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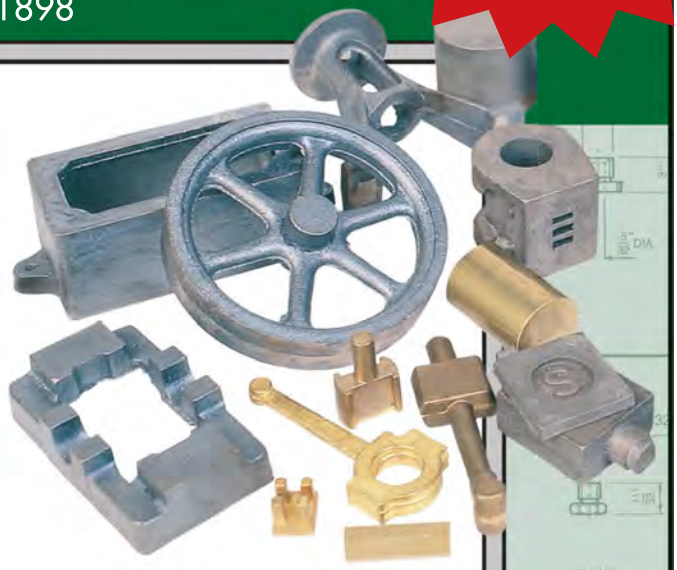

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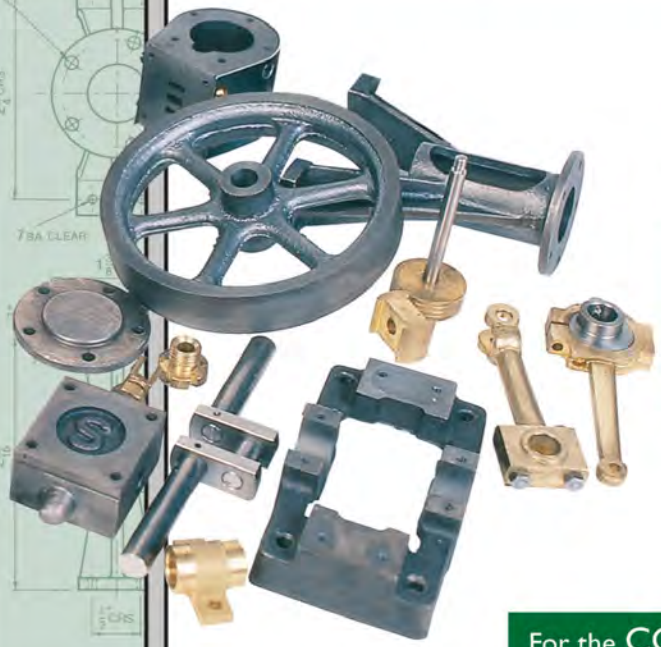

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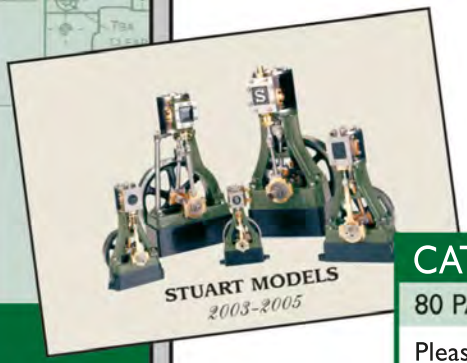

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October 2016 Vol. 38 No. 4

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EDITORIAL

MIDLANDS EXHIBITION

All too soon 'tis the season of mists and mellow fruitfulness but also that of the Midlands Model Engineering Exhibition at the Warwickshire Exhibition Centre.

Regular visitors to the show will already know that there is always plenty to see and a useful selection of trade stands for tracking down that odd-shaped piece of bronze, short piece of copper tube, odd fastener or unusual tool, the lack of which has been stalling the current workshop project. If you haven't been before, give it a try – I am sure you will not be disappointed. I am looking forward to meeting old acquaintances and getting to know some new faces, and perhaps even persuading some of you to write something for our magazine about what you have been doing.

There will be the usual lectures plus some new ones, notably Gary Wooding, who will talk about the properties of precious metals, and Mark Brockley, who will introduce us to a selection of clockmakers' tools. Mike Haughton will shed some light on workshop illumination and DAG Brown will introduce us to the world of 3D modelling. You can check the times for all the lectures on the exhibition website at www.meridienneexhibitions.co.uk which has the full programme.

You will find a convenient 'pull-out' show guide for the exhibition in the centre of this magazine, within which you will find a full list of the exhibitors and the trade stands, as well as directions for getting to the Warwickshire Exhibition Centre.

ROBERT STIRLING

This year is the bicentenary of the patent granted to the Revd. Dr. Robert Stirling for his 'heat economiser', better known to us these days as the 'Stirling Engine'. The Midlands Exhibition is celebrating this anniversary with a special display commemorating Robert Stirling and his engines organised by The Stirling Engine Society.

EIM STEAM PLANT

This month we are introducing the EIM Steam Plant. Designed and described by Martin Gearing, who is well known to many of you, this project is aimed at those looking for an interesting and wide-ranging starter project which will allow them to develop the basic skills needed by a competent model engineer. The steam plant includes the engine itself, a vertical boiler, a displacement lubricator and a hand pump. The boiler is gas fired and a suitable burner is also described. Every step is carefully described by Martin and is simple enough to be tackled by a beginner. To inspire you, if our front cover has not done so already, an example of the steam plant will be on display at the Midlands Exhibition.

Martin Evans
Editor

The front cover shows the first example of the EIM Steam Plant described by Martin Gearing, starting in this issue.

The steam plant will be on show at the Midlands Model Engineering Exhibition.

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Published by Warners Group Publications Plc, The Maltings, West Street, Bourne, Lincolnshire PE10 9PH
www.facebook.com/engineeringinminiature

Articles: The Editor is pleased to consider contributions for publication in Engineering in Miniature. Please contact us to discuss your work.

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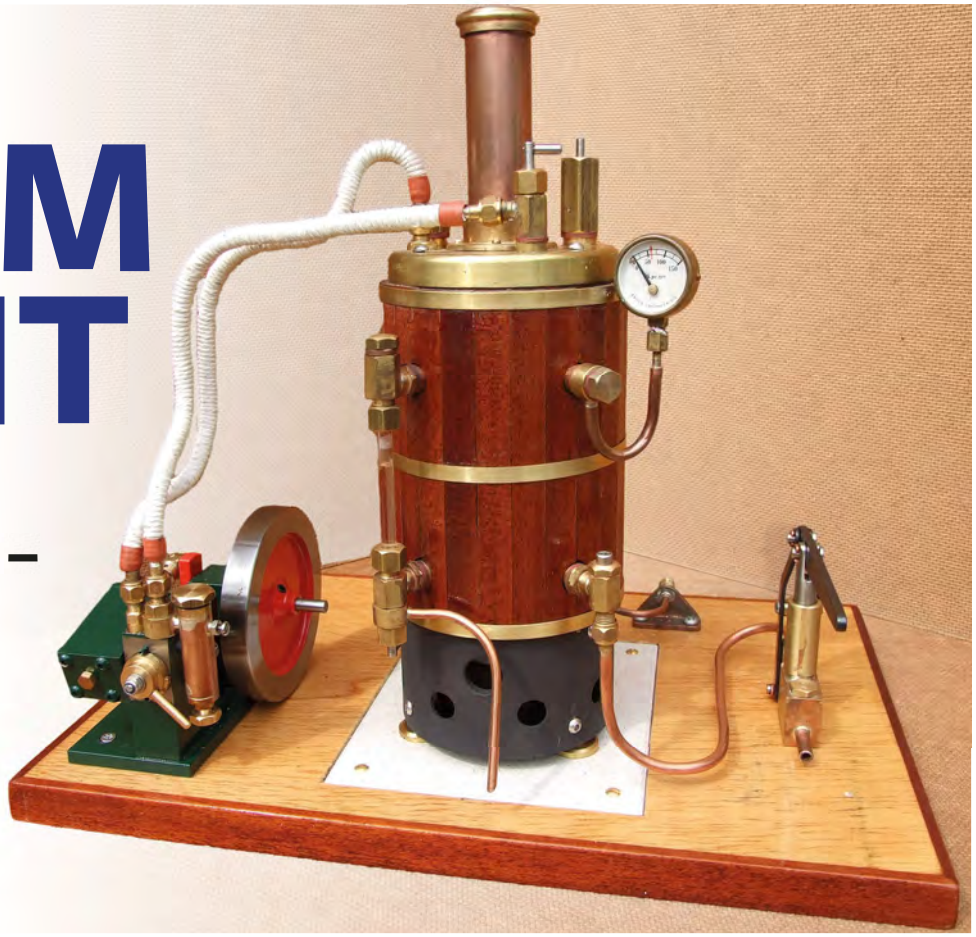
The EIM STEAM PLANT

INTRODUCTION – THE PROJECT

by **Martin Gearing**



In this new series Martin Gearing presents the 'Engineering in Miniature Steam Plant', a project aimed at those who wish to develop their practical skills in model building before going on – hopefully – to greater things. This project is designed to be straightforward to build and results in a rather handsome model with impressive performance.

An early childhood interest in any mechanism that moved led Martin to a career in maintenance, research and development, and adult instruction in mechanical and electrical engineering, both in England and Australia.

Sadly, the day of enrolling in the local night school class to build upon what had been experienced in the craft workshops has passed. But one only has to watch the activity around the machine tool dealers and material suppliers at model engineering shows to realise that the interest in making or repairing things still exists, amongst both young and old.

The purpose of this design is an attempt to answer the growing need for those motivated and interested in gaining or increasing their experience of the skills necessary to produce, complete, repair or maintain a working mechanical item by their skill of hand rather than using a cheque book. Having acquired these skills through practical experience, the repair or manufacture of similar styles of mechanism, regardless of size, becomes possible. The principles remain unchanged. Left to my own devices I would prefer to work to 12 inches to the foot, but the cost of materials and limited space available now precludes any such notion!

Who Is This For?

It is written for and aimed primarily at the beginner really as a training project to give experience. It assumes little or no prior knowledge and sufficient interest to seek out such additional information as needed when not certain, from the vast established resources available and joining with like-minded people where possible. I have chosen metric dimensions mainly because I refuse

Above: – The complete EIM steam plant after its first steam test.

THE SKILL AREAS COVERED FALL INTO FIVE SUBJECT AREAS:-

1. Centre lathe – Turning to length and diameter. Turning short tapers. Drilling, reaming and boring holes. Setting up and using a 4 jaw chuck. Drilling to a controlled depth, using the tailstock. Threading using taps and dies.
2. Making specialist profile tooling, both high speed steel and high carbon steel (Silver Steel/Drill Rod)
3. Vertical mill machine – Understanding datum locations and working from these datum. Checking the accuracy of the head alignment. Setting up and using a standard vice. Setting up and using a horizontal/vertical rotary table or dividing head in the horizontal and vertical mode. Bringing surfaces of material square and to size. Holding work to be machined at an angle. Drilling holes at coordinate locations. Milling radially to radial coordinates. Basic indexing.
4. The making of formers and flanging of metal. Annealing non-ferrous metal. Methods to enable thin walled tube to be drilled, formed and brought to length.
5. Joining materials using silver solder of different heat ranges.
6. Testing requirements for a steam boiler.

This is in fact pretty much everything that you are likely to want to do using a centre lathe, using a vertical mill, and building a small boiler, other than screwcutting in the proper sense of the word, or gearcutting.

WORKING DRAWINGS

Drawing Conventions Used

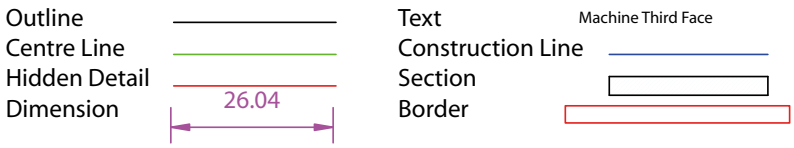


FIGURE 1

to pay the premium now demanded for Imperial tools and fixings, and think a beginner starting out would be more used to this system of measurement.

Constructors unable to cope with the metric system who have an established workshop can change everything to Imperial by using a calculator dividing everything by 25.4 and working in decimals. At the end of the day both measurement systems simply use numbers! Few sizes are critical and will be highlighted when encountered.

Can I Do This?

Whilst the buzzword for the moment is CNC and 3D printing, the tools required for this project are conventional and, most importantly readily available, which means that provided you can read or find somebody that can read the article to you, all that follows is achievable by the average person.

It was put together to give a person who had longed to build a steam locomotive since an early age an insight into all the skills required, but because of the pressures of work and children realistically didn't have enough free time. When he was first shown the drawings he said "It looks a bit more complicated than I was expecting." However when we looked at the components individually, and worked through how he thought they could be made, he realised that each part was achievable, bite size chunks being the order of the day – the sum of the parts making the whole.

This person was able to find an average of four hours a week during the winter evenings and weekends, producing an excellent working engine in 12 weeks.

Another person heard about the project and asked if she could be included. This was my ideal as the second person had no previous practical experience of workshop machinery or hand fitting skills, although she had always been surrounded by people engaged in mechanical or civil engineering most of her life. The fact that I am married to her just added another dimension to my experience as an instructor!

