rear corners have to be given the two radii to allow the bearings to slide fully home into the profile of the strap. After this, the process of fitting the second taper key has to be undertaken and for this fit we need the two halves of the bearing to be forced firmly back into the strap. I did not include a glut for the second key although by rights it should have one. I was mainly thinking of the degree of assembly difficulty when trying to fit all the parts between the frames (photo 11).

The valve gear parts

One of the interesting aspects of building this locomotive is that I have never constructed Joy valve gear before and, for those who are also unfamiliar with it, I have included a layout diagram (fig 1). The actual sizes for the links are those determined by Nigel Thompson which he described in his 'Wessie' article but, as I have said, the increased width of the connecting rod also influenced the thicknesses of some of the

links; however the distance between the cylinder bores remained the same. The lowest link is known as the anchor link and this is attached to a pivot rod positioned across the frame behind the leading axle. This too has to be the same thickness as the connecting rod - so 8mm in my case - but for some reason, and thankfully, I have not had to crank it through 10 degrees to miss any stretchers as Nigel did.

It will be realised that the two small 'jack' links that are attached to the connecting rod require a pivot pin and, for my assembly, I fitted a bush to the rod with a suitable oil hole above it. The pin itself was made from silver steel and threaded each end with a $\frac{3}{16}$ inch by 40 TPI thread and the holes in the jack links were tapped to suit. This meant I could assemble the parts until the threads were sensibly tight and the two jack links were in the same plane and able to turn freely on the rod without much sideplay. Carefully removing the inner portion of thread with a chamfer achieved the result. The jack



Here are the rest of the valve gear parts which can be identified from the layout diagram. They were laser cut from the most appropriate thicknesses of steel and shaped where necessary then given the usual clean dull finish.

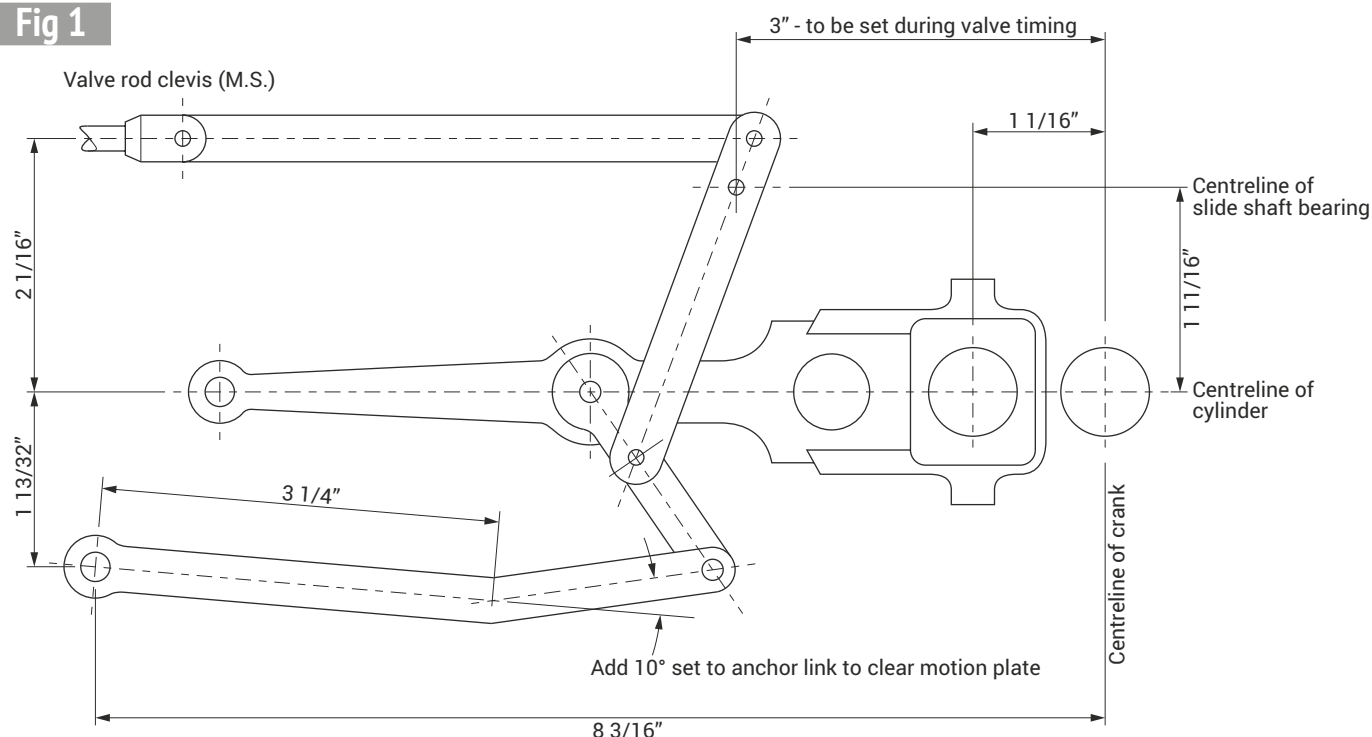
links are clearly shown with the connecting rods in the pictures for the last section.

Sitting outside the jack links is a pair of vibrating links that transfer the circular motion upwards to the sliders on the yoke shaft that is positioned across the frame in front of the driving axle. The uppermost hole in this link engages with the radius link that drives the valve rod with a small clevis. I made my clevises with a bronze bush and the radius link is wider than originally specified.

The pivot at the front end is another piece of silver steel retained with a taper pin (photo 12). The hole immediately underneath the connection to the radius link is the one that engages with the two sets of yoke sliders and these provide the means to vary the steam cut-off and when rotated backwards they put the system into reverse. This involves the main member of the valve gear – called the yoke or slideshaft – which I will describe next time.

● To be continued.

Fig 1



General Arrangement Of 'Joy' Valve Gear For Slide Valve Classes

Martin Young's Engines PART 1

Alan Barnes
meets a
prolific
engine
builder who
moved up a scale.



Martin on the footplate of the Foster.

Over the past few years Martin Young from Jarrow has completed a number of exceptional scale engines and, just for good measure, has built himself a full-sized Foster Wellington steam tractor.

As Martin recalled, 'The Foster project just appealed to me and really it is just a miniature engine in 1:1 scale'. All the more remarkable is that Martin has carried out all the work in his converted garage workshop and small back garden. Despite having to work in such cramped conditions he has built two 6 inch scale Burrell Showman's Road Locomotives, the Foster Wellington and a 6 inch Scale Fowler Showman's Road Locomotive. His earlier models have included 3½ inch and 7¼ inch steam locomotives, a 4 inch Garrett Traction Engine and a 6 inch scale Ruston Proctor steam tractor.

Martin continued, 'In 2004 I had shown my latest model, a 6 inch scale Burrell Showman's Scenic Road Locomotive which I had just finished. This had been built at home in my small garage which I had equipped with lathes, a milling machine and a good selection of tools. I had the opportunity to meet David Ragsdale and at that time he had produced a set of drawings for various parts of a Foster Wellington tractor. In addition to the drawings he was also selling some of the castings made from his own patterns. While it would be fairly straightforward to re-scale the drawings to produce a scale model I began to seriously consider the challenge of building a full-sized Foster. After all it's just a miniature engine with bigger and heavier bits!

'I had discovered a photograph of Foster Works No. 3002 which was originally

built in 1904 and I decided that my new build would be as close a replica of this 'lost' engine as possible. My mind was made up and having bought the drawings and ordered the castings the first thing to attend to was a re-vamp of the workshop. I bought a new lathe and a new milling machine and made arrangements to sell the newly completed 6 inch scale Burrell Showman's to finance the new project. Despite upgrading the workshop, it was clear from the outset that some of the larger parts were beyond the capabilities of my own equipment. However, I was fortunate that the engineering firm where I work kindly agreed that I could use their equipment in my spare time, to machine the larger parts.

'The welded steel boiler was commissioned from TRS Boiler Makers in Derbyshire and they worked from the

David Ragsdale drawings. I started work on other parts of the engine including the front wheels and rear wheels with all the parts being cut from sheet steel and steel rod and then rolled into the correct shape and welded. I made and machined the eccentric rods, clack valves and most of the other brass fittings and soon the workshop and the garden were full of piles of different bits of engine.

'I was keen to keep the Foster build moving but with any project you are at times in the hands of your suppliers and I was beginning to get a little frustrated. Having a part-built engine and not being able to work on the next stage was starting to get on my nerves. There was still space in the garden, not a lot I grant you, but with time on my hands I toyed with the idea of starting another scale engine. Those initially idle thoughts gradually resolved into yet another project and I decided to begin the construction of a 6 inch scale Fowler B6 Showman's Road Locomotive. Having two projects on the go would hopefully minimise any 'downtime'.

'The castings for the Fowler were ordered from Live Steam Models, which were based on the Edward George patterns for a Fowler Road Locomotive. As this build progressed I had to make a number of patterns for castings which LSM could not supply. In addition, I also had to make patterns for all the Showman's fittings which would be required. As far as the boiler was concerned, I made arrangements for this to be built by Tony Baldwin at A J B Engineering. The boiler with a working pressure of 200psi was delivered bang on time in 2007 although during the time the boiler was on order I was able to build all the wheels for the Showman's engine and had the rubber tyres fitted by Reliant Rubber in Bradford.

'The wheels for the Fowler were now sharing the yard with the part built Foster which was coming together nicely. The engine was now



Drawings and castings came from David Ragsdale.



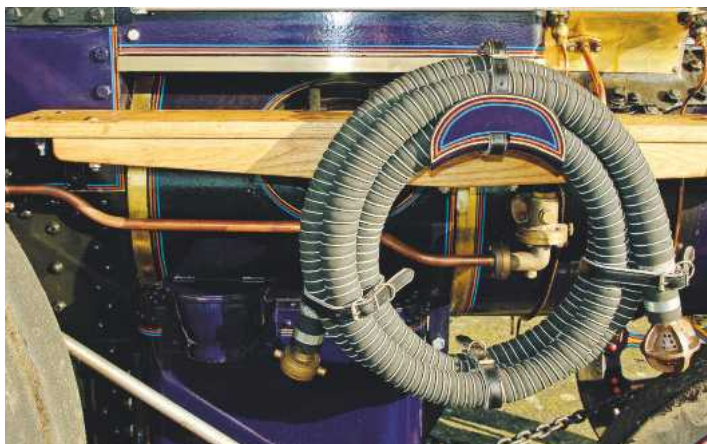
Foster Wellington detail.

on its wheels and the piles of parts had greatly reduced in size and the engine itself was beginning to look more like a traction engine than a pile of scrap. In the middle of 2007, just before the Fowler boiler was due, the Foster was taken apart for painting - another job which was carried out in the back garden taking advantage of any calm fine days, which are something of a rarity in this neck of the woods. Everything was painted by hand using a specially mixed batch of red which matched the colour of a Foster Wellington steam tractor in an old photograph. The lining was completed using a Beughler Pen which gave very fine lines and a good result. By November the painting was finished and the engine had been put back together enabling me to spend the beginning of 2008 building and fitting the canopy. The completed Foster was ready in time for an appearance at Beamish and has been rallied every year since then.

'Work on the Fowler had slowed while I finished the Foster but with the full-sized engine now more or less completed I was able to concentrate on the



The old airfield at Brunton gave the Fowler its first chance to stretch its legs.



The wooden running boards and hose are nice details.



Nameplate on the side cover.

Showmans' engine. I did most of the work on the new Bridgeport Mill and a Colchester Triumph 2000 which I had installed in the workshop. These machines were large enough to handle most of the work but with their permission I used my employer's Webster and Bennet vertical borer to machine the final drive gear

blank and the flywheel. I cut all the gears myself apart from the gear teeth for the final drive which were cut for me by Douglas Ward of Seaton Delaval.

'The boiler had been delivered and I could now start to attach the various parts which I had made over the past few months. The stays were machined and



Front view of the dynamo.

I fitted the hornplates and bearings followed by the front end, complete with its wheels. The belly tank was made up from sheet steel and duly fitted as was the steering shaft and the worm wheel. The tender came next and this was again bent up from sheet metal using a fly press, all the work being carried out in the garden. I have found the fly

press to be a very useful tool and over the years it has been used for many different jobs including broaching keyways, reverting wheels and bending and shaping a multitude of metal parts.

'There followed a brief lull while I 'played' with the Foster but then it was back to the Fowler. The axleboxes were machined and fitted to the hornplates and the winding drum, diff, final drive gear, axle and rear wheels followed. The next stage saw the fitting of the brake shaft and the brake blocks, the installation of some of the gearing and the steering shaft and steering wheel. I used the Bridgeport Mill to machine the cylinder block and when completed this was positioned on the boiler. More machining followed with the crankshaft, the motion and pistons all being completed in turn. Then it was a case of fitting everything together and 'fettling' to ensure everything was as smooth as possible.



The driver's eye view.



Cylinder and flywheel.

'The large canopy posed a few problems as it could not be made and fitted while I still needed to work on the engine as there was just not enough room. However, the supporting struts needed to be in place as they were part of the engine and it was surprising just how much room the steadily growing Showman's engine was taking up in the backyard which was already occupied by the Foster Wellington.

'I built the canopy from a supply of seasoned ash timber which I managed to find and after several years of engineering work I now had the opportunity to turn my hand to a spot of carpentry. The canopy was worked on over the winter of 2011-2012; by the beginning of 2012 I was pleased with the progress on the Fowler and it looked as though I would be able to get it finished in time for a late season rally at least.

'The dynamo proved to be a problem as the first unit which I had planned to fit just looked much too small when it was in position. Luckily a local showman, Les Vernon, who is an engine owner himself, let me have a larger and much more powerful unit which could generate 110 volts at 63 amps and this proved to be ideal.

'A period of test running and trial steaming revealed only minor problems which were soon remedied and then I was faced with the task of painting. The engine which had taken so



Martin machining the cylinder block on the Bridgeport Mill.



Boiler and firebox (photo Martin Young).

long to build was dismantled and work began on preparing the parts for painting. The small workshop and backyard are not really suitable for spray painting so everything, primer, undercoats and top coats were all carefully applied with a brush. I had elected to use a dark blue livery and when the top coats were completely dry the lining was applied with the Beugler Pen but the whole job of painting, lining and re-assembling took several months and the rally season slipped by. However, I did manage to get the Fowler to the Northumberland Vintage Tractor Club Rally at Brunton in October 2012 where it made its debut. Apart from one or two minor problems the engine performed very well and the large open areas of tarmac on the old Brunton airfield gave the engine the first real opportunity to 'stretch its legs'. Since then the scale Showman's has been rallied each year along with the Foster Wellington.'



Drilling the boiler for the cylinder block fixing studs (photo Martin Young).

All photographs, unless otherwise stated, are supplied by Alan Barnes.

● To be continued.



Fowler motion detail (photo Martin Young).



Fowler canopy frame in place (photo Martin Young).

Quarter Scale Bentley BR2 Rotary Aero Engine

PART 6

Mick Knights explains how he made the master connecting rod and the eight slave rods.



Continued from p.576
M.E. 4597, 12 October 2018

We'll start off gently with the master connecting rod and the accompanying slave rods. The master rod itself is too big to swing in the Myford so all the work in its manufacture will be carried out on the CNC milling machine. Any engineers who are contemplating this build without the same level of equipment as I have will of course have to resort to the rotary table and conventional milling machine in order to generate all the radial features. I do, however, use the conventional milling machine for the initial operations and the operation where the boring head is used to finish the central bore, as this needs to be parallel and held to a thousandth of an inch along its whole distance, which



Bentley BR2 aero engine.



Pitching out the centre positions on the master rod billet.



Pilot drilling the pivot positions.



Rough drilling the central bore.



The locating nest of dowel pins.

would be a big ask if generated through circular interpolation using a milling cutter on my little CNC mill.

The starting point is with a quite sizeable aluminium billet. Once face milled to finished thickness the eight slave rod pivot bores, along with the small end bore of the master rod are pitched out and centred (**photo 85**). The billet is milled to finished thickness at this initial stage as it wouldn't be possible to hold it in my lathe to face to thickness due to the length of the master rod itself. The pivot points, along with the small end bore, are pilot drilled for reaming at a later stage on the bench drill (**photo 86**). The main bore was also rough drilled at this stage to remove as much metal as possible (**photo 87**).

With all the pivot points reamed to finished size, the

billet was transferred to the CNC mill for the rest of the manufacturing processes. A pattern of drilled and reamed holes was produced in the sacrificial sub table in order to locate the billet in the correct orientation using a number of dowel pins (**photo 88**). Once located, the initial body diameter was generated (**photo 89**). The master rod, along with the radial body, was then milled to finished size and to the bottom face of the master rod (**photo 90**). With one side complete the billet was reversed and relocated on the nest of dowel pins, where the central material was removed to the depth of the master rod face (**photo 91**). The rest of the radial body was then generated, which broke through the remaining web of the billet leaving the master rod, at this stage of the machining, high and dry (**photo 92**).

Before the internal area - where the slave rods will pivot - is machined, the central bore is set true on the conventional mill and bored to finish size (**photo 93**). The angled sides of the master rod are carried into the central relief area, which means the angled face of the master rod has to be set true in the dividing head ready to rough out the central area (**photo 94**). The central material is removed leaving 0.020 inch on either side for finish machining (**photo 95**). Once completed



Initial generation of the body.



Finish milling the master rod to the depth of its bottom face.



Milling the reverse face.



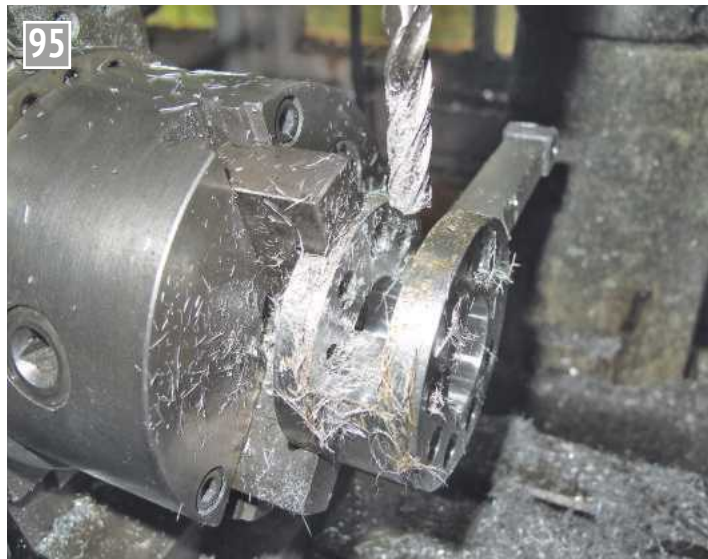
End of the initial machining.



