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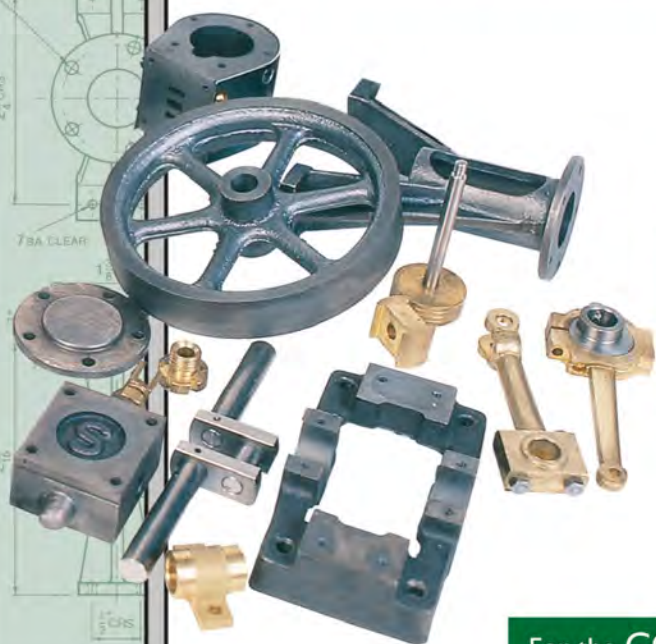
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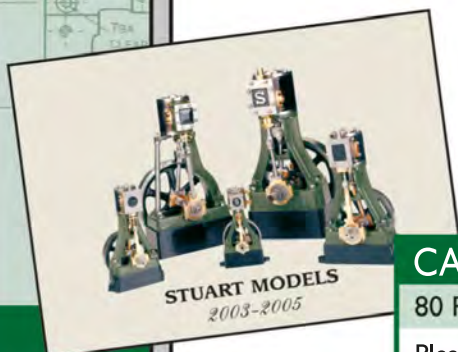
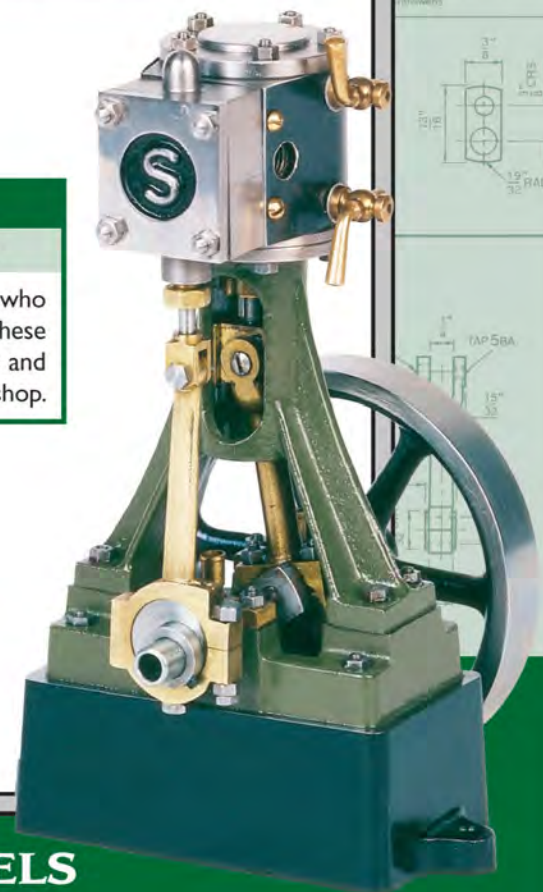
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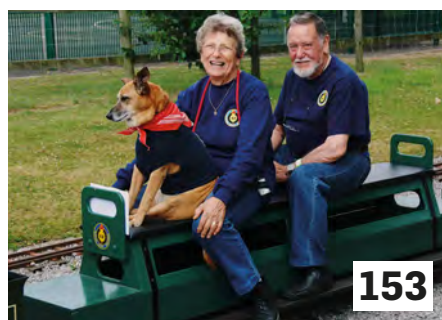
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FRONT COVER

The front cover shows Mr Jan Huijgen, from The Netherlands, with the cylinder block and motion bracket from his 3" Fowler road locomotive.
Photograph: Edward George

EDITORIAL

AXES TO GRIND

Martin Gearing's introductory article on the EIM Steam Plant (last month's EIM) has prompted a communication from David Wood making some very pertinent points about axis conventions for milling machines. The resulting discussion has led to a minor correction to the article which appears on page 180. All of this has made me realise that this is not such a straight-forward issue.

Let's consider the three machines I'm most familiar with. The first is a Myford VMC machine. Increasing the reading on the Y-axis handle (cranking it clockwise) moves the table away, which is equivalent to moving the tool in the Y- direction. Increasing the reading on the Z-axis handle (the 'knee') moves the table up, effectively moving the tool in the Z- direction. These are both opposite to the 'CNC convention'. The X-axis doesn't count as there is a handle at each end and the dial readings go in opposite directions – so you can take your pick. The CNC machine I sometimes use at my evening class is consistent with the 'CNC convention' – increasing readings indicating tool movements in the positive directions. My CNC machine at home (a Boxford 260 VMC, currently 'in course of arrangement', as they say) muddies the waters a little in the picture on the front by describing the X and Y axes in terms of the table movement (ie X+ to the left) and the Z axis in terms of the tool (quill) movement. However, a moment's thought confirms that this is equivalent to the 'CNC convention' as far as tool movement is concerned.

The conclusion that I draw from all this is that CNC machines appear to be consistent in using a 'proper' right-handed set of axes. Manual machines, however, appear to vary according to the whim of the manufacturer. In this case I suppose the important thing is to be clear what convention is being used and then to be aware of where your own machine differs from this and be prepared to indulge in the appropriate mental gymnastics. And what is the worst that can happen? I suppose you could either end up machining fresh air or producing a part which is the mirror image of what you wanted. D'oh!

RESTYLE

I hope you have noticed that we have given EIM a bit of a facelift. We did a trial run last month using Martin Gearing's steam plant article as a 'guinea pig' and, emboldened by the lack of any adverse reaction, we have now rolled this 'restyle' out to the rest of the magazine. We have also made modest changes to the front cover, which we hope will make it a little more eye-catching on the news-stands, with the obvious aim of selling more copies. I hope you will approve of these changes, which I can assure you are only to the style; the high-quality, informed and erudite content to which you have become accustomed will remain just the same!

I would also like to make you aware of a new website forum we have set-up. It can be found at www.model-engineering-forum.co.uk with the aim of being the number one forum to share knowledge, information on your own projects and ask questions to fellow model engineers. Please take a look and start contributing.

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by Graham Meek

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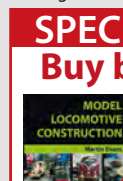
MODEL LOCOMOTIVE BOILERMAKING

by Alex Farmer

Drawing on many years of practical experience the author explains in detail by over 300 descriptive photographs the construction of a model locomotive boiler from the selection of tools and materials through the working of the metal to the testing of the finished boiler.

WELDING by Richard Lofting

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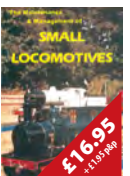


MODEL LOCOMOTIVE CONSTRUCTION by Martin Evans

This book deals with the construction of model locomotives, electrically-driven, for the popular gauges '0' and '1'. The reader is taken right through the subject, which is dealt with in a practical manner. Chapters include a discussion on the tools and equipment required before a start is made, the selection of suitable materials, building the locomotive bodywork, turning wheels and axles, making scale valve gear, dummy riveting, detail work, making boiler mountings, painting & lining.

THE MAINTENANCE & MANAGEMENT OF SMALL LOCOMOTIVES by H. E. White

As the title implies, this is a very comprehensive work on all aspects of building and operating a live steam locomotive. 12 chapters cover the locomotive, its running, track, right through to passenger carrying. A must for any steam enthusiast's library.

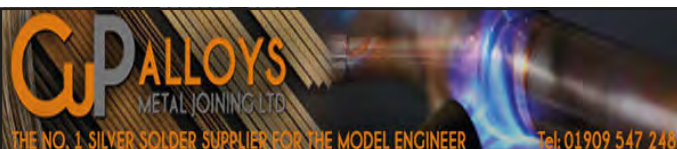


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The Great Dorset Steam Fair 2016

Edward George reports on his annual pilgrimage to the UK's biggest steam fair

BY EDWARD GEORGE

The 2016 Great Dorset Steam Fair, now in its 48th year, was as successful as ever. The show, at over 600 acres, is one of Europe's largest outdoor events, originally just 'steam' but now incorporating a wide range of nostalgia, rural and industrial crafts, vintage collections, animals, vintage and modern fairgrounds, and entertainment stages. There is no other event like it which perhaps is why over 200,000 visitors attend each year.

Wherever possible exhibits are displayed working, doing the job for which they are designed. This philosophy is as pertinent with the models as with the prototypes. Photograph 1 shows a 3" Marshall, rebuilt by the owner from a very 'average' model; after re-construction the original parts left were the boiler and the major castings. All the motion was replaced, each piece cut from the solid (as opposed to being fabricated). The attention to detail was most impressive including the correct lining as advised by Richard Wilcox, the liveries officer from the Road Locomotive Society. There are still a few more parts to be re-worked including the wheel lining which should be black not yellow but as the wheels are yet to be re-built this has been left for the moment.



Probably the most talked about and admired exhibits were the 'Foden Speed 6' and 'Foden Speed 12' steam lorries (both owned and restored by Mike Dreelan) and the excellent 3" scale model of a Speed 6 being built by Norman Smedley. 'Speed 6' implies a 6 ton capacity and 'Speed 12' a 10/12 ton capacity, the Speed 12 having twin back axles. Foden's built 134 'Speed 6' and 'Speed 12' steam wagons between 1930 and 1932; they were Foden's final design of steam wagon and are widely regarded as the 'pinnacle' of steam wagon building.

ABOVE PHOTOGRAPH 1
A beautiful 3" scale Marshall driving a scale baling machine, exhibited by Vince Hawkins.

BELOW LEFT PHOTOGRAPH 2
Foden Speed 6 'O' Type wagon.

BELOW RIGHT PHOTOGRAPH 3
Foden Speed 12 'Q' Type wagon.

The Foden Speed 6 'O type' Undertype Steam Wagon (photograph 2) is works number 13750, built in 1930. It was supplied to Mr King of Bishop's Lydeard, near Taunton, as a demonstrator. It was in commercial use until the start of the second world war when it was laid up, becoming ever more derelict, until May 14th 1988 when it was part of the 'King Sale' when a number of Foden wagons and other engines were auctioned. The 'O' type was in a truly dreadful state after nearly 50 years out in the open. The wagon changed hands several times before being purchased by the current owner on 2007.





The second wagon, a Foden Speed 12 (photograph 3), is works number 13976 and was built in 1931. It was sold in 1932 to S & AG Davies of Enniscorthy, Ireland, and made twice weekly journeys to Dublin. It was last taxed in 1945 and sold to a local farmer in 1947. The wagon was dismantled; the chassis was cut and the rear portion used as a farm trailer, the front axle sold to another farmer, the boiler used in a tannery, and the water pump converted into a crop sprayer. Happily in 1969 a group of preservationists located as many parts as they could and returned them to England. Again the parts passed through a few more owners – gaining some parts from another speed 12 works no. 13766 along the way – before being purchased by Mr Dreelan.

The boilers on these wagons are of a 'pistol' nature with a round firebox and a horizontal water tube barrel.

The working pressure is 275psi with a heating surface of 82.5 sq. feet and a grate area of 3.66 sq. feet. The brakes are internal expanding and steam operated via a foot pedal.

The 3" model of the 'Speed 6' is being built by Norman Smedley and in your author's opinion is every bit as epic as Mr Dreelan's restorations (photograph 4). It was built entirely from Foden works drawings along with numerous photographs and measurements from Mr Dreelan's 'Speed 6'. The model so far represents 17 years' work. It includes such details as a pattern from which to make a mould of the tyres which have not only the correct profile but also the correct tread pattern (see photograph 5) and the 6 start worm and 29 tooth worm wheel in the back axle differential unit.

2016 marked the Steam Plough Club's 50th Anniversary. An



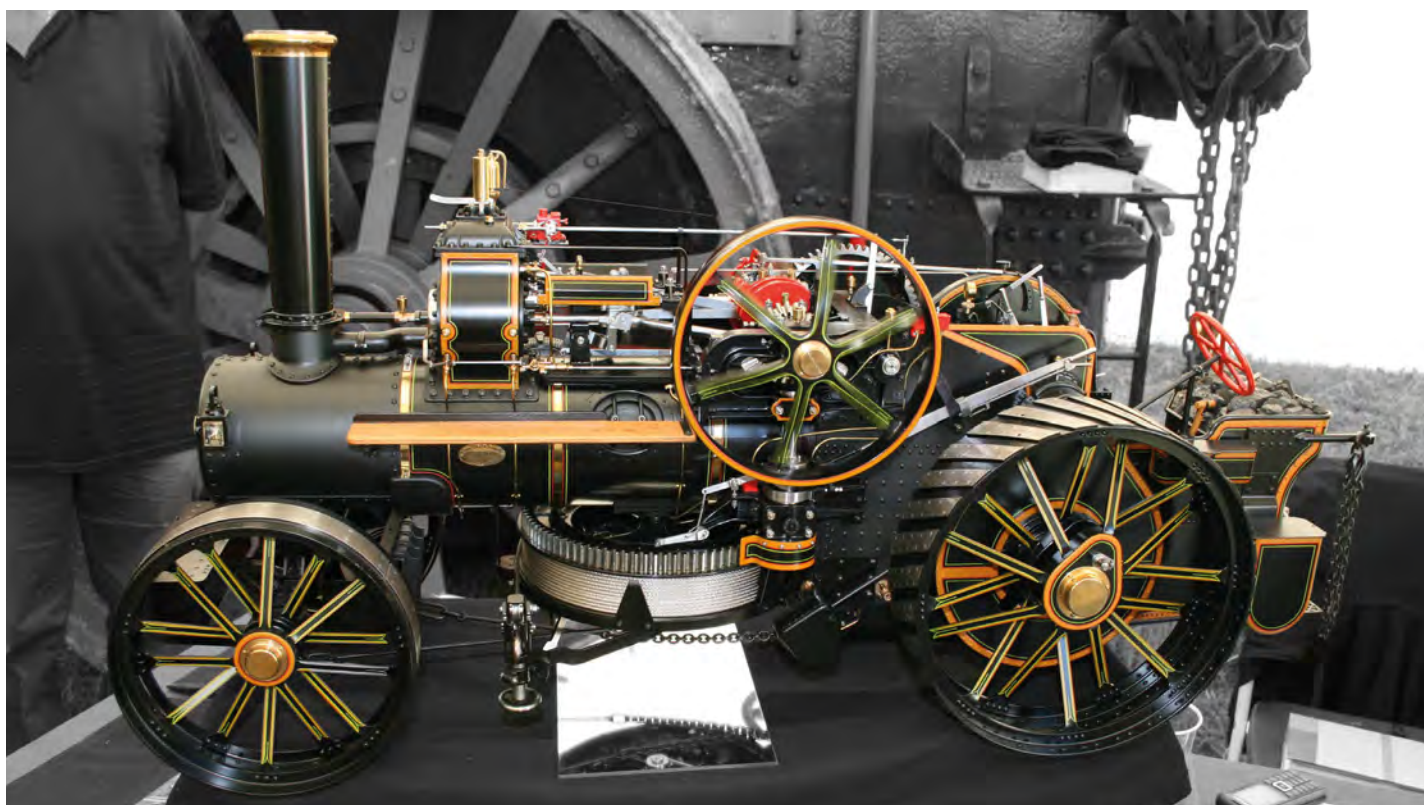
ABOVE PHOTOGRAPHS 4 AND 5

Norman Smedley's superb 3" scale Foden 'Speed 6'. The cab is made from English ash and the roof and back panels from Oregon pine. The framework is yet to be clad in aluminium sheet. The wheels have the correct profile and the correct tread pattern.

BELOW PHOTOGRAPH 6

All the way from The Netherlands; Jan Huigen's spectacular model ploughing engine.

impressive display was prepared in the NTET (National Traction Engine Trust) marquee. Entering the tent the most popular exhibit, always marked out by the constant crowd of admirers, was the Fowler BB1 ploughing engine in 1.5" scale built over a period of 28 years by Jan Huigen from the Netherlands (photograph 6). Jan was inspired by the BB1 print by the late Geoffrey Wheeler. He used numerous photographs of BB1s and copies of the works drawings from The Museum of Rural Life in Reading. The model is entirely scratch built and no castings were used. All the fittings are to scale including the water and pressure gauge. I was informed that the motion would turn over on .25 bar; indeed you can run the engine by blowing down a tube into the boiler. I hope our editor can spare the space for a large enough picture to do the model justice (Will that do? – Ed).



By way of a complete contrast photograph 7, also part of the Steam Plough Club's 50th Anniversary, shows a full size 12NHP single cylinder Fowler ploughing engine works no. 1908. The engine is being rebuilt by Paul Ransley. The rebuilding involves a complete new boiler assembly, numerous castings, including wheel hubs with spokes cast in, new gears and a whole host of other ancillaries. No. 1908 left the works in February 1873 for Harman Visger of Chiseldon in Wiltshire, originally as a single engine ploughing engine with an anchor for the return of the rope, but 18 months later a second engine was acquired to work the by then more usual two-engine system: an engine at each end of a field drawing the plough across back and forth between them. No. 1908 ceased work in 1944, was stripped of its major parts, and sold for use as a soil steriliser on a nursery on the Isle of Wight. The remains, essentially just a boiler and cylinder, were acquired by the present owner in 2005 and restoration commenced with the intention to rebuild her as closely as possible to her original specification.

My last piece of engineering to offer readers is 'Onward', a Fowler B6 Super Lion, works number 19989, originally of 1933 but so very carefully re-manufactured between 2002 and 2016 by Dave Eves (photograph 10). The 1933 engine was built as a showman's engine then converted to a road engine for heavy haulage during which she broke her back axle and was cut up by Cohens by the roadside. Dave Eves has made every effort to make as faithful a replica as he can and it is believed (but not certain) that the dynamo fitted is original. A true engineering 'tour de force'. ■

RIGHT PHOTOGRAPH 7
12 NHP Fowler ploughing engine works No. 1908 under restoration by Paul Ransley.



RIGHT PHOTOGRAPH 8
The pattern for the final drive gear wheel on 1908. The pattern is in two halves and the core box used to make all the individual cores for the gear teeth is laid on the grass below. The item like a clock was a device to double check the alignment of all the gear teeth cores to ensure an even spacing of the cast teeth.



BELOW LEFT PHOTOGRAPH 9
The completed final drive.

BELOW RIGHT PHOTOGRAPH 10
'Onward', a full-size replica built from original Fowler works drawings and completed this year.



The Atkinson Steam Wagon

Graham Sadler creates a large pile of swarf out of which should emerge a pair of cylinders

BY GRAHAM SADLER CONTINUED FROM PAGE 132 OCTOBER 2016

With hindsight there is a far better way of machining the cylinders than the method I used so I will describe this better process. It is really just a change in order to make things simpler. The photographs are for the method I used but they show the machining setups clearly. Each block is initially finished 70 x 72+ and the bottom face should be left as big as possible in order to increase the projection of the exhaust flange so that it clears the lagging. The advantage of the new method is the removal of the need to pack the cylinder to the exact height for boring and also other steps become simpler.