This resulted in a rigorous confirmation that what I had designed was truly fit for a beginner and proved the build stages did not make assumptions of prior knowledge, and that the descriptions were not set at too high a level – always a risk.

The second 'Guinea pig' continued – dismantling her engine for painting after a trial run on air – by making a copper vertical boiler to produce the steam to run the engine. This included all boiler fittings and water feed hand pump.

Making the boiler began with making the formers and learning to flange tubeplates. This was followed by making threaded bushes and silver soldering – using different temperature range solders – which culminated in a completed boiler being successful in passing the shell two times working pressure test examination.

This was followed by making all the boiler fittings and lastly a hand pump to supply water to the boiler necessary for operating the engine on steam, followed by the fitting of a gas burner.

The result can be seen at the beginning of this article (photograph 1) – taken after passing its 1½ times working pressure hydraulic test followed by the steam accumulation test resulting in the issuing of a full boiler certificate. It can also be seen at this year's Midlands Model Engineering Exhibition.

For maximum convenience and ease of use, the chosen method of firing was Butane/Propane mix freely available in a variety of sizes. Included therefore are the details for the making of a dedicated gas burner. However I accept that not everybody will want to consider making such an item and have included the necessary details to mount and fit a commercial ceramic burner.

Will It Work?

The steam plant will work provided the builder aims to achieve the dimensions within the tolerances given in the following notes but, if failing to achieve them, accepts that the ONLY way to achieve a Successful and Reliable Working Mechanism is by rejecting the component and starting again, taking care not to repeat the mistake!

To complete this project you will need or have access to the following -:

Basic hand tools including a means of marking out.

A lathe of at least 90mm (3½") swing.

A small vertical milling machine.

Access to a band-saw (jigsaw is the second choice) would be a great help, but an alternative method for cutting the platework would be a fine toothed hacksaw.

If you don't have access to – or your budget won't stretch to – the reamers suggested, then an alternative is to "step drill" which means acquiring for the required hole sizes, drills of the finished size required and 2 or 3 in 0.1 steps smaller. E.g. Steps to produce a reasonably accurate Ø4 hole with good surface finish you would - centre drill, drill Ø3.7, drill Ø3.8, drill Ø3.9 and finally Ø4 using slow feed and lubricant. By this method, provided the drills are in good condition, an acceptable sized hole may be produced, but a reamer is much faster and gives an assured sized hole!

You will also need to be able to make sense of two-dimensional drawings. I have included pictures that show all the setups. Also included are drawings known as 'sectioned' drawings. These are views of what you would see if an imaginary knife had sliced through the part, with the surface that had been 'cut' shown as 'hatched', with lines usually at 45°, clearly showing where everything is located very simply without ambiguity, containing a lot of information in a small space. By relating the text with the drawings and pictures most of any terms that are unfamiliar will be self-explanatory. I was always told 'The Great Practical Mechanical Engineers' of old (who, in the main, were more interested in action so didn't waste time inventing complicated words) created most of the terms!

Please understand the notes are NOT THE ONLY WAY of completing the project - if you have a preferred method that is safe for you and the tool you are using, and achieves the same result, then use it! However the methods described are ones that have worked for a person with no prior experience and are shown in the supporting pictures and have worked for everyone I have been involved with so far making the complete steam plant.

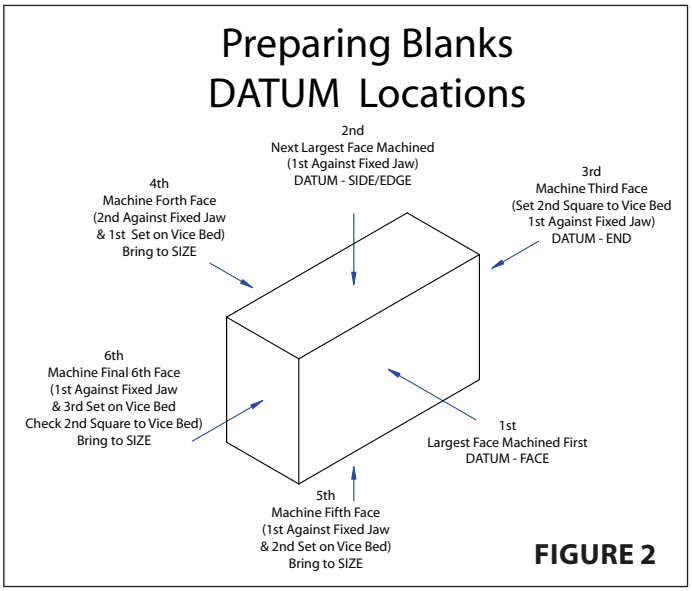
How Do I Go About It?

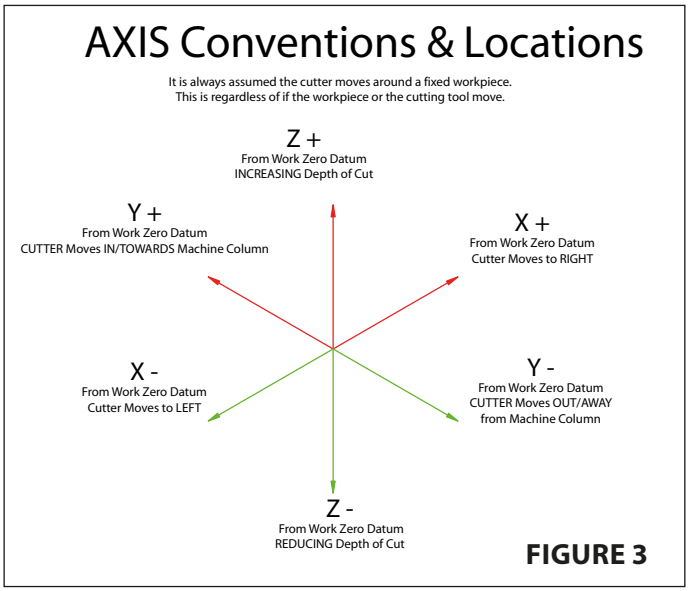
In the various 'Build Guidance Notes' the component headings will be followed with the parts drawing reference and the suggested blank material size (thickness – width – length), all shown in bold type and underlined. e.g. BASE – Item E1 – Brass – ¼" x 2" x 4".

BASE – Item E1 – Refers to the drawing that accompanies the text.

Virtually everything you will be constructing during this series will make reference to a drawing. The drawings I have provided take some liberties with the current accepted 2D drawing standards in an effort to simplify things. The editor has agreed to reproduce the drawings using colour in an effort to make things easier to understand as the majority of beginners may never have received tuition in formal 2D technical/engineering or mechanical drawing.

Those who may have been lucky enough to have been shown drawings based on 3D modelling will be more used to putting detail onto a screen and applying material





around it. This is the way it happens in 'additive' manufacturing such as 3D printing and will tend to be the opposite of conventional 2D drawing. 2D drawing assumes that we start with a 'lump' of material and remove areas in the form of drilled holes, grooves, slots, reductions in diameter/specified sections – in simple terms, 'subtractive' manufacture, the way it happened - until recently!

The different conventions I have chosen to use within the drawings in this article are shown in figure 1. This shows what the different colours and types of lines denote.

Before an item can be made from a drawing an understanding of the principles behind dimensioning must be understood. A simple example would be if you were asked what your height was you would give a figure, let's say 1800mm tall. The number would be meaningless without the word tall. By adding tall after a number, it is universally understood that the measurement is taken from the ground on which you stand to the top of your head. The ground in engineering terms is referred to as the DATUM from which the measurement is taken and in this case only applies to one direction – vertical - your height. When you become involved in making three-dimensional articles you have to have three DATUMS, one for thickness, one for width and one for height/length.

The first task when beginning to make an object using conventional methods is to prepare the material blank by accurately forming three DATUMS, from which the three dimensions of THICKNESS, WIDTH and LENGTH may be created. Refer to figure 2.

This will hopefully make it easier to understand DATUMS and a suggested sequence of preparing a blank, after which any further details may be machined, turning the blank into a part - with luck identical to that shown in the drawing the dimensions had been taken from!

Another convention that needs to be understood is the reference of machine tool slide movement related to the tool position, equally relevant to manual or CNC machinery.

In simple terms it may be thought of as 3 separate planes each at 90° to one another. A simple description is that both the horizontal movements are referenced to the machine column. LEFT and RIGHT movement is given the letter X. IN/TOWARDS and OUT/AWAY is Y.

To make sense of the direction in each plane, remember RIGHT = X+, LEFT = X-. IN/TOWARDS = Y+, OUT/AWAY is Y-.

The vertical movement UP and DOWN is given the letter Z and is slightly more difficult to comprehend as it relates to the progression of the cutting tool into and out of the work. INTO = Z+, AWAY = Z-. Where Z+ can be used for either when the quill moves the cutting tool down, increasing the depth of cut OR the knee on the machine column moving the work up onto the cutting tool, increasing the depth of cut. Z- can be used for either the quill moving the cutting tool up, reducing the depth of cut, OR the knee on the machine column moving the work down away from the cutting tool, reducing the depth of cut. This is shown graphically in figure 3.

The project is divided into six parts, each with a reference letter:

1. E – Engine.
2. DL – Displacement Lubricator.
3. HP – Hand Pump
4. B – Boiler.
5. BF – Boiler fittings.
6. GB – Gas Burner

Each part may be regarded as a separate stand-alone 'sub-project' for those who may find interest in the individual sections as they are covered.

Enough talk – let's make a start! Next time I will list the metal stock and other parts needed to make the engine and explain how to set up your milling machine square and parallel in preparation for embarking on this project.

To be continued

ACCESS TO THE FOLLOWING SPECIALIST TOOLS IS REQUIRED:

Taps and dies, covering the range; Metric M2.5 - M6. ME¼", 5/16" & ⅜"x 32 tpi. 1 BA Tap.

Running centre.

Calliper's – preferably digital, and a 0 – 25mm outside micrometer.

Collets covering the range Ø3 – Ø12mm diameter would be a tremendous help though not essential.

Drill set 1-13mm in 0.5 steps + Ideally 1 – 6mm in 0.1 steps.

Ø3 flute centre cutting or 2 flute slot drill. Ø1.5, Ø3, Ø6mm.

End mill Ø10 & Ø12mm – Fly cutter if available would be useful.

Ø3, Ø4, Ø5 and Ø8mm reamer if possible (although an alternative method is suggested above).

Centre locator or short stub of silver steel around Ø10 x 100 long and 0.1mm feeler gauge.

Soft faced hammer – Nylon is ideal.

Dial Gauge for setting up work and tooling – metric or imperial.

Small Vee Block.

4"/100mm Engineer's Try Square

A selection of parallels for use in setting up work in the milling machine vice.

Small tube of High Strength Sleeve and Bush retainer, Loctite 620, 638 or 648 or equivalent.

‘Quickie’

Building a battery-powered locomotive in a few weekends

Part 2

Jan-Eric Nyström continues with the bar frames

Continued from page 95, September 2016

A Bar Frame

The frame for this locomotive is extremely simple: a 5" by 24" rectangle built from key stock, ½" square – again leftovers from building my 4-4-0 live steam locomotive. Ordinary cold-rolled steel could be used too but not hot-rolled iron, which is too soft and not manufactured to exact enough dimensions. In photograph 3 (shown last time and repeated below) you can see how I constructed the frame – just four pieces of stock, squared at the ends, and bolted together with M6 socket-head bolts into tapped holes in the end pieces. (Welding of key stock is not recommended; it becomes brittle and may crack at the weld.)

In addition, there are two bars loosely attached to the frame with bolts and springs. The superstructure will be attached to these bars. The bolts pass through slightly oversized holes in the frame so the heavy batteries will ‘float’ on the springs seen in the photograph. There are washers between the frame and the bolt head, as well as the springs. Thread lock fluid secures all the bolts so they won’t work loose in use.

The axleboxes are extremely simple: 1½" x 2" pieces of ½" thick aluminium plate, found in my scrap box, bolted to the frame with two bolts each. The plates are drilled to take the PTFE-coated bearings, which are pressed in. Note that the axle boxes have no springs at all; they are rigidly attached to the frame. However, the frame flexes slightly and even on my very uneven, removable lawn track I seldom have derailments.

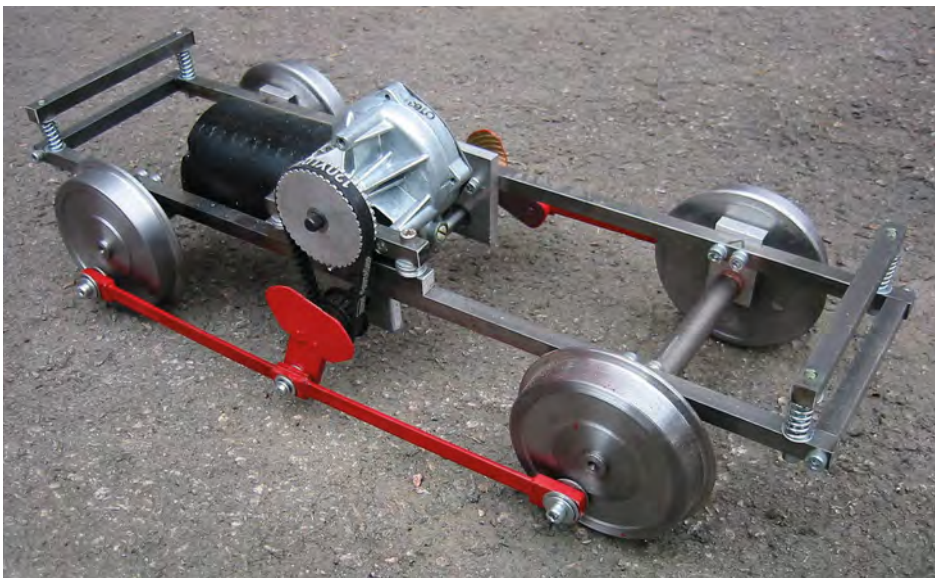
An alternative method would be to attach factory-made, ball-bearing pillow blocks to the frame as axle boxes. Asian-made versions are nowadays very inexpensive to buy on eBay or other websites and will do admirably for this light use.