Finishing the through bore.



Clocking the angled side of the master rod.



First stage roughing out.



Setting the second roughing operation.

the rod was reversed and again clocked true (**photo 96**) where the remaining material was roughed out (**photo 97**). Finally each side was machined by rotating the dividing head's crank handle in one continuous cut leaving a parallel area in which the slave rods will fit snugly but will be able to rotate freely (**photo 98**).

Next up are the eight slave rods which really are a quite straightforward series of operations, which, after turning, could be quite easily produced with the aid of a rotary table – but, as ever, I use the CNC. The first operation is to turn the central relief and once a large enough undercut is achieved the diameter is turned with a suitable profile cutter (**photos 99 and 100**). There of course needs to be adequate space for the milling cutter to clear the side of the vice after the side faces have been machined to finish width so the rods are set up on the mill with the aid of a suitable distance piece (**photo 101**). With the CNC all operations can be accomplished at the one setting (**photo 102**) but of course if machined on the rotary table, each end would be an individual operation. All the bores need to be bushed; these are produced in the normal way by turning on a tapered mandrel to ensure concentricity (**photo 103**). **Photograph 104** shows the finished assembly.



Removing the rest of the material.



Finishing the side faces.



Initial turning.



Finish turning.



Setting using a distance piece.



Milling the two ends and bores.



Turning the bronze bushes.



The finished assembly.

●To be continued.

Sieg SX2 Plus Miller CNC Conversion

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



Continued from p.594
M.E. 4597, 12 October 2018

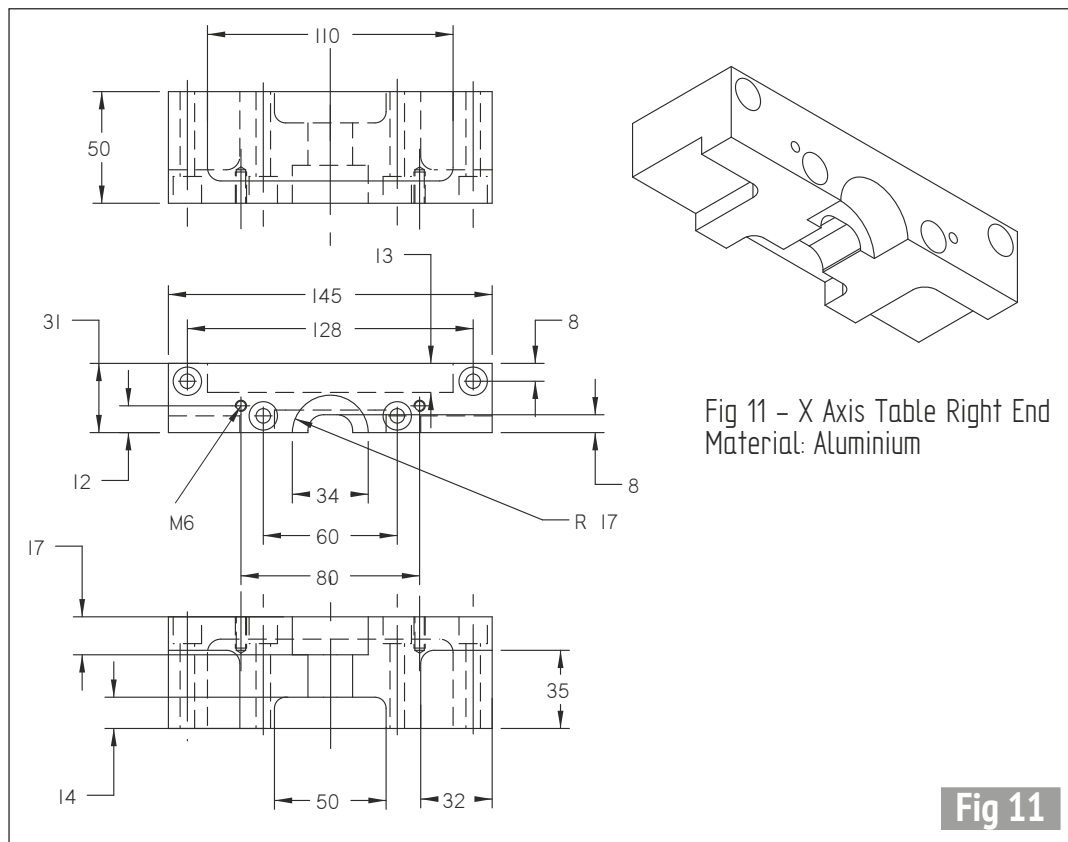


Fig 11

Fitting the X screw

Here we deal with screw alignment which is far more involved. Figure 5, shown earlier (M.E.4595, 12th September), gave a clear idea of how tight things are for this assembly. The height is

fixed firstly by machining the pocket for the ball nut carrier in the saddle assembly but many dimensions can only be established stage by stage. The motor plate adjusts up and down to match the height of the fitted screw, with the nut

carrier and right end support both being able to slide sideways (front to back of the machine) to match the motor plate position. To say the least, this occupied a lot of thinking! Machine the two X table end pieces (**figs 11 and 12**) but not the curved pocket in the right hand one, which is machined along with the motor plate later when we have established its exact position.

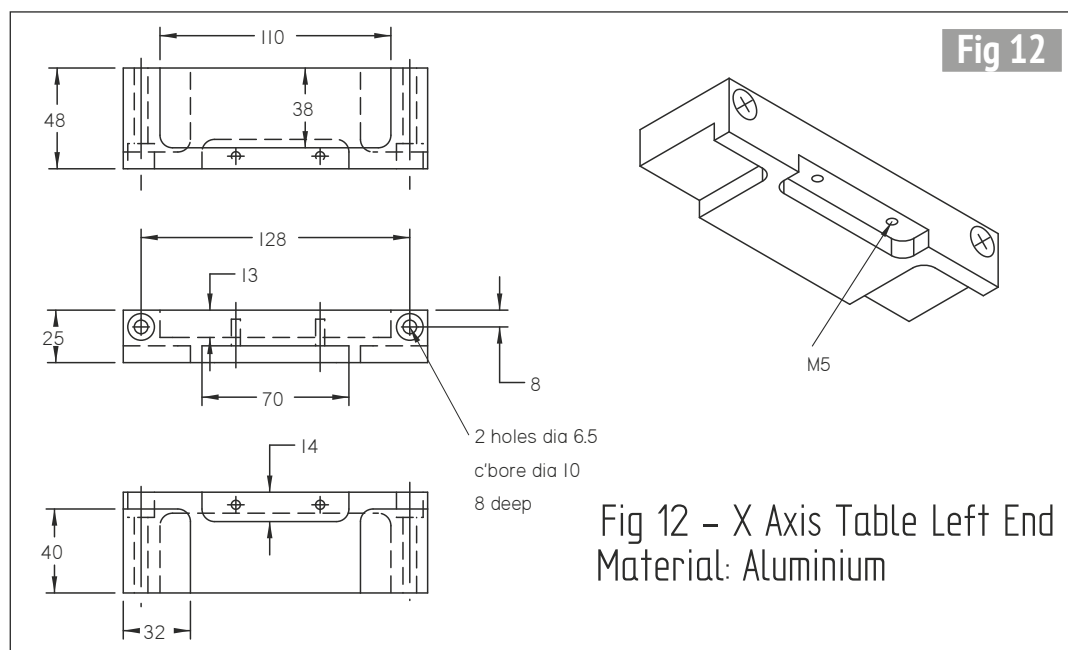


Fig 12

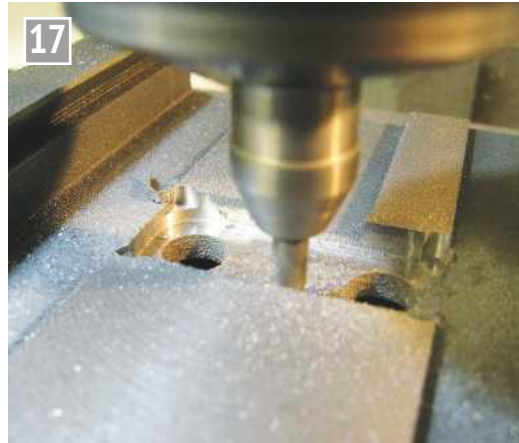
Fig 12 - X Axis Table Left End
Material: Aluminium



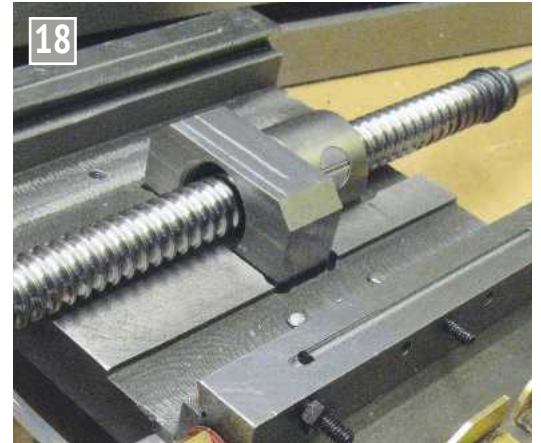
Fig 15
Finished X table end mounting.
Complicated! Note: the clearance for the bearing housing is cut later.



16
Drilling the coolant drain hole in X right table end.



17
Milling the pocket for the X nut carrier - underside of saddle.



18
Fitted X nut and screw in the saddle. Note oilways.



19
Setting X screw heights. Note the plate for X nut carrier bolts.



20
Boring the X motor plate and table end for the thrust bearing housing.



21
Mounting plate removed to add adjustment clearance - increase the bore diameter or move spindle towards the top of the table end.

In **photo 15**, note the widened ball screw trough. Fix them in place on the table so that the tops of them are flush and lie exactly 2mm below the table top. Use a piece of plate to gauge this. Not detailed in the drawings are the holes to drain coolant out of the top pockets. These need to be made as big as you dare and they thread their way between the mounting screws, so they need to be drilled at an angle (**photo 16**). Close observation will show you faint scribe lines and dissolved marker pen. Does anybody know of a marker pen which is really permanent? My old alcohol-based pens have expired and, despite trying loads of the new 'safer' versions, they just don't work as they did - the ink now rubs off easily or is dissolved by coolant. Marking blue also seems to be the same.

Now it's time to butcher the

saddle. Clearance for the nut carrier is initially nonexistent so we will mill out a pocket seating for the carrier. The depth is found by measuring the gap between saddle base and the underside of the table. The depth of the seating is now the height of the carrier plus the minimal 0.7mm clearance at the top of the nut under the miller table minus the gap found above. Mine needed 3.75mm to be removed below the bottom of the existing clearance groove, leaving 4mm of iron under the pocket. Rough out with a 12mm slot drill. A small cutter can then be used to overcut the corners to allow about 3mm of lateral adjustment in the Y direction, as shown in **photo 17**.

As the pocket is cut the original counter bored nut mounting holes for the cap screws holding the original

nut (underneath) are exposed leaving large gaping holes, as seen in the photograph. This is the reason for the 2mm plate we fitted earlier to provide a fixing for our ball nut carrier. Now the position of the slots to enable lateral adjustment of the carrier can be spotted through and cut to enable the X nut carrier to be fixed down to its pocket. Use M6 button head screws here as they are thinner but, even then, they only just clear. It will be obvious that clearance needs to be cut for the nut itself, enough to enable it to be screwed out without disturbing the carrier after it is finally positioned and aligned.

Following this, use ideally a 14mm or $\frac{1}{2}$ inch diameter ball nose cutter to cut the clearance for the screw by widening the groove on the right of the saddle and make a new one on the left. Aim for

a clearance of just less than 1mm below the screw. The object here is to remove as little as possible, the rounded groove removing a little less than an end mill. It is also better from a stress point of view. There's plenty of strength remaining in the saddle as the dovetail 'strips' will keep it stiff. This is clear in the assembly (**photo 18**). I did hear of somebody milling out a groove in the underside of the main table for screw clearance. NO WAY! It's already at minimal thickness so this action would seriously weaken it.

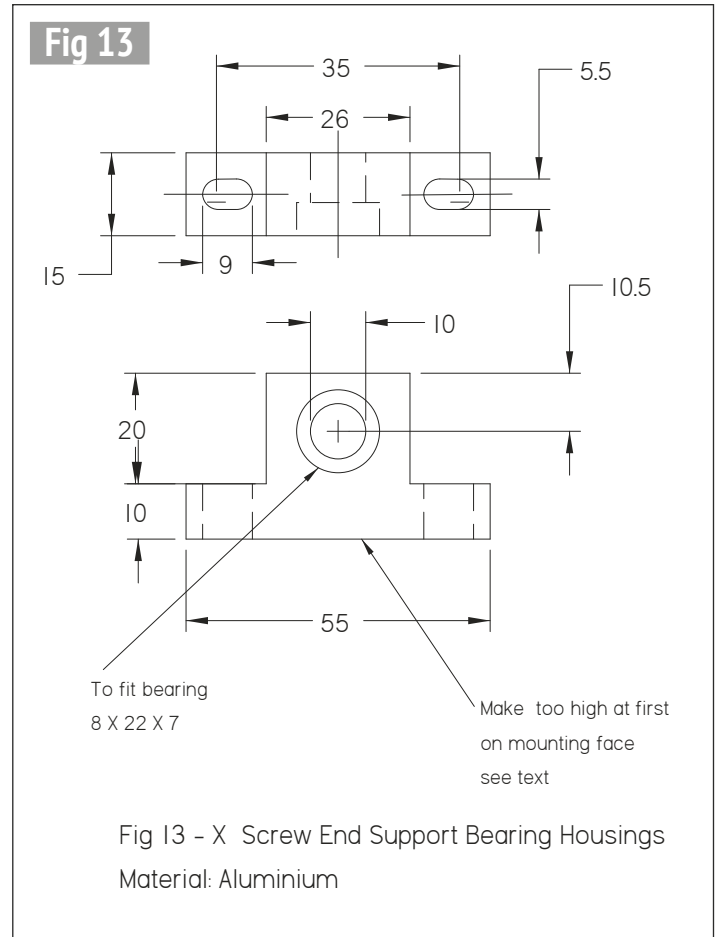
With the vertical position of the screw fixed in the centre we have a reference. Now we need to get the height position of the screw so the hole for the thrust bearing housing can be cut in the X motor plate. With the setup as shown in **photo 19**, with the table upside down on the bench, fit the screw

to the saddle and mount this with the gib strip in the centre of the table. Use packing under each end of the screw to get it level using parallels, depth micrometer, slip gauge, drill bit etc. in relation to the dovetail slide seating, not what at the moment is the highest part of the table but the first step down. When this is eventually achieved and you are satisfied, stamp the exact amount of packing needed at each end on the table itself for future reference. Now simply measure with callipers the distance between the top face (at the moment underneath) of the right end block and the bearing seat and subtract the radius of the bearing seat ($\frac{3}{16}$ inch), which gives the vertical position of the 30mm diameter hole for the thrust bearing housing.

Remove the right table end, fix the motor plate in position onto it using M6 screws in the vertical slots, with the top and front edges in perfect alignment, then grip the end block in the machine vice. Use an edge finder to pick up the edge then move the table the measurement found above and get the hole position on centre. Now bore both pieces

at the same time. But caution here. Don't go too deep as the clearance in the end block will break into the swarf and Tee slot area on the top of the block. Don't touch the vice handle but remove the motor plate and increase the diameter of the curved bit in the mounting block so the motor plate can move up and down for final adjustment (photos 20 and 21).

Fix it back on the Sieg table, assemble the thrust bearing and check the screw position again with the packing. Loosen the nut carrier bolts and slide the saddle as far as it will go towards the thrust assembly, then tighten gently the motor plate and carrier bolts. This fixes the lateral and vertical positions of the right end of the screw. The nut carrier screws may need adjustment, so the slide is moved fully back and forwards, but watch the screw as it revolves. Any misalignment will cause the screw to oscillate and orbit. Fiddle with the positions of the two completed mounts to get minimal oscillation. When satisfied measure again the size and the height for the support bearing block at the other end, which is adjusted



in the same way as we did for the Y screw (fig 13). Here I admit to a total fluke - I left the extra material on but found that the height of what was to

be the non-mounting face was in fact the exact size needed to 0.01mm! (The steps hadn't been cut at this time.)

●To be continued.

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- **Train in a Bottle**
Stewart Hart offers a gift idea for the fast approaching festive season.
- **Tractor Canopy**
Chris Gunn makes the canopy for his six inch Garrett 4CD tractor.
- **Height Gauge**
Graham Sadler explains how you can make a simple centre height gauge.

- **Point Motor**
Martin Evans explains why and how he made his own 'made-to-measure' point motors for his garden railway.
- **Dorset Steam Fair**
Graham Gardner shares some of the things he found at the Great Dorset Steam Fair.



Content may be subject to change.

ON SALE 23 NOVEMBER 2018



Lötschberg

John Olsen, talks his way down the engine room steps on board a beautiful Swiss paddle steamer.



Around the turn of the millennium I spent a couple of years working in Germany. Some of my holiday time was spent in Switzerland and this included a very pleasant week camping near Interlaken and exploring the various lines of the Bernese Oberland Bahn. It was only after leaving that I realised that the ferry boats plying on Lake Thun and the Brienzersee included two genuine paddle steamers and I hadn't even gone near them. Ever since then I have had the desire to return and make up for the omission - but Switzerland is a long way from

New Zealand! The opportunity came recently, however, when my wife and I were able to include a few days in Switzerland towards the end of a world trip. First we travelled on the Glacier Express and then retraced some of the route in a rental car, finding that some of the high alpine passes were still snowed in even in early June. This meant we had to take a longer way around but we managed to get to the little town of Brienz in the late afternoon and found a bed and breakfast for the night. A bit of research showed that the paddle steamer, *Lötschberg* (**photo 1**) was

scheduled to run a service in the morning - starting at Interlaken, at the other end of the lake - and doing one round trip up the lake and back. We didn't have time to do the whole trip, so we either needed to get to Interlaken to catch the boat, or to get back from Interlaken after the trip. That would leave the rental car in the wrong place either way. The penny dropped with the realisation that the Swiss have excellent train services, so that it was quite easy to simply leave the rental car behind, catch a train from Brienz to Interlaken and take the paddle steamer trip back.



1 Lötschberg approaches the wharf at Interlaken Ost.



2 Feathering paddle wheel. The engine was turning slowly to warm up.



The attractive counter stern seen as she moves to the loading wharf.