WORK ORDER

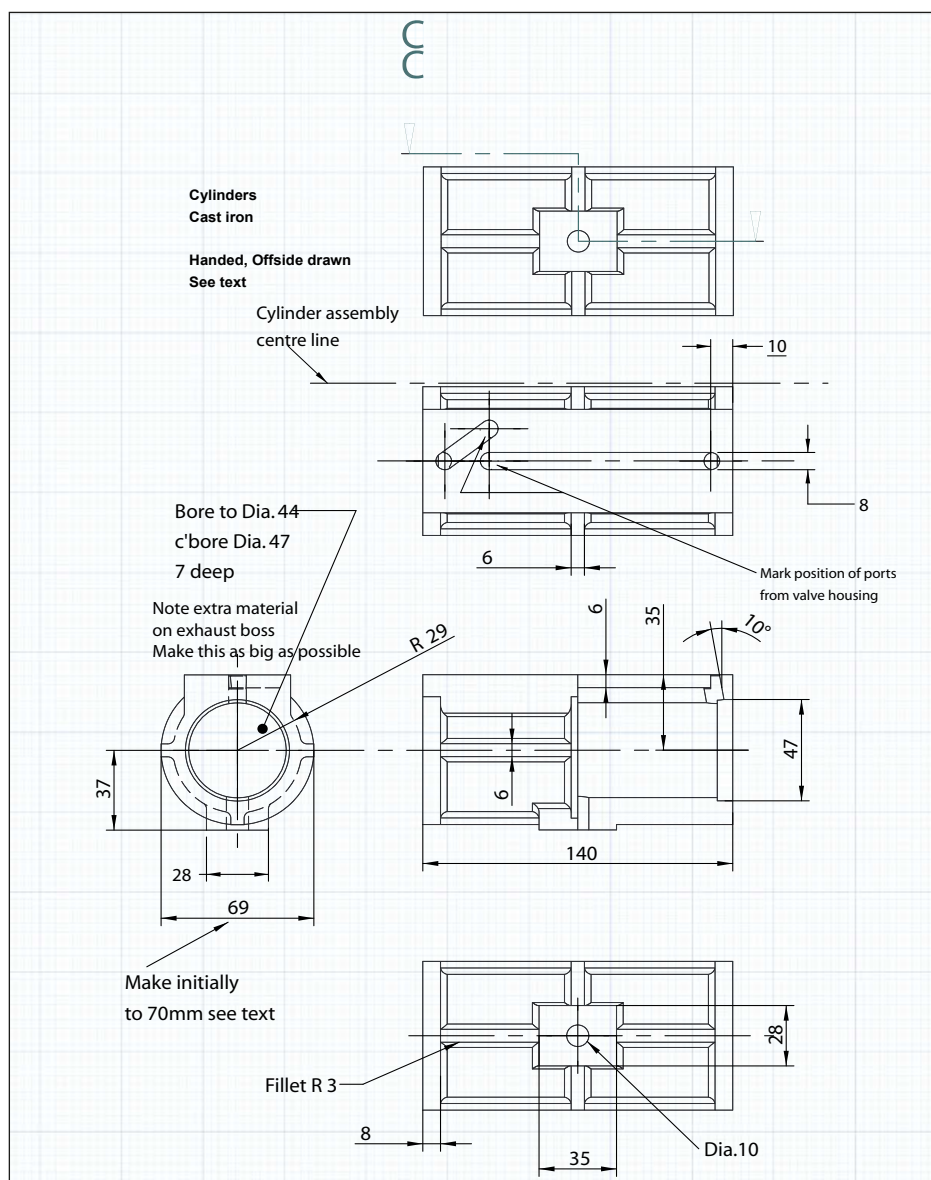
Production is a chicken and egg situation again; you do part of the work on one-piece, make another then go back to the first to finish it. The overall timeline was given in the October issue covering the valve housings, on page 129. The 75mm x 75mm raw blocks are approximately 150mm long. These are eventually finished to 70 x 73 (ish) and later reduced to 69mm diameter by rotary milling. Don't be tempted with what will seem a cheaper option of buying 70mm bar in the first place as it would make things very tight on size. The first task is to drill through them with the largest possible hole directly through the centre. This for most people will mean clamping down onto the lathe cross-slide. The next task is to clean up two faces to act as datums. This can be done by fly cutting. The first cut is easy, as the block is clamped down using the drilled hole, but the second is more difficult. It can be accomplished by clamping to an angle plate or by clamping down on the table using the centre hole and shims to pack the block up to get the already machined face vertical. Get these faces square and to a good finish – one will be the bottom (see photograph 1).

The extra material (over and above the theoretical 70mm square) will be at the bottom and it is there to enable the exhaust mounting boss to protrude fully outside the cladding. Close inspection of the cylinder drawing will show this. The extra amount should be about 2mm (but better if this is greater) so the centre of the block will be 37mm (35 plus 2) above the bottom face. Measure the height of your block to find the larger dimension and then arrange the block, machined face down, on the cross-slide so that this dimension lies on the vertical axis. The face in contact with the cross-slide is now the bottom and is finished. Stamp it in

a waste area for identification. My centre height over the cross slide is 52.6mm (2.072") and the required height is thus 52.6 minus 37 = 15.6mm of packing. As $\frac{3}{8}$ " material is 15.9mm this will do nicely giving 1.6mm extra height on the boss. I had a ground plate from an abandoned project from years ago and used that. This, of course, as soon as you clamp down, will make the blocks handed so be careful; the vertical machined face may be at the front or back of the cross slide depending on your blocks. Clamp it down with due regard to all the strength being in the lump of the cylinder not the relatively fragile cross slide and use a dial test indicator to get the other machined face parallel to the lathe axis to close limits.

BORING

Face the end by flycutting with a cutter block mounted in the 4 jaw. Mine was made when my dividing head was built and is a piece of 20mm square steel about 100mm long with a reamed $\frac{1}{4}$ " hole close to one end for the cutter which is secured with two grub screws – with a single grub the bit will move. Start the line boring with as big a bar as you can get in the central hole, which obviously you have already prepared, but later when the hole gets bigger switch to a second even larger bar of at least 25mm diameter and bring the bore to size. Keep the length of the bar as short as possible but as it's likely that your revolving centre will actually go





**ABOVE LEFT
PHOTOGRAPH 1**
The initial fly-cut of
the cylinder block.



**ABOVE RIGHT
PHOTOGRAPH 2**
Boring the cylinder
block.

inside the bore it could be possible to get away with a bar of only about 200mm long, the longest part being at the headstock end with the cutter close to the tailstock end. Photograph 2 shows this process in the early stages.

To set cuts on this type of bar use a small stack of slip gauges on the bar to give the protrusion from the bar, and a protection block for the tool to be pushed against. Another way is to fit the tool into an angled hole in the bar so that the protrusion can be measured with a micrometer or callipers.

The late and great toolmaker George Thomas once designed an inline boring bar which, if I remember correctly, had an angled internal bar to clamp the bit and a headed 40tpi screw to advance the tool by pushing directly against it; very nice it was, but one has to stop somewhere! The actual diameter of the bore is not important (the pistons and covers will be turned to match each one) but it's a lot better if they are the same.

The boring process is a long slow job and, as can be seen in photograph 3, I was reducing mass on the corners of the other block at the same time

although I now feel this was a bad idea. To ensure a good finish in the bores I honed my cylinders later and an outstanding finish was easily produced!

Don't forget to mark clearly this all-important end which will be used for mounting onto the crosshead assembly – it has to be geometrically square to the bore. Produce the counter bores by line boring or (which is easier) set the size, use a boring head, then reverse, set true to the datum face to length and cut the counter bore at the other end.

CUTTING IT DOWN TO SIZE

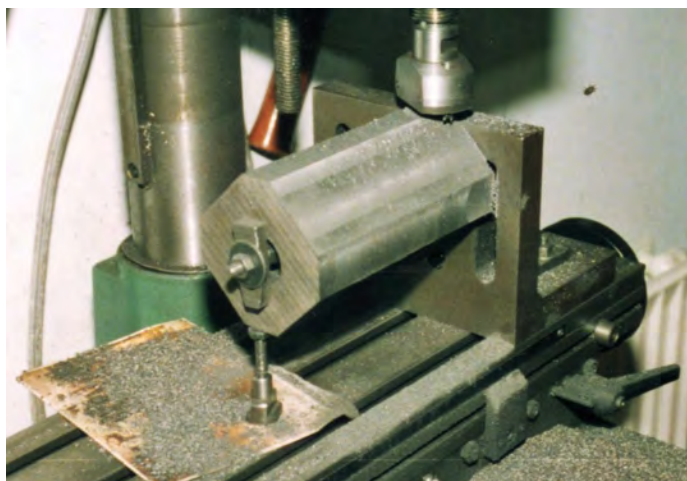
Now it's back to the miller and the bore provides an accurate reference for bringing the cylinder to 70mm wide and what will be the top at 35mm from the hole centre (not the 69mm final dimension in the drawing – this is to give a finishing cut of 0.5mm for the rotary milling of flanges and webs and allow space for the cleading). This is achieved by measuring the wall thickness of the bore on each side to determine the amount to be removed from each side, which will be dependent on the exact size of your bores. The first job

is to place the work on the machined face which is NOT the bottom and finish what will be 'vertical side' to bring it to the correct size, then flip it over to re-machine the other 'vertical side' so the bore is central.

The top is last so that the sides can be used to reference the position of the valve housing plate. The finish on the top must be good to ensure a steam tight joint with the valve housing plate. The valve housing base plate is clamped in position including the gasket you will use (so it can be drilled at the same time as the rest of the holes), ensuring it is parallel to the edge of the cylinder and 11mm in from each side to get it central. The mounting holes can be drilled using coordinate methods or using previously marked centres. The steam ways are drilled through both the housing plate and the cylinder with a slot drill as we need a flat bottom, but do take care with the depth, which is 9mm total (6mm into the cylinder). Don't forget the cylinders are already handed due to the boring and facing process so make sure you are using the correct valve housing base at the correct end! The angled slot will need to be

**BELOW LEFT
PHOTOGRAPH 3**
Removing mass
from the other
block.

**BELOW RIGHT
PHOTOGRAPH 4**
More mass
reduction.



on what will be the inside between the cylinders when mounted on the cross head assembly. Observation of the photographs will show that I did this in a different but slower order...

The method above ensures the positions of the slots are accurate. Remove the valve plate and cut the steam ways with the slot drill. The steam ways do not go right to the ends of the cylinders but stop short and an angled hole is produced with the slot drill again into the bores by angling the miller head. See photographs 5 and 6.

Now we will produce the cylinder covers and glands and fit them in place, but for this description we will assume that has been done.

MILLING THE OUTER PROFILE

Firstly, the cylinders need to be marked out to avoid mistakes amid the mass of dirty swarf using preferably a surface gauge or height gauge. The marking out guide and table (figure 1, below) gives all the positions. Many of the dimensions are repeated on different faces and from both ends. To preserve the positions they can be lightly dot punched. Note that none of the marking out uses the bottom of the cylinder for reference.

I was a bit haphazard about milling the blocks to get the shape, and experimented with different methods, and I now feel I have the best way. Basically, the blocks need to be changed into something a little lighter! It creates a mass of swarf.



LEFT PHOTOGRAPH 5
Cutting the long steam way.



RIGHT PHOTOGRAPH 6
Cutting the angled steam way.



LEFT PHOTOGRAPH 7
Starting on the profile.



RIGHT PHOTOGRAPH 8
Profiling – here we are looking at the bottom.

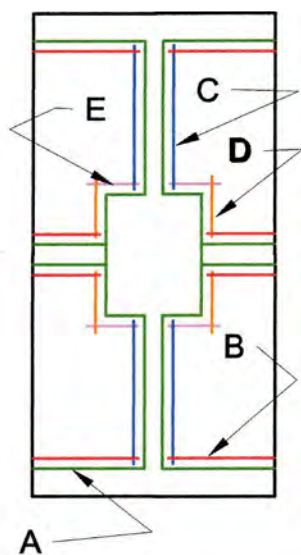
I started early on by mounting the block on an angle plate with a jack under the front to take off the corners at 45° to produce the position of the end flanges and the webs but it's not really required and makes setting up more difficult (photograph 3 again).

BELOW FIGURE 1
MAKING OUT GUIDE AND TABLE

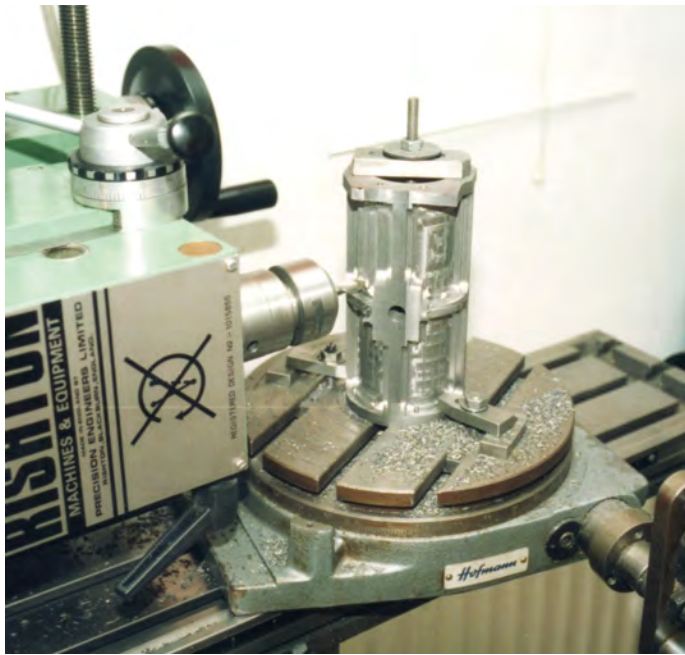
There are several ways of removing the material but there is no quick way. It may involve a number of tool changes from end mill to ball end cutters. These days with a big dividing head I would mount the cylinder horizontally, gripped by the bore and a plug in the other end. At the time,

Green lines A represent the FINISHED edges of the webs, exhaust boss and flanges.

Lines B,C,D and E represent the centre of a 6mm diameter ball end cutter used to finish webs etc. to give a corner fillet and thus the limit of deep roughing. It is assumed the block has wall thicknesses of 13 mm to top and sides i.e. 70mm overall. I would suggest doing it in this order to keep the lines short and to avoid overlong and unwanted marking out.



LINE ON DIAGRAM	WHAT IS IT FOR?	HEIGHT FROM ENDS	HEIGHT FROM SIDES
A	Outline of flanges	8	
A	Outline of cross web	67	
A	End of exhaust boss	52.5	
A	Edge of long web		32
A	Long edge of exhaust boss		21
B	Limit of roughing on flange	11	
B	Limit of roughing on cross web	59	
C	Limit of roughing on long web		29
D	Limit of roughing on exhaust boss		18
E	Limit of roughing on exhaust boss end	49.5	
F	Sides of top face (not shown)		11
G	Limit of roughing top face (not shown)		8



**ABOVE LEFT
PHOTOGRAPH 9**
Finishing the centre
webs and removing
the milled steps.

**ABOVE RIGHT
PHOTOGRAPH 10**
Cylinder and piston
material.



error is increased. As we will be using a 6mm diameter ball end cutter for the web and flange edges to give a decent fillet all the roughing cuts should finish $\frac{1}{2}$ this diameter – 3mm plus a margin of 1mm from each finished edge position in the positions where we marked them out.

Clamp the cylinder down by the bore again and clock one of the machined faces true then fix stop bars along the length and at the end to allow repositioning without the need to use the dial test indicator again. I was lucky here having a vice which just, and only just, held the block. The importance of table stops for this task cannot be over-emphasized. In the cutting diagram I have only indicated one cut of each type to avoid confusion e.g. there are 4 positions where cut no. 1 will be used (others are under the arrow leaders for cuts no. 7, 4 and 6). The best way to achieve them is to do one position, at the front and one at the back (of the cylinder relative to you), remove the block, clean up, rotate the block to a new position and repeat. Always do 'a fresh air cut' with the spindle too high after repositioning just to be on the safe side. The number of passes to remove each section will depend on your machine, and the cutter, being carbide, will run at a high speed.

Originally, my cutting information gave the depth of cut and the width taken from the cylinder edges but the text and description I decided would be too confusing so it's better to work your own out from your 4:1 drawing – you will have a better understanding and

cut sizes can then be taken directly with digital callipers. Don't forget the roughing cuts should finish at the sides and ends 3mm from the final web and flange position as these will be finished to size with a 6mm ball end cutter. So for example for the length positions along the cylinder: we are using a 12mm cutter, and the extremities (not the spindle position) of the cut 1 should finish at 11mm from the end of the cylinder (flange 8mm wide plus half the cutter diameter, which is 3mm), and at the central web $70 - 3 - 3 = 62\text{mm}$ from the end of the cylinder (cylinder centreline – $\frac{1}{2}$ web – ball cutter radius).

Table stops are almost essential here as there are a lot of cuts to complete. Table dials or even the beloved DRO will lead to errors as concentration lapses, and it will! For the cuts at the front of the cylinder (on your side) the cut must start at the left of the cylinder and work rightwards towards the end, and in the reverse direction for the cuts at the back. Note that some cuts are short due to the exhaust boss (see figure 2). When this bottom face is finished you can use the same Z settings as used for the sides thus ignoring the extra 'added' for the exhaust boss – here the red line of cut 5 shows the finishing with the ball cutter.

Eventually, the roughing out will be completed and one switches to the ball cutter to produce the radius to the flange and webs. I feel this is vital to avoid stress concentrations in the corners of a complex component subject to operational stress, both mechanical and thermal.

ROTARY MILLING

This process caused me a lot of apprehension but fortunately was very straightforward, though needing a lot of concentration to avoid cutting into the flanges. I was unable to arrange stops on my rotary table – pity. Firstly scribe the outline of the cylinder covers on the currently square end faces as a guide.

I did the flanges first with the miller spindle vertical. For the rotary milling the exact setup will depend on your equipment. Produce a centring plug from 6mm plate. For the webs and the main body the rotary table and is stood vertical but as mine will not stand up the table had to be horizontal and I had to rotate the miller head to set the spindle horizontal (photograph 9). It worked a treat and was a lot easier than expected! While the steps could be left in the cylinder walls, it's ugly; one always knows it's been left a mess and takes up valuable lagging space needed to preserve the heat in the cylinders when in steam. I remember seeing one machined cylinder at an exhibition and the finish was not far from being polished! There are limits....

Note the finished size over the flanges and webs is 69mm, leaving 1mm space for the two cleading sheets (the cylinders are spaced at 70mm centres). NB don't do the flanges or rotary milling until after finishing the valve housings and fitting the exhaust and inlet flanges – see October issue time line.

Just for fun photograph 10 shows the materials for the cylinder covers and pistons including spares.

« TO BE CONTINUED »

Steam, Burgers and Very Late Nights

DAVID HARTLAND REPORTS FROM THE TAUNTON MODEL ENGINEERS 70TH ANNIVERSARY

Taunton Model Engineers is 70 years old this year. Since we did not have a party at the 50th anniversary, and most of us will not be around on the 100th, we decided to do something now! The ground level track at Creech St Michael was the venue with many visiting locomotives working the trains for the day, along with traction engines running in the adjacent playing field. An exhibition of members' work was set up in a marquee and the fairground organ lent an air of a full size steam rally to the proceedings. Over 500 visitors came to see the show and running went on all day. At 4pm the Chairman, Mike Johns, officially congratulated the Club on its 70 years and the new Club Hymek locomotive was named 'NOEL WHITING' after a prominent founder member. His widow, Rose-Marie, unveiled the nameplates. Toasts were drunk and a huge cake was distributed to the members.