When making the coupling rods, which also have PTFE bearings (set in small brass blocks silver soldered to the steel rod), I of course made sure that the length between the holes in the rods was the same as the distance between the axles. This is one of the very few critical dimensions in the whole engine!

Quartering the Wheels

When attaching wheels to their axles you must ensure that the gauge is set correctly! (I use 7.190" between the outside of the flanges for my 7¼" gauge.) I put nylon washers between the wheels and the axleboxes to provide simple thrust bearings and also left about ⅛" of side play. This ensures easy running of the locomotive. Of course, I had taken all this into account when planning the width of the frame.

Photograph 3 – The frame of the locomotive is very simple, just a rectangle of ½" square steel. The superstructure, with heavy batteries, will be attached to the spring-loaded bars. The drive design seen here is not final. Later on I relocated the motor below the frame and replaced the belt drive with a set of gears.



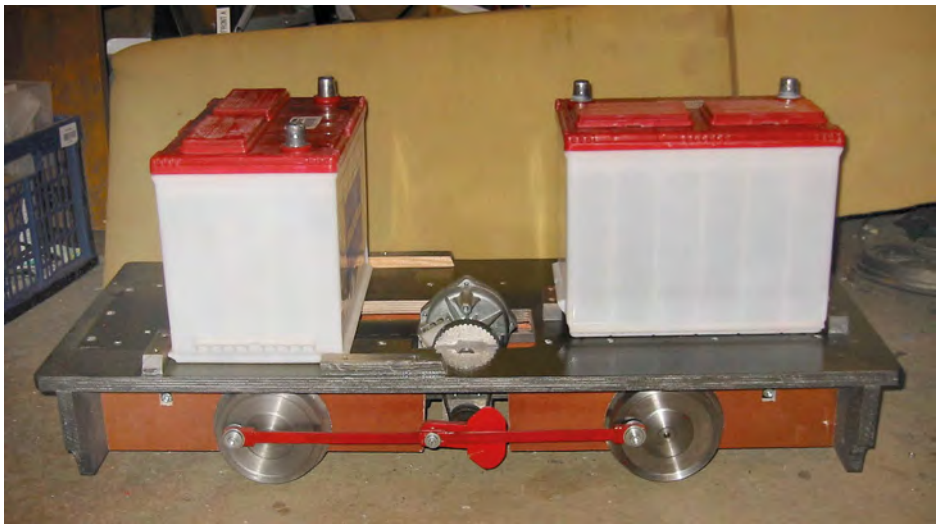
Again using Loctite 603, I set the wheels on one axle with the pins at approximately a 90° angle, just by eye (not forgetting to place the axleboxes and nylon washers onto the axle first!). In fact the actual angle doesn’t matter – it can even be off by several degrees – but it is important that the angle is the same on both axles. So, on the second axle, I left one of the wheels loose. I then attached the axleboxes to the frame provisionally, as well as the coupling rods, on one side between the two rigidly mounted wheels and between the second pair of wheels (one of which was left loose). I was then able to find the correct position for the loose wheel simply by testing that everything turned freely, with no binding. At this time I also tightened the bolts holding the axlebox plates to the frame, after putting a few drops of Loctite between plates and frame. Now I knew for sure that the distance between the axles was indeed the same as the length of the coupling rods!

Then I removed the loose wheel and put Loctite inside the bore of the wheel, not on the axle – thus avoiding Loctite seeping into the bearing. I then quickly put the wheel and the rod back in position. Since it takes a few moments for the Loctite to start curing I had time enough to again ensure that both axles were still running freely, with no binding of the rods, and that the gauge on the second axle was correct too. Then I left the assembly alone for a few hours until the Loctite on this last wheel had cured. Now I had my wheels quartered, quickly and easily, without jigs or tools!

I did not worry about a possible botching of the job – if necessary, I could have removed a wheel from an axle by slowly heating it with a small propane torch. A Loctite bond can be released by heating to approximately 200°C. (PTFE can stand that temperature for a short period of time, so the bearing would not have been destroyed by careful heating.) Fortunately, the quartering was successful on the first attempt.

I did not have to quarter the cranks on the drive axle since they are fastened with setscrews, two on each crank, 90° apart. The cranks could be adjusted and set after I had everything else assembled.

I found a few toothed-belt pulleys and belts in my scrap box, so at first I used them to transfer the power from the motor to the driving axle, as seen in photograph 3. However, when I had the



Photograph 4 – Two car batteries provide ample tractive power and much needed adhesive weight for the locomotive.

locomotive pull a heavy load for the first time, the belt snapped! The torque was simply too high for the belt. Having to gear up a speed that was too low after first being geared down by 1:48 in a worm gearbox is not very efficient. So, I scrapped part of what I had already built, removed the gearbox from the motor and used two simple gears instead, 12 and 100 teeth respectively, giving a transmission ratio of 1 to 8.3. I now attached the motor crosswise below the frame with pieces of ½" stock.

Cab and Hood

The batteries are placed on a 320 x 800mm piece of ¾" plywood, which is the base of the superstructure (see photograph 4). One of the batteries sits crosswise, and fits in the cab, while the other is placed lengthwise and is covered by the 'hood'. Strips of wood hold the batteries in place and these strips also guide and position the cover when it is slipped over the batteries.

Front and back bufferbeams are also made of ¾" plywood. I painted these, and the base, with graphite-gray hammertone spray paint – it looks nice and small scratches and dents don't show on the mottled surface. The brown plywood under the base was removed when I substituted the original belt drive with gears. I have simple drawbar couplings between locomotive and passenger wagons, secured with ¼" bolts.

I now had all the mechanics of the locomotive assembled. The next task was to get the right 'look'. Using ⅜" plywood, I built a one-piece cab and hood to cover the batteries. Planning the work on graph paper ahead of time made an easy job of cutting suitable pieces and assembling them, as seen in photograph 5. To keep it all together I used square strips of wood in the inside corners and staggered the screws so they wouldn't touch each other or split the wood. After filling the screw-

Photograph 5 – The plywood one-piece cab and hood, of very simple construction, was built in a few hours.

HANDLE WITH CARE

Car batteries store a huge amount of energy, and can be dangerous if used improperly. A short circuit or wiring error may heat the connecting leads to white heat or even vapourize them instantly! Always use a fuse in the circuit, dimensioned according to the maximum current the motor draws under a heavy load. Connect the batteries only after all other connections are in place. If the fuse blows disconnect the battery and check your wiring carefully.

Batteries contain sulphuric acid, which is corrosive and will burn your skin and eyes if spilled. Hydrogen gas is given off from a battery during charging. This poses an explosion hazard so avoid all fire and any sparks. Do not smoke! Connect the charger to the mains after you have attached the charging leads to the battery. If the power is on when the clips are attached to the battery terminals a spark may ignite accumulated hydrogen. For the same reason always unplug the charger from the wall before you remove the clips from the fully charged battery.

head countersinks with epoxy filler and sanding the resin surface of the waterproof plywood to a matt finish I could paint the cab and hood. I used a thin coat of primer first and then car touch-up spray paint in colours that matched the 'prototype' as closely as possible – my local auto parts shop has an amazing assortment of colours on the shelves.

Handrails were made by bending 3/16" steel rod to shape. I threaded the ends and attached the rails to the base and cab with nuts and washers. The handrail loops at the front and back of the locomotive enable two people to easily lift the locomotive on and off the track, even though it weighs around 100lb, most of which is the batteries.

I didn't bother with ventilation grills or other details but left the cosmetic work at the stage shown in photograph 6. This is a locomotive intended mostly for kids, who don't even notice the lack of all those 'correct' details!

I rummaged through my electronics scrap box and found a few nice add-ons that I installed on a board inside the cab. All controls are accessible through the cab's rear windows. Starting from the left in photograph 7 you can see the main power switch, volt and ampere meters, above them a fuse holder and, on the right-hand side, a direction switch, a red pushbutton for a cheap car signal horn (kids love this feature!), a switch for half/full power and a socket for the "remote control" above the horn button.

Hardening and Tempering Silver Steel

Makers of PTFE-coated bearings suggest that a pin or axle surface should be hardened and, since this is an easy process, I decided to do it. It is not absolutely necessary; the pins (and the bearings) will last for a very long time even without hardening. However, I used "silver steel" for my crankpins. This material can be hardened by heating and subsequent quenching in water, while some other types require quenching in oil. The exact temperature to be used depends on the material so follow the manufacturer's recommendations.

Using a propane flame, I heated the pins, placed on a firebrick, until they glowed 'bright cherry red' at approximately 820°C. I then quickly dumped them into a pail of water. This makes the pins extremely hard but very brittle (a file won't even scratch the surface). They need to be tempered by heating to around 260°C. This can be done in the oven in the kitchen or by slow and careful heating with a propane flame. If the pins are polished before tempering it is easy to see when the correct temperature is reached. The colours are not very strong but can be seen clearly in bright light. For coupling pins, a yellow-brown colour indicates a suitable temper – still hard but tough enough so as not to break in use. When the right temperature is reached the pins are dumped into water. Before use the pins must again be polished to a mirror finish.

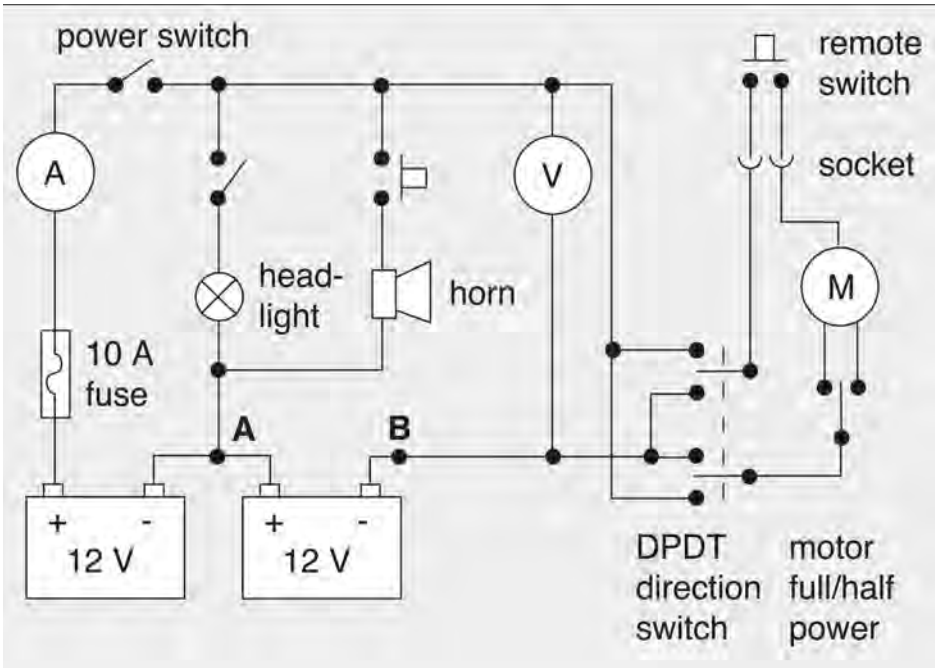


FIGURE 1 –
This circuit diagram shows how I connected all the components. The direction switch is a double pole, double throw type. My wiper motor is a dual-speed model and a simple changeover switch selects either half or full speed. The two meters, the horn and the headlight are added as optional equipment. The headlight and horn are 12-volt units – if 24-volt units are used connect them at point B instead of A. The actual connections needed in a locomotive of this type will depend on what features you want to have. Only a main power switch, a fuse, a direction switch and a hand-held on/off switch are absolutely necessary.

The remote is just an on-off switch in a plastic box with a spiral cord connection to the locomotive. Even though it is very rudimentary it does give the young 'engineer' a definite feeling of being in control! The switch is a spring-loaded model, and returns to the off-position when released – i.e. a 'dead man's handle'. This is a necessary safety feature; the young engineer is instructed to let go of the remote box if anything surprising happens and then the locomotive simply stops. The internal electric connections of my locomotive are shown in figure 1. Note that any cables carrying motor current should be adequately dimensioned in order to withstand the current! Since the headlight and horn are 12 volt models I took the power from the point marked A in order not to burn them out with over-voltage – if you have 24 volt units they should be connected to point B instead.

Photograph 6 – 'Quickie' is now ready for its inaugural run.