The engine seen from the passenger area.



The writer at the controls. The large wheel is the reversing gear. Air and feed pumps to the left.



Cylinders clad in Russian Iron. Piston valve on high pressure and slide valve on low pressure.

We duly caught the train and arrived in Interlaken in plenty of time. The ferry wharf is only a very short walk from the railway station and we found the *Lötschberg* at the wharf, the engine warming by slowly turning the paddle wheels (**photo 2**).

There are two paddle steamers based at Interlaken, the *Lötschberg* serves the Brienersee and the *Blüemlisalp* serves the Thunersee. After a short wait, *Lötschberg* moved up the river a short distance to the loading wharf and we were able to board (**photo 3**). I was pleased to find that the engine is visible through a well in the deck (**photo 4**) so I started the voyage watching the engineer following the commands from the bridge as he brought the ship up the channel and out onto the open lake. I took an opportunity to show one of the officers the 'brag book'

I had in my pocket, showing photographs of my own steam launch under construction in New Zealand. He took it below to show the engineer, then came back and said that after the first stop I could go below and take a look at the steam plant (**photo 5**). I spent most of the rest of the trip down below looking at the engine and talking to the engineer, Peter Wyss.

The *D.S. Lötschberg* was built by Escher Wyss in 1914, with her first day in service on the 25th of July 1914. It will be realised that this turned out not to be the ideal year for new tourist ventures, with the First World War breaking out only nine days later. She was put out of service for the duration and did not return until 1923. Even then demand for service was light and did not build up until after the Second World War, when she began to cover up to 9000km per season. She

was gradually modernized and improved and managed to survive discussions of scrapping her. Then in the winter of 2000/2001 she underwent a complete restoration.

The ship is 56.6 meters long with a beam of 12.8 meters; unladen draught is 1.2 meters, while fully

loaded she draws 1.5 meters. Passenger capacity is 800 and her displacement is 253 tonnes. The engine is a diagonal compound with a piston valve on the high pressure cylinder and a slide valve on the low pressure (**photo 6**) and Stevenson's link motion is used (**photo 7**). The condenser is a jet type, which



The Stevenson link motion. Since the engine turns slowly, the oilers can go around with the motion.

means that condensate is lost to the lake (**photo 8**). For this reason, a water treatment plant is required to de-ionise the feedwater which is taken from the lake. This plant is duplicated for reliability.

The boiler was converted to oil firing back in 1968 (**photo 9**). Both the engine and the hull were built by Escher Wyss of Zurich. The engine is substantially built and beautifully kept (**photo 10**).

The paddle wheels are of the feathering type, a feature that makes a great difference to the efficiency of a paddle steamer. In the early days of steam ferries in Auckland, New Zealand, a ferry boat was built in Auckland to a design supplied from England. The performance achieved was not good, a maximum speed of 3 knots being reached. After some correspondence to and fro with the designer, it transpired that non-feathering wheels had been fitted. When these were changed to the specified feathering type, the speed increased to 5 knots, with no other changes to the plant. This shows the sort of difference the feathering wheels can make. A related advantage is that there is much less splash and spray from the wheels.

The number of sailings each day, and the vessels used, will vary with the season so it is suggested that you check with the BLS website given in the references before making your travel arrangements. At the time we travelled, the *Lötschberg* was making two round trips each day, while a motor vessel was making three. The trip from Interlaken Ost to Brienz takes just over an hour, so a round trip would take a bit more than two hours. There are typically eight or so stops, but there are a couple of optional stops in the timetable. As mentioned above, train services in Switzerland are excellent so it would be quite easy to make a day excursion from Bern or from Lucerne, or even to include a trip on the steamer as part of travelling by train between those two



Low pressure side of engine. The horizontal cylinder is a feedwater heater and beyond that is the jet condenser.



The oil fired boiler.



The substantial main bearing housings and the crank.



On deck looking towards the bow and east up the lake.



Departing from Brienz near the head of the lake.

cities. The scenery is, of course, excellent (**photos 11 and 12**) so other members of the family will enjoy the trip even if they do not spend the whole time peering into the engine room. Depending on the particular cruise, full meals or a limited choice of food will be available (**photo 13**). Check the timetable for details of this (**ref 1**).

It is a great part of Switzerland to base yourself in for a holiday. The Brienz Rothorn Bahn station and the main line railway are just

across the road from the wharf, offering the possibility of a steam powered excursion on the rack railway to the summit of the Rothorn, 2244 metres above sea level (**ref 2**). The Bernese Oberland Bahn also offers the possibility of rack railway trips from Interlaken to a number of summits, the most famous being the trip to the Jungfrauoch at 3454 metres, the highest railway station in Europe.



The restaurant area.

REFERENCES

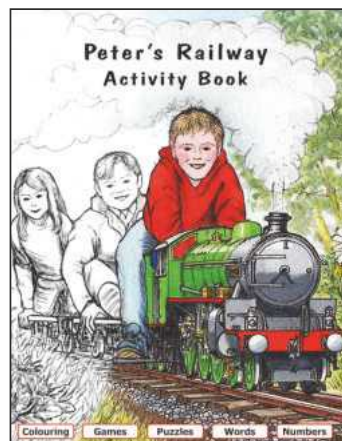
1. BLS website is at www.bls.ch
2. Brienz Rothorn Bahn website is at brienz-rothorn-bahn.ch
3. Bernese oberland Bahn website is at www.jungfrau.ch/en-gb/

ME

Book Review

Peter's Railway Activity Book

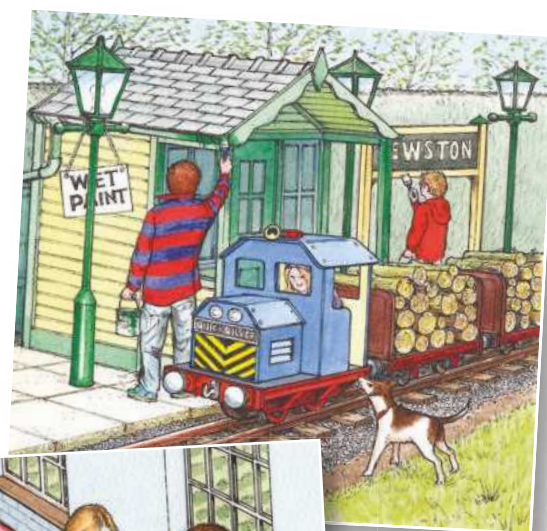
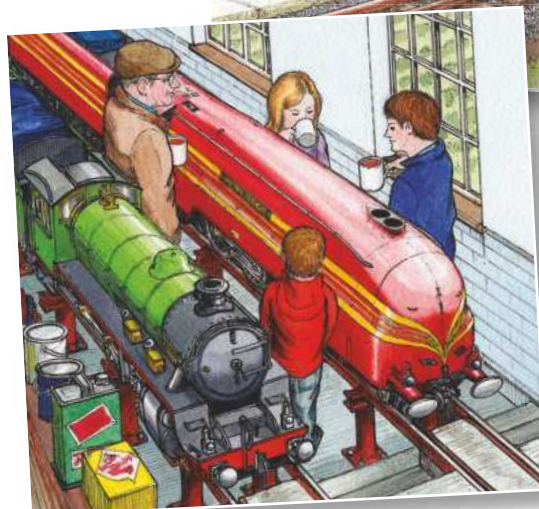
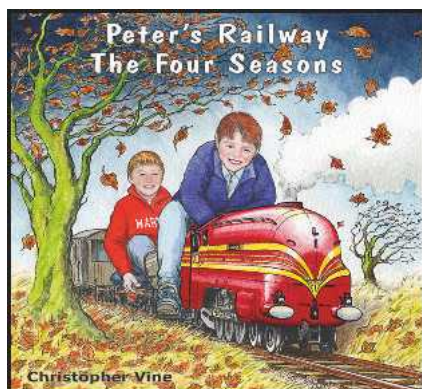
By Chris Vine



Chris Vine is the well-known author of the series of railway story books called *Peter's Railway* which describes the building of a miniature railway by Peter and his Grandpa across their farm. The delightful paperback books are written for children who love trains and engineering and are suitable for all children from age 3 to 90!

This activity book is complementary to the series and in it Chris has produced a wonderful selection of activities including word searches, puzzles, games, numbers and colouring. The railway station centre page is a particularly useful item covering all the hazards that can exist on a modern-day railway station with a challenge to find all the hazards. There is a very good technical section which is both educational and informative and again provides a good mental exercise with the gear puzzles. Youngsters will love the railway jokes and anagrams and I expect the "SPLAT" wagon will find a lot of enthusiastic friends. An interesting crossword will provide a good challenge to both young and old minds as will the word search page

Beautifully illustrated by John Wardle, this book will



provide hours of entertainment for both children and their parents or guardians and there really is a sting in the tail - which caught me out completely. I won't spoil it here so you will have to buy the book to find out. With Christmas on the horizon this would be a first-class stocking filler for all ages and at only £4.99 it represents real value for money.

In addition, Chris's latest book in the *Peter's Railway* series is called *The Four Seasons* and describes operations on the railway over all the seasons of the year. In the winter, the main activity is concentrated in the workshop where the sleeper painting wagon is built. Spring arrives and the track work and maintenance begins ready for the summer driving season. When the summer season starts Peter and the children embark on an ambitious project to raise funds for the local children's hospital and the story shows how they make it a successful event. A visitor with a large locomotive

greet the autumn season and the exploits of the railway during the darker nights with a ghost train and pumpkins are described. A small technical section explains in clear detail how a simple hand pump works and gives details of the sleeper painting wagon.

All in all, this is another excellent book for young readers with lots of excitement portrayed through the children's activities. As with all the series, the superb illustrations are provided by John Wardle and they really add to the atmosphere of this little railway. I hope that the examples here show the quality and happiness of the books, which I thoroughly recommend as a good entertaining read and, again, at just £4.99 another bargain buy.

Both of these books are available at petersrailway.com where you can get a signed copy and dedication from Chris or at most preserved railway sites as well as Amazon (ISBN 978-1-908897-31-2).

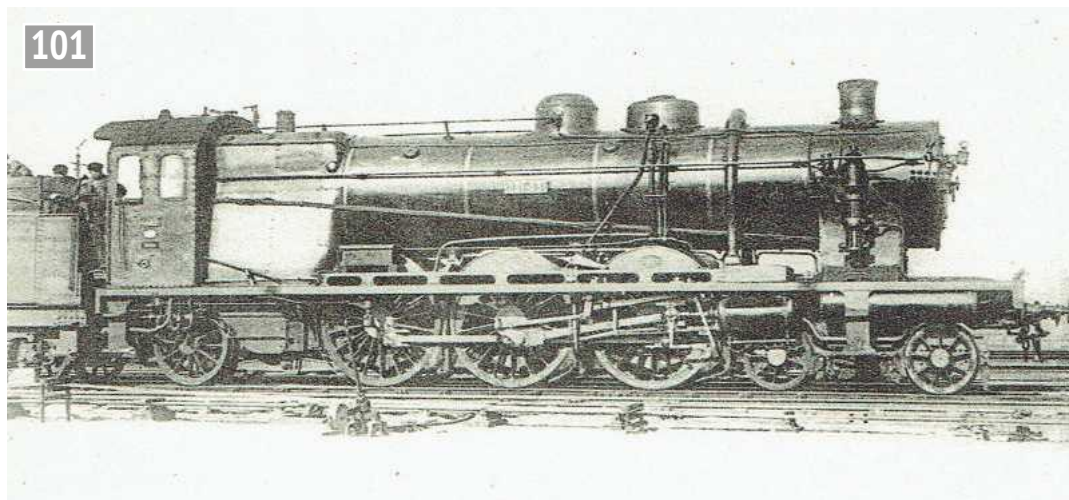
John Arrowsmith

Technologie sans Frontières

PART 21

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

Continued from p.568
M.E. 4597, 12 October 2018



Ouest/Etat Dieppoise.

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

The credit for introducing 1.94m driving wheels which Chapelon takes to be part of the accepted definition of a fast passenger type locomotive, is often accorded to the second generation P. O. Pacifics, the 3501 series (**ref 1**). In fact, the driving wheel diameter of the P.O. 3501 Series is invariably given as 1.95m, 10mm more than the Ouest and the Midi locomotives, conferring a half of a percentage point advantage upon the P. O.. Vilain says that they were particularly intended for the easier Bordeaux and Nantes lines and were identical to the 4501 series in everything but the wheel diameter. The initial twenty were built in 1909 by S.A.C.M. to their works numbers 5869-88. Eventually fifty were built, the remaining thirty by Fives-Lille (F.L 3608-37).

The two P. O. Pacific classes, more especially the 3501 series, called forth encomiums from Vilain (**ref 2**). He maintains that: *These beautiful locomotives with very simple lines had truly a great appeal and symbolised in a perfect manner the modern locomotive of that époque.*

Van Riemsdijk (**ref 3**) qualifies this enthusiasm in pointing out that although capable, the performance of these Pacifics fell somewhat short of what might be expected from this substantial enlargement over previous machines. The horsepower was in the region of 2,000 ihp in the unsuperheated condition and even when the later engines were superheated they failed to exceed 2,100 ihp. He accounts for this partially by the greater overall running resistance entailed in the Pacific type but

more specifically he identifies the steam path offered by the piston valves as problematic. Inside admission was used but the port arrangements are not clear from the available drawings. If their performance was deficient *pro rata* measured against earlier machines, this did not deter the Midi who showed continuing faith in the P. O. 3501 design, increasing its stock to fifty-five, all built by S.A.C.M.

The newly combined Ouest/Etat was more guarded and produced a design that took one step back, reverting to their version of the P.O. 4000 series 4-6-0s, Ouest series 3801-40. The chassis and running gear were essentially the same as the 4-6-0s. The layout of the cylinders maintained the classical de Glehn style differing from the 4-6-0s only in 20mm added to

the high pressure bore. The design also used four sets of conventional Walschaert's valve gear and piston valves were also abandoned in favour of the 4-6-0s balanced slide valves with trick ports on both high pressure and low pressure sides. They shared the 1.85m driving wheel diameter with the 4-6-0s.

The boiler was the single legacy of the Ouest twins, 2901-2. Its deficiencies were dealt with by extending the tube length from 6m to 6.3m. Despite the fact that it was unsuperheated, the inter-stage reheater used for the twins was dispensed with and the smokebox length assumed more modest proportions. The rear driving wheels were closed up towards the middle drivers to provide more space over the Bissel truck for the spreading water legs of the Belpaire firebox which had a sloping throatplate to clear the wheels.

Fifty were built under three orders, the first by Five-Lille, (F.L. 3656-75, Etat 6501-20), the second by Schneider (S. 3056-75, Etat 6521-40) and the third by Cail (C. 3146-55, Etat 231.051-60). They were known as the *Dieppoises* (photo 101) from their intended service but almost as soon as they had begun work they were overtaken by disaster. Derailments at Bernay and du Perray took place in 1910 and 1911. The cause was controversial but Herdner identified a combination of the bogie design and the uncompensated suspension as the cause. On less well laid track the springing tended to unload the bogies causing them to jump the track. The immediate response was to limit their speed to 60 km/h and they were confined to goods service. Some rebuilding ensued, the suspension was modified and the bogies were replaced with the American swing link pattern. From June 1912 they were permitted again to run at 120 km/h on the Paris-Caen and the Paris-Mans lines and 110 km/h on the route to

Chartes and Thouars, where the curves had 500m radius (ref 4).

It was unfortunate that the *Dieppoises* began their careers in this way for, after rebuilding they were to prove in Vilain's phrase: ... *amongst the most successful of French Pacifics* ...

Van Riemsdijk (ref 5) recalls that they worked until the late nineteen-fifties despite being unsuperheated and in 1914, one attained 92 mph whilst being used to test aircraft wing sections!

During the First World War the operation of railways in France, Britain and the USA were taken under government control as nationally unified entities and this experience led to each of these nations considering restricting post-war locomotive production to a limited number of standard types.

In the longer term the directions explored by the Ouest and Etat railways were to prove a diversion. The Orleans 3501 series transpired to be more influential. During the First World War the operation of railways in France, Britain and the USA were taken under government control as nationally unified entities and this experience led to each of these nations considering restricting post-war locomotive production to a limited number of standard types. The French favoured the P.O. 3501 series and on this basis the *Travaux Publics* were designed as a state enterprise retaining the trapezoidal grate but substituting a round-topped firebox. The Bissel truck wheels were also enlarged. Inevitably, after 1918 the Etat became the principal user of the design whilst the Est's only Pacifics were *Travaux*

Publics. The Alsace-Lorraine, re-united with France after 1918, also took a number.

Such a nationally directed policy was anathema to the Paris-Lyons-Midi Railway which continued to follow its own well entrenched traditions. The *Grande Ligne's* involvement with compounding began at virtually the same time as that of the Nord railway. Adolphe Henry initiated what became a firm P. L.M. allegiance to multi-stage expansion in 1887 but eschewed the de Glehn model,

but without de Glehn's driver controlled variable cut-off on the low pressure cylinders.

The last locomotives built under Baudry's regime were express service 4-6-0s which reverted to cylinders *en batterie* under the smokebox with high pressure outside. This by no means represented a conclusive stance for, when the first P.L.M. Pacifics appeared, simple expansion continued to be investigated but with the additional question of superheating added.

By the time that the P.L.M. were considering introducing superheating, there was a growing body of opinion that high temperature steam obviated the need for compounding. It was contended that as the higher steam temperatures resulted in reduced cylinder wall condensation, multi-stage expansion was unnecessary. Further, higher temperature steam allowed boiler pressures to be lowered, reducing maintenance. Internationally, many railways were seduced into building locomotive boilers to these retrogressive tenets. The P.L.M.'s exploration of the Pacific locomotive epitomised this experience.

● To be continued.

preferring cylinders in-line (... *en batterie contrairement a la disposition de Glehn ... Vilain*), overhanging the leading axle with the low pressure outside. His successor, Baudry, showed a greater sympathy with de Glehn's ideas and the famous windcutters referred to in an earlier article were Alsation under their clutter

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2. *Ibid.*, p. 138.
3. The Compound Locomotive. *Van Riemsdijk, op. cit.*, p. 102.
4. Le Materiel Moteur et Roulant.....de 'Etat L. M. Vilain *op. cit.*, p. 343.
5. The Compound Locomotive. *Van Riemsdijk, op. cit.*, p.99.

Lathes and more for Beginners

PART 26

Graham Sadler
demonstrates
how to
produce well ground tools.