In the evening the celebrations continued in a less formal way with a barbecue and further toasts (!) and running carried on until well past dark until the lights on the Restaurant Car were the only illumination on the whole site.

It was a super day and was a great advertisement for the Club in



the local community. One of the most satisfying features was that a large majority of the members all took part in some way, either setting up, stewarding on the day, or helping running the trains. To all our members and visitors, the Club says a big 'Thank You'. ■



ABOVE

Line up of the visiting locomotives at the event. In the front is Tony Newberry's 4700 GWR 2-8-0; next is Robert Oldfield's Hunslet; then comes Steve Gosling's Midland 4-4-0 and John Williams' narrow gauge engine. Behind in the siding is David Hartland's Drewry shunter and goods train. (Photograph Don Hancock)

LEFT

Roy and Diana Fathers and Chloe enjoying a ride on the train. (Photograph Don Hancock)

RIGHT

Andy Webb driving Steve Gosling's Midland 4-4-0 passes the Boat Club's exhibition.



MORE PICTURES FROM TAUNTON >>

**TOP**

Robert Oldfield driving his Hunslet followed by Andy Webb driving Steve Gosling's Midland 4-4-0. (Photograph Don Hancock)

MIDDLE LEFT

John Pickering at the controls of the new locomotive with Rose-Marie Whiting, her son and grandson riding behind. (Photograph Don Hancock)

MIDDLE RIGHT

James Lewis, Barry Baxter and Dave Wood availing themselves of the restaurant car facilities during the late night running after the barbecue.

BOTTOM

Mark Sweet with his 5" gauge Pannier on the 'Home Trainer'. This locomotive ran for the longest distance in the whole show but did not go anywhere! (Photograph Neil Evans)

Katie Update

A progress report on the project to restore Sir Arthur Heywood's 0-4-0T to working order

BY MARK SMITHERS

On August 6th 2016, nearly two years after the R&ER Heritage Group's project to resurrect Sir Arthur Heywood's 1896-vintage 15 inch gauge 0-4-0T Katie made its first public appearance at the premises of Station Road Steam Ltd. at Metherringham in Lincolnshire, the engine made another appearance during an Open Day and the opportunity was taken to record the progress that has been made on the project during the intervening period. As will be seen from the accompanying illustrations, work on the locomotive is now at an advanced stage although sadly it will not make its operational debut at Ravenglass during the centenary year of Sir Arthur's death, partly as a consequence of efforts at Ravenglass being directed towards work on expansion of the Museum before the locomotive's reconstruction project can be completed.

Starting with the parts of the engine above running board level, the boiler is now mounted on the frames and it has been fitted with an internal hinge and locking linkage for the smokebox door. Most of the main steam and exhaust piping is now in place although the upper (internal) blastpipe has yet to be fitted. The dome cover is in place although it still requires further work in order to bring its appearance up to the required standard.

The weatherboard and side tanks have been manufactured and fitted and these were very much in evidence during the Open Day. Although detailed constructional methods for the tanks differ from the originals one authentic touch is that, as with the latter, they are double-skinned (i.e. consist of an internal tank proper and an external valence, which will be painted in the classic lined green Heywood livery). The rear handrail and its associated sheet

had yet to be fitted at the time the accompanying photographs were taken although the pillars were in place.

Looking at the upper rear area of the locomotive generally the boiler backhead area is complete, with the classic Heywood firebox 'dry backhead' with its upper (firehole) and lower (damper) doors, and is now in place, along with the water gauges. These latter components, unlike their original counterparts, are fitted with three-glass protectors. On the far right hand side is the pedestal for the reversing and steam brake levers; the reversing lever is in place along with the screw fine adjustment control but the steam brake control lever has yet to be fitted, as has its associated valve below footplate level.

Moving on to the locomotive's chassis, the most obvious evidence of progress when compared with two years ago is the fact that the motion rods and valve gear are now in place. The distinctive Geoghegan-pattern 'split cup' bearings for the coupling and connecting rods are very much in evidence as are the 'banana' trailing swinging links, so characteristic of Heywood locomotive practice from 1894 onwards. It is only when these components have been fitted that the space limitations in the rear chassis area can be appreciated.

On the left hand side there is scarcely room to accommodate the bellcrank for the handbrake control whereas, on the other side, the lower portion of the reversing lever has to be cranked inwards to allow sufficient space for the 'swing' of the lower part of the die-block slide when running in a forward direction (it will be remembered that this part of Heywood's valve gear is similar in its operation to Hackworth's – see the accompanying illustration).

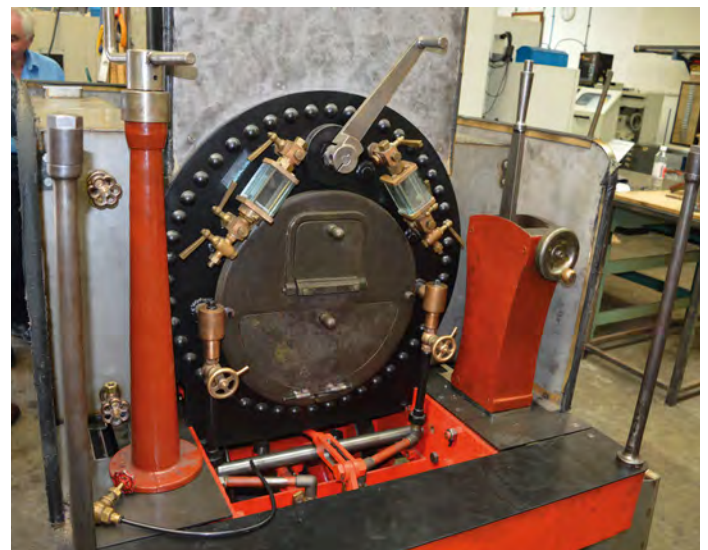
BELOW

A left hand front three-quarter view of Katie as on display at the premises of Station Road Steam Ltd. at Metherringham, Lincs. during the Open Day on August 6th 2016. The boiler has now been fitted to the frames and the chassis is largely complete, having been tested with compressed air prior to the occasion.



BELOW

A rear general view of the backhead area of Katie. The backhead is effectively bisected by the grate, with the upper door being the firehole door, whilst the lower door is the damper (both are hinged to open downwards). On the right of the picture is the combined reverser and steam brake pedestal (the steam brake control has yet to be fitted) whilst to the left of the backhead is the handbrake. The 'revised' piping (injector steam feed as opposed to delivery) associated with what would have been the clack valves on the original boiler is readily apparent and the true purpose of the new components is betrayed by the wheels operating the steam valves. This design alteration was necessitated by the fact that the new Katie boiler, unlike that made at the same time for James Waterfield's replica of Ursula, does not have an underhung steam take off (termed a 'blow off' flange' by Sir Arthur!) piped directly into the steam dome.





ABOVE

One of the most peculiar features of the last five Heywood locomotives was the internally mounted smokebox door hinge. This was evident from photographs taken in the carriage shed at Eaton Hall in 1940 and during the scrapping of the last surviving original Heywood locomotives at Balderton in 1942. The linkage for opening and locking the door can be seen here. The ability of the door to slide away from the smokebox front is conferred by the provision of an intermediate link in the hinge arrangement, although this could have been accomplished by means of a slip hinge. This feature was not reproduced on the Ursula replica.

The size and position of the central frame stretcher on Katie precluded the fitting of a steam brake connecting rod in the location found on the other 'mature' Heywood locomotives (the 1942 scrapping photographs reveal that on the final 0-6-0Ts this component was of sufficiently curved profile to pass beneath the trailing and intermediate stretchers on these locomotives) and a means had to be found to keep the corresponding components on Katie forward of the stretcher.

Close examination of the surviving original mainframes revealed a fairly large hole in the right hand frame, located to the rear of the central stretcher, which would have been for the pipework linking the steam brake cylinder to its control valve. By this means it was possible to prove that the steam brake cylinder was anchored to the trailing face of the stretcher and that its control valve was, again unlike the locomotive's sleeved axle sisters, located forward of the reverser/steam brake lever pedestal, but still below footplate level. The location of the steam brake cylinder on Katie allows for a relatively high position in the mainframes of the cross-shafts for the handbrake and the dieblock when compared to the Heywood sleeved-axle locomotives.

The cylinders and steam chests were largely complete by the time of the 2014 Open Day but two components that have made their appearance since that date are the cladding sheets for the cylinder barrels. The distinctive drain cock arrangement, with its visible leading lateral bar, had yet to make its appearance at the time of the latest photographs, as had its associated control rod in the footplate area immediately to the left of the lower part of the boiler backhead.

BELOW

On the new Katie boiler, it has been necessary to relocate the clack valves to the leading portion of the barrel and the left hand valve is seen here. These valves should not be obtrusive to the casual observer during normal operation.



ABOVE

Katie's front tubeplate is seen in detail in this view. The tube arrangement is similar to the original save for the fact that the outer lowermost tube on each side has been replaced by a washout plug, thereby reducing the number of tubes from 57 to 55. As with the original, there was only one steam pipe within the smoke box, on the right hand side, hence only one displacement lubricator, the piping for which is visible in this view. The front tubeplate is secured to the barrel by genuine (as opposed to dummy) rivets and the upper section of the blastpipe has yet to be attached.

One important change of heart has occurred since the 2014 Open Day and the compilation of my first EIM feature on this project. As I detailed at that time, the lack of a 'blow-off flange' on the lower part of the new boiler for Katie was something of a headache, given the fact that the original decision not to fit a steam brake had been reversed. Early thoughts on how to circumvent this problem had turned to concealing two small steam pipes within the valence ahead of the mounting bolts for the weatherboard which could take steam down to a supply for the steam brake and injectors. In the end, so far as the injectors were concerned, it was decided to adopt another arrangement in which what were the clack valves on the original locomotive become the steam supply valves whilst new clack valves are located at the leading end of the boiler barrel below the level of the top of the tank, thus being out of sight of all but the most determined observers. The revised arrangements are made clearer by the accompanying illustrations. As regards a steam supply to the brake control valve, this still required fitting but would be perfectly possible to conceal within the boiler lagging descending in a rearward direction from the dome area.

The story of the project to reconstruct Katie has been a protracted but fascinating one, not without its setbacks (not least the 2013 fire at Ravensglass), but it is now nearing completion and the locomotive's debut in steam, probably in the Spring or Summer of 2017, is to be eagerly anticipated. ■

BELOW

The surviving side tanks from Muriel at Ravensglass have fillers of a rectangular profile, a pattern that appears to have been followed on the final Heywood 0-6-0Ts (but not Ella). It has therefore been decided to follow this particular lead with Katie and the left hand filler is seen in this view. Unlike the replica of Ursula, Katie's side tanks are of the double-skinned variety in which the components bearing the nameplates are effectively just valances. This was the original configuration used by Heywood for his 'mature form' locomotives, as once again evidenced by the 'scrapping' photographs of 1942 and surviving components from Ella and Muriel.



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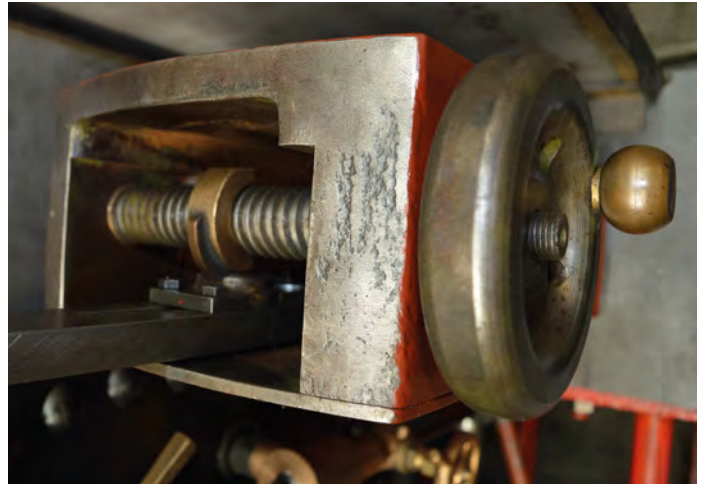


ABOVE

One of the main features of the valve gear used on Heywood's last five locomotives was the trailing arm, or swinging link, which from Muriel onwards was of the 'banana' configuration seen here. The rather cramped layout of essential components at Katie's rear end is exemplified by the position of the handbrake bellcrank in this view.

BELOW

The injectors are located between the mainframes at the rear of the locomotive, behind the boiler backhead and in a position flanking the handbrake connecting rod. This would in all probability not have been far from the location of the original items.

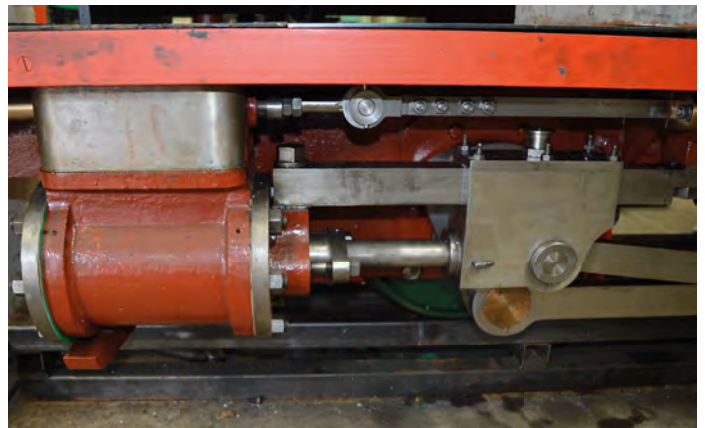


ABOVE

Katie's combined lever and screw reverser is shown in this view, with the steam brake control lever, which was yet to be fitted at the time of the photograph. The 'half nut' in the centre of the picture is engaged and disengaged with the screw thread by means of a spring clip actuated by a spindle passing through a suitable hole along the axis of the reversing lever.

BELOW

Katie's left hand cylinder, steam chest, single slide bar, crosshead and intermediate valve rod and valve spindle are shown to advantage in this view. These are of typical later Heywood construction: points to note are the split adjustable configuration of the intermediate valve rod (secured by four nuts) and the pin-and-collar fastening for the pin securing the intermediate valve rod to the spindle, with a similar pattern of fastening being used for the crosshead and connecting rod. The split enclosed leading 'cup' bearing for the coupling rod is also readily apparent, as is the cotter pin securing the crosshead to the piston rod.



By way of inspiration for things shortly to come – James Waterfield's Ursula was in steam during the Open Day.

'QUICKIE' – Building a battery-powered locomotive in a few weekends

Jan-Eric concludes his description of 'Quickie' with an account of the fitting of a motor upgrade and remote control.

BY **JAN-ERIC NYSTRÖM** CONTINUED FROM PAGE 115 OCTOBER 2016

A STRONGER MOTOR

The more popular 'Quickie' became, the weaker the wiper motor seemed to me, so after six years of watching it struggle with ever-increasing loads (those kids get older and heavier every year...) I decided to replace it with a better motor.

A motor intended for use in electric scooters, with a 350 watt power output rating (needing a 450 watt input, thus around 75% efficiency – photograph 9), cost me only around £50 and the electronic controller (capable of handling 500 watts) was also cheap at about £20. I ordered them both from www.petrolscooter.co.uk but there are other suppliers too. The controller unit has a multitude of leads – some were not needed for this project so it is important to follow the manufacturer's instructions on how to connect motor, controller, battery and switches.

The only mechanical modification necessary was to attach the new motor to the frame. This was an easy job, thanks to the fact that the diameter of the motor is just small enough not to interfere with the drive axle. After that, I only needed to remove the original factory-installed chain-sprocket wheel from the scooter motor's axle (it took me a while to realize that the thread was left-handed!) and instead attach a small pinion of 12 teeth to mate with the original 100-tooth gear wheel on the drive axle, which was slightly rusty after many years of use, as seen in photograph 10.

I turned an adapter, large enough at the motor end to slip over its axle, and with a smaller diameter at the other end it could accept the pinion, which was attached with Loctite 603 and, as an added safeguard, a 4mm

screw to prevent the pinion from working itself loose. This adapter was then attached to the motor axle, again using Loctite, and further secured with a roll pin in a hole drilled through the adapter as well as the axle.

REMOTE CONTROL

Then, for something completely new – radio control! I was surprised to see that toy cars incorporating a 27MHz radio transmitter and receiver sold for £10 or so in my local store. There were several models available so I bought two; one of them was destined for the locomotive and the other was just a spare – but you will later see that there was a use for its remote!

When I was a youngster in the early 1960s (and already mechanically inclined of course) radio-controlled cars were scarce and immensely expensive so, despite fervent hints and wishes, I never got one as a birthday or Christmas present. I did get one with cable steering but it certainly didn't provide the same experience as a cordless transmitter would! Times do change – today, I can just step into almost any shop and buy a radio-controlled toy car for less than the cost of lunch at a local restaurant.

Opening up one of the toy cars, I found a small receiver circuit board inside (photograph 11). It has two leads connecting to the battery compartment (via an on-off switch), one lead to the external wire antenna and two pairs of leads going to the car's two small electric motors, one for the steering, the other providing driving power to the rear axle of the car.

RIGHT PHOTOGRAPH 9

A motor intended for electric scooters. The sprocket wheel will be replaced by a pinion gear.



RIGHT PHOTOGRAPH 10

The electric scooter motor replaces the original windshield-wiper motor, fitting into the same space. A new 12-tooth pinion meshes with the old drive gear.



RIGHT PHOTOGRAPH 11

The receiver circuit board in the toy car. When it is removed, be sure to note and mark the connection of all the wires – any mix-up will probably destroy the board when power is applied!



The operation of the transmitter's two levers is just on-off: forward/backward, and left/right for the steering. There is no speed control nor any fine control of steering. In fact, all the transmitter/receiver system does is to provide on-off power for the driving and steering motors, in either direction.

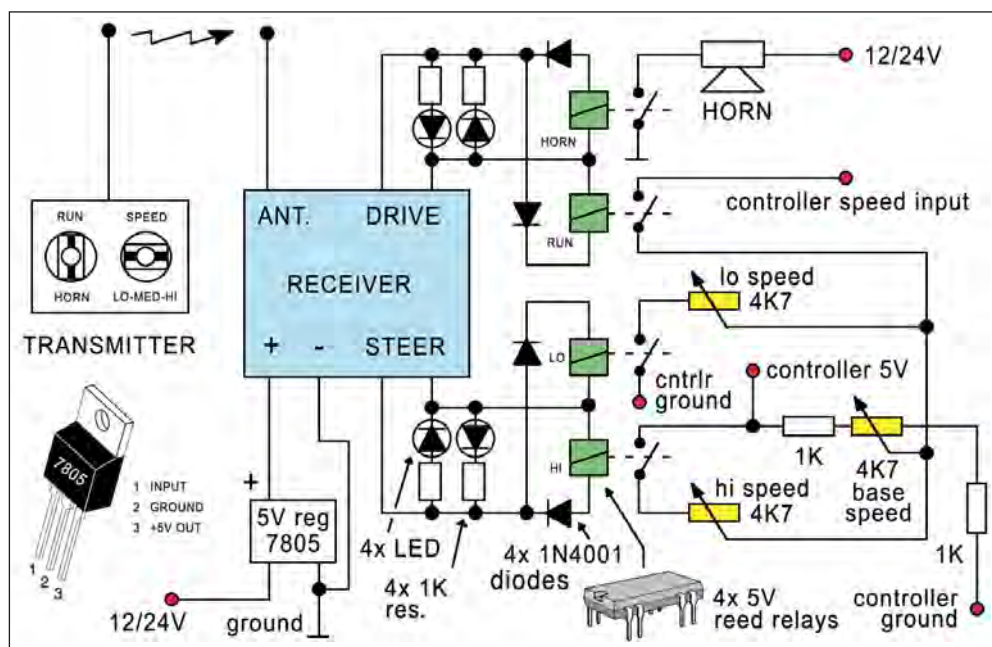
This made me think – the receiver could actually provide four different ‘signals’ that I could use for controlling ‘Quickie’ – but only two of them simultaneously. This could be accomplished with four diodes and four small 5-volt ‘reed’ relays. The latter consume very little power so they can be connected directly to the receiver circuit in place of the toy car’s motors.