Photograph 7 – The control panel of the locomotive is accessible through the rear windows of the cab.

Small but Popular!

I call this engine 'Quickie' because of the short building time (only 48 workshop hours) and also because it is immediately ready for use when put on the track – no boiler filling, firing, or waiting for steam pressure – just switch it on and run!

The popularity of this tiny locomotive is evident in photograph 8. One summer afternoon I found eleven (yes, count them, eleven!) neighborhood kids watching me run my two steam locomotives. With the kids around, the steamers were put aside, and the little battery locomotive was the centre of attention. All the kids got their turn at the control, which really is nothing more than the on/off switch – and the ever so popular horn button! They ran the locomotive for several hours but since the motor draws very little power (on level track no more than 2 to 3 amps) I didn't have to charge the 60 amp-hour batteries very often, even though some of the kids returned for a ride almost daily.

Even visiting adults enjoy a 'Quickie ride'! For some extra fun, I sometimes give them the famous 'Disneyland spiel' in a lampooning voice: "Welcome to the ride. Keep your hands and feet inside the vehicle at all times. Please remain seated until the train has come to a complete stop. No flash photography!"

The wiper motor has stamina but on the 4% grade the speed drops to a crawl if there are two adults or more than three or four children on the wagons. The kids don't seem to mind – the important thing is that they are locomotive engineers! The youngest one so far was no more than 2 years, 3 months old at the time of her first run and she handled the loco expertly.

To be continued

Photograph 8 – Neighbourhood kids gather around 'Quickie'. Since the youngsters were allowed to run 'Quickie' all by themselves it proved to be more popular than the steam engines, which were set aside.

A Swiss Boiler Test

by **John Arrowsmith**

Hopefully readers will recall my visits to a number of Swiss railways a couple of years ago. One of the locations was the Brienz - Rothorn Bahn, the owners of some 12 steam rack railway locomotives. One of the 1935 veterans, N° 7, needed some long awaited repair work to its firebox and boiler. Despite extensive enquiries in both Switzerland and Germany no company would take on work to an 85-year-old component. Rivet work on boilers is a lost art and and only welded boilers are now available in these countries.

Following a fact finding tour to the UK in early 2014 the company decided to engage the London & North Western Railway Heritage Company in Crewe. This company exhibited a competence and engagement that gave the BRB confidence to move in this completely new direction, to the UK, for boiler work. L&NWRH despatched Steven Latham the Works Manager and Richard Watkins his 'encyclopaedic' boilersmith to Brienz in April 2014. This visit enabled them to ultrasound and assess the boiler regarding potential hidden horrors inside. This visit concluded with a meeting to which the Swiss boiler inspector was also invited.

For the technically minded the work was to include: removal of the 'new' welded firebox installed in the 70's, removal and replacement of all boiler tubes, steam pipe, removal and assessment of the foundation ring, replacement of the firebox with a new copper (riveted) firebox as per original design circa 1932, new front tube plate and sundry other work. All in all a major rebuild to an old component. The proposed procedures were agreed with the Swiss boiler inspector and the boiler was shipped to Crewe in December 2014 ready for rebuilding work to start in February 2015 when staff from the Brienz - Rothorn Bahn would visit.

It had been part of the agreement with Crewe that engineering staff would assist with some of the rebuilding work. This was duly planned for August 2015 and was to be a special activity for the BRB Team to gain a better understanding of boiler work. The result was that Daniel, Bruno and Kurt (and Mike) had the rare opportunity to hammer out the front and rear walls for the inner firebox. Believe me, bending 32mm copper plate takes some doing but the result is immensely satisfying although it's too hot to touch for hours afterwards!

During the Autumn of 2015 construction of the inner firebox had been completed, the foundation ring re-installed, steam pipe renewed, tube plate replaced, boiler tubes renewed, stays, palm-stays, and crown-stays renewed. All fitting mountings were re-threaded and cleaned up. It may be a small boiler in railway engineering terms but it has just as many components as a large one.

This is the old firebox removed from No 7.

Pressure starts to rise as the fire really gets going.

The plan was to have N°7 back in traffic in the Spring of 2016. It was a tight schedule and was always dependant upon the boiler returning by February 2016. Crewe responded in style and during the Christmas period brought the work to a close. The boiler tests were planned with another BRB attendance in January.

The cold hydraulic test was made on the 18th January and on the 21st the BRB team in Crewe witnessed the steam test. This was when I visited the works as a guest to watch the procedure. Any model engineer who has been involved in boiler testing models knows the trepidation that goes with it. It is no different with full size boilers. The BRB were just as apprehensive as anyone else. A good fire was slowly bringing the pressure up and, to keep the water level on the mark, hot water was added via a feed pump. It was a cold morning so when bacon and sausages were produced and popped on the shovel in the firebox the resulting baps were welcomed by one and all.

While the steam pressure was rising we were given the opportunity by Steve Latham to visit the rebuilt facility in Crewe and see the restoration work being undertaken to a number of standard gauge locomotives.

Having lived in Crewe as a youngster and visited the old works a number of times I was not really prepared for the new facility. It really is a superb working environment equipped to undertake

The bacon is on its way into the fire.

the full range of preservation work. It was really a flash back to the 'good old days' with a GWR Castle, an LNER A4, an A2, two Southern Bulleid Pacifics all together in a repair shop, in various stages of restoration, plus an LMS Royal Scot in steam getting its final examination and main line paperwork. A very rare occurrence or, there again, maybe not – here they all were along with numerous carriages and a Class 47 diesel. The paint shop was an absolute joy to behold with the superb level of finish being attained, by hand! Even the reception whets one's appetite with an exquisite 7¼" gauge David Aitken model of a Beyer-Peacock built GWR 0-6-0 tender engine on show.

Then it was back to the steam test and now the pressure was at 215psi and as the fire was maintained the safety valves lifted and kept the pressure to its acceptable test level. UK boiler examiners carried out a thorough check and the boiler was duly certified for use.

It only remains now for the boiler to be shipped back to Switzerland and mounted into the smokebox and frames. The L&NWHR fitters will be carrying out the hot riveting in Switzerland to complete the project. It is very gratifying to know that, despite all the negative atmosphere that exists in some quarters that the UK skills are in decline, there are still organisations able to carry out this type of work and at Crewe they are actively engaged in making sure this continues. ■

The splendid new repair facility at Crewe.

A new inner tubeplate for a locomotive under repair.

A new firebox inner shell for a similar locomotive.

The inner tubeplate and firebox for a Bulleid pacific waits to be completed.

215psi and holding steady as the valves work as they should.

The 20th Sacrewell Miniature Steam Rally

by **DAG Brown**

The cooperation between Sacrewell Farm Centre and Peterborough Society of Model Engineers started in 1997, the park having the space and the society the contacts. The organisation was left to the Society and two prime movers did most of the spade work: Roy Mosley and Doug Crampton, who devoted so much time to making it a lasting success. Sadly Roy is no longer with us but Doug's organisational skills were still very much to the fore, dealing with the nearly fifty entrants to the show. Cooperation from the Centre was all that could have been asked for; the field was well mown and the services laid on as required with excellent access and parking.

Sacrewell Farm Centre is on the outskirts of Peterborough, close to the Great North Road, originally working farmland and now a place which seeks to demonstrate to young people many aspects of the farming business which is a major industry in this part of the world. Demonstrations of old methods, even an old shepherd's hut and a recently restored water mill, blend with a modest population of animals including cows, sheep, goats, pigs and chickens; there are even some peacocks – not part of farming in my book! The farmland retains an original modest pattern of roadways in reasonable condition for a road run of locomotives. In restoring the water mill they are able to demonstrate the basic principles of water power and the way in which it used to provide a vital service for the community.

Especially at weekends there are many families enjoying the facilities and it is not unusual for some other fringe activities to be provided; a miniature steam rally goes down well. Besides the engines on the move there was a static display of models in one of the barns, which complemented a static display by the Peterborough and District Model Boat Club. They even managed to arrange for a Spitfire from the Battle of Britain Memorial Flight to pay a visit which it did so effectively with a double circuit of the ground in honour of the occasion. That was a poignant sight in a near-cloudless sky, noticeably bringing out the Grandads to celebrate.

The rally, by now well established, attracts engine owners from quite a long distance, the farthest entrant being from around eighty miles away. Most, however, were from the surrounding counties, namely Northamptonshire, Leicestershire, Lincolnshire and Rutland, with the host county of Cambridgeshire being represented by Society members.

On arriving at the field one was met with the spectacle of the usual array of caravans, trailers and motor homes, most people staying overnight on the site. There was plenty of room for steam raising and safe movement of the engines whenever they were ready. The surrounding area provided a more than adequate facility for exercising the engines' lungs and the clatter of gearing and gentle exhaust beats gave an authentic feel to the day.

It was well publicised that at 2.30pm there would be a road run around the estate, on which roads there is some interesting terrain; by definition a water mill must be at low altitude, which in this case meant a steep incline for the engines to climb on their way round. That gave a good photographic opportunity to sort the men from the boys!

As a fitting tribute, Roy Mosley had bequeathed two trophies for annual presentation at this rally, determined by a ballot of all those taking part in the weekend's celebrations. Roy's son Chris presented the prize for the 'best engine in steam' to Chris Gunn for his 6" scale Garrett 2 cylinder compound engine and for the best static exhibit to David Dean for his 5" gauge 'Speedy' tank locomotive.

Doug Crampton's Foster driven by Luke Geeves.

Pat Franks with bright red 'Puffer'.

A brace of Burrell compounds – Messrs Sosbe & Pywell.

Bill Cooper's Savage 'Little Samson' smartly turned out.

Burrells compound and simple – Phil Weston & Chris Webb.

The timing of the road run was the same as a race known as the 'Lamb National', expressly for little woolly jumpers. That drew the crowds from the families who were visiting the centre and no sooner had the final baa gone up than a load of steam-driven engines descended upon the same area of the site, preceded by a portly gentleman with a red flag to warn the crowds of impending danger. Most of the engines were to 4" scale and most had been built by their owners.

Easily the most numerous of the engines were Fosters. Two reasons come to mind for this fact – there were two original designers: Peterborough's very own Roy Mosley and Bill Newcombe. The designs are accurate and relatively easy to build and accurately prepared parts are readily available through Live Steam Models. The Fosters fall into two categories, simple and compound, the latter type being of the double crank variety. A few comments are due on the individual entries.

Tony Baldwin, well known for his boiler-making efforts, was preparing to raise steam as I arrived in his 4" scale double crank compound, named Shirley B after his late mother. Like so many of the class it is painted in red livery.

By contrast, Peter Spikings from Northampton was driving his 3" scale engine which he had scaled down from Roy Mosley's version of the double crank compound. Interestingly, he built it with the full showman's kit on it including canopy, dynamo and all the trimmings, arranging for it to be easily removed. As he confessed to me however, he found it difficult to drive in showman's rig so he took it off for public running.

A whole clutch of 4" scale Foster simple engines ran over the weekend. The first which I must mention is the agricultural tractor (as most of them were) built by Doug Crampton himself. Wisely he preferred sunbathing in the administrative pitch so he let out the preparation and driving to Luke Geeves, a young Peterborough member who demonstrated his competence in the matter, carrying his sister as ballast.

While on the subject of young drivers I should mention that there were one or two handling non-steam miniatures including two small Land Rovers, one being a commercial 'toy' and the other built from MDF, looking suspiciously like the Apache design, of which I have personal experience. In addition a couple of other toy vehicles appeared for the parade through the farm.

To reinforce the fact that the hobby is still producing models there were a couple of newly finished Fosters (within

Oldest engine in show – Peter Nixon's 3" scale Burrell from 1980.

Richard Cannell's 3" scale Fowler.

Eddie Lancaster with 4" scale Foster simple engine 'The Old Gel'.

Graham Sadler with 3" scale Atkinson.

Roger Kightly's 6" scale Foden simmering in the sun.

Chris Gunn with nearly new 6" scale Garrett tractor.

the last year): Pat Franks had one called Puffer, which was certainly making all the appropriate noises, and another by Malcolm Saytch of Chalfont St Peter in Buckinghamshire, again to the Bill Newcombe design. Malcolm has been a loyal participant in most of the Sacrewell rallies.

A much older version of the same engine was driven by Mike Moss; this dates from 1997 and is often to be seen working hard and coupled to a saw bench.

On the heels of the Fosters were the Burrells which, of course, are far more common in full size. These give more variants to study and early in my attendance my eye caught sight of a pair of 4" scale single crank compound road locomotives. Built as a pair by two friends Arthur Sosbe of Market Harborough (Gemini2) and Tom Pywell of Leicester (Gemini1), they shared the work according to their talents and are frequent visitors to Sacrewell.

Another Burrell compound road locomotive, this time a double crank machine called Princess Polly, was brought by Paul Salmon who took six years to build it. Likewise another similar machine was by Phil Weston, who took even longer for completion, painting it in the style of the full size 'The Badger', while Mark Harris of Chatteris finished his example in 2013.

Single cylinder simple Burrells were well represented, for example Colin Alexander of Middlesex brought his Warrior Queen. Peter Nixon of Newton in Derbyshire was driving probably the oldest model of the day, having finished his 3" scale engine in 1980 to Plastow's design. It is still going strong.