Continued from p.655
M.E. 4598, 26 October 2018

Form of lathe tool bits

Now we need a few more details about the angles needed when forming lathe tools to be added to the basics I gave a while back.

The actual clearance and rake angles which form the basic shape of tools are dependent on two main factors. The sharper the tool angle, the easier it is for it to get under the surface of the work and the easier it is for the sheared material to slide over the face of the tool. However, the sharper the angle, the more the tool point is prone to being degraded by crushing forces and abrasive wear. Furthermore, there are points to observe about the way different types of material actually form chips, due to their differing properties, hardness, *ductility* (the ability of a material to be deformed and bent) etc. or how some materials will actually cause the tool to self-feed by being pulled into it during cutting. This is the reason that brass tools should have zero side and back rake. I won't go further into this massive field as there are people out there with far greater knowledge than me and the internet is easily available for further research or investigation.

As it is, the angles often quoted are to enable the maximum rate of metal removal in industrial situations, not in the home workshop. You will have found our very crude knife tool made with an angle grinder or drill mounted small grinding wheel still cuts and it cuts well. True, it won't be as efficient as a

tool with perfect angles but it still works and that's what it is all about. My tools almost invariably use 6-8 degree clearance for the front and side with a bit of variation of end shapes and rake angles.

A while ago, I had a serious look at Tubal Cain's recommendations for tooling shapes and angles, with a fair amount of other research as well. I came to the conclusion that there were only a small number of actual grinding angles needed. In addition, because of the range of angle values he provides for different materials, many of the tools can be fitted into different material types. Again, to re-iterate, tool angles often quoted relate to industrial use where efficiency of time (i.e. big cost) is balanced with tooling (small cost). This is something which is inverted for us as price is often more important than time.

We have a much smaller range of tooling, frequently switching between different materials as opposed to doing long production runs on the same component/material combinations. If the front and side clearance figures are looked at, it will be obvious that there is not a lot of difference between them for most metals, which formed the basis for this rest.

So, given below is what I have been successfully using - and I have over 15 HSS tools in common use and a plethora of specials! The table shows my adaption and simplification of Tubal Cain's information. For instance, the back rake he gives for steel

tools is 6-10 degrees. I stick with 8, so I know exactly what values to use when a regrind is needed. Don't forget to label the tools so you know exactly what they are for, as many are very similar!

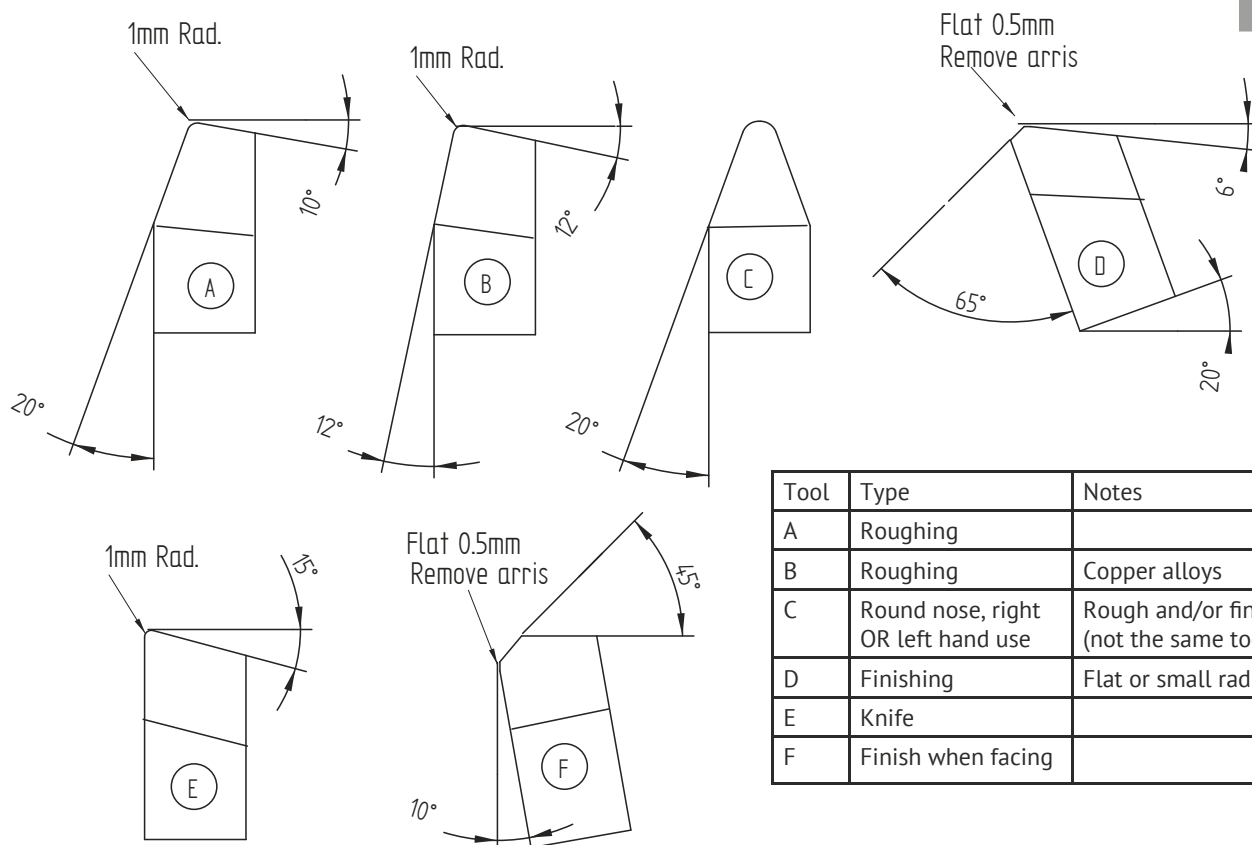
Tool table and diagrams

Figure 29 provides a useful chart of cutting angles for a variety of different tools.

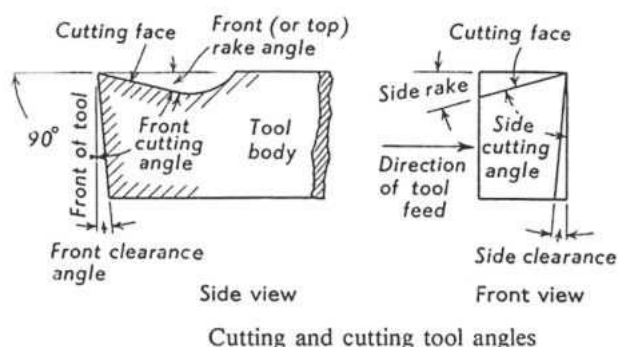
It will be noted that the classic round-nose tool, C, is almost the same as the roughing tool but as it is working in two directions it has zero side rake, making it an ideal finishing tool similar to tool D. However, both have an angled or rounded form leaving a fillet at any shoulder we turn, found in the vast majority of our work. This is good from a stress and strength point of view but it is difficult to obtain a good mating face fit with the matching bore unless excessive internal chamfering is undertaken. For this reason, it is good practice for shaft/shoulder junctions to have a tiny groove made with a narrow rounded parting type tool, the edge of which can be used to give the shoulder a fine skim.

With tool C the end rounding is a compromise - too small and it can lose the shaving finishing cut, too big and it will cause chatter. So, start with a decent radius and reduce the width at the tip if you get chatter. One tool is not shown in fig 29, and this is the chamfering tool, which is almost identical to the round nose but is at 45 degrees and finished to a point, having a

Fig 29

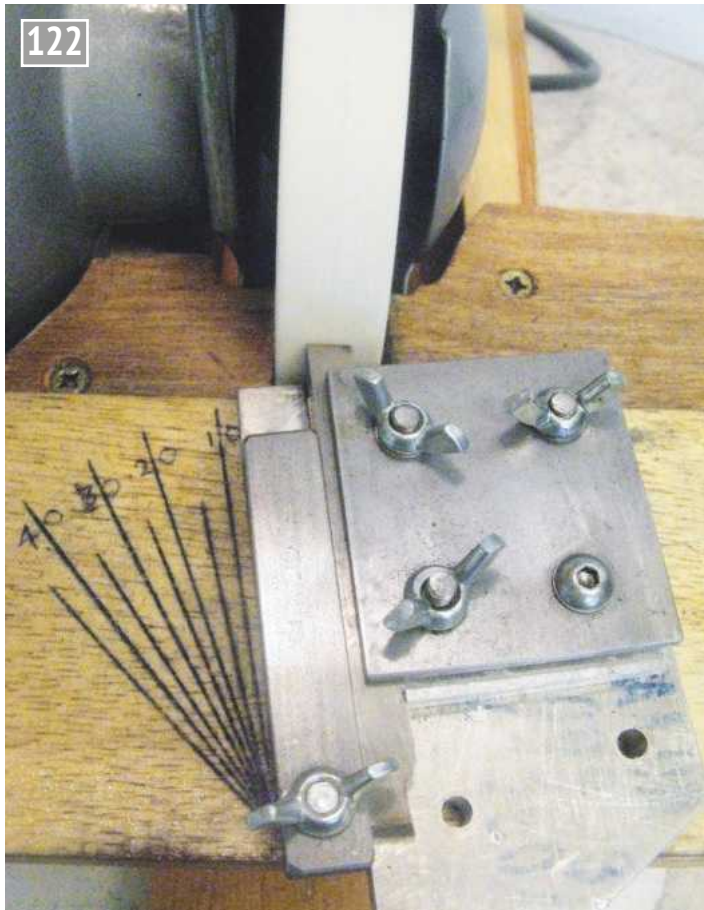


Tool	Type	Notes
A	Roughing	
B	Roughing	Copper alloys
C	Round nose, right OR left hand use	Rough and/or finishing (not the same tool)
D	Finishing	Flat or small radius
E	Knife	
F	Finish when facing	



Material	Work Type	Angles in Degrees			
		Front Clearance	Side Clearance	Side Rake	Back Rake
Steel	Rough Finish	8	8	16	8
		8	2	0	18
Hard Steel	Rough Finish	8	8	12	6
		8	2	0	12
Cast Iron	Rough Finish	8	8	12	8
		8	8	0	8
Cu/Pb	Rough Finish	8	8	18	12
		8	8	18	12
Brass or Lead Bronze	Rough Finish	6	6	0	0
		6	6	0	0
Alloy	Rough Finish	8	8	18	8
		8	2	18	8

Based on
Model Engineers Handbook
by Tubal Cain, Third Edition
Pages 5.2-4



Roughing tool, grinding the front 8 clearance at 12 degree trailing angles.

modest back rake. Use the tool holder without the slider and add the 2 degree strip to get zero top rake for tools which have a back rake. Both of these tools can be used with seriously coarse feeds. I suggest you photocopy this page, laminate it and mount on the wall next to your grinder.

Grinding a steel roughing tool

As an example we will make a roughing tool for steel. We'll make a crude knife tool which formerly took me about 40 minutes to grind with the angle grinder. It won't take us more than 10 minutes including setting to centre height and it will be a lot, lot better.

Firstly, rough out the end shape on the coarse wheel, thus preserving the fine wheel. Clamp the bit on the long edge and set the slider angle at 12 degrees. Grind the front clearance by holding the clamp jig in the left hand squeezing it against the slider arm. Use the right hand to hold it firmly but gently down on the slider

which is pushed very gently but positively forward to ensure the guide locates on the platform edge. Slide the whole lot until the grinding is complete. You can tell when you have got to the top as the grinding sparks will dance on the top of the tool bit rather than disappearing below.

Reset the slider arm to 20 degrees (or any approach angle which is required) and re-clamp the bit on the front of the holder and grind the side clearance. Flip the bit over so that the back of the tool is down and grind the side rake, which at the moment will be set at 8 degrees. If you want to add back rake, position the slider arm anti-clockwise to the required angle being careful not to remove more than a whisker of the cutting point of the tool. Use the stop to limit the leftward movement so leaving a clean stem at the limit of the rake wedge.

Finally, hone the bit on an oilstone, which because of the slightly hollow ground faces will be an easy task (photos



Side clearance at 8 with 16 degree approach angle.



Flip tool bit onto its back edge to grind the side rake 16 degrees and back rake of 8 degrees.



The partly formed top face.



Finished and honed steel roughing tool.

122 to 126). I said it was easy, or at least it will be after you have done a few! Be sure to have a pot of water handy to cool the bit as it's being ground. HSS tooling can work very hot but it doesn't do it much good during grinding so don't leave it too long. (I won't go into why.) HSS with added cobalt will far outlast a standard HSS tool and is worth the extra cost.

To finish this section, photos 128 to 132 show what to expect from different tool forms all cut on the same piece of bar.

●To be continued.

Using the stop to grind the top of a left-hand tool.



A range of tools and the swarf they generate at 0.1mm (0.0035 inch) feed per revolution (from top): A, inserted roughing; B, super rougher with 10 degree negative rake; C, inserted right-hand knife (SCLCR type); D, HSS right-hand knife; E, HSS finishing (with abuse); F, roughing with no back rake - tool in photo 126 gives chips the same as type A.



Tool C in action.



Tool D in action.



Tool F in action.



Tool B in action - note the shear planes on work and swarf; tool A shows similar shear patterns.

ME Vertical Boiler - Constructing the Boiler

PART 17

A project aimed at beginners wishing to develop their skills or those requiring a robust vertical boiler for the running or testing of small steam engines. **Martin Gearing** completes the chimney and moves on to the firebox shell.



Silver soldering the chimney

Use a fine abrasive paper to clean up at least a 10mm length at each end of the 22mm diameter tube.

Form two rings of 0.7mm diameter silver solder (55%) to fit the tube snugly. Lightly coat one end of the tube with flux and fit one ring. Lightly coat the 22 x 8mm recess in the chimney base and fit onto the tube pushing down the silver solder ring against the chimney base.

Stand the chimney base on the edges of two fire resistant blocks placed about 30mm apart (**photo 96**).

Heat from below, directing the flame upwards through the gap towards the chimney base, and occasionally playing the flame on the tube, just above the silver solder ring but avoiding the silver solder ring itself. Continue heating until the silver solder flows and is drawn into the gap between the tube and the chimney base.

Allow to cool before placing in the pickle for about 10 minutes, rinse and lightly coat the free end of the tube and the 22 x 3mm recess in the chimney cap with flux. Fit the

remaining silver solder ring to the tube before fitting the tube and cap together. Push the silver solder ring against the cap. Position the two fire resistant blocks about 20mm apart and stand the chimney cap on the edges of the block. Repeat the same exercise as before to secure the cap.

Allow to cool before pickling, rinsing and cleaning up. Put to one side.

Firebox shell – Item B17

16swg Brass (**figs 45 and 46**)

Mark out a 245.5 x 45.5mm rectangle of 16swg brass, using a try square working against a guillotined edge (whilst probably not a brilliant finish, it will almost certainly be straight), to ensure both ends are square. Cut out using a 32tpi hacksaw, taking care not to cross the marked lines. Using a file, clean up the guillotined edge checking with steel rule to make sure that it remains straight. Bring the 45mm width measurement to within the ± 0.1 mm tolerance by filing down to the line and checking frequently along the length with callipers.

As the rectangle will have to be bent to form a cylinder after

drilling it should be annealed now. Remember not to carry out the annealing in bright light.

Because there are 24 holes to be drilled, and given the length of the workpiece, it will be found to be a great help if the centres for the holes are marked out at this stage to catch any errors when indexing manually. Refer to fig 45 for the orientation of the datums. Scribe parallel lines from the long datum edge at 8, 17, 32 and 42.5mm. Place the stock of a try square against the long datum edge as you measure from the end datum edge and scribe 18 lines across the width at the relevant points only (otherwise it will look like you've marked out a mesh!). It also helps to write at each intersection with a fine marker the size of the hole to be drilled (**photo 97**).

There are several acceptable methods for proceeding. The method described will use the accuracy and security inherent with a milling machine. It could be debated that it would be easier to use a drilling machine but, given the material and the fact that to **safely** drill nine of the larger holes the work would need to be clamped at each setting, any time-saving becomes debatable.

Select parallels of a width that stand 25 - 30mm above the table when dropped into the outer milling table Tee slot, aiming to get the least amount of slack possible (perhaps the addition of another parallel and a steel rule dropped in as well). Place the rectangle of brass, with the long datum to the outside against the parallel and the end datum to the left, on a

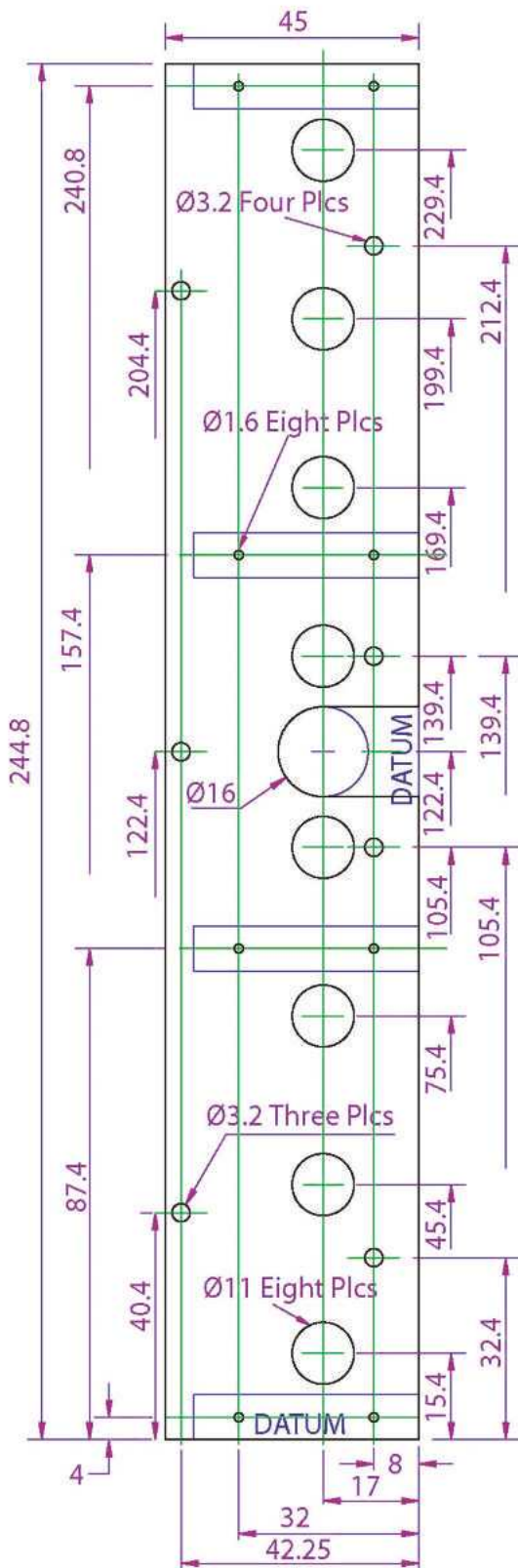


Chimney base ready for silver soldering.