So, first of all, I removed the receiver board from the car (photograph 12). I was surprised that there were components ‘missing’ on the board i.e. several holes with no parts soldered in that position. (I assume there are several versions of the receiver being manufactured, some having more components than others, all using the same board design.)

The vacant holes enabled me to attach a voltage regulator directly to the board, as seen in the inset in the photo. The little transistor-like 7805 chip can drop the locomotive's voltage from 24 volts to 5 volts, which is perfect for the receiver since the toy runs on three AA batteries in series – a nominal 4.5 volts. If you intend to do the same make sure that you choose such holes on the board that have no copper-trace connections to any other components or you can simply cut (i.e. isolate) the unused end of a trace and use that for attaching the regulator. It can of course also be mounted off-board. No heat sink is necessary for the regulator since the receiver's current draw is low.

The circuit diagram in figure 2 shows how I connected the relays, diodes and a few resistors to the receiver board. The green squares represent the relay coils while the yellow rectangles are variable resistors, used to set the three different speeds the system can provide. The fourth 'channel' is for the locomotive's horn – a feature popular with kids of all ages!

The reed relays I used are in 'DIP' packages, having eight tiny pins that will fit on a perforated prototyping board. Different manufacturers may have different pin-outs for the relay contacts and the coil so check with your vendor on how to connect the relays.



**ABOVE
FIGURE 2**

FIGURE 2
A circuit diagram showing how the receiver is connected to the four reed relays, as well as the rest of the circuitry needed to interface the radio receiver to the motor controller.

**BELOW
PHOTOGRAPH 12**

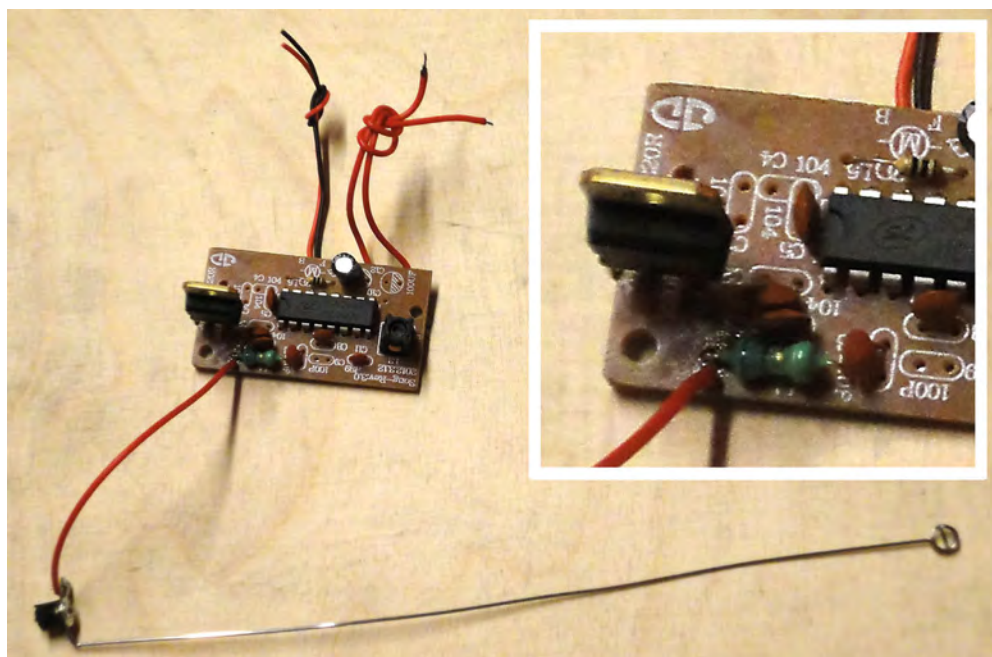
PHOTOGRAPH 12
The component side of the receiver board and its wire antenna. The knotted leads were originally connected to the steering and driving motors, but will soon be connected to the locomotive's reed relays. The inset shows the addition of the voltage regulator. The power leads from the locomotive's batteries are not yet connected to it.

Since the motor controller requires a variable voltage for controlling the speed of the motor, and the simple receiver circuit only provides on-off signals, I designed a circuit with three independently variable speeds. The yellow variable resistors ('pots') accomplish this; one sets the base speed, which is chosen when the speed lever on the transmitter is in mid-position, and the two other pots either lower the speed or increase it, depending on which way the transmitter's lever is moved. Simple, but it works!

The red points on the diagram show the connections to the rest of the electronics. I have not included any further instructions on how to connect a motor controller since there are different models. All have at least a speed input and connections for battery voltage and ground while

some models have additional features, such as brake and lock inputs, output for a brake light, etc. Do follow the manufacturer's instructions since a wiring mistake can 'fry' the electronics!

I installed all the components in a new control panel or ‘dashboard’, if you so wish. Photograph 13 shows, from top left going towards the right, the main switch and the ‘ignition key’ under it – most electric scooter controllers have a ‘key switch’ input and it’s a good idea to use it; one time a 4-year old started the original ‘Quickie’ without permission, causing it to run away and collide with my steam locomotive. Fortunately neither locomotive was damaged, thanks to the low speed. But now, with a more powerful motor, a safety lock is mandatory!



Continuing from the ignition key there is a combined volt and ampere meter, showing battery voltage and motor current, and below it a couple of sockets for charging the two batteries, and their individual voltmeters. Then the two white-capped 'pots' used for setting low and high speed, the direction switch (never throw it while the locomotive is in motion!) and an arrowed knob for the 'base speed' pot. Under these there are four LEDs that indicate the state of the receiver outputs – they are all indicated on the circuit diagram in figure 2.

The panel (photograph 13) is cut from $\frac{3}{16}$ " thick acrylic sheet, easily drilled and milled (use sharp bits and a high speed!), then sanded with fine emery paper in the horizontal direction only. This provides a nice, matte sheen that doesn't smudge or take fingerprints as easily as the shiny, original acrylic surface.

Under the panel, three large holes are drilled in the plywood. These allow cables from the motor controller to be connected to the fuse box, containing a main fuse of 25 amps, a motor fuse of 20 amps and a couple more fuses for the horn and the electronics. The third hole is for the yet-to-be installed receiver antenna.

In photograph 14 you see the back of the control panel. The little perforated prototyping board, right under the pots and direction switch, contains the reed relays as well as the LEDs and their resistors. The receiver board is barely visible in the shadow under it, partly hidden by a piece of plywood protecting the battery connectors. The motor controller box is totally hidden behind the plywood. When building, one must always be careful to avoid short-circuits and use sturdy wires for the high-current circuits.

RIGHT PHOTOGRAPH 13

The acrylic surface of the new control panel is sanded to a matte finish. The digital meters show battery voltages and motor current.



RIGHT PHOTOGRAPH 14

The rear side of the panel. Note the thick wires needed for the high motor current – almost 20 amperes! The motor controller (a black box) is completely hidden behind the plywood.



BELOW PHOTOGRAPH 15

This young engineer thinks he is running the locomotive himself but his father is actually controlling the engine. Since the new motor can provide a speed of over 10mph this is a trick worth remembering!



Photograph 15 shows a little trick that may be necessary when a young engineer absolutely insists on controlling the engine all by himself: give him a 'dummy' remote without batteries, and sit behind him, controlling the loco with your own remote – which does contain batteries! (Now you know why I bought two toy cars...) In this way, you can provide pleasure to the young 'driver', while you are yourself ensuring safe running and stopping – and a low enough speed!

All in all, I spent only 48 hours in the workshop and hardly any money building this locomotive in its first incarnation and only a few more evenings to modify it with the stronger motor and radio control. The pleasure it has provided is immense, both for the kids who run it and for me, when I hear their laughter and watch their smiling faces.

A small locomotive like the 'Quickie' may seem like a toy but it is heavy and can be dangerous if handled improperly. Children do not always understand this. Although the speed is low, inertia is high and even a small accident may cause painful damage to a child's fragile limbs.

Always remember the Live Steam motto:

SAFETY FIRST!

Always instruct the children in the proper use of the equipment and make sure they understand and follow the rules.

Instruct the driver to stop immediately if anything unexpected happens.

Never let children play alone with the equipment! A responsible adult must always be present. If there are many children several adults should also be present and alert.

If a very small child runs solo an adult should always walk beside the train all the time.

Do not let children walk on the track or beside a moving train. They may stumble and fall. No running at the track site at any time! Nevertheless, keep your site free of obstructions and sharp objects.

Never let someone get in or out of a car until the train has come to a complete stop. With children riding, this should only be at the instruction of an adult.

Riders must always sit securely in the cars. Do not let them lean out, pick up objects, etc. Explain that a car may tip over or derail if they do not follow this rule.

If a child misbehaves take him/her off the train immediately, while the others may continue riding. The lesson is quickly learned!

Following these simple rules, outdoor railroading can be a safe, fun and satisfying hobby for children and adults alike. ■

HAPPY RAILROADING!

PHOTOGRAPH 16

The most glamorous 'Quickie' driver; our summer neighbour, Swedish actress Josephine Alhanko (who was crowned "Miss Sweden" in 2006, but is now a Mrs.) enjoys a ride with her son. Fun for everyone!



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Building the LNER/BR Y4 in 5" Gauge

Doug Hewson discusses the manufacture of the firehole doors and offers a pair of sliding doors as an alternative to the prototypical drop-down door

BY **DOUG HEWSON** CONTINUED FROM PAGE 140 OCTOBER 2016

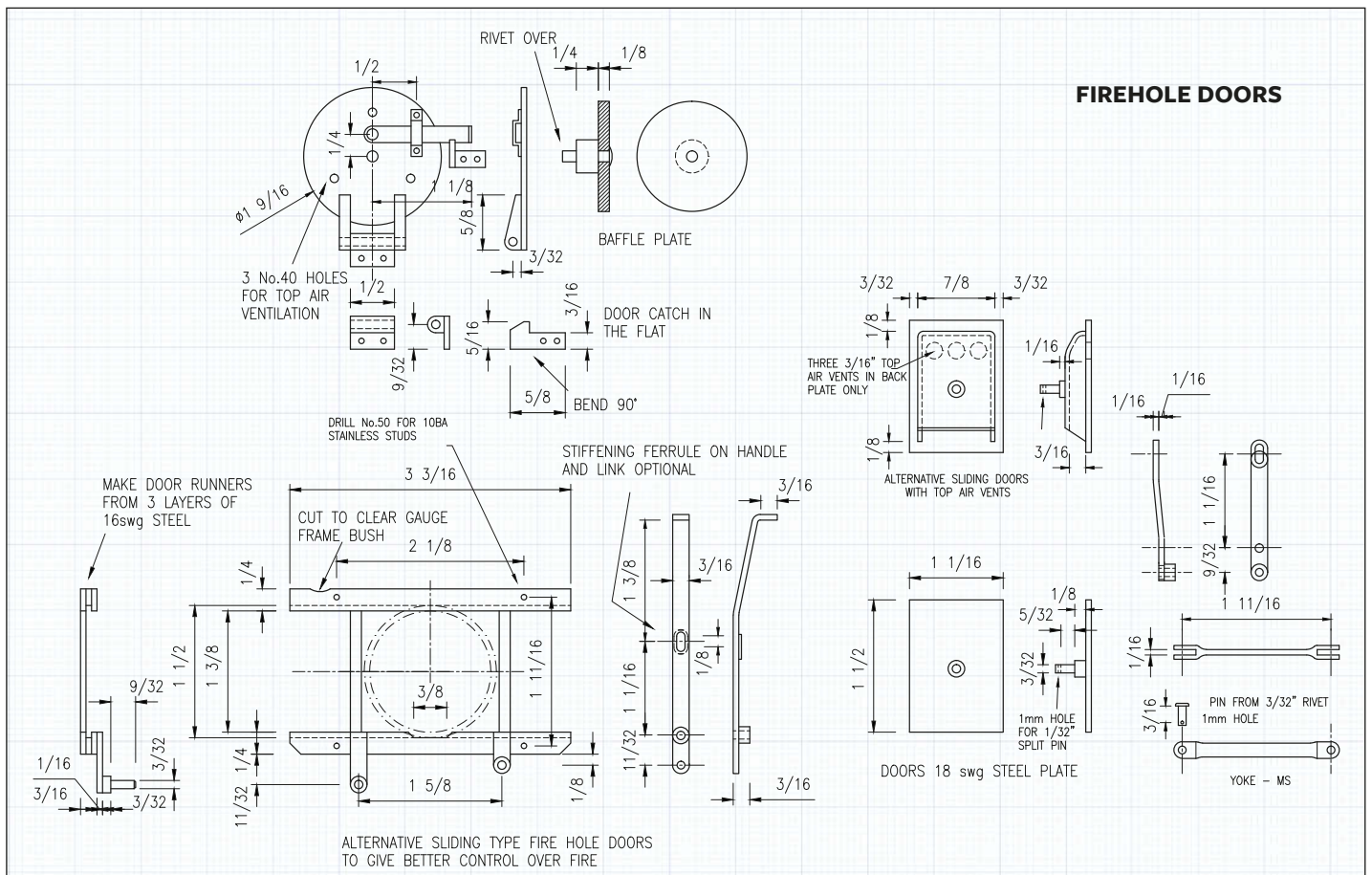
We can now press on with making the firehole doors but before we begin we need a few words.

Firehole doors are not just a plate (or plates) to block the hole up but on the slightly more sophisticated locomotives they are one of the main tools for controlling the fire. If you have good firehole doors you need never see the locomotive blowing off. One often sees people driving round completely oblivious to what the safety valves are doing but who just keep shovelling in coal relentlessly and do not seem to realise that a lot of the coal and water is going straight up the chimney. I

think that they think it is all part of the scene but a good driver will never let the safety valves blow if matters on the footplate are all in order. If you keep an eye on the pressure gauge, as any good driver should, then when the needle is approaching the red line, that is the time to crack the firehole doors open and if the needle continues to rise then bang the injector on for a couple of minutes. Either way this will cool things down. If the engine is working hard the way we work ours then just turn the injector off or shut the doors otherwise you will find that the pressure drops too quickly and then you could soon be in trouble with a lack of power.

A PAIR OF SLIDING DOORS

When I built my first Y4 I decided to make some sliding doors as they are very controllable and if I am making a bit too much smoke one can just crack the doors and the smoke will soon clear. The problem with that is that I love to see some smoke and I normally use a mixture of Welsh steam coal and some lovely smokey stuff from the last working private mine in the Forest of Dean (just up the track from Cannop Ponds stone works). They always seemed pleased to see someone when they finish their shift at 3ish and I love to go and have a good natter with them. Last time I went there they were using the digger to clear up and at the rear end there was an

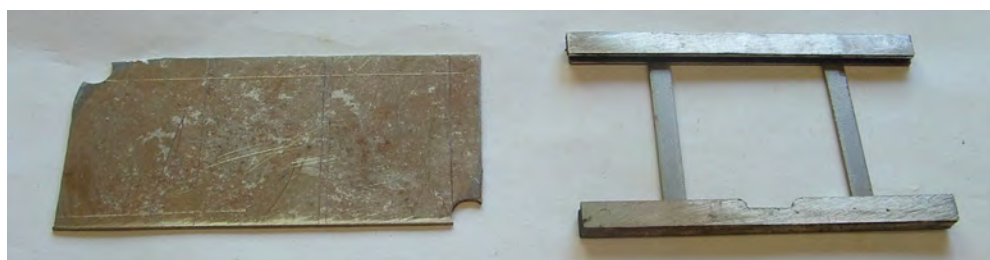
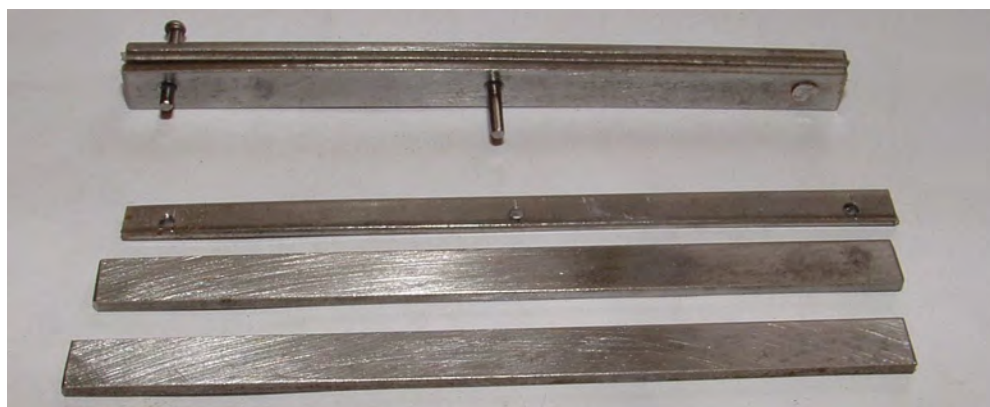


open toolbox with a Grey Wagtail's nest in it. One of the birds was sitting on the eggs and just riding around the yard peeping out to see what was going on and seemed totally unconcerned.

Anyway, to get on. From the works drawings which I have it looks as if the Y4 had a drop down door but there was no ratchet on it for adjustment so for my purposes I abandoned that. For this engine I have once again chosen to fit the sliding type doors which are infinitely adjustable. I have shown three drawings showing different types of door; one is the drop down type, one is a pair of simplified sliding doors and the latter is a slightly more sophisticated sliding door similar to the GWR and LMS ones which have top air vents in the backplate which I think are very important to achieve full combustion of the coal. Both of these types are hollow and are open at the bottom to create an air vent. In the backplate there are three $\frac{3}{16}$ " drillings for the top air vents. On the backplate of the LMS doors there are three louvres cast across the back.

STARTING WITH THE RUNNERS

I made a start with the top and bottom runners and these can be milled from solid but, as with my other engines, I fabricated them from three layers of 16swg steel strip. The front and rear strips are $\frac{1}{4}$ " x $\frac{1}{16}$ " and the centre piece is $\frac{3}{16}$ " x 16swg. However, you can also make the rear ones in one piece cut out of 16swg plate with the spacer pieces as part of the plate and then you will not need to worry about silver soldering top to bottom. I silver soldered the runners and cleaned them up (I had the strip handy so made mine separately). Before you go any further with the bottom runner you will need to file out a $\frac{3}{8}$ " gap at the bottom so that coal dust can not choke it up and prevent the doors from closing. Once I had the runners made I then cut the two spacers, which need to be exactly the same length of course. I checked



mine with the digital callipers. These were laid on a firebrick block and silver soldered in place. I then turned the assembly upside down and silver soldered the tabs for the lever pivots on separately. For the two pins I used one of my drilling jigs to drill the split pin holes first and then fitted them into the tabs with the two small collars on and silver soldered those as a separate exercise. The tabs will not melt off as it would take a lot of heat to do that. Just remember when silver soldering the pins in place that the pinholes need to be vertical for tidiness. This was all left in the pickle for a few minutes and then given a good clean up. No need to worry too much as this whole thing will be painted black when completed.