No rally would be complete without a Fowler in steam and an A7 class agricultural engine in 3" scale was run by the Peterborough Society chairman Richard Cannell. Bearing in mind the fairly small dimensions of this model it was not surprising that Richard had to confess to taking a short cut in the road run to avoid running out of water.

A single example of a Garrett 4CD engine in 6" scale was making its debut at Sacrewell with Chris Gunn of Kettering. This engine has already been mentioned as a notable example, winning the Roy Mosley award.

And so to the steam lorries; last year's winner was Roger Kightly with his impressive 6" scale Foden C-type lorry into which he could fit as driver, giving the impression that he was comfortably sitting inside the cab while driving!

Finally Graham Sadler, nicely liveried in bowler hat, was running his 3" scale Atkinson lorry with its uniflow engine which he is currently describing in Engineering in Miniature. ■

Making a Regulator Clock to a New Design

Part 14 – Finishing the case

by **John Reynolds FBHI**

Continued from page 103, September 2016

Now that the main body of the case is finished this final article covers the mouldings, the door hinges, the glazing beads and fitting the glass, the bottom closing panel, the hanging bracket, the stabilisers, the door catches and applying a decorative and protective finish. Finally the installation of the movement together with a suitable beat plate is described.

Upper and Lower Mouldings

The upper and lower mouldings can be simple or complex depending on taste and availability of facilities to produce them. Indeed, the old Biedermeier Vienna regulators had simple bevels in an architectural form. This style of moulding was used on the prototype case as shown in photograph 61. It is a good idea to look at other regulator cases, or photographs of them, before a decision is made. The concave mouldings I used on this case are shown in photograph 62. To make these I removed the bulk of the waste with stepped cuts on a circular saw and finished them with a moulding plane. Composite mouldings made using a router, commercially available beading and mouldings recovered from redundant furniture, such as the tops of wardrobes, are other possibilities but try to match the colour and grain of the main timber used. Photograph 63 shows the composite moulding I used for the bottom of the case and photograph 64 shows a closing moulding being applied to the top of the case.

The mouldings have to be carefully mitred at the corners. It is best to cut the front piece or pieces first. The side pieces are left a little too long to allow more than one chance to get them right. When the corners are satisfactory glue the front moulding on using the minimum amount of adhesive. Hold it in position for five minutes or so until the glue starts to grip then leave it to set over night. The side pieces can then be fixed and, because the front piece is set, it is possible to push the mitred corners tight together. If a closing panel is to be fitted to the base, as is usual, make sure that the mouldings are deep enough to cover the edges of this panel.

Photograph 61 – Architectural moulding on the prototype clock case.

Door Hinges

Fitting hinges can be difficult for the inexperienced so it is necessary take care and make haste slowly! Photograph 65 shows the middle hinge of the three on the left-hand side of the door. Note that the upper and lower edges of the hinge are in line with the centre rail of the side frame. The lower edge of the upper hinge should be lined-up with the lower edge of the upper rail, and the lower hinge should be lined up in the same way. Use only the best solid brass hinges and appropriately sized slotted head brass screws.

Photograph 62 – Concave top moulding.

Photograph 63 – Composite moulding on the bottom of the case.

Photograph 64 – Adding the top moulding.

For good cabinet making the hinge is let almost fully into the side frame (by about 95%), allowing just a little for clearance. Let all three hinges into the side frame in this way then place the door in position again with the cardboard spacers top and bottom. Mark the hinge positions on the door then make a tapered recess for the door flap of each hinge to sink into. This is demonstrated in figure 63. The hinging is done like this to preserve the line of the door which should not be upset by the hinges.

Photograph 65 – The door centre hinge.

Glazing

There should be just enough timber left for the glazing beads. Make these the same width as the rebates (10mm) and a little more than the depth of the rebates so that they stand proud on the inside when the glass is fitted. Do not try to make them flush on the inside as this is very difficult to achieve and any error here accentuates the joint. The beading can be rounded off if desired as shown in figure 58 (see part 13 of this series) but unless all the beads are exactly the same the results will be disappointing. Do not make mitred corners for the beads as these make them very difficult to remove if a glass has to be replaced. Instead make the top and bottom beads full length then make the ends of the side beads square, or shaped to fit round the top beads if they have been rounded-off.

When fitting the glass the beads can be held in with brass screws or veneer pins. If veneer pins are used pre-drill the beads with 1 mm holes about 200mm apart to ensure perfect results.

The case is now nearly finished. The top is usually left open and this is where I placed the battery holder for the automatic winding system. Here it is out of sight and easy to access. However the base is usually closed in, as mentioned above, and this panel can now be fitted by simply gluing it in place. It can be a piece of veneered MDF or a piece of fair-faced ply and it should be a good fit between the mouldings.

Hanging the Clock

This is a heavy wall clock and a substantial hanger is required. In this case it is made from a piece of angleiron or brass angle and is bolted to the back cross member of the top panel (see figure 64).

Photograph 66 – The assembled case.

The bolts pass through the cross member and the MDF panel with the heads and a washer inside the case. They are not seen once the movement is fitted in the case. The case construction is now complete and photograph 66 shows my case at this stage.

Two stabilisers or spurs should now be made up and fitted to the case. These are most often seen on the outside bottom of Vienna regulator cases. The pointed ends of the stabiliser screws grip the wall to help prevent the clock from swinging on the wall, particularly when the door is opened. These can be purchased in pairs from materials suppliers for fitting outside the case. However I decided to make up more substantial stabilisers for fitting inside the case at the two bottom corners of the backboard. For these, two 45mm lengths of 2BA brass or steel threaded rod are

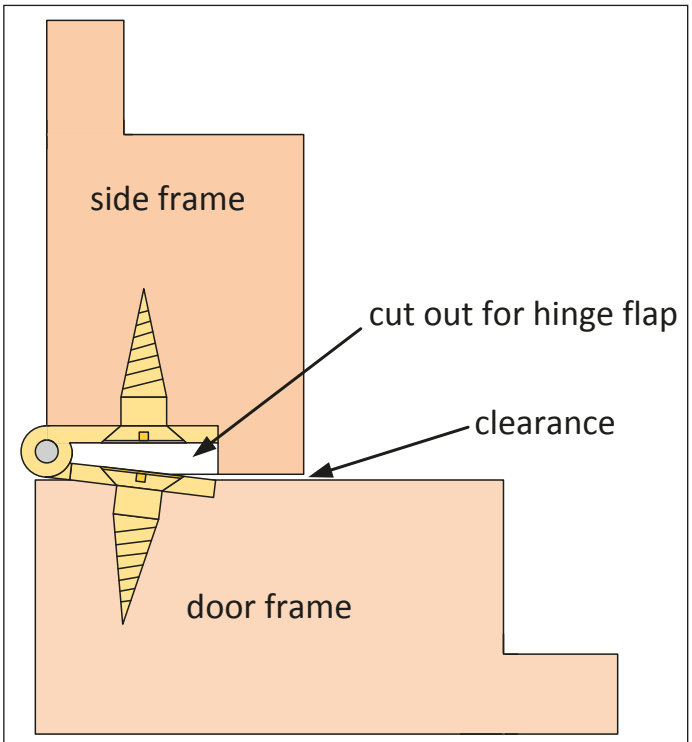


FIGURE 63 – SECTION SHOWING THE CORRECT INSTALLATION OF THE HINGES.

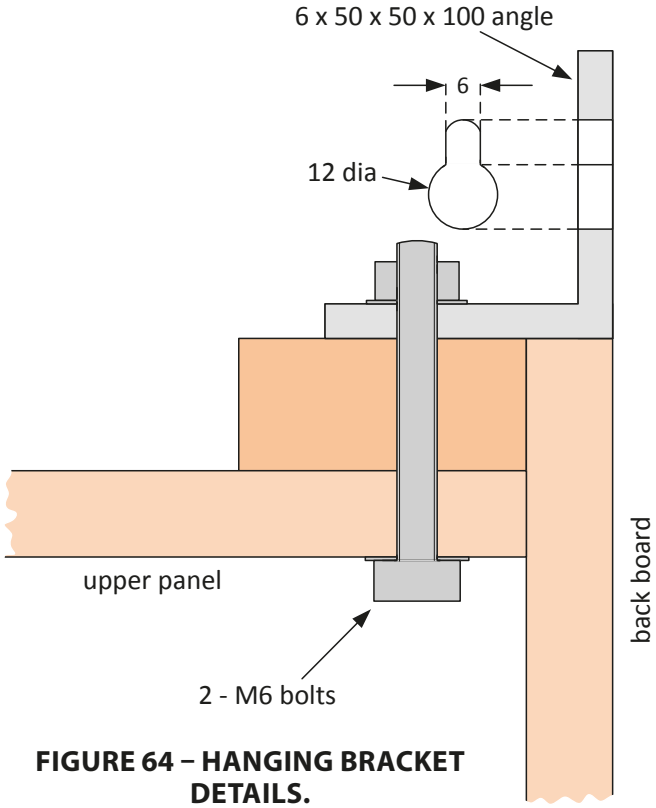


FIGURE 64 – HANGING BRACKET DETAILS.

required. Turn a sharp point on one end of each length and make up a 20mm diameter by 5mm decorative brass head for the other end as shown in photograph 67. Drill a 4mm central hole in each head and tap each with a 2BA taper tap. Do not form a full thread as the heads need to fit very tightly on to the screws. If the heads do not feel tight enough soft solder or Loctite the screws to solve the problem. Drill two 4.8mm holes in suitable places in the back board and feed the screws through from the front. Make up two 25mm square plates from 2mm (or similar) brass with a central 2BA thread and two small holes for fixing screws. From the back of the case wind the plates on to the stabiliser screws and then fix them to the back of the case with small brass screws. In operation, the stabiliser screws are turned so that the points just grip the wall.

Door Catches

There is insufficient room in the woodwork to accommodate a lock for the door unless it is of the type which is often used on bracket clocks. These are difficult to find, expensive, not very strong and two may be needed. I therefore decided to to use catches as shown in photograph 68 and figure 65. I made these from 1.5mm brass and they are screwed to the side of the case with a 1.5mm washer between the catch and the case to ensure they do not mark the woodwork. The washers were a little smaller than the hub of the catch, which is 14mm in diameter. The distance from the catch screw hole to the edge which secures the screw on the door is 38mm. The screw on which the catch pivots is ideally a raised head countersunk screw with a countersunk washer placed under its head. A round head screw with a plain washer would be an acceptable alternative. For the door a ⅝" number 4 screw will be adequate.

Finishing the Case

The finish to the case is largely a matter of personal choice and expertise. After sanding down the case with fine glass paper, and making sure that any surplus glue has been removed, the case can be stained if desired although I found that this was not necessary. When any staining is thoroughly dry a protective finish, which will also enhance the colour and the grain, should be applied. I used a shellac based sanding sealer for this purpose. One coat is applied, allowed to harden and then well rubbed down with medium steel wool. A further coat is then applied and rubbed down with 0000 grade steelwool. A few coats of clear wax polish finishes the job. This will produce a pleasing result on most timbers but practice on some waste pieces of wood first is advisable.

Photograph 67 – The stabiliser screws.

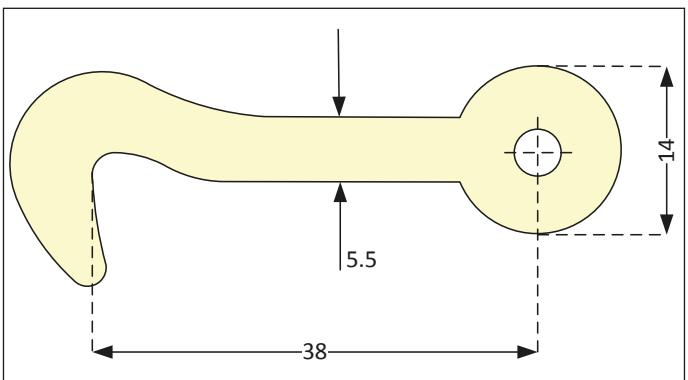
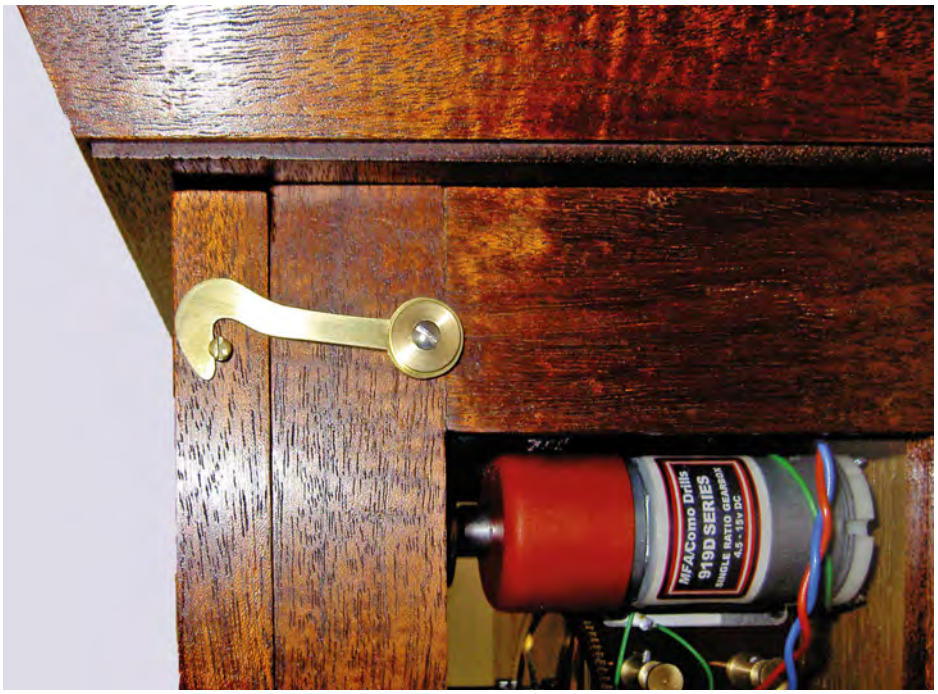


FIGURE 65 – DOOR CATCH DETAILS.