Firebox marked out.

Fig 45

Fig 45 - Firebox Development
Item B17

piece of 10 - 20mm thick manufactured board, before fitting four clamps with two near to the ends and two spaced equally between them. NOTE – you will most likely have to move these as work proceeds, to gain suitable access for the drill chuck, but provided only one clamp is slackened at a time there is no risk of the work moving.

Fit a 10mm diameter end mill to the spindle and move the cutter to the left hand end on the X axis and to the rear of the rectangle on the Y axis. Position the cutter at least 5mm clear of the milling table and clamp the spindle. Machine the end face on the Y axis, feeding the work towards the machine column. Remove only sufficient to produce a continuous cut.

When the cut is completed, zero the X axis. Feed the tool clear on the Y axis, to the front of the work piece rectangle and move the work 5mm to the left. Zero the X axis. The spindle is now at the **X axis DATUM**.

Feed the work 249.8mm on the X axis to the left, bringing the cutter to the right-hand end. Clamp the X axis. Feed the work slowly away from the machine column on the Y axis. This will result in the rectangle having two parallel ends, both square to the long datum edge and measuring 244.8 mm in length.

Move the work back to the X axis datum at the left end of the work. Position the work behind the spindle on the Y axis clear of the cutter before moving the work 10 - 15mm to the left on the X axis. Very slowly feed the work out (away from the column) until the rotating cutter **just** marks the front datum edge on the length of brass. Zero the Y axis feed dial before raising the cutter clear of the work. Move the work 5mm out. Zero the Y axis feed dial. The spindle is now at the **Y axis DATUM** on the brass rectangle.

Using the table of coordinates overleaf, move the spindle 4mm to the right on

Fig 46

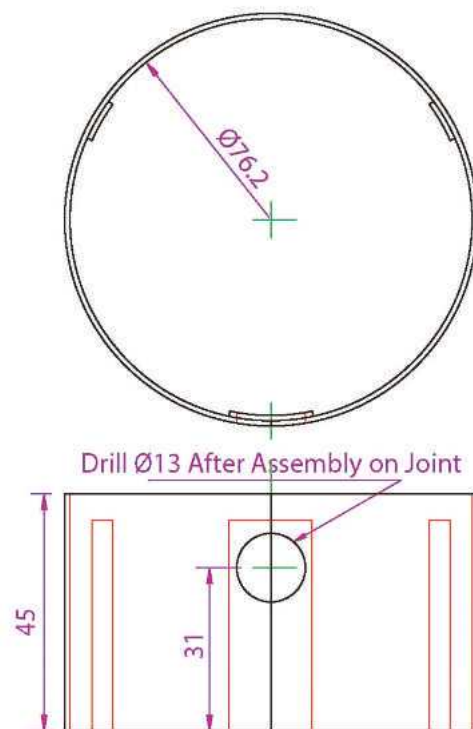


Fig 46 - Firebox



Drilling firebox completed.

the X axis. Centre drill and drill 1.6mm diameter at the two Y axis coordinates of 8mm and 32mm as listed in **table 5**.

Continue down the listed X axis coordinates centre drilling and drilling the sizes indicated at the Y axis coordinates given until the 24 holes have been completed (**photo 98**).

Remove and deburr all holes and edges on both sides of the rectangle. Scribe two lines from the long datum to contact the central 16mm diameter hole tangentially. (*Tangential = A straight line just touching the outside of a circle.*). Saw away the waste, cutting between the lines, and file the edges of the slot back to the line. Chamfer the straight edges of the slot.

Forming the firebox shell

A simple wooden former either from hardwood or multiple thicknesses of plywood glued together 76.2mm diameter by 35 to 45mm long is required initially to form and later to

true the firebox after it has been silver soldered. Use the same procedure of holding the blank against the chuck jaws with a running centre put through a 8mm washer to prevent it forcing too far into the wood as you did for previous formers.

In a vice with soft jaws fitted, grip the blank against the former with about 15mm protruding to the right of the vice jaw. Starting as close to the former as you can, bring the end round against the former using the soft faced

Table 5				
Firebox hole coordinates	Y	Y	Y	Y
	8	17	32	42.25
X 4	Ø1.6		Ø1.6	
X 15.4		Ø11		
X 32.4	Ø3.2			
X 40.4				Ø3.2
X 45.4		Ø11		
X 75.4		Ø11		
X 87.4	Ø1.6		Ø1.6	
X 105.4	Ø3.2	Ø11		
X 122.4		Ø16		Ø3.2
X 139.4	Ø3.2	Ø11		
X 157.4	Ø1.6		Ø1.6	
X 169.4		Ø11		
X 199.4		Ø11		
X 204.4				Ø3.2
X 212.4	Ø3.2			
X 229.4		Ø11		
X 240.8	Ø1.6		Ø1.6	

hammer. Move the blank so that about 80mm protrudes and repeat (**photo 99**). Turn the strip around and repeat these two stages on the other end (**photo 100**).

Using hand pressure, bring the two rounded ends together and clamp them together between the vice

jaws encouraging the strip to conform with gentle application of the soft faced hammer. Pass a length of soft wire through holes drilled 45.4mm in from each end and tighten until the two ends meet. Put to one side.

●To be continued.



Bending at one end.



Bending at both ends.

No.274

The November issue of Model Engineer's Workshop will bring you the opportunity to take a **FREE six-month trial** of Alibre Atom3D.

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MODEL ENGINEERS' WORKSHOP



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The Southern Federation Rally 2018

Tim Coles reports from this year's rally, held in Cambridge on the 7th and 8th of September.



Tom Parham's prize-winning Jinty tank, based on the design by Martin Evans, with extra added detail.

For those who are not aware, the Southern Federation of Model Engineering Societies boasts some 223 affiliated clubs and societies, mostly in the UK. The combined membership of these organisations totals an impressive 20,353 people. In the past, the federation has held more than one rally

in the year but interest has waned with increasing travel costs and now a single event is held each year. Cambridge and District Model Engineering Society Ltd was pleased to be asked if they would host the prestigious SF rally this year.

Preparations for the rally started some months before the due date, with a special sub-committee holding regular meetings under the very able chairmanship of CADMES operations manager Colin Bell. Amongst other preparations, the club house was refurbished by an enthusiastic team, led by Dr. Helen Hale. The site was generally tidied up by the membership, though special effort was put in by the Clarke family, Peter, Andrew and Graham. Colin Bell arranged for a large marquee to be erected in order to house an exhibition of work produced by CADMES members and various gazebos were set up to house the visiting locomotive

registration desk, the club barbecue and the musical entertainment.

Some five caravans took up the offer of accommodation and set on the newly-acquired strip of land along the southern edge of the site. Overall, there were some 17 visiting locomotives and one traction engine, accompanied by a total of 60 visitors. An amazing 21 clubs were represented, travelling from as far away as Leeds, Southampton, Romney Marsh, and Oxford.

One traditional aspect of the rally is the awarding of the Australia Trophy for the model locomotive judged to best represent a commonwealth prototype steam locomotive. This is judged by a team of three; a member of the SF committee, the previous winner and someone nominated from the host club. In this case, the host club member was



A farm stationary engine, one of John Taylor's collection of esoteric I/C engines (photo by Norman Wells).



The visiting traction engine having a run around the site (photo by Norman Wells).



Cambridge club member Paul Rushmer bravely took his diminutive 08 shunter around the 3½ inch gauge sections of the track (photo by Norman Wells).



A general view of the station area with a variety of trains in action (photo by Norman Wells).



A visiting saddle tank sits on the high-level steaming bay with the station area in the background. There's a Sweet Pea somewhere under there (photo by Dr. Helen Hale)!



The magnificent model of the Cambridge sewage pumping engine built by CADMES member Don Unwin and kindly exhibited by the Cambridge Museum of Science and Technology (photo by Dr. Helen Hale).



The steaming bay filled with happy visitors and their engines (photo by Dr. Helen Hale).



Another of John Taylor's models, which looks rather like a steam engine but is in fact I/C (photo by Dr. Helen Hale).

Tim Coles. Tim is well-known for his working model of the gas turbine locomotive GT3 and as a founding member of GL5. Although, like many such competitions, the decision was difficult, the judges unanimously awarded the cup to Tom Parham for his excellent 5 inch gauge Jinty 3F tank. They went on to make a special CADMES award for best club exhibit to John Taylor, for his collection of finely-engineered but little-known IC engine models. The award for the furthest travelled visitors went to John and Lyn Taylor, who came all the way from Leeds.

The weather early on the morning of the rally was drizzly but this quickly dried up and the rest of the day was fine. This gave the visiting locomotives a good chance to run around the kilometre or so of ground-level 7¼ and 5 inch gauge track, part of which also caters for 3½ inch gauge. The four acre site of the Cambridge club is partly-wooded and provides an interesting run

with modest gradients to tackle. Tea and coffee were available throughout the day and lunch took the form of a barbecue manned by club members Dave Wright and Peter Penfold.

Towards the end of the afternoon there was a prize-giving ceremony with (happily brief!) speeches from the SF committee, including vice-president Ivan Hurst, vice-chairman Mike Chrisp and President Brent Hudson who, incidentally, is a long-standing member of CADMES. Musical entertainment was provided during the day by Simon Holmes, supported by a lot of electrical gizmos! In the evening, there was a party in the marque, with fish-and-chips provided from a van on site. Some visitors stayed on into Sunday and two of them were persuaded to act as guards during the afternoon's public running!

There was much praise for CADMES from the SF committee, who attended. Indeed, they declared that



Tom Parham receives the Australia Trophy from SF President Brent Hudson (photo by Dr. Helen Hale).



Colin Bell, the rally organiser on behalf of CADMES, presents the prize for the furthest travelled visitors, John and Lyn Taylor from Leeds (photo by Dr. Helen Hale).

this SF rally was the best for some years and that the Cambridge club, and especially the organising committee, had done a great job. The

Cambridge and District Model Engineering Society Ltd can be rightly proud of such a great event.

ME

A 7¼ Inch Gauge Riding Trolley

PART 7

Jon Edney makes a riding trolley for his garden railway.



Continued from p.561
M.E. 4597, 12 October 2018

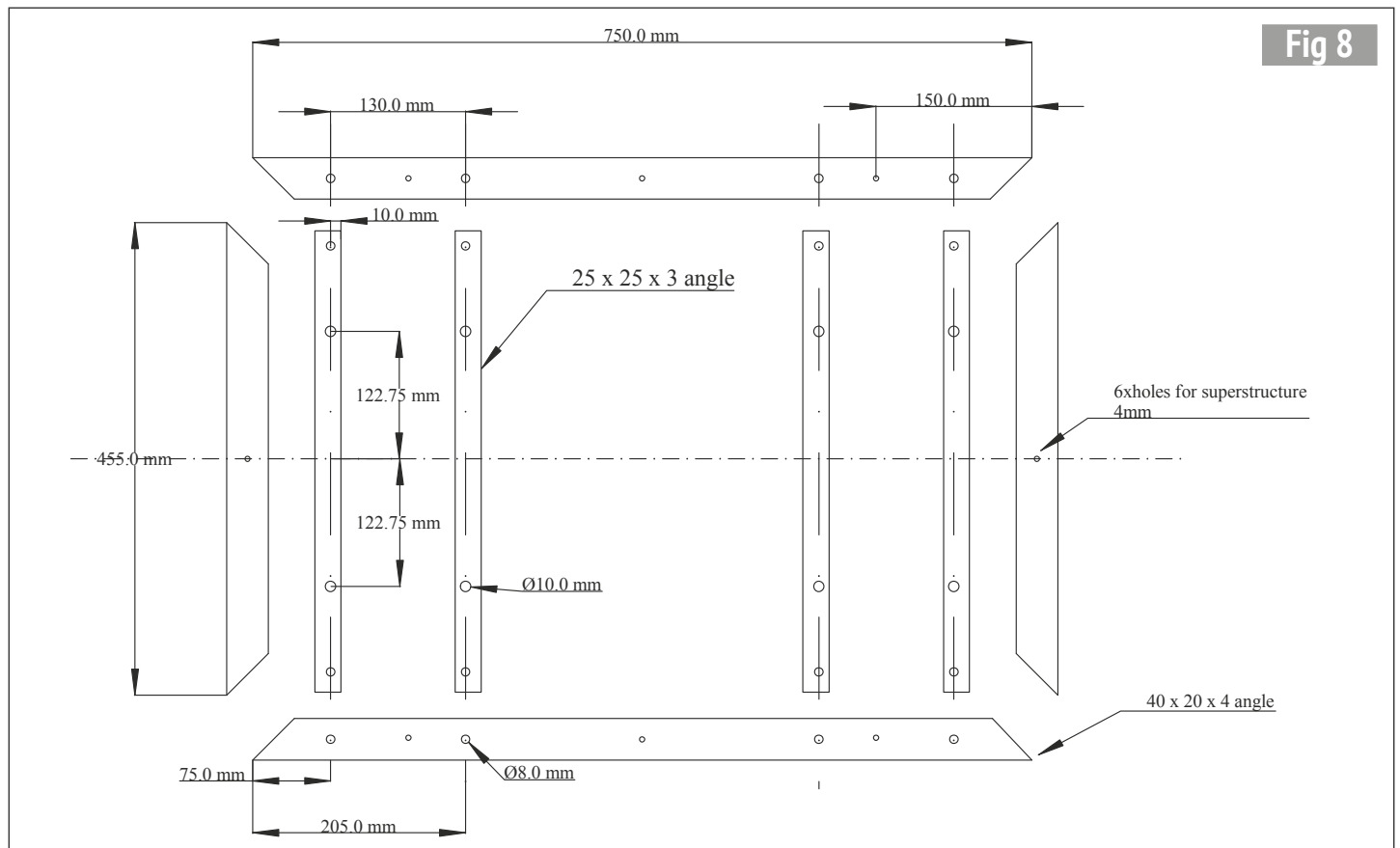


A wonderful way to spend a Sunday afternoon.

The main frame supports the suspension units and provides a flat mounting for the superstructure. It is very simple both in design and construction providing

you have basic arc welding skills. The plan of the frame components is shown in **fig 8**. When I made the first of these trucks I had no idea what size to make it so I just guessed the

dimensions making it 455mm wide (about 18 inches) and 750mm long. My own track at home has no limitations on loading gauge but I think these dimensions are fine for most



tracks. I haven't really found any guidance online. Obviously, it would be simple to change for your own requirements. My track has some sharp bends (6m radius) so I didn't want too long a wheelbase. In practice this size seems to have worked well for my needs.

The frame

The structure of the frame comes from fairly hefty 4mm hot rolled angle steel 40 x 20mm. The corners are simply cut at 45 degrees and butt welded. If done properly this provides a very strong and fairly rigid frame. Cross members 25 x 25 x 3mm are bolted across the frame and the suspension units are bolted on to these to provide the correct gauge. Finally, the wooden superstructure is screwed on to the frame and is easily removed.

The first step in construction is to cut out the four pieces of angle iron to the correct length. I don't have a power hacksaw and was not enthusiastic about cutting 4mm angle with a manual hacksaw so I cut the pieces using a 1mm thick disk in an angle grinder (**photo 33**). I did this free hand which means the results are not exactly accurate but I found it good enough for welded joints. You may have a more accurate way to make the cuts or more patience with a hacksaw! At this stage I also ground chamfers on all the edges that would be mated for welding to ensure deeper weld penetration that could be ground flush after cooling.

I now drilled 3mm pilot holes at all the locations shown on the plan. Because the welding is relatively inaccurate the 8mm cross member holes will need to be spotted through to the suspension support bars and this will be easier with a smaller hole.

I have never had any training for welding but back in the late 1970's I needed to keep my car, a Triumph Herald, on the road so I bought a £50 arc welder via



Precision cutting of the four main frame members.



'Exchange & Mart' and learned by trial and error. That same old welder came into its own two years ago when I built my track using steel bar rail welded to 3mm cross ties - over 5,000 welds in total. To make the track I built an 8ft long table out of sheet OSB with plenty of four inch holes for clamps. I used this to make the 38 sections of track including a switch unit. This table is very useful for welding jobs like this.

To make the frame I clamped the four pieces upside-down on the table, ensuring square corners. I then tack welded the inner corners, removed the clamps and turned the frame right way up to weld the top joint and outer edges. The chamfer, ground on the edges earlier, ensured a nice groove to weld into. Once cooled, chipped and brushed I used the angle grinder to level the welded joints and clean up generally. The welded frame along with four suspension support bars is shown in **photo 34**.

The remaining construction steps for the frame are straightforward. I bolted the suspension units to the support bars before attaching the bars to the frame. This allows them to be correctly



The parts of the frame laid out before assembly.



On the rails.

Assembled, with the wheel sets fitted.

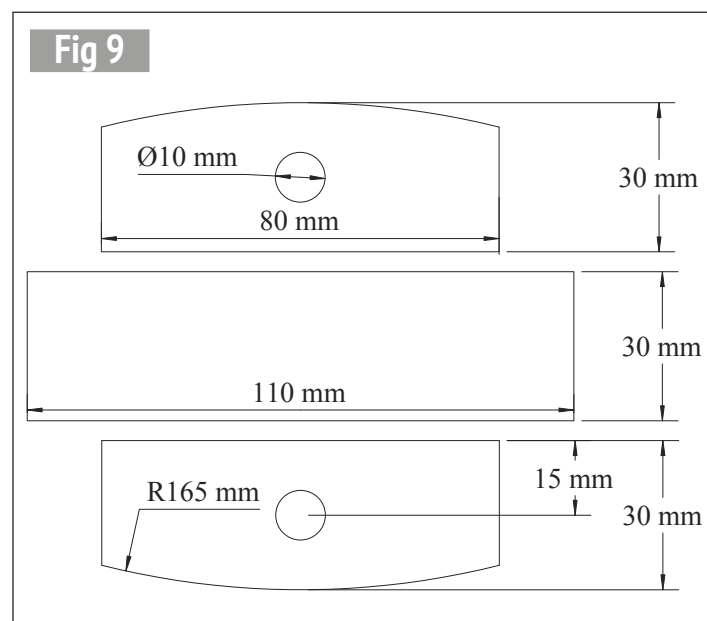
positioned with the specified spacing prior to spotting through the pilot holes in the frame and drilling the 8mm holes to complete the assembly with Nyloc nuts. The completed frame is shown in **photo 35** and on the rails in **photo 36**.