THE DOORS

I next turned my attention to the doors. These are just a couple of rectangles of 18swg steel plate so that they slid freely in the slides and if you are making the simple ones then that is it. However for the better ones you will then need

TOP

Here are the steel strips of two different widths which I used for making the runners for the doors.

ABOVE

The spacers for the runners and the door backplates marked out ready for cutting out.

to make the boxes to go on the front. These were also cut from 18swg plate. I began with a couple of pieces $1\frac{1}{8}$ " wide and scribed a line down each side $\frac{3}{16}$ " from the edge. These were bent down over a piece of $\frac{3}{4}$ " x $\frac{1}{4}$ " BMS bar. I then had to trim the curves down each side and bend the centre piece over a curve filed across the top end of the bar to form the top curves.

These plates were then silver soldered to the backplates and the curves filed to shape to make a nice smooth outline. It is well worth doing and does not take that long. I think I had completed the silver soldering and had them all cleaned up in about $\frac{3}{4}$ hour from the start. The last thing to do was to turn the two pins and spacers and silver solder those in place and then they can be cleaned up again.

HANDLE AND LINKS

For the handle and the right-hand link I have shown an alternative reinforcing plate over each oval hole where they drop over the operating pins. Once again it is not absolutely essential to fit these but if you do they will last a lifetime. I used some $\frac{3}{16}$ " x 16swg strip



LEFT

Ready for silver soldering the bottom tabs in place without the pins.

CENTRE

One of the front plates now formed ready for silver soldering on to the backplate.

RIGHT

The two doors and the handle and link silver soldered with the reinforcing plates on.



**TOP LEFT**

The yoke with the fork joints bent up ready for silver soldering.

TOP RIGHT

Yoke all fluxed up and ready to go.

LEFT

Milling the little slot in the handle.

RIGHT

The job complete with doors in place. Below, the rear view of the doors showing the air vent holes in the top of the back plates.



for the handles and links as I always keep a stock of this. I usually have some cut in various thicknesses and widths by our local sheet metalwork people on a "You scratch my back and I will scratch yours" basis. They just use their scrap offcuts as it does not matter what lengths they are. I also used a snippet of the same stuff for the reinforcing pads. And these were silver soldered on. I made a No.40 drilling at each end of the slot and then (being lazy) I mounted them in the milling machine and joined the slots with a $\frac{3}{32}$ " end mill to make a lovely job. You can file them of course if you prefer. The reinforcing plates need filing into a nice annular ring around the slot, if that is the correct word!

You will also need to make some small bosses for the handle and the link to fit over the pivot pins. These are turned from a piece of $\frac{3}{16}$ " BMS bar and for these I turn them down to $\frac{1}{8}$ " diameter about $\frac{3}{32}$ " long first, to make a spigot for locating them, and then centre and drill down to about $\frac{1}{4}$ " deep with a No. 50 drill. These were parted off $\frac{1}{8}$ " long and the spigot was silver soldered into No.30 holes in the lever and link. The holes can now be drilled out No. 40 for a nice easy fit on the pins.

To make the yoke I again used a piece of the same strip as the handle and cut it about $1\frac{1}{4}$ " long. I made the forks from a piece of $\frac{3}{16}$ " x 20swg strip folded over the end on the strip. These "U" shaped pieces need to be plenty long enough so that the bends can be cut off later and to leave enough room for the pin holes. To aid silver soldering the forks in place I closed them up a little so that they had to be sprung over the yoke

strip. Once these are silver soldered on the No.40 holes can be drilled at each end then the bends cut off and filed round. To make the pins I always use $\frac{3}{32}$ " rivets but turn the heads down flat to leave about $\frac{1}{32}$ " thickness and then cross drill 1mm for $\frac{1}{32}$ " split pins.

GETTING IT TOGETHER

The doors can be slid in place, lever and link dropped over them, and then the yoke pinned on. In fact, I found that I had to pin the yoke on first as the rivet ends need to face outwards so the pins can be seen and if one falls out it is easily spotted by your fireman. You should

BELOW

I just thought you might like to see this. It is a view of the firehole doors on Foxcote Manor on the Llangollen Railway, where I spent a morning on the footplate – in fact I got a drive too which was unexpected. This shows the doors nicely and the nice fire which I had just built up for the journey back to Llangollen.

now find that the doors slide to and fro nicely and, as I say, should last well beyond the life of the engine. One mistake I did make was, in later life, I decided to make a proper little teacan shelf but the problem is I never drive on a raised track and I found the shelf got in the way of seeing the fire so it has got to go.

A drop of oil on the runners works wonders until they are run in. If you oil them in service they will attract coal dust and the little heap of coal in the middle will prevent the doors from closing. You can easily give the gap a quick clean with the shovel though.

« TO BE CONTINUED »



The EIM Steam Plant

Preparation

Before embarking on the project **Martin Gearing** explains how you can ensure that your milling machine is properly aligned and lists the materials you will need to make the engine and lubricator.

BY **MARTIN GEARING** CONTINUED FROM PAGE 111 OCTOBER 2016

CHECKING MACHINE HEAD AND VICE ALIGNMENT

The fastest method of producing flat surfaces square to adjacent faces, and parallel to opposite faces, is by using a milling machine, and in the home workshop this is almost always of the vertical type. You must ensure that the head is truly vertical to the table. This is quickly checked by swinging a dial test indicator (DTI) mounted on a 'L' shaped bar across the table to see if there is any deviation and adjusting the head until zero movement is achieved when at extremes on the X (left and right) axis and extremes on the Y (away and towards you) assuming you are standing at the front of the machine. See photograph 1.

Depending on the machine's construction the Z (up and down) axis is a function of a moving quill in the head and/or machined slides in the mainframe, onto which the knee and head is mounted, and will be at 90° to the X and Y slide ways. In the following descriptions I will be referring to a machine (generally referred to as a VMC type) with a quill in a head rotatable in two

planes, with a depth stop but with no fine graduations, and the X axis table & Y axis subframe, mounted on a knee moving the Z axis on dovetail slide ways in the front of the machine frame. The X, Y and Z slides all have graduated dials. All references to 'setting feed dials' to zero is of course equivalent to 'push to zero' for those lucky enough to have a DRO (Digital Read Out)!

If you have a machine with the X axis table and Y axis subframe located on a fixed base and column with the Z axis movement provided by the head moving on the main column, you will have to amend some of the instructions.

Before any metal can be cut the means of holding it has to be set true to the milling machine table. In almost all cases this will take the form of a milling machine vice having a fixed jaw on the body that is secured to the table bed by means of "T" bolts that locate in the slots in the machine table. Machined into the body of the vice are slides that accurately guide the moving jaw at 90° to the fixed jaw by means of a feed screw.

It is customary to align the fixed jaw parallel to the X axis (left and right movement), and this is done by using a DTI with its base mounted firmly to a convenient part of the machine head or frame, and the vice mounted onto the table with the fixing bolts lightly secured. The table is then moved so that the fixed jaw passes the stylus of the DTI. Any deviation from parallel will show up as movement on the dial. This must be reduced to zero by moving the vice body as necessary by tapping the body – always remembering to lift the stylus. This is so that the shock of the tapping doesn't damage the mechanism of the DTI. Tedious though it may seem at first, the time spent in achieving zero will be repaid in the accuracy achieved in all of the work held in the vice from now on.

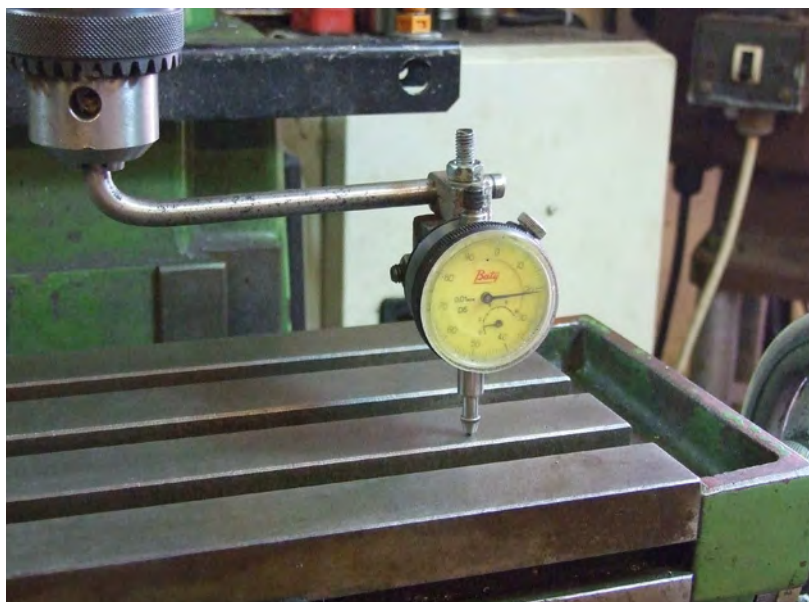
When no movement on the dial gauge results after passing the stylus the full width of the vice jaw with the securing bolts fully tightened, you are ready to make a start. The fixed jaw becomes your vertical reference at 90° to the bed of the vice within the inherent accuracy of the vice. See photograph 2.

BELOW LEFT PHOTOGRAPH 1

Checking the milling spindle is truly vertical to the table.

BELOW RIGHT PHOTOGRAPH 2

Checking that the vice fixed jaw runs parallel to the X axis.



GETTING THE MATERIALS YOU NEED

The following lists give:

- 1 A metal cutting list
- 2 A sundry items list

Noggin End Metals have agreed to make a pack (ask for the EiM Steam Plant metal pack) to cover the bulk of the materials required at a very reasonable cost, and will be found a great help if you are starting out and don't have 'preferred' suppliers or dad's workshop when he's out!

The sundry items list includes suggested suppliers and some alternatives.

The mix of metric and imperial dimensions has been brought about because I've tried to obtain the lowest cost from a single source, which makes the whole fag of getting all the materials required very much easier and with a discount. I'm sure there are few that find pleasure in going to 60 different suppliers for 60 different items, and this would be extremely dispiriting for a beginner starting out with little or no stock of material.

The original steam plant was well under way during the negotiation to supply a materials pack for the construction; an effort to get the best value for money and the convenience of a 'One-Stop Shop' is the reason the more eagle eyed reader will notice some of the materials suggested are different from the ones in pictures of the steam plant. Any changes have been considered carefully and only accepted as equal or an improvement to those pictured.

Most of the additional sundry items are also available from either of the two suggested suppliers.

I'm bound to say that I have no connection with any of the suppliers other than that of a very satisfied customer over several years. ■

ADDRESSES

■ **NOGGIN END METALS,**
Rear of Unit A5/A6, Industrial Estate,
Sneyd Hill, Stoke-on-Trent ST6 2EB

■ **BLACKGATES ENGINEERING,**
Unit 1, Victory Court, Flagship
Square, Shaw Cross Business Park,
Dewsbury WF12 7TH

■ **POLLY MODEL ENGINEERING,**
Atlas Mills, Birchwood Avenue,
Nottingham NG10 3ND

■ **CUP ALLOYS,**
Unit 36, Matrix Business Centre,
Nobel Way, Dinnington,
Sheffield S25 3QB

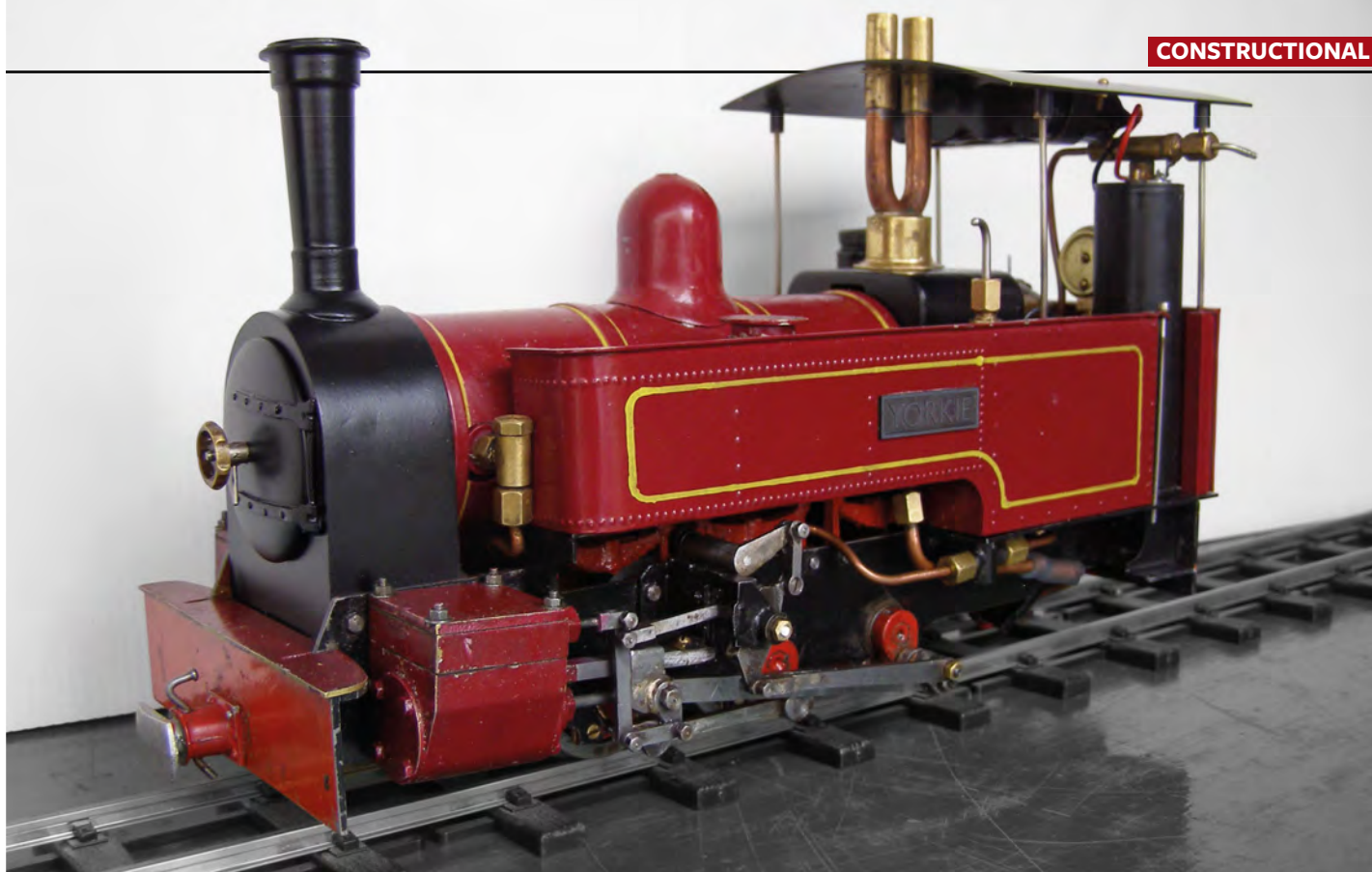
DOUBLE ACTING OSCILLATING ENGINE & DISPLACEMENT LUBRICATOR - METAL REQUIRED

(All in metal pack supplied by NOGGIN END METALS 01782 865428)

Ref.	Material	Section	Dimensions	Notes
2,12-15	Cast Iron	Cont. Cast Rnd.	Ø 35x4"	Cyl. parts, bearing
19	Cast Iron	Cont. Cast Sq.	50x50x1"	Port block
20	Cast Iron	Cont. Cast Rnd.	Ø 25x1"	Piston
3	Cast Iron	Cont. Cast Rnd.	Ø 75x1"	Flywheel
7	Brass CZ121	Round Bar	Ø 6x12"	Reverse valve lever
4	Brass CZ121	Round Bar	Ø 10x4"	Thrust, fixture
DL	Brass CZ121	Round Bar	Ø 12x6"	Disp. lubricator
11,12B	Brass CZ121	Round Bar	Ø ¾"x6"	Reverse valve, gauge
DL	Brass CZ121	Hexagon Bar	8AFx4"	Disp. lubricator
DL	Brass CZ121	Hexagon Bar	10AFx4"	Disp. lubricator
DL	Brass CZ121	Hexagon Bar	½"Afx4"	Disp. lubricator
1	Brass CZ121	Flat Bar	¼"x2"x4"	Base
12E	Aluminium	Round Bar	Ø 1¼"x4"	Cover fixture
Various	Aluminium	Round Bar	Ø ¾"x6"	Turning fixtures
18	Bronze LG2	Round Bar	Ø ½"x1"	Big end
DL	Copper Tube	Round Tube	Ø 7/16"x4"	Disp. lubricator
21	Stainless 303	Round Bar	Ø 1/16"x12"	Pins
18	Stainless 303	Round Bar	Ø 3x12"	Scratch stick, RV stud
6	Stainless 303	Round Bar	Ø 4x12"	Piston rod
19	Stainless 303	Round Bar	Ø 8x12"	Filing buttons
17	Stainless 303	Round Bar	Ø 1½"x1"	Crank disc
5,6	Silver Steel	13" Length	Ø 4x13"	Piston rod and pin
4	Silver Steel	13" Length	Ø 5x13"	Crankshaft

Double Acting Oscillating Engine & Displacement Lubricator - Metal Required Sundry Parts List

Item No.	Description	Notes	No. Off
Blackgates Engineering www.blackgates.co.uk 01924 488888			
Polly Model Engineering www.pollymodelengineering.co.uk 0115 9736700			
Various	Loctite 638	High strength retainer	1
28	BS007 'O'-ring	Piston rod seal	1
27	BS013 'O'-ring	Piston seal	2
26	Grub screw	M3x5 socket head	1
25	M3 nylock nut	Reversing valve stud	1
24	M4 nylock nut	Cylinder pivot stud	1
23	M3x12 set bolt	Cylinder head	9
22	M3x12 set bolt	Cylinder rod end cover	9
20	M3x12 set bolt	Cylinder head plug	9
DL	Silver solder	Ø0.7x600 Silverflo 55	1
DL	Flux	EasyFlo powder 50g tub	1
CuP Alloys www.cupalloys.co.uk 01246 566814			
CUP1	Silver solder	Ø0.7x600 455	1 Pack 5
CUP2	Flux	EF flux 50g sachet or 250g pot	1
CUP3	Cleaning salts	Non-toxic 100g (optional)	1
Local hardware store/plumbers/builders' merchants			
LS1	Wire wool	Medium wire wool	1
LS2	Abrasive paper	120 Aluminium Oxide - roughing	1
LS3	Abrasive paper	180 Aluminium Oxide - finishing	1



'YORKIE' – A Yorkshire Engine Company 0-6-0 Locomotive in 16mm

This month **Malcolm** and **Derek** bring 'Yorkie' to a state of near completion

BY **MALCOLM HIGH** AND **DEREK CROOKES** CONTINUED FROM PAGE 127 OCTOBER 2016

FOOTPLATES

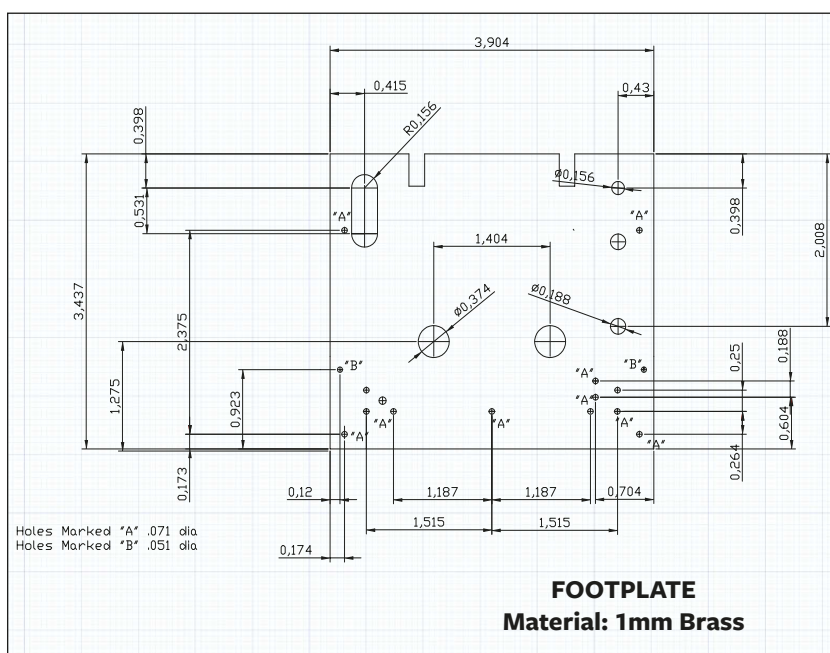
There are a couple of platework items to complete. The cab footplate is a piece of 1mm brass. There are a number of holes to drill in this as shown in the drawing. It is bolted to the rear horizontal plate on the buffer beam. There is also the front footplate to make which attaches to the corresponding plate at the front of the locomotive. Neither of these should cause any problems.