Photograph 68 – The upper door catch.

Fitting the Movement

The movement can now be fitted inside the case. To do this lay the case down on a flat surface and place the movement inside the case with its mounting plate and steady pinned spacers attached. Adjust its position such that the bezel is equidistant from the each side of the door frame. The gap at the top of the bezel to the top rail of the door frame should be 1mm more than at the side or the dial will look too high. Make absolutely sure that the 30 – 60 centre line of the dial is parallel to the door stiles. There are only four screws needed to attach the mounting plate but their location is particularly important. Make sure that the movement is fully down in its key-hole slots and, as a precaution, place some double-sided adhesive tape on the mounting points to hold everything in place. Double check that the dial is in the correct position before marking the position of two of the four holes. Drill pilot holes for the screws carefully with a hand drill and insert two 4 mm screws. Check again that all is well and then drill the pilot holes and insert the other two screws.

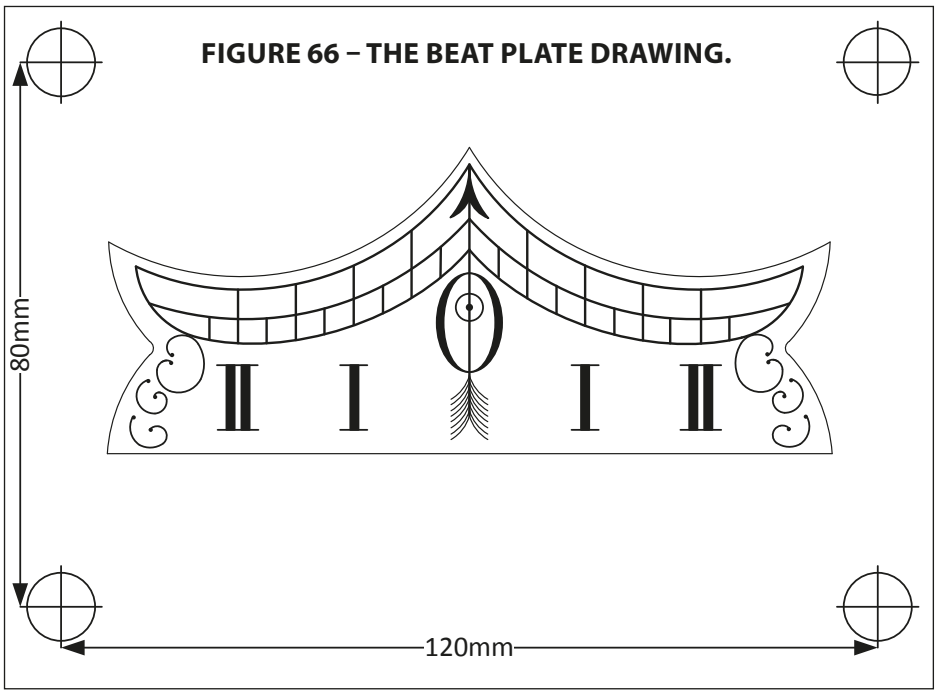
Beat Plate

Figure 66 is a drawing of a beat plate for a seconds pendulum. This can be made using the photo-etching process described in part 11 of this construction series. The drawing is available as a PDF via the Editor by email. As well as beat setting it also helps when hanging the clock. It should be fitted to a small block of wood or piece of brass angle such that it is in close proximity to the tip of the pendulum. Make sure that its centre is vertically below the suspension, which will not necessarily be exactly at the centre line of the case.

This completes the assembly of the clock and it can now be hung on a strong screw and commissioned as described in Part 12 of this construction series. Photograph 69 shows the finished prototype clock.

I hope that everyone who has followed this series to make their own regulator has enjoyed the experience and that it has resulted in a clock to be proud of. For those who are currently making the regulator, or who intend to in the future, I can be contacted by email via the Editor if there are any particular problems encountered with the construction. ■

FIGURE 66 – THE BEAT PLATE DRAWING.

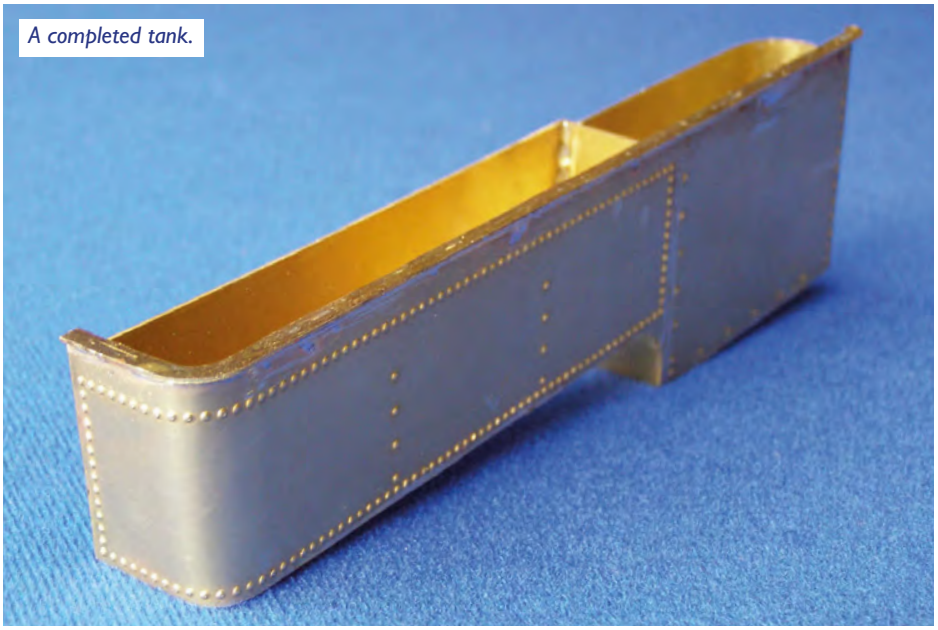


Photograph 69 – The finished prototype clock.

"Yorkie" – a Yorkshire Engine Company 0-6-0 Locomotive in 16mm

By **Malcolm High** and **Derek Crookes**

Continued from page 99, September 2016



A completed tank.

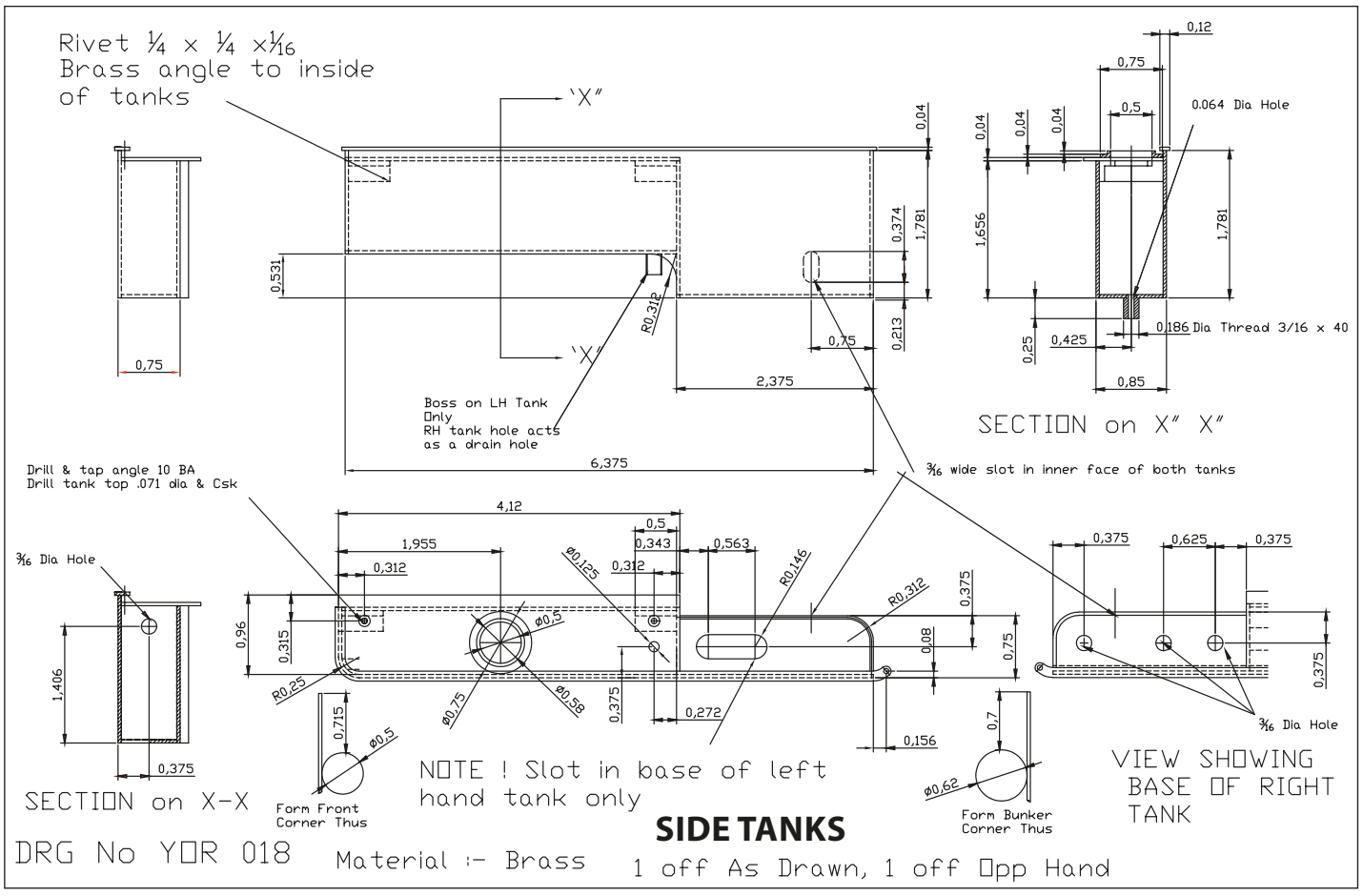
Side Tanks

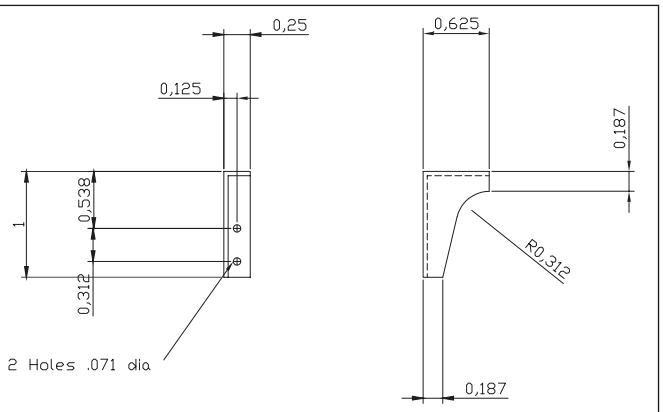
There is not a great deal of plate work on the locomotive. The tanks and bunkers form the majority of it. On the model the left-hand tank contains water whilst the right-hand houses the radio gear. Note that the battery is in the top of the roof.

The tanks on the prototype were riveted and these are formed on the model by using the riveting tool described in a previous issue of this magazine. The number and rivet pattern were determined from the one image available. Normally, when using the riveter, spacing is determined by the outer diameter of the anvil. However this is not really a practical proposition for these tanks as there are vertical and horizontal lines of rivets which have to line up. The solution is to use a jig.

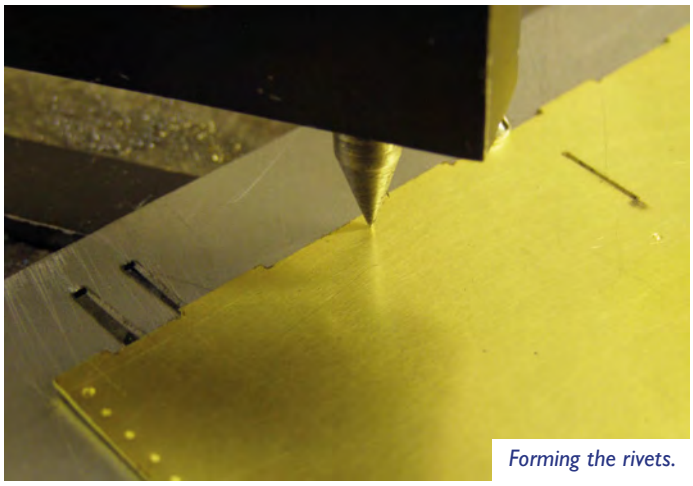
In use the brass plate is bolted to the steel jig and is lined up by placing the edges of some of the tabs against locators in the jig. The locators are pushed through such that they protrude by 1mm or so. For the other tank they have to be pushed back through the plate so they protrude in the opposite direction. In this way one jig can be used to do both tanks. In the riveter the normal anvil is replaced by a blank one just 2mm in diameter and 1 mm high.