The coupling block

The truck needs couplings to connect to adjacent stock. I used a pair of plates with a 10mm hole so that a metal tie can be inserted and secured in the conventional manner with a vertical pin retained by an 'R'

clip. This is then mounted at the height specified in the 7¼ inch gauge specification. The coupling is made from three pieces of 6mm thick steel; the back plate and the two horizontal plates as shown in **fig 9**.

The two horizontal plates are curved. This is really cosmetic unless the joining tie is very short indeed. However, I feel this curve is really needed to give a good appearance. The problem is how to cut that curve? The first time I did this I made a jig with a pivoting arm. The plate was screwed on



to the arm so that it could be mounted on the milling table and moved against the milling cutter. I learnt very quickly how much force a milling cutter exerts and realised that it would not be safe or practical to move the arm while the cutter was rotating. I had to clamp the arm and move it a little bit at a time taking light cuts. It took ages.

I didn't fancy going through this again so I decided to try out, for the first time, a laser cutting supplier. I exported the plan from TurboCAD in a document exchange format (DXF) and emailed it to LaserMaster Ltd. for a quote (other suppliers are available). Not cheap – but not too expensive considering the saving in time and effort – and within a week I had the component parts accurately and cleanly cut (**photo 37**). They even cut out the holes



The laser cut parts for the coupling block.

Stages in the assembly of the coupling block.

which I had set for 9mm diameter so that I could drill out to 10mm easily. In fact, I had several sets made to use in future trucks and projects since a significant part of the cost is setting up the job.

To assemble the coupling I clamped one curved plate flush with the top of the back plate and tack welded the ends. After removing the clamp, I welded the whole joint along the bottom edge

of the curved plate. I then bolted on the bottom curved plate with a 6mm spacer to ensure that the holes lined up. After tack welding the bottom corners, I removed the bolt and spacer and welded along the bottom join. Three couplings in different stages of welding are shown in **photo 38**. This approach leaves the top edge clean and neat. The bottom edge of both curved plates is welded and quite

rough but it not visible when mounted. Don't forget to drill the mounting holes in the back plate before welding!

●To be continued.



In the next instalment we will add the superstructure to complete the riding trolley.

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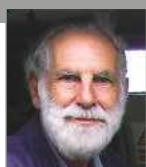
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A 1/3 Scale GWR Swindon 8 inch Water Crane

PART 2

Canon Roger Davis felt that there must be better ways of watering a locomotive than sticking a piece of old hosepipe into the tank and decided to do something about it.



Continued from p.559
M.E. 4597, 12 October 2018



General view of water crane.

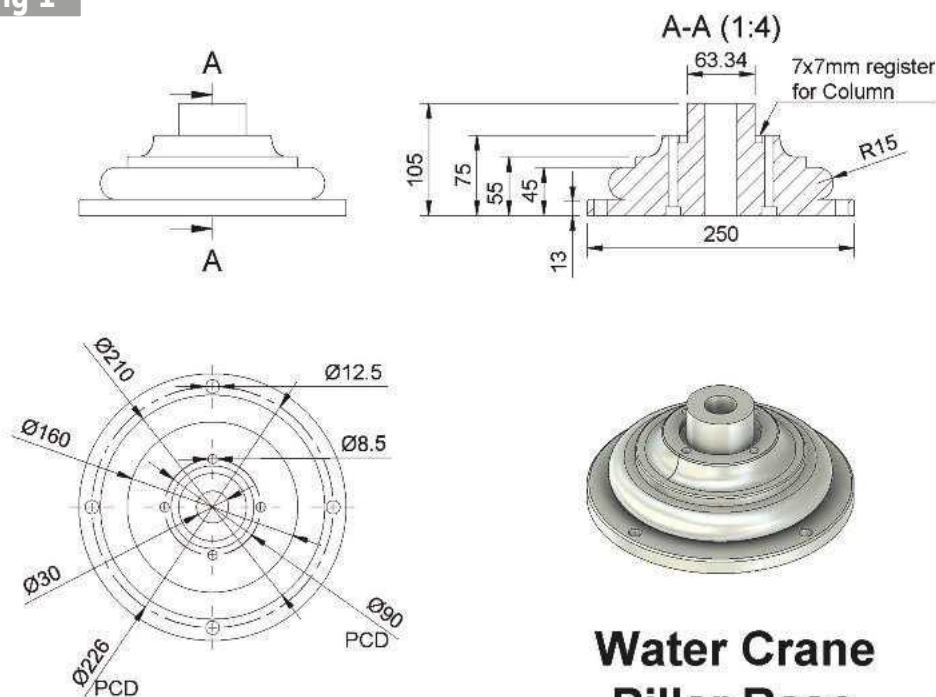
The Column, base and capital (figs 1, 2 and 3)

The first item to be tackled was the tapered column. Measuring over 1000mm this

item required a somewhat longer lathe than that found in most domestic workshops – mine, certainly. Fortunately, the Bath & West Railway, owned

and run by East Sussex SMEE, has a well-equipped workshop including a Harrison v350 lathe capable of accommodating over 48 inches between centres. Careful examination of the Swindon drawings showed an original taper of 2 inches over 10 feet 9 inches (1 degree included angle). This equated to a set-over of the tail stock of 8.4mm for turning the model column between centres. The stock is a tube so the top end of the column at the tailstock required a top-hat centre to be made and press fitted into that end (**photo 5**). To drive the work piece a centring plate with split collar to clamp the tube's outer diameter was made with a slot for a drive pin to engage with the Camlock back plate (**photo 6**). The taper was turned with a succession of cuts but leaving a short section (approximately 90mm) at full diameter to be turned later to give the top end

Fig 1



Taper turning - top hat and tailstock revolving centre.

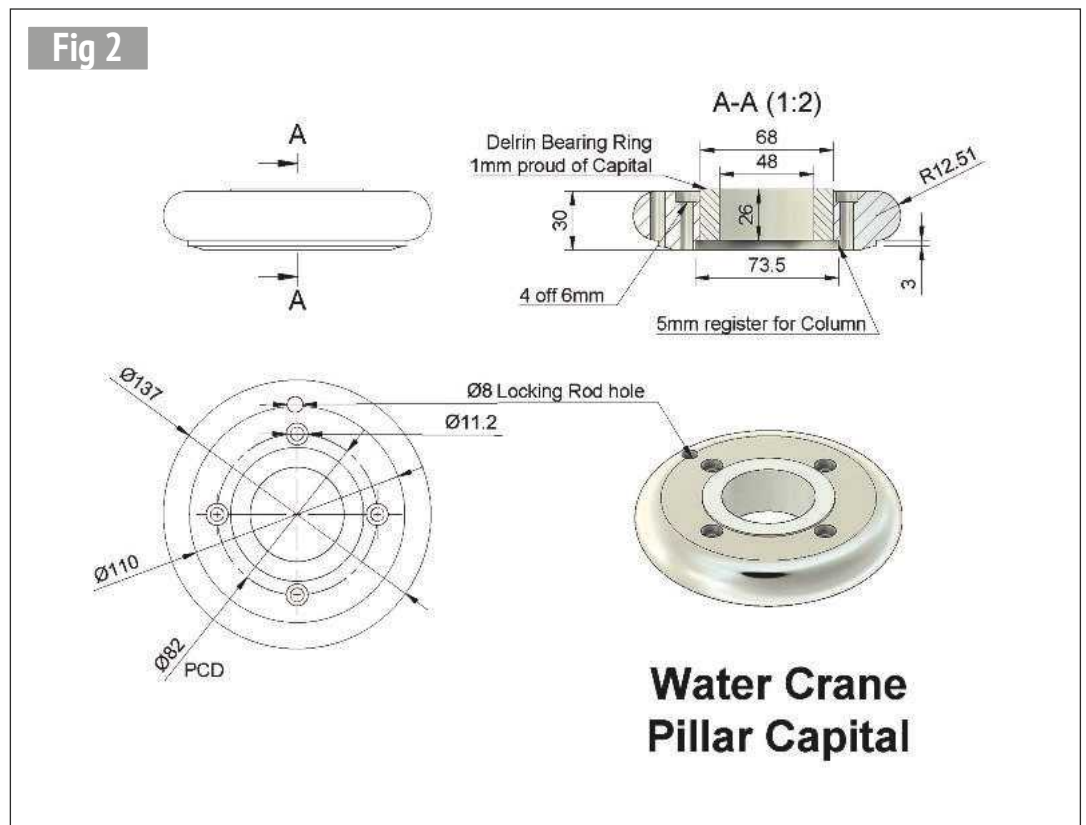


Taper turning between centres - driven clamp plate for workpiece.

decorative detail and the blend into the capital. (This latter work would be done, of course, with the set-over of the tail stock removed.) The column was then turned end-for-end to allow final finishing of the bottom of the column with its 7 x 7mm register ready for fitting to the decorative base (**photo 7**).

My own workshop is equipped with a Warco GH750 lathe fitted with digital readouts which was more than adequate for all remaining machining operations. The 300mm diameter aluminium slab for the crane base was mounted directly onto the 11 inch diameter face plate using tapped holes where eventually the crane mounting bolts would go (**photo 8**). This was a straightforward turning operation with the decorative detail done by eye using the ever reliable Greenwood Tools parting tool insert for roughing out, by steps, the concave and convex profiles and finally finishing with the GT button tool. The central hole, ultimately for the 28mm water supply pipe, was drilled and bored to 30mm (**photo 9**).

It was a similar turning operation to make the column capital with the addition of a rebate on the top face in which to fit the Delrin bearing ring (1mm proud) (**photo 10**). The crane head unit would turn on



Final turning between centres of column.



Rough profiling of pillar base.



Pillar base boring for water feed pipe.



Pillar capital with Delrin upper bearing ring.



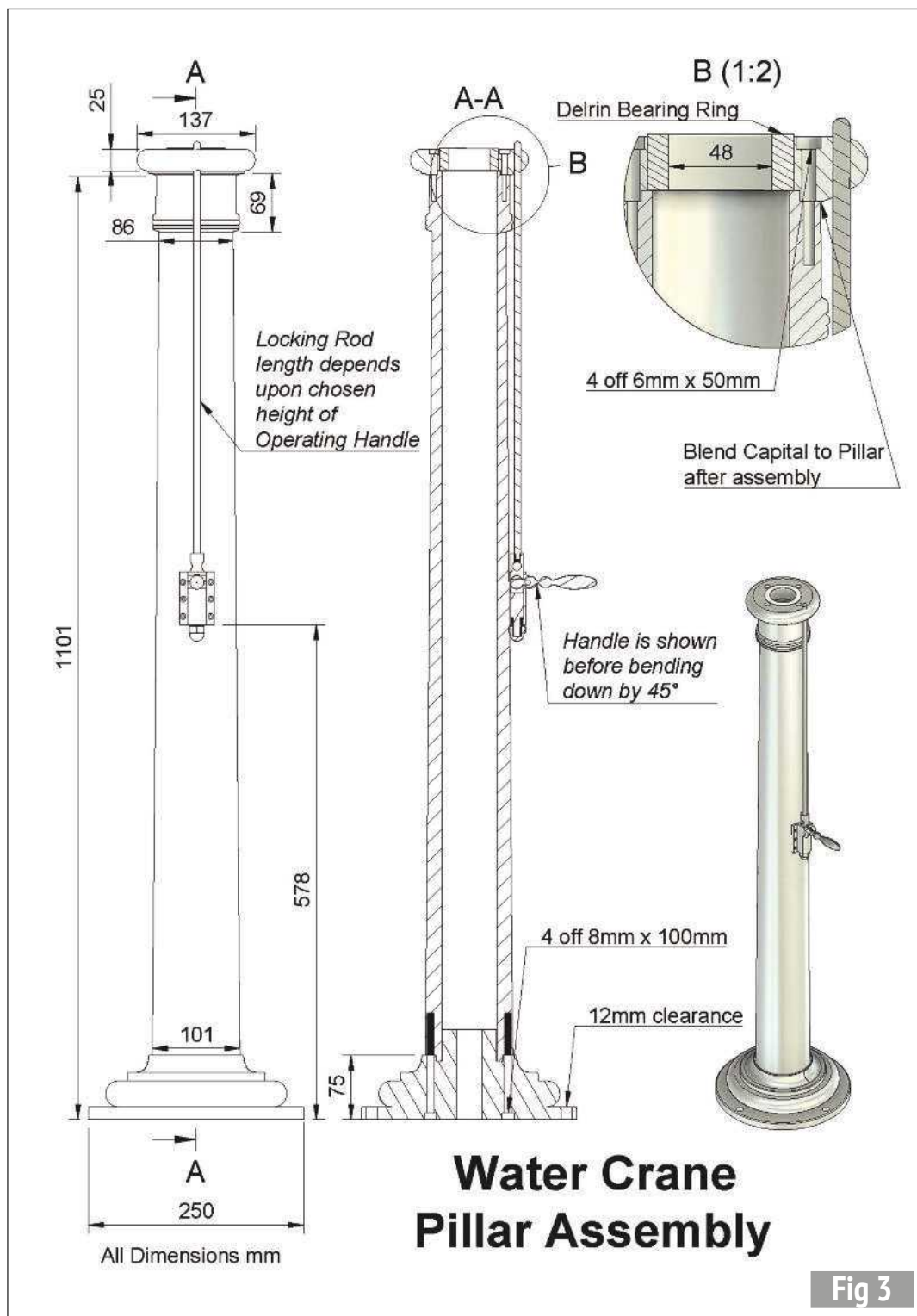
Overwhelming aluminium swarf!



Final blending of column to capital and upper column decoration.



Assembled Water Crane pillar.



this with a matching brass ring. The Delrin ring was also bored to 48mm to act as the upper bearing for the 48mm stainless steel tube that was to act as both pivot and water delivery pipe. A 5 x 5mm register for the column was turned on the bottom face. The only problem in my very cramped cellar workshop was the immense amount of curly aluminium swarf that these and other operations produced; at times they threatened to overwhelm both machine and machinist (**photo 11**)!

Four counterbored 6mm holes were drilled on an 82mm PCD for fixing the capital to the column. These were used as guides to drill the column for matching threaded holes. With the capital fixed in place it was back to the Harrison lathe for the final contouring between centres of the decorative details of the upper end of the column and blending it into the capital (**photo 12**). The base was bolted to the column in a similar manner with four counterbored 8 x 100mm bolts on a 90mm PCD. The assembled column can be seen in **photo 13**.

●To be continued.

A Diversion into Rotary Broaching

PART 2

Ray Griffin describes his construction of a rotary broach from a kit of parts and continues his paean to the almighty DRO.



Continued from p.579
M.E. 4597, 12 October 2018

Magic moments with a DRO

The diameter of the work had to be reduced to 0.787 inch and I had my first moment of delight with the DRO. Fine cuts were taken until it was clear that the surface was running true. I stopped the spindle and measured the diameter of the work. I then subtracted the diameter required i.e. 0.787 inch from my measured diameter to show the amount to remove.

The X readout was set to zero and I reduced the diameter in increments until the readout showed 0.005 inch above the required size. The work was stopped, measured and found to be 0.005 inch above size. It was a simple matter to remove two cuts of 0.002 inch then one of 0.001 inch to give the required diameter. At that moment I was converted to complete faith in DRO readings. Before that, I would have arrived at the desired diameter but it would have taken longer, been less sure, and needed several stops and remeasures to get there. The vagaries of working between graduations on the dial are a thing of the past.

I noted the same benefit when cutting the thread. An M20 x 0.5mm pitch thread is detailed on the plan, with Imperial alternatives. I chose the 55° angle for the thread at 52TPI. The choice was governed by my external screw cutting tool obtained from Greenwood Tools which uses inserts of 55°. The screw cutting tool was placed at 90° to the work and advanced until it was just touching the surface. I normally coat the

surface of the work with a blue marker pen, as this instantly shows when the tool touches.

The X readout was set to zero and I checked that the readout indicated distance travelled as I had to cut the thread to a depth of 0.0155 inch. The tool was moved just past the end of the bar and advanced 0.005 inch. The leadscrew was engaged and a trial cut made. My machine has a jog function which allows me to start the motor at a slow speed and stop rapidly, in both forward and reverse modes. I find this a real bonus when screw cutting, as I feel in complete control.

When sufficient thread had been cut, the motor was stopped, the tool withdrawn to a position past zero (remember backlash), reverse was selected and the tool run back to the starting position with the leadscrew engaged. In my early days with this tool, I made the mistake of leaving the insert in the advanced position, imagining that the tool would follow the primitive thread. This was a grave mistake and led to broken inserts before I realised my error. The tool was returned to the plus 0.005 inch position and 0.003 inch added. The process was repeated until within 0.005 inch of the final size when finer cuts were made to completion.

The centre was hollowed with a boring tool to a depth of 0.5mm, forming a ring to contact the outer race of the outer bearing. It remained to drill two 1.6mm holes at 14mm apart - providing a means to tighten the ring to the body and part the ring from the



The shank.

stock using a parting tool. My Q-cut tool from Greenwood tools never disappoints on a job such as this.

Making the shank

The shank (**photo 8**), made from the 1 inch diameter FCMS supplied, was next on the list. This commenced as a straight forward turning activity to create a 32mm x 10mm shaft to grip the tool in use. This was parted from the stock leaving 8mm of the larger diameter attached. The work was removed from the chuck and held by the new shaft. As usual, I used ER collets to hold the work to avoid marking the shaft with chuck jaws. The larger diameter was then faced down to 6.5mm in length.

The plan calls for a 4mm wide slot 0.5mm deep crossing the exact centre of the face. My Quickstep tool post milling attachment set at centre height made light work of this, without removing the work from the lathe. Two holes of 3.5mm diameter were drilled 16.5mm apart, also using the Quickstep. The slot and holes can also be accomplished with a milling machine, if care is taken to ensure that the slot is central. Two 6mm diameter

counterbores 4mm deep on the opposite side to the slot were then made. I later came to regret following the plan and including these counterbores, as I will explain later.

Making the body

The body, the piece that posed a good test of my new DRO was next on the list. The six changes of internal diameter included a thread and looked interesting. The internal diameters to accommodate the bearings need to be a close sliding fit on the outer races. A press fit is not required but, on the other hand, the bearing should not be slack. The depths of the lands also needed careful control.