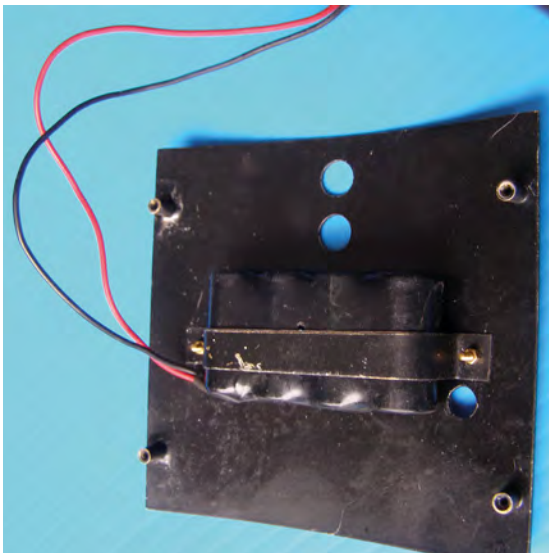
ROOF

The roof is another piece of 1mm brass formed as shown in the drawing. Holes are required for the safety valve exhaust pipes and the gas filler. You can leave the latter out if you wish but it means removing the roof every time you have to fill the gas tank. It is connected to its supports by four sockets as shown

ABOVE

A whole Yorkie – after this instalment yours should look a bit like this bar the paint and pipework!





in the drawing. These are a simple turning job and can be attached to the roof with soft solder. If you are going to use radio control the batteries will end up in the roof as we could not find any other position for them. This will be covered in a later article.

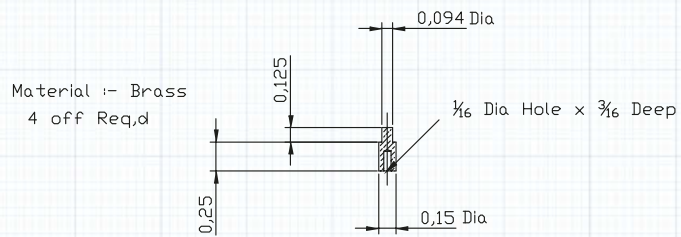
The roof is supported on four $\frac{1}{16}$ " diameter rods mounted in $\frac{3}{16}$ " square brass as shown in the drawing. Start by cutting four pieces of brass bar to approximate length then face off to final length in the lathe. If you have a self-centring four-jaw chuck that is ideal otherwise you will have to centre it manually. One end of the rod is tapped 10BA to accept the bolts that hold it to the footplate and the other is drilled $\frac{1}{16}$ ". It may be that you can only get 1.5mm diameter stainless rod for the uprights. If this is the case drill 1.5mm. Now mark out, drill and tap the 10BA cross holes. These attach to the cab plates so if you have the laser cut parts these can be used as a template. Finally cut the stainless rod to length and Loctite it into the holes in the ends of the brass bar.

ABOVE

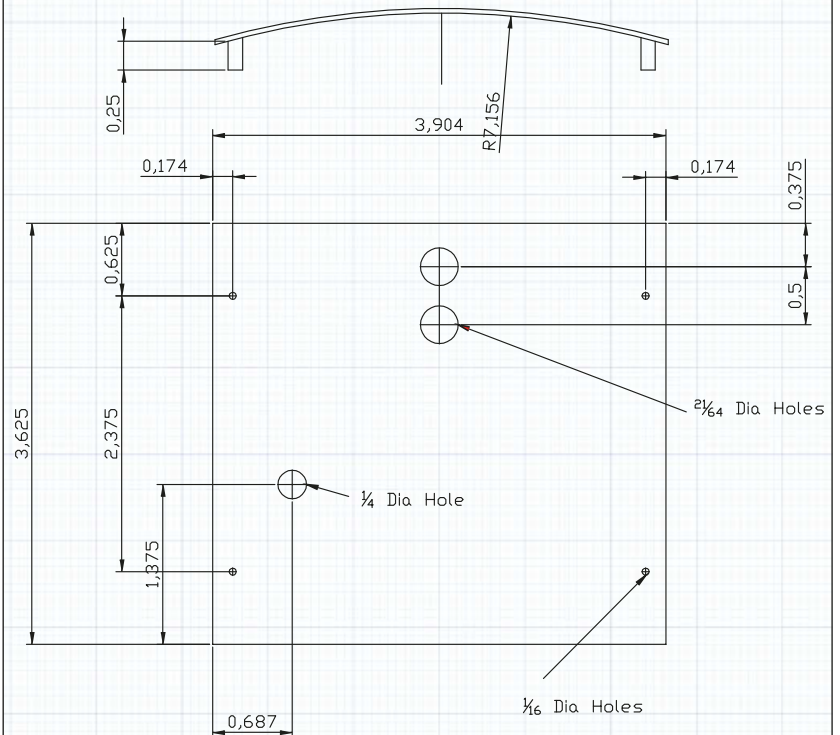
Roof showing the position of the battery pack if you have radio control.

BELOW LEFT ERRATUM

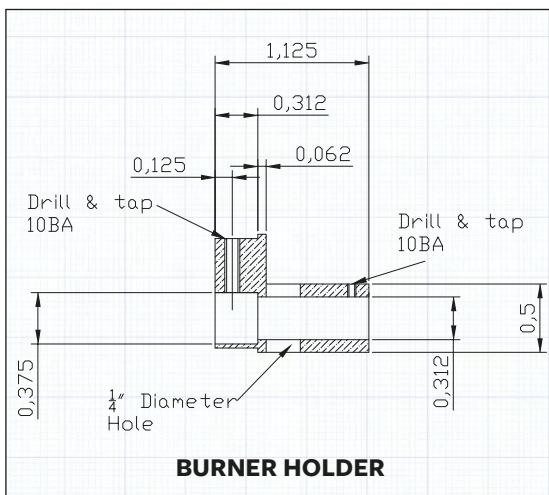
We need to include an erratum for the September issue. On the burner holder drawing the hole is shown in the wrong place and we have taken the opportunity to improve it by adding a 10BA fixing hole. Thanks to Alan Smith for noticing the error. We have built many of these holders before but somehow on this occasion the drawings have got mixed up.



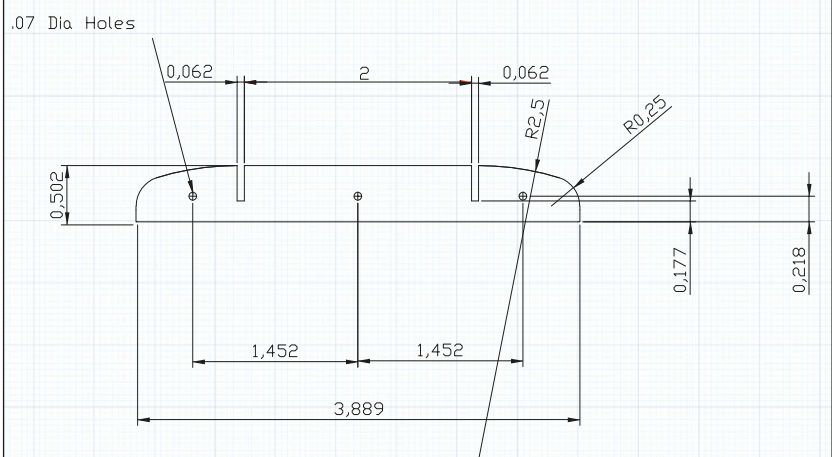
CAB ROOF SUPPORT SOCKET



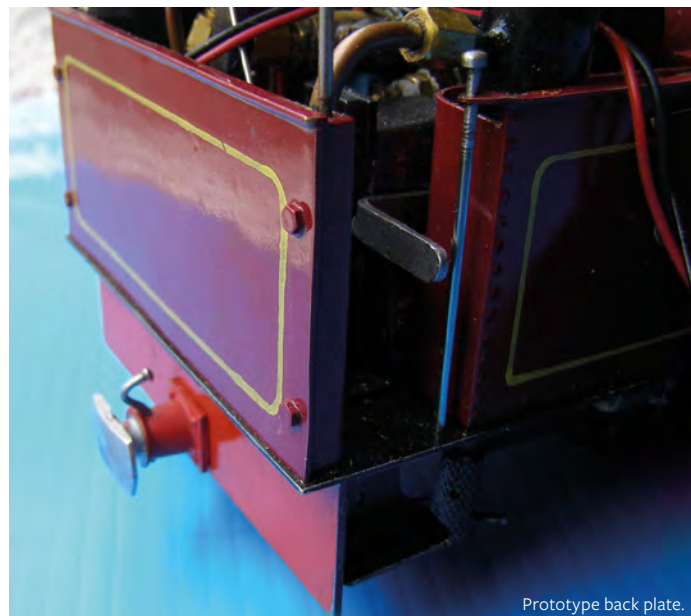
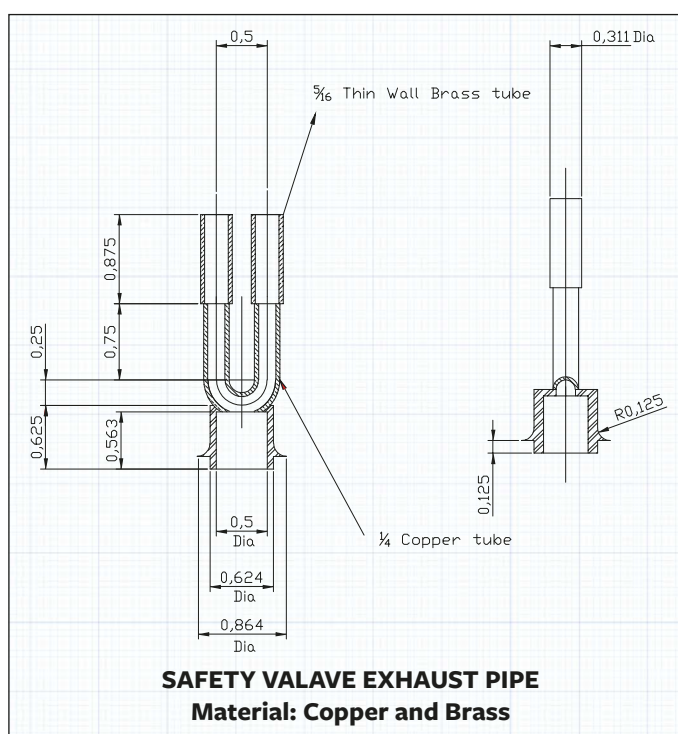
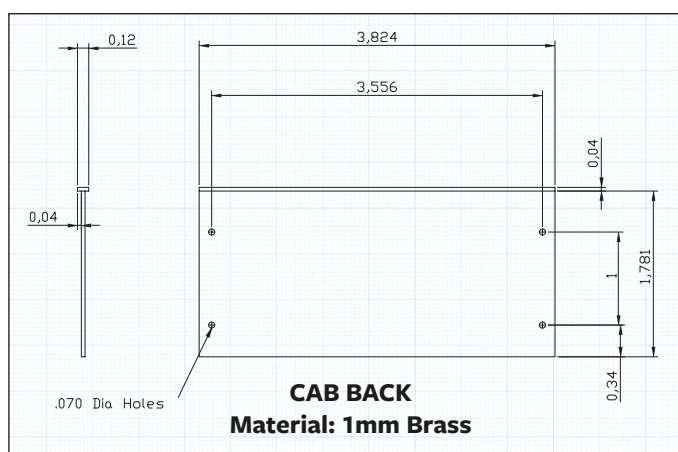
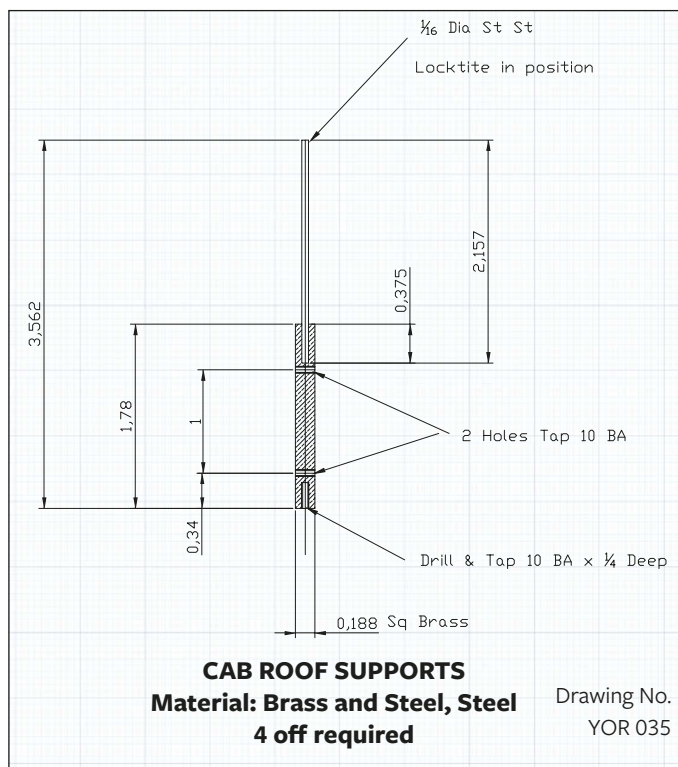
CAB ROOF
Material: 1mm Brass



BURNER HOLDER



BUFFER FOOTPLATE
Material: 1mm Brass



CAB BACKPLATE

The backplate is another piece of 1mm brass. It is not known if there were any rivets in this plate so it has been left blank. If in the future this information becomes available then the correct rivet pattern can be produced. The only real difficulty on the backplate is the narrow strip that sits on the top. If you are using the laser cut parts the strip has slots in whilst the backplate has corresponding tabs. This ensures the joint is not only strong but that the top plate sits centrally along the backplate. The backplate has two of the roof support sections bolted to it and these in turn are bolted to the footplate, thus fixing the backplate in position.

SAFETY VALVE VENTS

The safety valve vents through two pipes which go through the roof. Start by turning the base from a piece of one inch diameter brass. The pipes are made in two sections. The bottom section is a piece of 1/4" copper tube formed as shown. To stop the tube collapsing when being formed it can be filled with lead or soft solder. Melt this down and pour into the tube sufficient to fill the section being formed. Alternatively obtain some round plumbers solder that will go into the tube and make a slight bend in the tube where the final bend will be. Thread the solder into the tube and melt it with a small blow torch so that it fills the area you have bent. Once formed heat the tube again and allow the lead or solder to flow out. Alternatively make a steel former out of a piece of one inch diameter bar. Cut a groove in the bar to accept the copper tube such that the inner diameter of the bar is now a quarter of an inch. Anneal the copper tube and gently form it in the jig. On completion the bottom of the radius will need removing in order to silver solder it to the base you have already turned. Cut the copper to length and soft solder in place the two pieces of brass tube to complete the safety valve vents. Note how these need to line up with the two holes in the roof.



« TO BE CONTINUED »



Bristol Model Engineering & Model Making Exhibition 2016

BY JOHN ARROWSMITH

The theme of this year's exhibition was the 175th Anniversary of the GWR Swindon Works and a number of clubs entered into the spirit of this with some excellent displays of GWR locomotives in different gauges. This well-balanced show had just about every conceivable type of model on display either complete or under construction. There was even a full size example of a Spitfire Merlin engine on display – who can ever forget the amazing miniature working model by Barry Hares a few years ago.

The most comprehensive array of models was provided by the host club Bristol (photograph 1 – above), which covered the main range of popular GWR locomotives plus a good number of other models, all of which showed exemplary workmanship and skill. The selection of GWR models was just too large to describe every one but the 4700 2-8-0 model in 5" gauge by Graham Hawkins at the front of the line-up will give you a flavour of the overall quality. A fine MK1 coach in 5" gauge built by John Huggins, in chocolate and cream livery, was another example of Swindon rolling stock (photograph 2). A superb Lancashire & Yorkshire 0-6-0 class goods engine was beautifully finished and presented (photograph 3) and a couple of horizontal stationary engines, including a Galloway's Non Dead Centre engine (photograph 4). A really fine example of a Skeleton Clock to the John Wilding design by Phil Bridgeway added diversity to the display.

A good selection of GWR prototypes came from the Westland & Yeovil District SME including King class locomotives in both 5" and 3½" gauges and a 5" gauge old-style County Class 4-4-0 as well as others under construction. A nice display by the Taunton SME included an impressive American 5" gauge Washington 4-4-0 built by Phil Mortimer (photograph 5). A couple of private entry traction engines showed up the difference in scale between the engines. The 6" Burrell convertible is under construction by Richard Lunn while alongside it stood the 4" McLaren owned by Ross Hopkins (photograph 6). A very well made 6" scale Foden Steam Lorry stood out in the centre of the hall. Not quite complete, it was nevertheless an impressive model (photograph 7). In complete contrast to the steam lorry, the Woodspring Model Sailing Club had a wide range of large sailing and motorised boats on display.



Photograph 2



Photograph 3



Photograph 4



Photograph 5



Photograph 8



Photograph 6



Photograph 9



Photograph 7



Photograph 10

The I/C Engine Builders Group always have a good range of excellent models on show and this year was no exception. The new freelance Opposed Twin Cylinder Supercharged 2-stroke engine built by Tom Pasco was typical of the quality of models being exhibited. This 42cc engine will turn a 24" x 10" propeller with ease via a 0.702:1 reduction gearbox. A 1/3 scale Gnome 9 cylinder Rotary Aero engine was a glorious example of the type (photograph 8). Continuing with the i/c engine theme the Rolls Royce Heritage Trust displayed a sectioned version of a V12 Merlin Aero engine along with a variety of other full size engine details (photograph 9). David Everet displayed an unusual engine in the form of a 1/3 scale Baker Monitor 4hp Hit & Miss Engine. Quite a large selection of exhibits was presented by the Air, Water and Land Model Group which included hovercraft, MTB's, fire engines, trucks and an variety of other interesting vehicles (photograph 10).