Start with a piece of scrap brass the same thickness as the tanks. Place the blank anvil in the base of the riveter. Adjust the height stop so that the former stops





SIDE TANK SUPPORT BRACKET
1 OFF AS DRAWN
1 OFF OPP HAND
MATERIAL: MS



Forming the rivets.

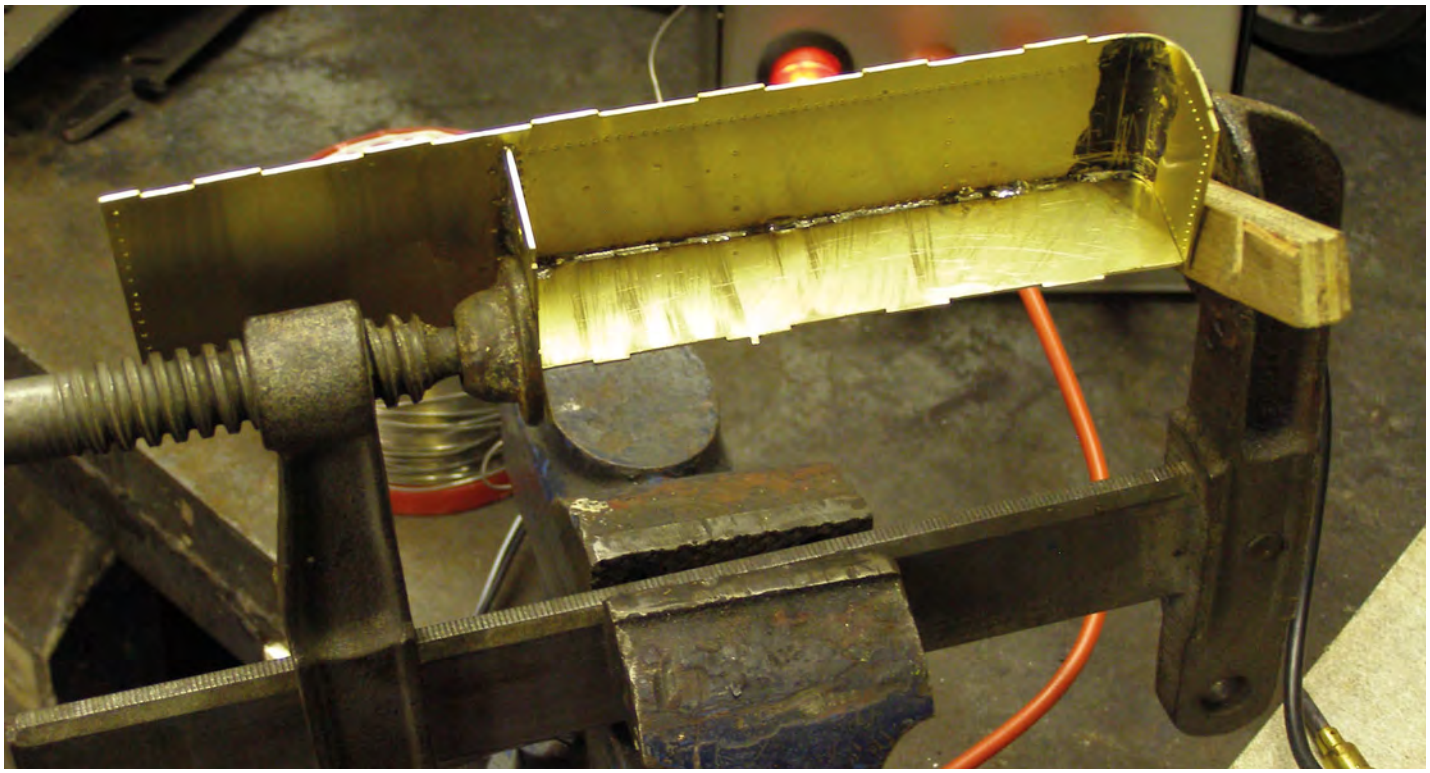
(Right) – Forming the front curve in the tank – note the use of soft wood to protect the rivets.

0.7mm from the anvil. Place one of the holes in the jig over the anvil and form a rivet in the scrap brass. Adjust the height stop until you are happy with the height of the rivet head. You may have to reduce the height of the anvil if the brass contacts it.

If you are using the laser cut parts take one of the tank sides and clean out the slots. Check that the tabs on the relevant part will go through without too much persuasion. Remember that there may be small nibs on the external corners of the tabs which need to be filed off. Occasionally the centre of the slot does not fall out. In this case it will have to be removed with a thin-bladed screwdriver and the slot cleaned up with a ground down junior hacksaw blade. Push the tabs in the jig through so that they protrude by 0.7mm or so. Place the brass on the jig using the tabs to position it and some M4 nuts, bolts and washers to fasten it to the plate. Starting in one corner form the first rivet. Move around the jig forming the rivets. Eventually it will be necessary to remove one of the nuts and bolts as it will foul the riveter base. Once these can be replaced, they should be. If you make an error the rivet head can be pushed back with a small flat faced punch and a light hammer.

With the rivets completed the side can be formed by hand over a piece of bar in the vice, as shown. To protect the rivet heads a piece of soft wood can be placed between the jaw of the vice and the brass. Check the radius is correct by using the base as a template. The tabs on the jig are now pushed through to the other side and the opposite hand tank is riveted and formed.

Soldering the outer skin to the base - note the use of soft wood to protect the rivets.



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MIDLANDS MODEL ENGINEERING EXHIBITION 2016

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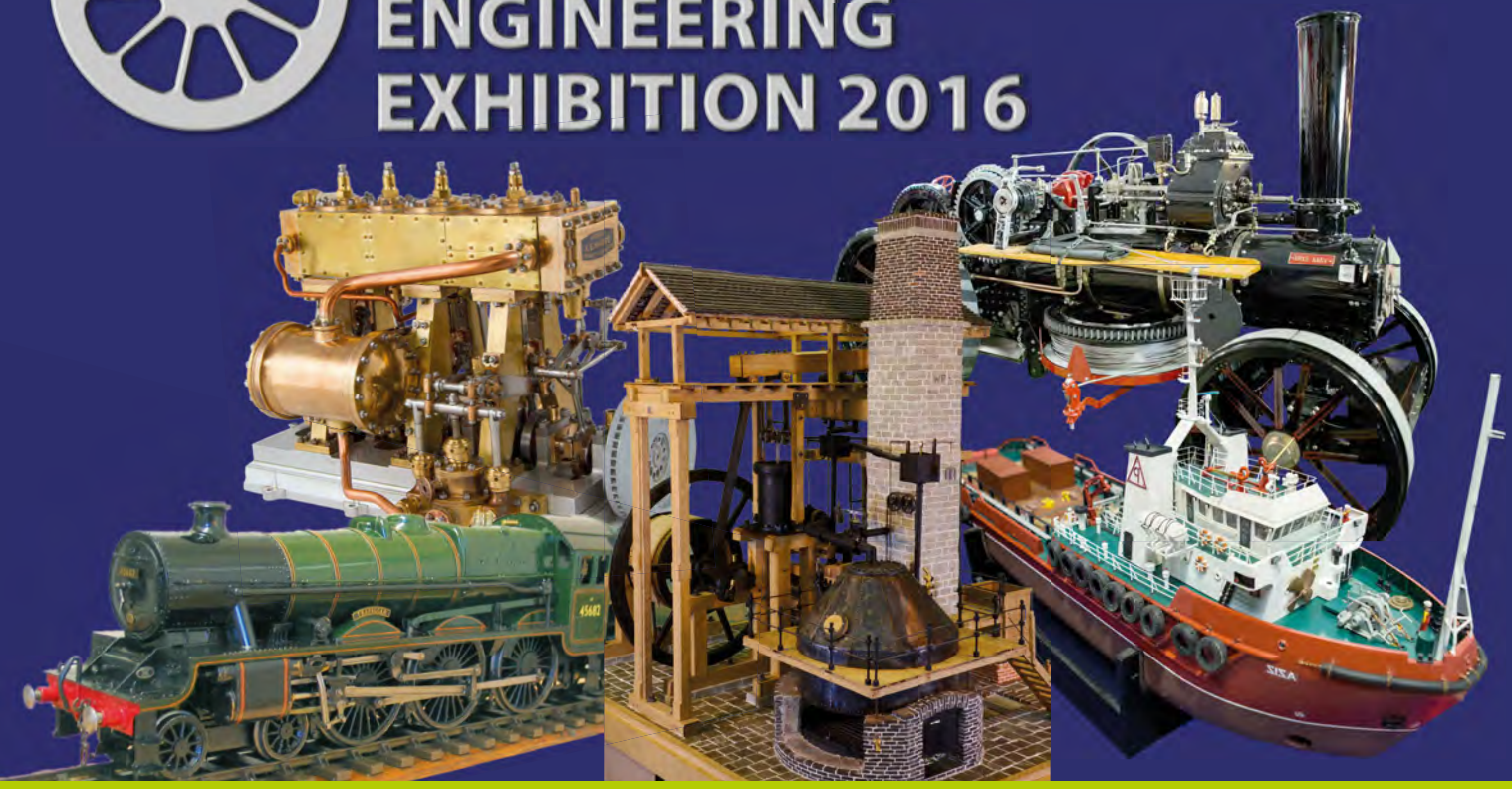

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Chris Deith
Exhibition Director

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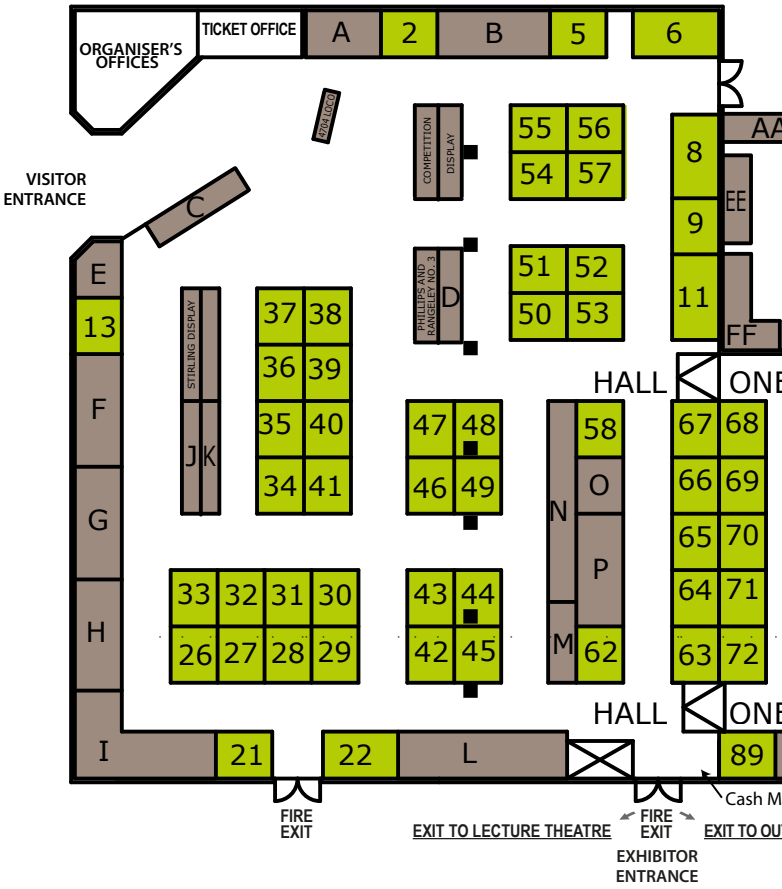

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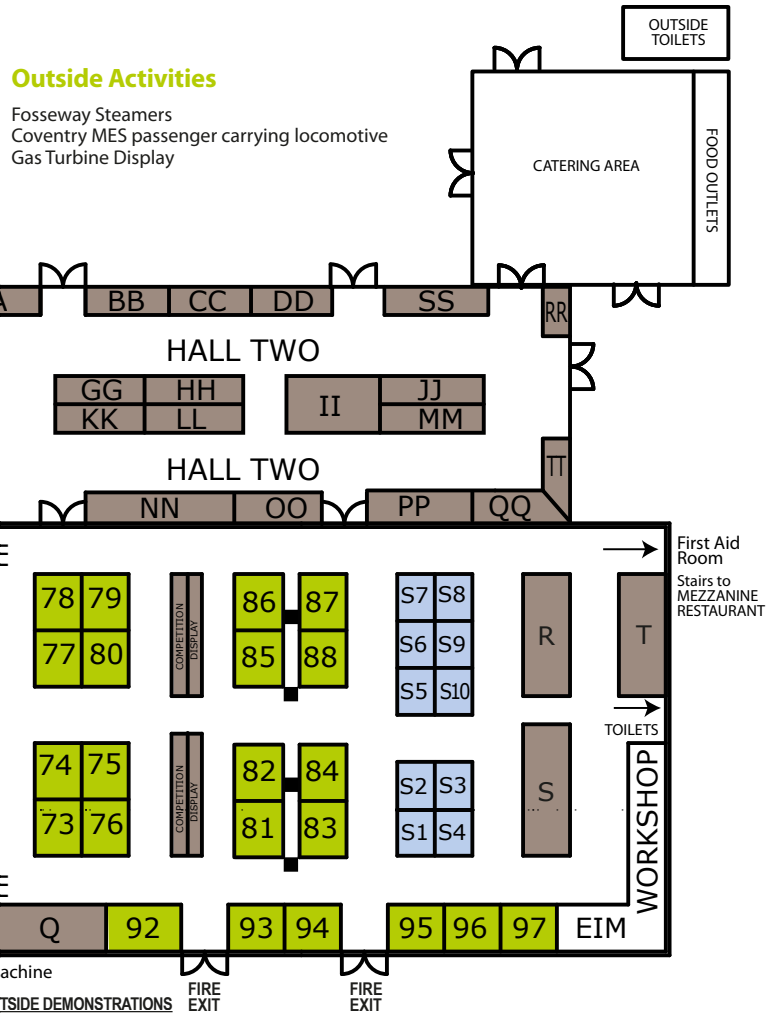