I started by gripping the piece of 1 inch FCMS provided in an ER collet, with 35mm protruding. The end was faced and a centre made with a spotting drill. The outside was then turned to a diameter of 24.5mm for the length of the bar. Internal work commenced by drilling with increasing larger drills to provide a final diameter of 9mm for a depth of 35mm. A boring bar was used to enlarge the hole to a diameter of 11mm and a depth of 25mm.

The DRO now showed its strength. The boring bar was touched on the outer end of the bar and the carriage location set to zero. The tip of the tool was then introduced into the end of hole and, with the work rotating at a slow speed and careful manipulation of the cross slide, brought into contact with the bore. The cross-slide indicator was set to zero. So, I now had my two zero

parameters set. The hole was bored to a final diameter of 11mm and a depth of 25mm, to fit the smaller radial bearing.

Still being a bit sceptical about the DRO (Nooo! - Ed.) I stopped boring slightly below 11mm and did a trial fit with the bearing. As expected, more boring was required. As I now advance the tool in 0.005mm increments with confidence, it was easy to bore to a perfect fit. Cutting in such small increments is perfectly possible. The guidelines are - fine cuts with a sharp cutting tool. I like carbide tipped boring tools for this work, as they can be honed to a very sharp, mirror finish edge. Mine were supplied by Arrand but others are available. The lathe also needs to be set up so that there are no shaky slides.

The bore was then opened to a diameter of 18mm to a depth of 21.3mm. It was important to ensure that the bottom surface was flat as it forms the seat for the thrust bearing. Further boring was needed to expand the diameter to 19mm to a depth of 9mm, to fit the outer radial bearing.

Finally, a thread 3mm long was cut 55° x 52TPI for the locking ring, with a slightly larger diameter between the thread and the outer race of the bearing for clearance. The large bearing was located on its seat and the locking ring tightened. I found that circlip pliers fitted into the two holes useful for this.

The end of the locking ring was then faced to just prominent from the body. A parting tool was used to part the body from the stock leaving the body at just over

31mm. The body was reversed in the collet and finished to a length of 30.8mm then put on one side, so that the spindle could be made.

The spindle

This was turning work on a length of 7/8 inch diameter FCMS held in a collet (**photo 9**). The diameter was reduced to 17.6mm for a length of just over 30mm. The end was faced, centre drilled and a centre in the tailstock brought up for support. A 6.5mm section of the middle was left at 17.6mm with two reduced diameters on each side to accommodate the bearings.

When using a tailstock centre with my Myford, I find movement of the carriage very restricted due the proximity of the tailstock. To my mind, rigidity of the work is best preserved if the barrel of the tailstock is not extended more than 20-30mm out of the body. In this tight space, I find that the Piddington extended tool holder from Myford, coupled with a turning and profile tool using inserts with 55° corners, allows turning of small diameters close to the tailstock centre. Cutting towards the headstock is space limited on this spindle, so the extended tool holder and fine turning tool were invaluable.

The portion of spindle nearest the tailstock was turned to a diameter of 10mm for a close sliding fit in the larger outer bearing, together with a small land 0.5mm high and 12mm in diameter to support the inner race of the bearing. The reduced diameters at the headstock side of 10mm for the thrust bearing and 7mm for the small radial bearing were easier as there is more space for cutting tools. I used a Q-Cut parting tool to remove most of the excess metal and then a left-hand turning tool to reach final dimensions.

Final sizing of these diameters presented a dilemma. They must closely fit the bearings but it is not possible to make trial fits,

as the work is in one piece. Options were available. The first would have been to turn the spindle between centres to optimize concentricity. Fine in theory, but my kit is too big for this small spindle. I opted to finish turn to final dimensions and hope for a close fit. After all, I had developed confidence in the DRO (Aaah! - Ed.) and I have an accurate micrometer.

Once the shaft diameters were finished, the next requirement was the boring of a socket in the end of the shaft to seat broaches. An 8mm diameter hole, 20.3mm deep, with a flat seat is needed. First thought was to drill a hole, 7.9mm diameter and find my 8mm reamer. This is not a good route, as my reamers are all hand reamers and these are slightly reduced in diameter at the starting end, which would result in a tapered socket.

I started by drilling through the spindle with a 4mm drill, forming a hole for a drift in the event of a broach stuck in the socket. The hole was then bored to size using a miniature boring bar purchased at a model engineering exhibition. Progress with boring was monitored with length of ground silver steel, 8mm in diameter included in the kit. A firm sliding fit was required. Before using the silver steel as a test piece, I made a slight chamfer around the end to be used for testing, with a fine file.

Often, cut ends of steel lengths have sharp or ragged ends distorting the true diameter. With the bore to size, the boring bar was traversed to the centre of the hole, at the design depth, to cut a flat surface - again, the DRO earned its keep. The spindle was parted from stock to a length of 30mm. Final work on the item was to drill and tap a 4mm hole, for a grub screw, in the widest part.

Finishing the body

With the spindle sitting on the bench, final work could start on the body. The plan indicated a flat surface on each side 0.5mm deep for the full length. I turned to the



The spindle.



The body.

milling machine for this. The body was laid lengthwise in the vice resting on a length of parallel sided steel, so that one or two millimetres of the work showed above the top of the jaws. I keep a selection of parallels in various widths and thicknesses for this purpose. At first, the jaws were lightly closed on the work, and then the top surface tapped with a wooden mallet, as the jaws were firmly closed. This makes sure that the work is lying flat in the vice.

When doing this type of work, I always clean the flat, inner surfaces of the vice jaws, all sides of the parallel, and the work piece with a piece of clean cotton material. Failure to do this could mean a piece of foreign material raising one end of the job causing non-parallel sides.

Before removing the body from the vice, a 4.2mm hole was drilled in the centre of one flat surface and 12.5mm from the end with the screw. This hole allows access to the grub screw in the spindle.

The next work was on the non-screwed end of the body. Instructions were followed closely, as it seemed important for the correct functioning of the tool. The body was stood upright with the screwed end resting on a flat surface in the milling vice and the jaws lightly closed on the flat sides.

The plan called for the body to be tilted through 1°, so that when it is finally screwed to the shank, it sits like a reduced version of the leaning tower of

Pisa. The method proposed in the instruction sheet showed that a 0.45mm feeler gauge introduced under one edge of the body would provide the necessary tilt. As the vice was tightened the top surface was tapped with a wooden mallet to make sure that it was seated properly. I gave a blue colour to the top surface with large permanent felt tip marker. Light cuts were taken with my 40mm face mill to remove the coated surface. Approaching the end, very light cuts ensured that all blue was removed, while removing as little metal as possible.

A land, 4mm wide and 0.4mm in height, was required across the centre of this now

elliptical surface. It seemed inadvisable to remove the work from the vice for marking out, due to the difficulty of returning it to the same tilted position. My normal method for centring holes under the mill of putting a close-fitting bar in the chuck and moving the table until the bar enters the hole does not work in this instance due to the elliptical shape of the hole.

I chose to use my laser centre end edge finder. The width of the body across the flats was measured as accurately as I could; then placing the laser spot on one edge and traversing the table for one half of my measurement, the body was centralized. I coloured the surface with the blue marker, replaced the laser with a scribe and, lightly touching the surface, scribed a line across the centre. Small dividers with a centre screw, normally found in drawing sets, were set at 2mm and used to scribe a line each side of the centre; setting out the width of the land at 4mm. Taking light cuts with a small end mill, the sides of the land were reduced to a depth of 0.4mm. I became cautious as the scribed line was approached and tested the fit

of the groove in the shank on the land after each cut. It was important to obtain a good sliding fit with no shake.

Final work on the body was to drill and tap two M3 holes on the centre line of the land (**photo 10**). Due to the tilt of the body, each hole had to be displaced 0.7mm from the centre. Following the instruction sheet, which explains this well, I drilled and tapped the hole on the uphill side 0.7mm away from the centre, and the other hole on the downhill side 0.7mm closer to the centre. All parts were cleaned in my ultrasonic cleaner and dried in acetone, prior to assembly. The M3 screws provided locked the shaft to the body and I used circlip pliers in the drilled holes to tighten the locking ring. The final tool, together with a broach, is shown in **photo 11**.

●To be continued.

Next time the newly manufactured broach will be used to cut a square hole.



The finished tool and broach.

Renewing the Raised Track at Bradford MES

Graham Astbury reports on the trials and tribulations of rebuilding their ageing raised track.



Introduction

Bradford Model Engineering Society goes back a long time to 1908 or before, being one of the oldest clubs in the UK and possibly the world. In 1966, the club was forced to move out of its premises in the grounds of an old mill and the then Shipley Council were most helpful in securing a site in Northcliff Woods in Shipley. This was a area of wooded land donated to the people of Shipley by Sir Norman Rae for their recreation. It was, therefore, appropriate that the Club was offered a part of the land to build a raised track in 3½ inch and 5 inch gauges in front of an Edwardian bandstand which was to become our clubhouse. The track was duly built and opened in September 1968 by the then Editor of the *Model Engineer*, Martin Evans. This opening was duly reported in the *Model Engineer* issue of the time (*Model Engineer*, 134, page 1047, 1st November 1968). The track has been in continuous use every year since then with an operating season from Easter to the end of October. After nearly 50 years, it was long past its sell-by date and needed replacing. This is the story of that replacement.

The original track

This track was built using two steel channel sections mounted on their sides as the track base, supported on steel angle 'A' frames set into concrete blocks. The track was fastened to the 'A' frames with roofing bolts through the wooden sleepers, with the rails sitting in chairs



The sample of the proposed new track.

which had been pressed out of galvanized steel sheet and screwed down with wood-screws to the sleepers. This design required annual painting and continual replacement of the sleepers as they rotted. In particular, water tended to be trapped between the sleeper and the steel channel, corroding the top of the channel section and rotting the underside of the sleeper. As this was inaccessible for painting, it was an insidious problem usually only identified when a wooden sleeper obviously required replacing.

After many years, the steel became so corroded in parts that the channels became too thin for continued use and required replacing. Whilst the original imperial sized steel was available, direct replacement was straightforward. However, as metric steel became the norm, it was increasingly difficult to match the old to the new in a seamless fashion.

Although the track was nominally level, it had become apparent that over the years some slight subsidence of about 5 inches had occurred on one of the ends of the oval, leading to a slight rise as the track approached the station. Some saw this as an advantage as it slowed the trains down when requiring to stop at the station – others saw it as a difficulty due to having to 'put the steam on' a little more just before the station with the consequent potential to overshoot. Finally, in 2016 discussions took place with the committee on the necessity of replacing the track and it was agreed that the work of replacing the old track would start at the end of the 2017 running season.

The replacement track proposals

The need to replace the track had been agreed during 2016 and all that remained was to decide on the type of construction of the new

track. Discussions also took place about the possibility of re-routing the track so that it had a folded internal loop within the existing perimeter. The late David Brimacombe prepared some drawings of such a track, which provided an increase in the length of the track from 440 feet to 536 feet. However, since the tightest curve would be considerably less in radius than the existing curves and several club locomotives in 5 inch gauge had occasional difficulties negotiating the existing curves, it was decided that the replacement would be identical in layout to the original track.

The design of the new track was considered carefully as there was, as always, a conflict between a low initial cost with high maintenance and a higher initial cost with lower maintenance costs. As the membership was not getting any younger, it was agreed that the low-maintenance option would be preferred. A number of different styles of track construction were considered and several were tested by David Brimacombe. The construction of the replacement track was then agreed as being a dwarf wall built with concrete blocks laid on their side onto a concrete foundation, with

the track being fastened to plastic sleepers sitting on the top of the blocks. A piece of track as it was proposed was assembled for consideration by the committee. This is shown in **photo 1** with the two sets of rails in place. Note also the stamped-out galvanised steel chairs to hold the rails, secured by stainless steel screws. Our elevated track has always had separate rails for the two gauges as this avoids an offset between 3½ inch gauge locomotive couplings and the driving trolleys.

The issue of expansion of the foundation, the wall and the track was a major consideration at the design stage. Reference was made to British and other design standards so that the design produced would allow for the necessary expected expansion movements. The use of aluminium rails was a particular issue with the expected expansion movement being many times more than that of the underlying structure. So far, the high temperatures of the hot summer of 2018 exceeded the design maximum temperature somewhat, but the track and turntable were still fully functional and the foundations and wall show no signs of movement or distress.



A cement grout is used to prevent the sleeper from moving.

Super-elevation was catered for by lifting the sleepers up using graduated spacers. These would increase in height as the super-elevation was applied, rising to about 16mm at its peak. The cement grouting under and between the sleepers is intended to prevent deformation under both lateral and longitudinal load during running as well as addressing possible vertical deformation. The construction method uses the spacers to set the track at the correct height to achieve the required super elevation, but it is the cement grout which fixes the sleepers in the correct final position (**photo 2**).

This method of track construction was costed out and the committee unanimously drew a sharp intake of breath when

the projected cost was announced. This original cost was done on the basis that the existing aluminium rails were re-used, as almost all of it was in good serviceable condition having been replaced in recent years, and on the basis that half the track would be removed and re-built in each of the winters 2017/18 and 2018/9. Looking at the costs, it was concluded that certain costs were being duplicated by doing the re-build in two halves and a considerable saving on the total cost could be achieved by replacing the whole track in a single winter season. One of the costs that would be saved was the hire of a concrete pump when laying the foundation – the minimum hire period was a day and the foundations



Using the laser alignment tool on the old track.



President Jim Jennings setting out for the last run on the original track.

would take less than this for the whole lot to be laid in one go rather than in two halves in successive seasons. Thus it was unanimously agreed by the committee (agreement at a committee meeting? How unusual!) that the whole track would be replaced over the winter of 2017/8.

The committee appointed committee member David Watts as project manager to oversee the whole job. Although he is not a railway enthusiast, he rapidly became conversant with the requirements of super-elevation and transition curves. He prepared a very comprehensive (and realistic) plan to execute the work which was due to start on the 4th October 2017. Prior to the start of the work, considerable time was spent surveying the old track, with both 'old fashioned' traditional dumpy levels and with laser sighting, to establish levels and reference points which would be used at a later stage to set out the new track.

The turntable had been re-built in 2008, so it was decided that since it was in good condition it would be retained along with the existing steaming bays so reducing the cost without sacrificing quality. However, the decision to retain the existing turntable effectively

imposed a fixed point which the new track had to meet perfectly in terms of both level and line so the accuracy of these surveys and of the fixed references so established was vital to successful subsequent setting out (**photo 3**). Form-work for casting a new station area slab was put in place during the surveying so as to align with the turntable. Finally, on the 30th September, members arrived for the last run on the old track (**photo 4**).

In the clubhouse workshop, the sleepers had been delivered in 2.4 metre lengths and were being cut to length by a chop saw – around 1,500 of them. Slowly, members were being lost behind the piles of sleepers accumulating in the workshop. Also in the workshop the steady 'clunk' of the flypress could be heard as the chairs were being pressed. The press tool was made by the late David Brimacombe, who also prepared the track sample. It was indeed sad that he became seriously ill and died at the start of September just before the work started on replacing the track.

The Demolition

The first task was to carefully remove all the aluminium rail by prising up the tabs on the pressed steel chairs and putting it to one side (**photo 5**). The poor state of



The first rails are removed.

the original sleepers and the steelwork forming the track are clearly visible. Once the rails had been salvaged, the remains of the rotting wooden sleepers came off the steelwork relatively quickly. As anti-tipping rails would be required on the rebuilt track, all these existing rails were carefully cut off and cleaned up ready for re-use later (**photo 6**).

All the old steelwork forming the original track supports was removed by cutting off the bolt heads and the steel was cut into lengths which would fit into one member's van so that it could be taken to the scrapyards and weighed in for scrap to offset

the cost of the rebuilding. This left just the 'A' frames set into their concrete bases (**photo 7**). The whole of this demolition took just one day, as there were four teams all working evenly spaced around the track – fortunately, we had the use of four angle grinders, but had to buy some really long extension leads to be able to reach the far side of the track.

● To be continued.



Cutting off the anti-tipping rails for re-use.



Only the 'A' frames remaining.

Next time we start to rebuild the track.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.



I began this missive with only one item in my inbox. It is now the following day, and I have seven. That's the spirit, keep 'em coming!

Firstly, to help Editor Martin, I will explain the habits of the Sheffield '218' bus, covered in ME 4595. From Sheffield, it travels to Chatsworth House, then to Bakewell, only about a mile away. On returning to Sheffield it does not call at Chatsworth. Therefore, those from Sheffield wishing to visit the House disembark there as expected, and after their visit, get on the next bus, travel to Bakewell, stay on the bus and hence return to Sheffield. *Mea culpa*, I could have made it clearer. (Ta! Very kind! – Ed.)

To the doctors on Monday, for a prescription. By the following Friday it had not been received at the chemists so I queried this with the surgery. They confirmed it had been issued, so they rang the chemists, who said they never got it. Technology, eh? A new prescription was issued, which I clasped to my bosom and returned homeward. Debs asked how I got on. "Success, due to charm, persistence and enormous amounts of string" (which I was quietly fashioning into a noose as I queued at the surgery).

By way of a change from spotting wayward apostrophes, or uncocked hand guns on the TV, I noticed the current John Lewis/Waitrose advert, starring two kids in silvery spacesuits. One of them has a multirange meter on his suit, but it only has one lead! It'll never work like that...

Secondly, friend Boris claims that negotiating with the EU is like strapping on a suicide vest and giving the detonator to your opponent. That sounds quite safe to me, since the detonator won't set the explosives off unless it is buried in them, rather than some feet away! (It might take the opponent's eyebrows off though. – Ed.)

In this issue: A matador, points, testing servos, a red flag?, Merlin, steamboats, a small tow truck and an enthusiast.

On the matter of buses, *FirstBus* was having an Open Day on 16th September, at their Olive Grove, Sheffield depôt at ten o'clock in the forenoon. OG is the 2nd biggest bus depôt in the UK, after Glasgow, so I thought it could be interesting. I am particularly interested in their hybrid vehicles. So, I arrived soon after the appointed hour, along with several others, to receive the distinct impression that we were not expected... No workshop tour tickets,



Police van 'hospitality suite'.

vintage bus tour tickets, programmes of events, list of exhibits, or souvenirs were on sale. By about 11.30 they began to appear.

Outside, in the display area, was a varied collection of vintage and modern transport, including a guest from rival, *Stagecoach*, two US police cars and a UK police van with guest accommodation (great sheet metalwork! - **photo 1**) which was crawling with children having a great time with the flashing lights, bull horn and two-tones. Some in-service vehicles appeared brand new, as suggested by the registration and some were decidedly 'tired' - used on the school run, maybe? And, Reader, yes, I met him! There's



Rotherham AEC Matador.