Photograph 11

Meccano is always a popular feature of this exhibition and this year the South West Meccano Club produced a large display of this old-style modelling system. A large garage with petrol pumps and period cars combined well with a miscellany of other exhibits such as a guitar, fairground rides and a traction engine, all under a large gantry including the five Olympic rings. On the Society of Model and Experimental Engineers (SMEE) stand Jake Sutton showed the latest progress on his 2-2-2 Lady of the Lake locomotive, which is coming along nicely and showing some first class workmanship (photograph 11). Other exhibits included a 3D Printer and various quality tools which clearly demonstrated the range of skills among the membership of this long established society.

The Old Locomotive Committee (OLCO) presented the popular 'Lion' locomotive in a range of gauges. 'Lion' is a fascinating engine to see in action and on display were examples of engines both complete and under construction. John Swindlehurst's 7½" gauge chassis incorporates a number of his design modifications including inside Stephenson's valve gear. The group are also seeing an increase in membership which is encouraging. A very attractive working layout by the Severn Mendip 16mm Group provided some colourful action for visitors to appreciate. "Mendip Vale" represents the junction of two narrow gauge lines which provided plenty of scope for a variety of motive power and rolling stock. A varied display by the National 2½" Gauge Association showed off what this gauge of modelling can offer. As usual the Guild of Model Wheelwrights presented a colourful range of superb models including a simple but fascinating Roman Cheiroballistra.

The West Huntspill MES featured a very nice example in 5" gauge of the GWR 'City of Truro' 4-4-0 as their centre piece. The display also included a 3½" gauge model of a GWR diesel railcar which is not commonly modeled. Another good range of GWR prototypes came from the Stroud SME and included a 5" gauge Manor and a 3½" County along with a couple of Panniers and a 1400 auto tank (photograph 12). If model warships are your main interest then the Surface Warship Association was the stand for you. A fine array of naval power was demonstrated with plenty of quality and detail (photograph 13). The Best in Show display was by the East Somerset Society of Model Engineers which presented a comprehensive selection of models including a rare Pooley Weighing Van complete with internal crane in 5" gauge (photograph 14). The Stirling Engine Society always provide a large active working display of these intriguing machines, which really do catch the attention of visitors. Some are simple low-powered devices whilst others are quite large experimental machines demonstrating a number of different mechanisms.

There was also a wide range of individual entries which included an extremely well made example of a bandsaw circa 1870 built by Tom Polatch and a lovely 5" gauge Somerset & Dorset 7F 2-8-0 built by Melvyn Marshman which caught the classic profile of these distinctive locomotives (photograph 15). The outside activities were



Photograph 12



Photograph 13



Photograph 14



Photograph 15

somewhat curtailed by the heavy rain showers whilst I was there but I did catch sight of a couple of intrepid steamers driving their engines to the strains of music from the street organs located in the car park. Well, that just about sums up my brief look at the Bristol MEX. I am sorry if I have not given you a mention but as always space is at a premium and rest assured your contribution, in whatever way, was much appreciated by both the organisers and the many visitors – thanks on their behalf for all your efforts. ■

Building the LNWR Coal Engine in 5" Gauge

Hotspur details the construction of the cab steps and the fitting of the entry stanchion rails

PART 9 – CONTINUED FROM PAGE 134 OCTOBER 2016

CAB STEPS

The back plate for the steps is made from $\frac{1}{16}$ " mild steel and is such a common feature of the earlier smaller LN&WR engines that a laser cut profile is available from my Lady of the Lake design. As the running board height for the 2-4-0 'Jumbos' is the same this plate will also apply to them. I have included the drawing of the back plate here and it shows the early version with steps that were just simple plates riveted on. However, later locomotives had a strengthened version which could have been a casting or more likely a welded construction.

I have fabricated these later steps by adding strips of 1mm steel but firstly we need to notch the top corner of the back plate. My drawing and picture shows the detail required to fit it under the running board against the end of the drag box plate and under the gusset that was silver soldered into the corner of this formed plate. The final fit of the steps needs to be level with the end of the dragbox and behind the valance bar.

The first task is to attach a bracket to the rear of the back plate using high temperature silver solder. This stage will allow the additional more usual silver soldering to be carried out without any risk of the brackets falling off. Bend the bracket from 18SWG steel $\frac{3}{16}$ " wide to be at exactly 90 degrees and position it level with the top edge of the back plate



ABOVE

A laser cut backplate shown with the completed right hand cab steps.

RIGHT

Ensuring the strip that forms the front section of the assembly has right angled bends.

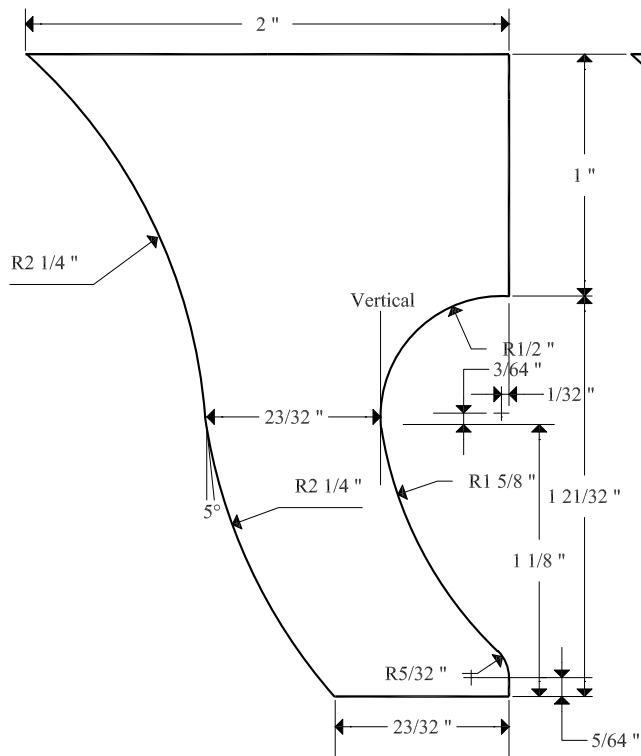
but 3mm in from the rear face. Cleaning up after the high temperature soldering is more difficult than for the lower temperature operation and I am not sure that using a citric acid solution is good enough. In my experience the dissolving of the residue can be patchy, with removal of the metal surface as well. So I think physical cleaning is best and, even though it is messy and takes longer, it avoids later disappointment.



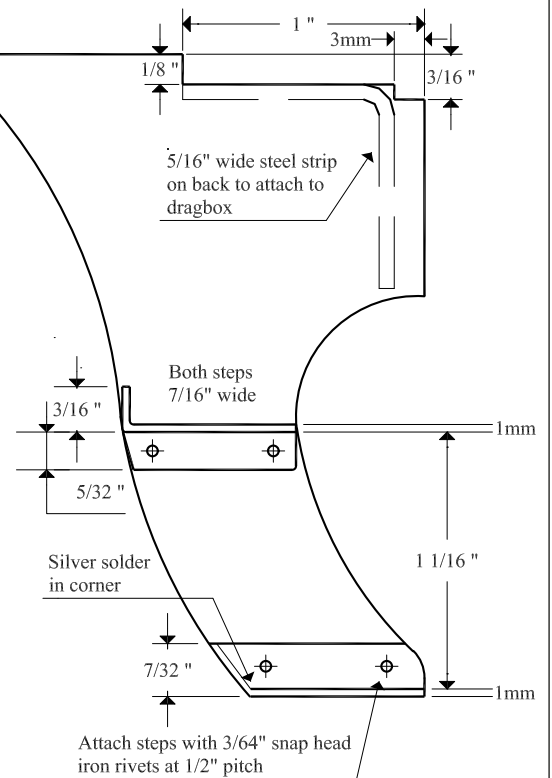
BELOW

The parts are held on a flat piece of fireproof board to check alignment and to solder the joint. Note the bent mounting strip has already been brazed onto the back face and is underneath the rear corner.

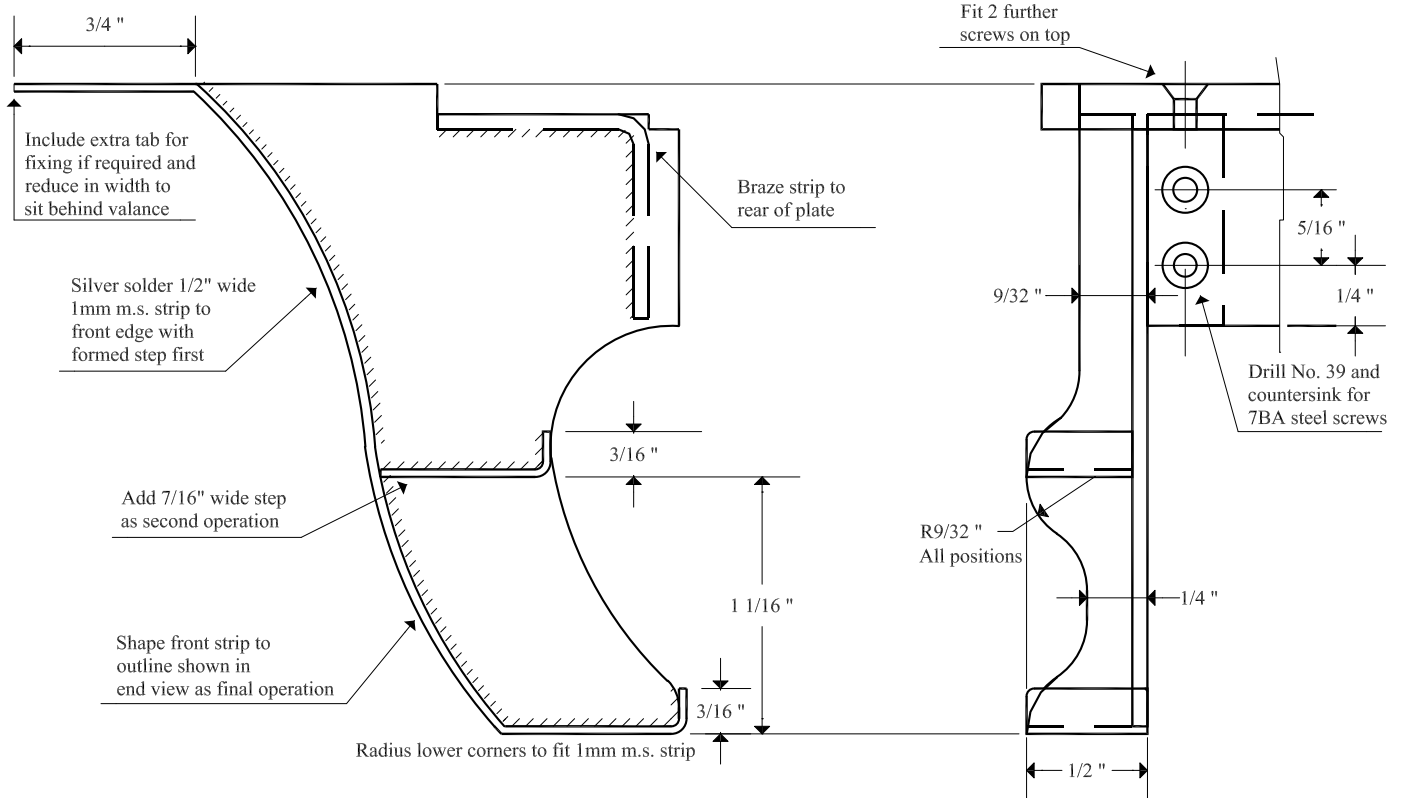




**OUTLINE OF STEP BACKPLATE
(1/16" MILD STEEL - LASER CUT)**



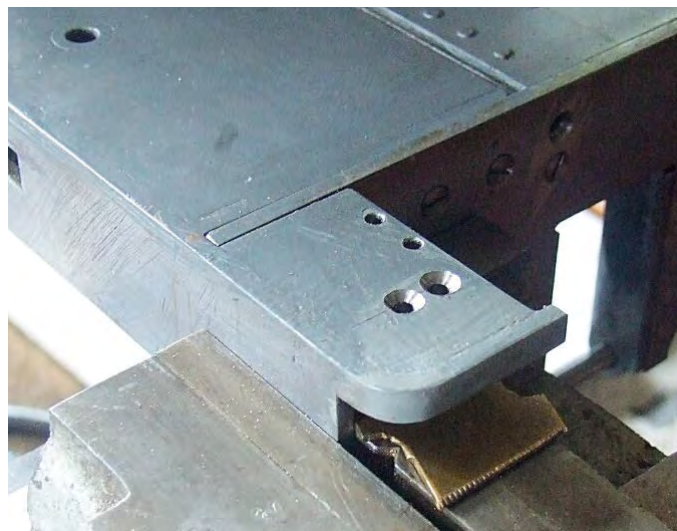
**ORIGINAL SIMPLE
PLATE STEPS**



LATER CAST OR WELDED STEPS (POST 1890'S)

**ABOVE**

The partially cleaned up assembly with the intermediate step in place for the last soldering operation.

**ABOVE**

The top fixing holes marked out, drilled and countersunk for the 7BA screws.

To begin the fabrication, take a 4" length of 1mm steel strip $\frac{1}{2}$ " wide and form the bottom step and the curved shape to suit the front edge of the backplate. When a close fit has been achieved the parts need to be carefully set up to silver solder the edge along the inside corner. Here I hope my photographs show the method I used. The last item is the addition of the intermediate step and, following a local clean-up for the joint, I found that placing the backplate at an angle allowed the part to be soldered in the correct position. Do not compromise on accuracy here and before any flux is cleaned off it is possible to re-heat the fabrication to alter the position of the step should this be necessary. Cleaning up took some time but is totally necessary before any paint is applied. Holding emery tape under the face of a small file gradually provides a bright surface and the final stage is to profile the edge of the front strip to the outline I have

drawn. This is often well illustrated in early pictures of the locomotives so it is worth looking through your books.

We can now deal with the attachment of the steps to the frame. It is necessary first to remove the cab assembly and the running boards as the steps are attached to the ends of the dragbox on each side. Fastenings can be used to secure the top and back sections of the rear support bracket. Initially, I considered using rivets to attach these steps but was concerned that if there was a mishap in service the steps would be difficult to remove for any rectification. So, mine have been attached using four countersunk 7BA screws in the rear face of the dragbox and down through the top under the running board.

When the running board is replaced the lower location hole for the cab handrail stanchion can be drilled through the plate and into the gusset in the dragbox. I found that a mark had been made in the paintwork showing the end of the cab side sheet so it was easy to mark the centre for the drilling position. A number 35 drilled hole just $\frac{5}{32}$ " deep is adequate for this task.

CAB HANDRAIL STANCHIONS

Now that we have marked out and drilled the socket for the lower end of the stanchion this can be turned and fitted. I used a length of $\frac{1}{4}$ " diameter stainless rod held in the 3-jaw chuck to initially make a centre in the outer end to be held in a tailstock rotary centre. The stanchion is nominally 4" long so the rod was held with an extra $\frac{3}{4}$ " protruding so there is a plain section beyond the lower end when the turning begins. Hopefully my photographs will show what I mean.

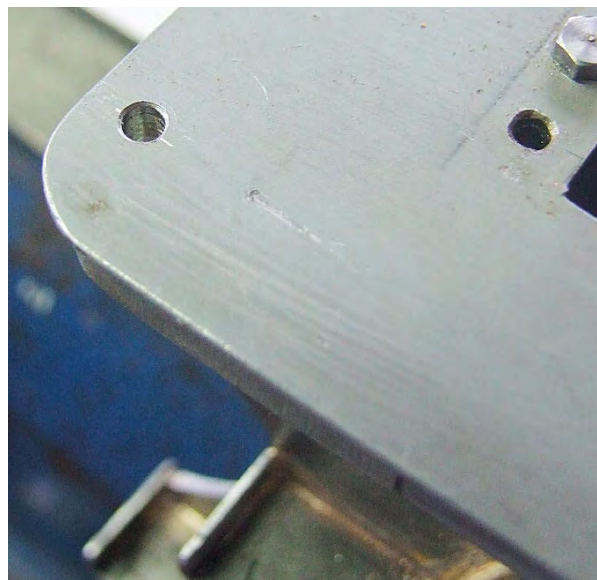
The first task is to set up the top-slide to match the angle to be turned. Unfortunately the travel of the trusty Myford slide is insufficient to undertake the task at one pass so the saddle will need to be relocated at some stage. Working out what the angle needs to be can be determined from the drawing but it is very small and, even if you do a calculation, the graduation marks on the top-slide quadrant are not very easy to interpret. It turns out to be around 1 degree of taper but this is almost immaterial. To simplify the task, consider the change in diameter required

**LEFT**

The right-hand steps in place; the two bolts on top are holding the running board through the holes used for the rear side sheet fixings.

RIGHT

The right-hand blind hole for the cab handrail stanchion; the mark left by the side sheet makes a useful centre line.



**ABOVE**

The two stages in turning the stanchion rail; a small ridge is just visible in the centre ready for final smoothing.

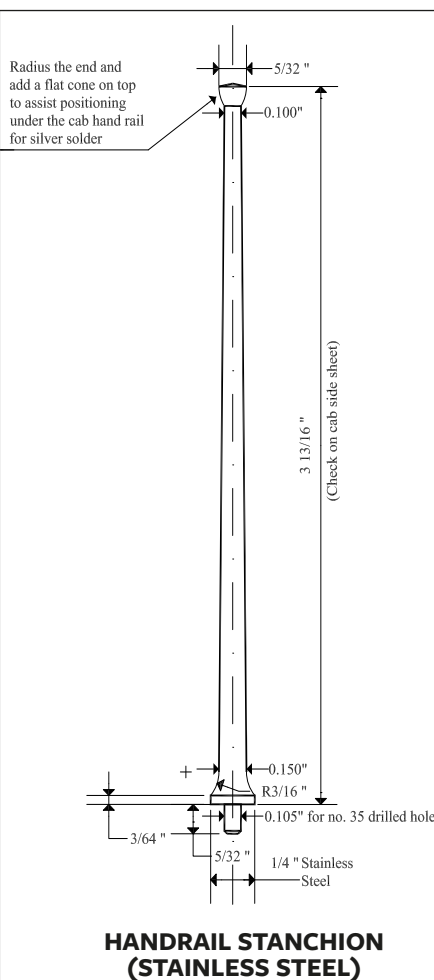
for half the length of the taper; then put a tool in the top-slide holder facing the work and put a mark on the material to show the two sections; move the topslide over and traverse the slide itself to check the change in diameter, remembering that the tool

movement will be half the diameter change. Check with slips or feeler gauges till you get it right.

Start by turning the radius at the lower end of the stanchion and make this nearest to the tailstock. It needs to be about $\frac{3}{4}$ " from

BELOW

The cab side sheet is inverted with the stanchion upright for silver soldering into a shallow countersink in the centre of the cab side rail.



the rotary centre as this will be held later to create the locating shoulder for the running board/chassis. You can use a small form tool for the radius at the base of the stanchion and run the lathe slowly with plenty of cutting oil, checking carefully with a digital or vernier gauge. Once the 0.150" reference diameter has been achieved swap the tool for one with a smaller radius and begin the taper turning, again from the tailstock end. I actually found that a longer well supported parting tool was needed to give clearance for the easy rotation of the topline handle as it is so close to the tailstock on the Myford series lathes. The lathe needs to run at quite a high speed for the best results and the tools have to be really sharp. It is not easy turning a small top-slide handle continuously (and to apply cutting oil) to avoid any 'dwells' that leave blemishes on the surface but I suggest you do not aim to remove more than 0.002-3" at a time and check once the full travel has been achieved that the taper generated cross-checks with the set up arranged earlier.

Proceed until the lower end of the stanchion has been completed, then move the lathe saddle and withdraw the rod to allow the upper half to be turned. Do not forget that the very top is a semi-ball end that fits under the cab handrail. It will be found that on such a long length the small diameter material bows away from the lathe tool and so a number of extra passes are needed to take off the 'spring'. If there are any blemishes then the judicious use of very fine 6" file can add the degree of smoothness needed and a fine emery tape will give an even finish. At this stage it is very important to check the length of the stanchion will match the height between the cab handrail and the running board before any parting off is attempted. Do this separately on each side of the cab in case of local variations.

The last operations are to turn a shoulder under the lower radius on the tailstock end and carefully create a diameter to locate in the hole in the chassis. Make this of sufficient length to cut off the unwanted stock material. The diameter of this shoulder is not critical and I made mine 0.002" smaller than the hole size. At the top, the dome section can be left slightly long and a shallow conical end created with a file. This can then be located in a shallow drilling indentation on the underside of the cab handrail.

Finally, the stanchion needs to be silver soldered to the underside of the cab rail and I have included a photograph of my set-up for the task. It does not require more than a fairly fierce pencil flame to heat the parts locally to make the joint and the task to clean it up afterwards is very quick.

Next time I will show the details for the oil boxes and the oil feed arrangement to the axleboxes.

« TO BE CONTINUED »

CLUB NEWSROUND

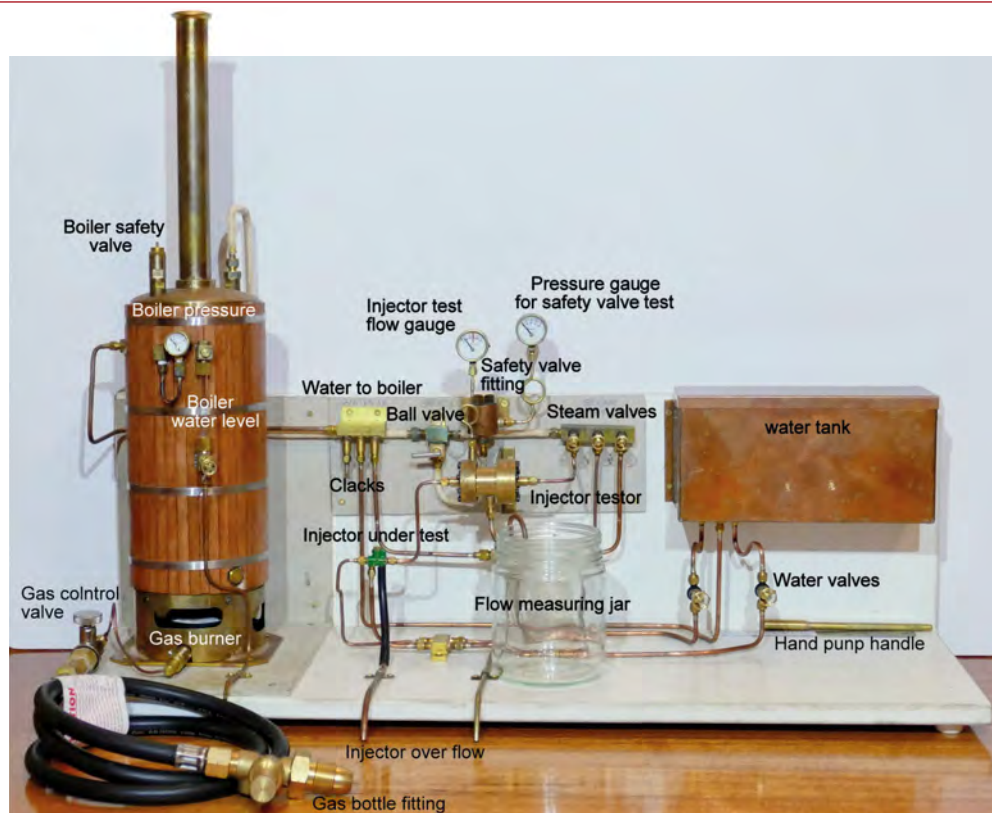


BY JOHN ARROWSMITH

Model engineering seems to be going through a bit of a transition at the moment with some clubs really progressing and building fine new track extensions and club facilities while a few others are slowing down with members and activities being reduced to a minimum. Clubs who once attracted good numbers of visiting locomotives and members to their events are finding that these days they are not so popular so they have dropped them from their programmes, along with other staples of club life like portable tracks. The older members just cannot handle the setting up and organisation any more – does this sound familiar in your club? The answer can only be to attract younger more active people into the club, not an easy task I grant you, but one that will have to be addressed if model engineering is to continue in its present form. Anyone got any good ideas on this? Lets hear them if you have! I understand that a new club has been formed in Exeter and has already had a portable track donated to them. They will be meeting at the St. Sidwells Community Centre in Exeter and I hope they will let EIM have their details in due course so that they can be included in our pages.

The exhibition season is upon us again and I hope those who visited the **Midlands Exhibition** at the Warwickshire Exhibition Centre enjoyed their visit; there was certainly plenty to see and admire. The new location of the **Model Engineer Exhibition** at Brooklands was a totally new venue and one which no doubt provided a good day out for both experienced model engineers and the casual visitor. Looking forward to January the **London Model Engineering Exhibition** at Alexandra Palace is again promising to be another fine example of all that is best in the model engineering world. I am looking forward to meeting many of you again at these events.

A Twenty Fifth Anniversary day was held at the **Belfast and County Down Railway** in June which was attended by members from a number of other clubs but, due to a mix-up in dates, not as many as they would have hoped for. However that did not deter the members from the **Lancaster & Morecombe, Nottingham, and Sheffield** clubs from enjoying great hospitality and good weather for two days at the Drumahay Junction Railway. The third day was very wet so they all adjourned to the nearby Transport Museum where their guide, a member from the club, provided a detailed insight to the exhibits. He used to work there of course, so to have an expert guide was a bonus. The track at Drumahay is termed a drivers' track because a 1 in 80 gradient on leaving the station sorts the men out from the boys if you don't have enough steam and with lots of bends it seems to go on for ever. Our congratulations to all at the railway for achieving a notable milestone in their history.



ABOVE
Injector and valve testing rig built by members of the Steam Locomotive Society of Victoria Inc.

At the **High Wycombe MES** the first public running day coincided with the HGSA's annual beer festival, with a beneficial effect on the club's passenger numbers. A queue began to form at about 10.45am and by the time they started running at 11am there was quite a long wait for a ride. This continued until after lunch when the larger locomotives took over the operations. There was also a working set-up with a traction engine in steam working a hay baler. This created a lot of interest for visitors and also provided some useful revenue, the small bales produced being sold to pet owners

at 50 pence per bale! It was a very good operating day for the club with excellent returns which pleased the treasurer. Because this has happened for the last couple of years the club have decided to ensure the two dates coincide in the future, so that they continue to reap the benefit, which will mean they have to perhaps change their normal public running date to suit.

At their Summer Sunday members' steam up, nine steam locomotives were operating along with one diesel and this attracted a large number of members to enjoy the day on the newly laid track.

In the current newsletter from the **Old Locomotive Committee (OLCO)** there is a very good description of making leaf springs for older prototypes like 'Lion', and any other type as well for that matter. Dave Forrest is currently building a 5" gauge version of 'Lion' and described his method of making leaf springs that look correct as well as being fully working. On old locomotives of this vintage the springs were a very visible feature so Dave has designed and made a useful machining fixture that enables all the necessary machining functions to be carried out on the spring material. He is using a composite spring with both phosphor bronze and tufnol leaves. The tufnol leaves were formed and then heated for about an hour at 150 degrees C. The finished spring looks very impressive. The group have had some new members join recently which is always a good sign and they were hoping to have a good **LIONSMEET** at the Nottingham Society in August. I hope it went well and was well supported.

Down in the West Country the **Plymouth Miniature Steam Club** had a good start to the early operating season where they broke all their previous single day records for the number of passengers carried. This level of activity has led to a few track problems which have been rectified but further renewal will be required. To help cope with the passenger numbers they have been building two new passenger carriages as well as spare bogies for their other stock. Members' club days have also been enjoyable with a couple of new locomotives putting in an appearance. The club members here are very fortunate in having access to the Torbridge Academy which provides a wide range of workshop facilities and equipment. Included in these



ABOVE
Martin Sams from the Lancaster & Morecambe club with his 7¼" gauge Hunslet enjoys the sylvan surroundings as he drifts through the trees at Drumahay Junction Railway.

facilities is a CNC lathe, engraver and laser cutting equipment. The foundry side is being used to produce aluminium side frames for 5" gauge carriage bogies. The second half of the Autumn term starts on 3rd November so any prospective model engineer in this area who would like to be involved would be most welcome. The cost for this excellent facility is just £3 which sounds an absolute bargain these days. I bet there are not many schemes like that available elsewhere. They have an interesting talk arranged for the 16th November when Ted Morse will describe the History of Brass Musical Instruments, how they are made, work and repaired - no doubt some good metalworking practices are involved which could be of interest to model engineers.

There has been plenty of activity at the **Steam Locomotive Society of Victoria** over the last few months. An underground sewage pipe had moved so a very deep hole had to be dug in order that the pipes could be re-aligned but with the help of a small digger and an experienced member the work was completed during a good 12 hour shift. As for most clubs, track repairs are an ongoing activity and here sleeper renewal is continuing and the planning is well underway for the new unloader tracks

in front of the club house with the laying of a new concrete pad. The club's Pre-Convention Run was well attended and provided a good day's operating for both members and visitors. Three members here have built a very impressive looking test rig which can test injectors, clack valves, steam valves and safety valves, which must be very useful to members. The rig can also measure the flow rate through an injector. Again a very useful feature.

The **Taunton SME** celebrated their 70th Anniversary in July with a special Steam Gala held at their Creech St Michael track site (featured elsewhere in this issue). They enjoyed good weather, a good crowd of visitors plus locomotives, traction engines and even a Steam Organ so a good time was had by all. Routine maintenance continues with a new water supply now available at the station. Six new bogie frames have been assembled and are now awaiting the wheels, bearings and springs. Brake fittings and buffers are also needed for the new vehicles. The club's running days have been well supported and will be brought to an end following the Santa Specials in December. All at EIM offer their congratulations to the club on reaching this impressive milestone in their history. ■

BELOW
The traction engine and hay baler set up at the High Wycombe public running day.



YOUNG ENGINEERS

BY JOHN ARROWSMITH

Writing this note in August before the closing date for the Myford lathe award, I hope that there has been a good response as this offer will probably never be made again. Whoever finally takes ownership of this machine will have a great chance to expand their basic knowledge of machine work and will be able to hone their skills in their own personal surroundings. Hopefully the young person can begin to increase their model engineering ability and interest while at the same time perhaps assisting their club projects and becoming an even more valued member.

Lots of young people have been very actively exercising their interests in model engineering and helping out at their clubs over the summer months and I hope that this continues during the winter. The various exhibitions will provide great experiences of what can be achieved and again I hope that this will inspire them to produce an entry in one of the many classes available to them. It was good to see a number of young people at the Bristol exhibition both taking part and being shown around with other family members. They actually seemed to be interested in the exhibits, some taking quite a long time to have details explained to them. When I was in Hall 3 at the exhibition I noted that the operations of the South West Truckers road layout were supervised by a number of younger people and, while the purists may say that this is not strictly model engineering, at least they were involved in a well organised club and exhibition and I am sure they can maintain what these days are quite complex machines. Their involvement is to be encouraged as who knows how these young people will progress. They might in the future be building their own i/c engines to power even larger models.

The pictures this month show how younger people are involved with model engineering clubs and with continued encouragement will help keep model engineering in the public eye.

One club that seems to be gaining a good number of younger members is the Black Country Live Steamers who seem to have the right mix of interests to attract younger people but one thing stands out – something that I have promoted a number of times in these pages – and that is the welcome they get when they first show an interest. If your club really wants to attract new members then the first approach has to be good and



ABOVE

James Walker with Stephen Greener's 7¼" gauge Pannier at Gilling.

RIGHT

Young men operating the South West Truckers layout at Bristol.



needs to be positive and indicate to the prospective member that they are welcome and will be given all the help they need to get involved. BCLS are obviously demonstrating this because they say in their current report that they have had a "dramatic increase in members"

their words not mine so they must be doing something right. We should all learn from this sort of experience. Nothing puts people off more than a "couldn't care less" attitude and "we cannot be bothered to make the effort" sort of reception – the answer once again lies in your own hands. ■

The EIM Steam Plant

A correction and clarification

By trying to make things as easy to understand as possible for a beginner I've slipped into the trap of mixing up the axis conventions used for CNC and machines fitted with Digital Read Outs (DROs), and the dial graduations used on manual machines.

Luckily an EIM reader, David Wood, a professional engineer with 56 years of experience, noticed this and between us we have corrected what I had previously captioned incorrectly in figure 3. I've also rewritten the text relating to the axis conventions (page 111, October issue) to explain better this difficult concept and how it has been adopted within the subsequent build notes for the engine's construction.

A modified version of the text is given below and I apologise for any confusion caused.

Martin Gearing

Another convention to be understood is the relationship between machine slide movements and tool position relative to the work. The following applies to CNC machinery and may be different for manual machines.

In simple terms the tool may move along 3 separate axes each at 90° to one another and both the horizontal movements may be

referenced to the machine column. LEFT and RIGHT movement relative to the column is given the letter X. IN/TOWARDS and OUT/ AWAY is Y.

To make sense of the direction on each axis RIGHT = X+, LEFT = X-. IN = Y+, OUT is Y-.

The vertical movements UP and DOWN are given the letter Z and are slightly more difficult to comprehend as they appear opposite to the way one would expect. They relate to the movement of the tool into and out of the work or, to put it another way, whether the distance between the tool and the work gets larger (+) or smaller (-).

The Z- value indicates the distance is

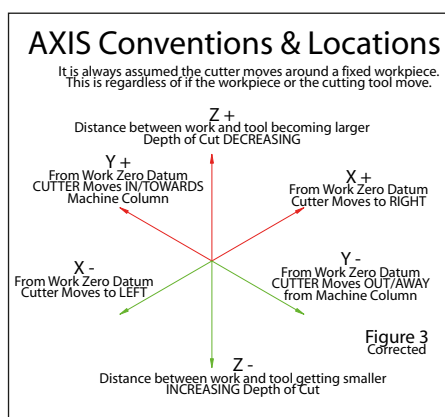
decreasing, and because of that the tool goes deeper INTO the work. The Z+ value indicates the distance is increasing, and because of that the tool moves AWAY from the work.

Depending on the machine design and construction, Z- can mean EITHER that the quill moves the cutting tool down, OR that the knee on the machine column moving the work up onto the cutting tool, INCREASING the depth of cut. Z+ of course indicates movement in the opposite direction, DECREASING the depth of cut. This is shown graphically in figure 3, above.

HOWEVER PLEASE NOTE, because most of you will be using conventional manual machines, and not all will have the benefit of DRO on the Z axis, I have DEPARTED FROM THE USUAL CONVENTION with this axis, and the build notes that follow will refer to taking a cut on the Z axis as positive (+).

This is because the Z axis table feed dial graduations do increase as a cut is taken, because the work is moved towards the cutter, in the case of raising the table, and likewise the quill or head graduations increase on almost all machines, if moving the tool into the work.

Should you be using a CNC machine you will be working from the drawing to write the code so the convention used in the text should not cause a problem but if you did use the text you'd be cutting fresh air! ■



NOVEMBER DIARY

2 Leeds SME. Bonfire Night Steam Up & Supper, Eggborough 15:00 – 21:00.	5 Keighley & District MES. Bonfire Night Party from 18:00.	6 Kinver MES. Public running 14:00 – 16:30.	11 Hereford SME. Evening talk: 'Steam Valves & Blast Pipes' from 19:30.
5 Ickenham & District SME. Public running, noon – dusk.	5 Nottingham SME. Bonfire Night Spectacular, Parkgate Station.	6 Reading SME. Public running Prospect Park 13:30 – 16:30.	12 Sutton Coldfield MES. Bonfire Night running, Little Hay 18:00 – 21:00.
5 City of Sunderland MES. Public running, City Illuminations.	5 Tiverton MES. Steam Up at Worthy Moor.	6 Sale Area MES. Public running Walton Park noon – 16:30.	18 Millerbeck Light Railway. Father Christmas Special. Booking essential.
5 Crowborough Miniature Railway. Public running, Goldsmith Leisure Centre 14:00 – 17:00.	6 Bournemouth SME. Public running Littledown Park 11:00 – 15:00.	6 Southampton SME. Public running 13:00 – 16:00. SO18 1PQ	19 Chesterfield MES. Public running at Hady.
5 Isle of Wight MES. Open Afternoon at Broadfields 13:30 – 16:30.	6 Echells Wood Railway. Kingsbury Water Park, 11:00 – 15:30.	6 Urmston MES. Public running Abbotsfield Park 10:00 – 15:00 and every Sunday.	20 Fenland Light Railway. Public running at Ramsey, Huntingdon 10:00 – 16:00.
5 Grimsby & Cleethorpes MES. Bonfire Night Running at Waltham Windmill 17:00 – 21:00.	6 Frimley & Ascot MES. Public running, Sturt Road 11:00 – 16:00.	6 Wigan & District MES. Public running at Haigh Hall 11:30 – 16:30.	26 Bradford MES. Annual Exhibition, Competitor and Social Day 13:00 – 17:00.
	6 Halesworth & District MES. Steam Up from 10:30.	11-13 International Boat Show at the Warwickshire Exhibition Centre Leamington Spa.	

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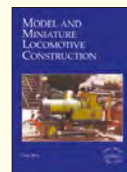
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Traction Engine Design & Construction Gilbert • £21.00

Originally published 2000, Geoffrey Gilbert's magnum opus is the only book which looks at all aspects of the design and construction of British traction engines of all types, and road rollers, built in the 20th century. Wagons are not included. Chapters cover Materials, Types under consideration, the Boiler, Boiler mountings, Boiler feed, the Engine (IE cylinders & motion), Gearing, Wheels & axles, Winding gear, Lubrication, Brakes, Tanks, Showman's fittings, Scarifiers and roller fittings, and much more. There really is more information here on the technicalities of the traction engine than you will find in any other book and, if you are interested in traction engines, working on them, or modelling one, you really must have a copy of this. 342 pages. Around 230 drawings and B&V photographs, plus maker's literature.



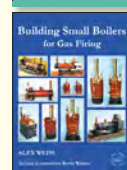
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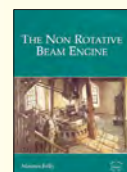
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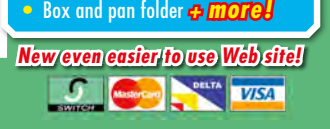
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- Sajo (Sweden) VRF 52M vertical mills
- Ajax AJT1 mill
- Adcock and Shipley 2E mill
- Colchester Triumph lathe
- J & S 540 grinders
- Startrite 18-S-10 metal bandsaw
- SIP pedestal spot welder
- Elliot 12" shaper
- Manual forklifts
- Surface tables
- Powered rolls
- Warco surface grinder
- Box and pan folder + more!

New even easier to use Web site!

PLEASE PHONE 0208 300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST
DISTANCE NO PROBLEM! • DEFINITELY WORTH A VISIT • ALL PRICES EXCLUSIVE OF VAT
Just a small selection of our current stock photographed!
We are currently seeking late 'Myford Super 7B' & 'Super 7 large bore' model lathes!

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