Leyland Comet coach.

always one! The obsessive. A mine of information, which he will release, at length, without request, even as one edged nervously away, pleading a prior appointment, muttering about men and dogs, etc, and wondering about the police van cell...

This Rotherham, AEC Matador rescue truck looked a mighty beast, starting life as a military artillery tractor (photo 2) and there was a range of past liveries. I thought the lined-out cream and blue of Sheffield Tramways was very smart. This Leyland Comet was beautifully finished; the coach version was introduced in 1948 (photo 3). The workshop tour was not so enjoyable as expected, seemingly because of the dreaded H&S. So we couldn't get up close and personal with the mechanical and electrical entrails. If you fancied a trip through a bus washing plant (inside a bus!) you could have one. An experience that not many can claim. Apart from maintenance and collision repairs, there was a specialised MOT area, a bus lift, for when a pit is not required, and two ride-on scrubbing machines ensured the floor was free of oil and dirt.

I didn't do the vintage bus tour, as it lasted two hours, but each one was well occupied. A pleasant day out, proceeds went to local Hospice, St Lukes, and the event commemorated 20 years of support for the hospice from FirstBus. I

picked up James Joyce's *Tramway Heyday* (not THAT James Joyce, nor the one who writes books on learning Irish) - a good book, illustrated in monochrome, many photographs not previously published, and all proceeds were to go to Crich Tramway Museum. Whilst on the subject of vehicles that run in predestinate grooves, I recently acquired *Rails in the Road*, by Oliver Green - a large-format comprehensive history of British and Irish tramways, on glossy paper, well illustrated, which I cannot recommend too highly.

Otago Model Engineering Society, Conrod, September, tells us that activities in the workshop are winding down in preparation for the running season. In six months the next Tether Car Exhibition will be held, and planning has begun. On the scale railway, Stuart



A Wren at Almondell Woods (photo courtesy of Robert McLuckie).

Reid thinks that radio control servos with 'servo exercisers' might be of use as point motors and is to try this out and report back. Kevin Gamble has almost completed his 'Clyde Puffer', modelled on a vessel called *Billy J*. He has given it a trial run but feels it is too fast and is working on slowing it down. (Perhaps it should be preceded by a man in a rowing boat bearing a red flag? - Geoff.) Henry Goosselink was digging a sump in his garage to help with drainage but the hammer drill being used created vibration which caused a shelf to collapse, creating more work! W. www.omes.org.nz

Edinburgh Society of Model Engineers have been invited to take their portable track to Trains on the Prom, at Rothesay Gala, on Bute, after last year's event caused so much interest. An extended track was taken, with van hire assisted by Enterprise, ferry by Caledonian Macbrayne and accommodation by Isle of Bute Trust. This resulted in a video on YouTube and lead

picture in *The Buteman*! Look for 'Rothesay Gala 2018'. Wasn't the weather great? Further photos from their new track are of a *Wren* (photo 4) and this diminutive signal box (photo 5). Robert McLuckie sent further pictures, to be featured later.

W. www.edinburgh-sme.org.uk

PEEMS Newsletter, September, from Pickering Experimental Engineering & Model Society, reveals a forthcoming visit to Parkol Shipyard in Whitby and the Horological Museum near Newark. Mike Sayers has finished his scale Bentley radiator, including drain valves; it has been pressure tested and does not leak. A talk by Ivan Shaw was most interesting and a detailed article describes his activities in aircraft design and building. Ivan wanted his own aircraft but, after 40 years and building 1000 for other people, he still didn't have one. Hence the *Merlin* personal aircraft. One seat, space for a folding bicycle, and folding wings, to fit in a shipping container or



Small signal cabin as above (photo courtesy of Robert McLuckie).

home garage. It will use 4-star petrol, rather than AVGAS at twice the price. The rigidity is such that, evenly laden with sandbags weighing 3900 lbs, wingtip deflection is 60 mm. The talk was followed by a Q&A session.

Jon Williams writes from **Birmingham Society of Model Engineers** to say that they have invited Rugeley ME to visit as they have just lost their track due to redevelopment. A date is yet to be agreed, but probably next spring.

W. www.birmingham sme.com

Graham Copley of **Ottawa Valley Live Steamers & Model Engineers** reminds us of the Montreal Model Train Exposition, now happening as I write. Graham thinks he detects a shift away from the virtual world of social media towards more tangible rewards, suggested by growing criticism of the medium, increasing popularity of libraries and bookshops, the Men in Sheds movement and reports of parents encouraging their children to get their hands dirty and Make Things W. www.trainweb.org/ovlsme

John Pickering writes from **Taunton Model Engineers** to say that their offer to buy the new site has been accepted, subject to the granting of planning permission.

W. www.tauntonme.org.uk

Goodwin Park News, Autumn, from **Plymouth Miniature Steam**, opens with a picture of steam yachts at the Calstock Steamboat Rally. Very pretty. The newsletter Editor, Dave Biss, is a steamboat man, and another boater is a professional cameraman, so watch this - www.youtube.com/watch?v=b2a7oC39COA The track is in need of upgrade and a draft plan has been produced for this winter's work.

W. www.plymouthminiaturesteam.co.uk

Helen Hale and Tim Coles present another fine newsletter, *The Cam*, August, from **Cambridge & District Model Engineering Society**, which was misfiled by your scribe, and for which I apologise. This issue runs to



16mm Wild Aster (photo courtesy of Dave Morley).

25 pages, so here goes... The response to the revamped periodical has been very positive and, indeed, copy for the subsequent issue is already to hand. A new carriage shed is proposed, and an extension to the track, which will enhance an already comprehensive (1km) layout. The forthcoming Southern Federation Rally (see report on page 719 spurred on the decision to refurbish the clubhouse beforehand, decorated in fetching shades of Great Eastern and LNER blue, not forgetting the woodwork, to which was applied the ubiquitous Magnolia. The Garden Railway Day in this case included a 3½ inch gauge ground level track, and Tim brought along two *Tich* models, one made by his late father-in-law and one by Tim himself, his first, with a commercial boiler. They normally reside in glass cases at home. He thought the star guest was Dave Morley's 16mm scale *Wild Aster*, coal fired, with etched plates by Diane Carney (photo 6). Rugby MES was visited in August, with Helen's Class 20. The track is a full mile long and a leisurely circuit can take 30 minutes. The crossword was set by Andrew Astles and readers are invited to send

in their attempts. There are points to be awarded - but what do points mean?

W. www.cambridgemes.co.uk

The Frimley Flyer, September, the Journal of the **Frimley & Ascot Locomotive Club**, opens with a picture of new member, Alan Wray, proving that he is not afraid of the heat and is willing to make the tea! Paul Naylor has a caravan which is increasingly difficult to extract and replace as required, due to advancing age (Paul, not the 'van') so he designed a powered tee-handled two-wheel truck to help him. This reminds me of similar machines used for moving small aircraft. A welding class at the club night with varying degrees of success. There were good attempts, bad attempts and a *Conferromino Horribilis* which I can't thoil to print.

W. www.flmr.org

Kingpin, autumn, from **Nottingham Society of Model & Experimental Engineers**, has a well-illustrated collection of articles covering IMLEC 2018, a visit to the Isle of Man, the 26th 'Sweet Pea' Rally, and an Enthusiasts' Day Out. The enthusiast was 13-year-old Daniel Fisher, who took an early interest in trains and was often seen at Bottesford station. Following a conversation with

a manager of East Midland Trains, Dan was offered a day's experience, covering trains, employees and jobs at EMT. Equipped with hi-viz vest, steel toecapped boots and a free day pass, which enabled him to travel on an HST, Class 222 Meridian, Class 153, 156 and 158, on two of which he was invited into the cab. He was shown workshops, training centres, and a 'vintage' Class 30 double header. A delicious lunch at mid-day was served in a First Class compartment. His guides answered Dan's questions and talked him through his experiences and visits. As his day drew to a close he was asked to make an announcement over the PA system at Market Harborough. He had many more experiences in the day, including being mistaken for an apprentice by former Prime Minister David Cameron! Thanks to everyone at EMT for making Dan's day so memorable.

W. www.nsmee.org.uk

And finally - Wanted, power supply unit designer, must be skilled in electronic design and CPR.

Contact:
geofftheasby@gmail.com

NOVEMBER

- 8 Sutton MEC.** Club night. Contact Paul Harding 0208 2544749.
- 8 Worthing & District SME.** Club meeting – ‘Police Collision Investigations’, Colin O’Neill and Andrew Stark, 7.30pm. Contact Geoff Bashall: 01903 722973.
- 9 Tiverton & District MES.** Club meeting at Old Heathcoat Community Centre, Tiverton, 7.30pm. Contact Chris Catley: 01884 798370.
- 9-11 The International Model Boat Show,** Warwickshire Exhibition Centre. www.modelboatshow.co.uk
- 10 Westland & Yeovil DMES.** Track running day 11am – 4.30pm. Contact Bob Perkins: 07984 931 993.
- 11 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.
- 11 Sutton MEC.** Sunday track day from noon. Contact Paul Harding 0208 2544749.
- 13 Northampton SME.** Talk: ‘Union Pacific Big Boy and Miniature Locos in the USA’ – David Viewing, 7.30pm. Contact: secretary@nsme.co.uk
- 13 Romney Marsh MES.** Members’ social afternoon, 2pm. Contact Adrian Parker: 01303 894187.
- 15 Cardiff MES.** Members’ projects. Contact Rob Matthews: 02920 255000.
- 15 Sutton MEC.** Club night. Contact Paul Harding 0208 2544749.
- 16 Rochdale SMEE.** ‘Gresley P2 Project Mikado 2-8-0’ – Keith

- Crabtree, at Castleton Community Centre, 7.30pm. Contact Rod Hartley 07801 705193.
- 18 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.
- 18 Tiverton & District MES.** Running day at Rackenford track. Contact Bob Evenett: 01884 252691.
- 19 Peterborough SME.** Talk: ‘Journey Man Engineering’ Roger Moseley, 7.30pm. Contact Terry Midgley: 01733 348385.
- 20 Grimsby & Cleethorpes MES.** Monthly meeting, Waltham Windmill, 7.30pm. Contact Dave Smith: 01507 605901.
- 20 Nottingham SMEE.** Talk: ‘7¼ Gauge Guinness Locomotive’ - Cliff Almond. Contact Pete Towle: 0115 987 9865.
- 20 Romney Marsh MES.** Talk: ‘Lines and Circles – an Introduction to CAD’ – John Shrubsole, 7.30pm. Contact Adrian Parker: 01303 894187.
- 21 Leeds SMEE.** Meeting night: ‘Advanced Steam – An Update’ – Nigel Bennett. Contact Geoff Shackleton: 01977 798138.
- 21 Salisbury DMES.** Natter night. Contact Jonathan Maxwell: 01722 320848.
- 22 Sutton MEC.** Talk: ‘Chemicals Part 2’ – Richard Burkett. Contact Paul Harding 0208 2544749.
- 22 Worthing & District SME.** Club meeting – Bits’n’Pieces, 7.30pm. Contact Geoff Bashall: 01903 722973.
- 24 Bradford MES.** Annual exhibition and competition, 12:30

- 6:30pm, Saltaire Methodist Church. Contact: Russ Coppin, 07815 048999.
- 24 Cardiff MES.** Steam up and family day. Contact Rob Matthews: 02920 255000.
- 25 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.
- 27 Romney Marsh MES.** Members’ social afternoon, 2pm. Contact Adrian Parker: 01303 894187.
- 27 Wigan DMES.** Bits & Pieces evening. Contact Kevin Grundy: 01942 522303.
- 29 Cardiff MES.** Talk: ‘Engineering Topics’ – Carl Pickstone. Contact Rob Matthews: 02920 255000.
- 29 Sutton MEC.** Club night. Contact Paul Harding 0208 2544749.

DECEMBER

- 1 Grimsby & Cleethorpes MES.** Public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.
- 1 Tiverton & District MES.** Running day at Rackenford track. Contact Bob Evenett: 01884 252691.
- 2 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.
- 3 Peterborough SME.** Bits & Pieces, 7.30pm. Contact Terry Midgley: 01733 348385.
- 4 Romney Marsh MES.** Talk: ‘Update on the P2’ - Andy Hardy, 7.30pm. Contact Adrian Parker: 01303 894187.
- 5 Brandon DSME.** Meeting at The Ram

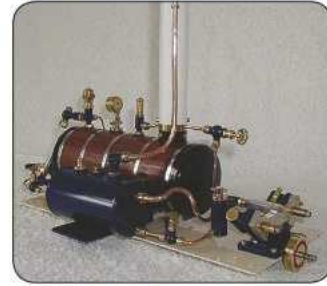
- Hotel, Brandon, 7.45pm. Contact: Mick Wickens, 01842 813707.
- 5 Leeds SMEE.** Christmas dinner at The Owl at Hambleton. Contact Geoff Shackleton: 01977 798138.
- 6 Cardiff MES.** Talk: ‘Confessions of a Private Eye’ – George Braby. Contact Rob Matthews: 02920 255000.
- 6 Sutton MEC.** Bits and Pieces. Contact Paul Harding 0208 2544749.
- 7 North London SME.** Festive gathering. Contact Ian Johnston: 0208 4490693.
- 7 Portsmouth MES.** Club quiz, Tesco Fratton Centre, 7.30pm. Contact Roger Doyle: doyle.roger@sky.com
- 7 Rochdale SMEE.** Auction Night, at Castleton Community Centre, 7.30pm. Contact Rod Hartley 07801 705193.
- 8 Rochdale SMEE.** Santa Special at Springfield Park, 7.30pm. Contact Rod Hartley 07801 705193.
- 8 Romney Marsh MES.** Xmas lunch at the Masonic Hall, Dymchurch, 12.30pm. Contact Adrian Parker: 01303 894187.
- 9 Bradford MES.** Northcliff Santa special, 11am – 3pm, Northcliff track. Contact: Russ Coppin, 07815 048999.
- 9 Cardiff MES.** Santa special. Contact Rob Matthews: 02920 255000.
- 9 Guildford MES.** Christmas Event 11am-3pm. Contact Mike Sleigh: pr@gmes.org.uk
- 9 North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.

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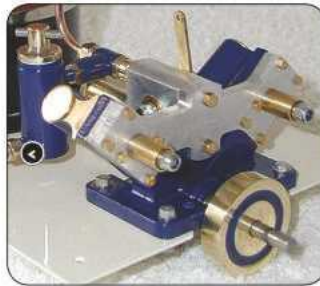
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The illustration shows the "Ribblesdale" boiler mounted on a common bedplate with the "Richmond" twin cylinder steam engine and a steam oil separator. The "Ribblesdale" boiler is constructed from copper components and silver soldered. The boiler is stoved with high temperature paint at 175 degrees C. The boiler is lagged with individual hardwood planks and held by stainless steel bands. To improve the boiler performance it is fitted with a ceramic burner. The finished boiler is pressure tested to 150 psi for continuous working pressure of up to 80 psi. A test certificate is supplied with the boiler confirming the test and guarantee of quality. The boiler is fitted with a water filler bush, pressure gauge, water gauge glass and blowdown valve, safety valve, vacuum valve, steam on/off valve, ceramic gas burner, gas pipe and gas on/off valve. The white/cream stove painted chimney is pre-drilled for the exhaust pipe bracket should you wish to extend the exhaust pipe alongside the chimney.

This plant is priced at £1550



The illustration shows the "Wharfedale" boiler mounted on a common bedplate with the "Richmond" twin cylinder steam engine and a steam oil separator. The boiler can be fitted with either the "Richmond" engine or "York" engine and a steam oil separator. These can be purchased as single items. The "Wharfedale" boiler is constructed from copper components and silver soldered. The boiler is stoved with high temperature paint at 175 degrees C. The boiler is lagged with individual hardwood planks and held by stainless steel bands. To improve the boiler performance it is fitted with a ceramic burner. The finished boiler is pressure tested to 150 psi for continuous working pressure of up to 80 psi. A test certificate is supplied with the boiler confirming the test and guarantee of quality. The boiler is fitted with a water filler bush, pressure gauge, water gauge glass and blowdown valve, safety valve, vacuum valve, steam on/off valve, ceramic gas burner, gas pipe and gas on/off valve. The white/cream stove painted chimney is pre-drilled for the exhaust pipe bracket should you wish to extend the exhaust pipe alongside the chimney and also includes a polished brass flared top. This plant is suitable for installation in all my boat products with ample power to drive your boat satisfactory.

The price for this model delivered by UPS within the UK is £1550. Please contact us to discuss delivery, based upon your requirements. You can now place a reservation on payment of £100. The balance of the purchase to be paid upon notification that the model is now ready for despatch.



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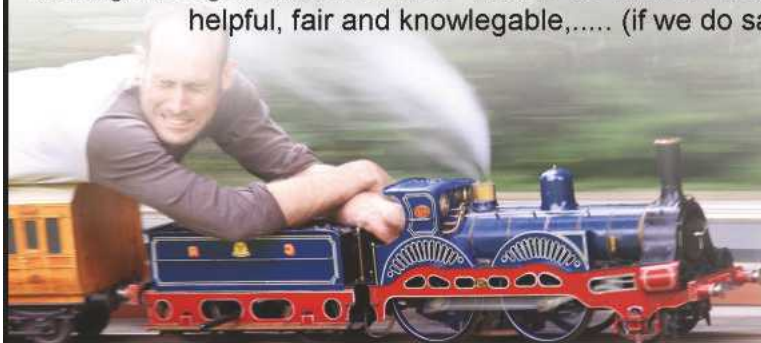


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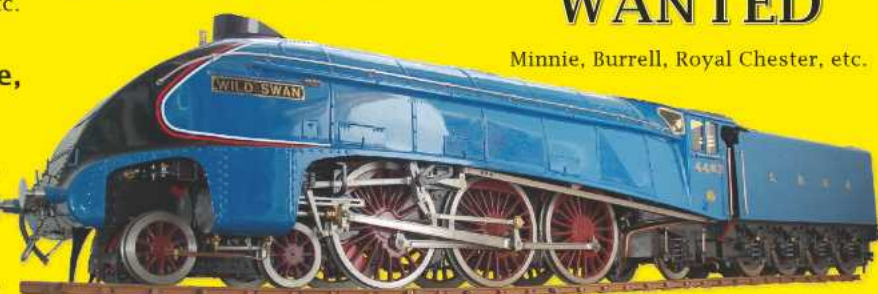


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