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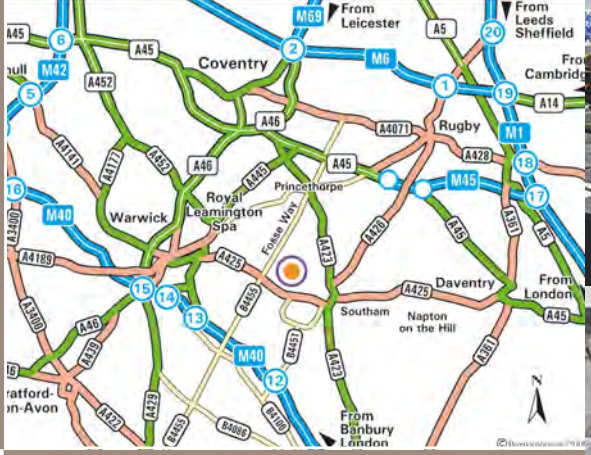
The exhibition will be held at the Warwickshire Exhibition Centre, Fosse Way, nr. Leamington Spa, Warwickshire, CV31 1XN on the junction of the A425/B4455, which is readily accessible from most parts of the country. It is at the centre of the national motorway network, with the M1, M6, M40, M42, M45 and M69 all nearby; Leamington Spa Railway Station is only 3.5 miles away. Birmingham Airport, with its domestic and international flights, is just 30 minutes away.



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VISITOR INFORMATION

Cash Machine
This is located at the exit door to the lecture theatre next to stand 89.

Cloakroom
This is situated just inside the main entrance at the organisers' office.

Exhibition Bus Link
This service operates between the exhibition and LEAMINGTON SPA Railway Station. The pick up/drop off point is at the end of the walkway in front of the exhibition centre.

The service runs continuously at 30 minute intervals. Journey time is approximately 10 minutes. There is no service on Sunday. Charges are £2.50 each way.

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If you require first aid please see any member of our security staff or go directly to the first aid room which is situated in Hall 1 at the foot of the stairs to the restaurant.

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Please go to the organisers' office at the main entrance or see any member of our security staff.

Organisers' Office
Located by the main entrance.

Places To Eat And Drink
Restaurants are available in both halls. Hall 1 has a first floor restaurant whilst Hall 2 has outside catering.

Toilets
Ladies and Gents facilities are located underneath the mezzanine in Hall 1 and outside behind Hall 2.

Opening Times
Thursday – Saturday: 10.00am – 5.00pm, Sunday: 10.00am – 4.00pm
(Final Admissions 1 hour before closing)

Should you require any assistance whilst at the exhibition, please contact either the organisers or a member of the security team or go to the main entrance.

LECTURE PROGRAMME

Thursday 15th October

Time	Lecture Topic	Presented By
11.00am	3D Modelling - Warts and all!	Derek Brown
12.00pm	Best Silver Soldering Practice	Keith Hale
1.00pm	Tools in a Clock Makers Workshop	Mark Brockley
3.00pm	Setting Up and Running a Small Scale Foundry for Model Engineers	Noel Shelley

Daily Demonstration 1pm - 2pm outside near lecture theatre
Noel Shelley and a working demonstration of his brass foundry

Friday 16th October

Time	Lecture Topic	Presented By
11.00am	Steam in Model Boats	Phil Abbott
12.00pm	Best Silver Soldering Practice	Keith Hale
1.00pm	Some Thoughts on Shaping Sheet Metal	Peter Stephenson
2.00pm	Lighting in the Home Workshop	Mike Haughton
3.00pm	Setting Up and Running a Small Scale Foundry for Model Engineers	Noel Shelley

Daily Demonstration 1pm - 2pm outside near lecture theatre
Noel Shelley and a working demonstration of his brass foundry

Saturday 17th October

Time	Lecture Topic	Presented By
11.00am	Some Thoughts on Shaping Sheet Metal	Peter Stephenson
12.00pm	Interesting Properties of Precious Metal	Gary Wooding
1.00pm	Tools in a Clock Makers Workshop	Mark Brockley
2.00pm	Lighting in the Home Workshop	Mike Haughton
3.00pm	Best Silver Soldering Practice	Keith Hale

Daily Demonstration 1pm - 2pm outside near lecture theatre
Noel Shelley and a working demonstration of his brass foundry

Sunday 18th October

Time	Lecture Topic	Presented By
11.00am	3D Modelling - Warts and all!	Derek Brown
12.00pm	Steam in Model Boats	Phil Abbott
2.00pm	**PRESENTATION OF AWARDS**	

Daily Demonstration 1pm - 2pm outside near lecture theatre
Noel Shelley and a working demonstration of his brass foundry

Book your tickets at www.midlandsmodelengineering.co.uk

All details correct at time of going to press. Subject to change. Please check website for up to date information.

The bunker also needs to be formed; note that the end has to be bent through ninety degrees where it solders onto the outer plate. Ensure you end up with a right and a left hand plate.

On the plate next to the boiler, one end is formed through a right angle. On the laser cut parts slots are cut to weaken the material where the plate has to be turned. Once all the parts have been prepared they can be assembled.

On the prototype cored soft solder and solder cream were used with a resistance soldering iron. For those who have not used one of these irons before the principle is as follows. A current is passed through a carbon electrode which is in contact with the brass. The latter is connected to the negative side of the equipment by a crocodile clip. The current can be varied by selecting different tappings on the box. The advantage of a resistance soldering iron over a conventional iron is that the heat is localised and very controllable. Having said that, a conventional soldering iron of around 100 watts may be used.

Do a dry run first to ensure all the tabs go through the slots. Start with the base and the bunker plate. The tab should go into the slot with very little resistance. Check the plate is set square with the base. Solder these together. Next fit the outer formed plate.

Resistance soldering iron and various solders used in the building of the tanks.

Use small toolmaker's clamps to ensure the plates are a good fit. Finally fit the backplate to complete the tank. The bunker is a smaller version of the tank. Note the differences in the parts depending on which hand bunker you are making. If you are not using the laser cut parts brass angle will be required to stiffen the corners.

The tanks fit onto the footplate and are also supported by a small bracket at the front.

To be continued

BOOK REVIEW

By **Paul Carpenter –** *4709 Project Engineering Manager*

Great Western Eight Coupled Heavy Freight Locomotives

By David Maidment

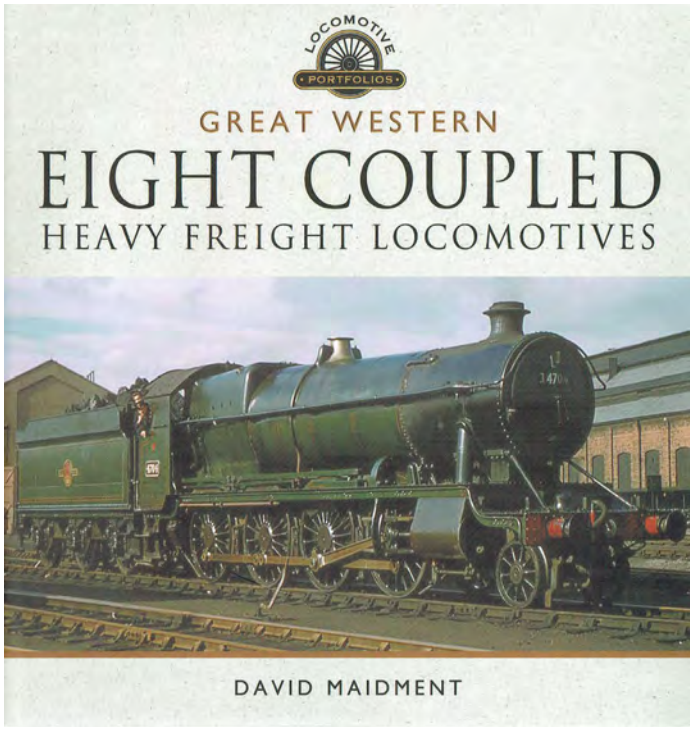
Publisher Pen and Sword Transport have embarked upon the 'Locomotive Profiles series' of books and the first of these is the Great Western Eight Coupled Heavy Freight locomotives.

David Maidment is an author well known and respected in railway circles and he commences this work by looking at the locomotive designers of the Great Western. He then takes a detailed and broad look at numerous locomotives of the eight-coupled wheel arrangement that operated on the GWR. As a lifelong railwayman David is able to provide us with an insight into the circumstances which challenged the GWR designers to produce locomotives which could perform specific tasks. He then sets this in the context of the changing requirements of the industry and the efforts of the GWR to satisfy these changing demands.

I expected to read about the 42xxs, 28xxs and of course the 47xxs and, whilst David deals with these in great detail, he also looks at a surprising number of other classes of this wheel arrangement that were either absorbed or acquired by the GWR. For all classes he looks in detail at their design and construction before discussing their day to day duties.

The book is full of beautiful photographs, both black and white and colour, and these provide a wealth of invaluable information for railway modellers, model engineers, full size restorers as well as historians and the armchair enthusiast.

Our 4709 project has been intimately involved with a 52xx and 28xx which were 'donor' engines for our 4709 engine and we have found this book a valuable source of information from both the photographs as well as the text information.



David was also the creator and chairman of the 'Railway Children' charity and all advances and royalties from this book are being donated to that truly wonderful and inspiring cause.

I can wholeheartedly recommend this book to everyone interested in the Great Western and in particular how they were so successful and effective at the movement of freight. ■

More Church Clocks

by **DAG Brown**

When I handed over the material for my previous article on this subject, our worthy editor agreed that he might look favourably upon some more material of similar nature (did I say that? – Ed) and, since I have been involved in working on some fifteen of the local instruments, there seems to be plenty of suitable material to explore. Apart from the coincidence of Tinwell and Bainton all the rest are of different design. Some of them have interesting features which seem unique. There have been odd scrapes in the work of putting them right and the work has led to meeting many interesting characters and to performing some other completely different tasks; so read on if you are gripped by the plot so far and I can promise you much variety and some excursions into tangential subjects in the months to come.

My wife's brother and his family belong to the church at Witham-on-the-Hill and he let me in for some remedial work on that clock, fairly soon after I had completed our own one. Witham as a village had fortunes built on the wool trade in the Middle Ages and some of the wealth stuck around to the effect that the church was well endowed, in particular the bell tower and its accoutrements, including the clock which dates from the late nineteenth century.

Firstly, in the tower is a peal of six bells, which did not go unnoticed with the proprietor of the local hostelry which bears that name to this day. Secondly, the burghers of Witham-over-the-Top wanted to outdo their neighbours, requesting the installation of a Westminster Chime on the quarter hours. Now this is rather unusual for country churches for very good reasons: that outburst of music requires there to be at least six bells in the tonic sol-fa, thus: in do, re, mi, fa, so, la, ti, do, the chime which is heard on the hour is:

fa, la, so, do
fa, so,la, fa
la, fa, so, do
do, so, la, fa.

My apologies for mentioning the tonic sol-fa scale but I could not think of a way of presenting this in any other way! What it means is that the Westminster chime makes use of four of the scale notes, omitting the second and third ones in the line. Towers with fewer bells do not have the high notes in the scale since every bell which is added

Witham church tower

must be the next one up the scale, starting with do. If we now consider the chiming every hour of the day and night four notes ring out at the quarter hour, eight at the half hour, etc., and during twenty-four hours we hear no fewer than 960 notes. Bearing in mind that the procedure is rung mechanically, by releasing the hammers on to the bells, this requires a considerable amount of energy and, in the case of Witham, the chiming train ran down in 40 hours, requiring a daily visit to the tower by the chap who wound the clock.

When I was asked to get involved I found several things wrong with it: the escapement mechanism had a fault which caused it to run erratically, losing time, and some of the bearings were badly worn, calling for some re-bushing – just the thing for my workshop. In addition they raised the question of how I might be able to automate the winding of the chiming train. So out it all came, like the process at Tinwell before it, and I was able to work on it in my own workshop. However, in the world of parish church clocks it is a whopper! It weighs in at some 300kg in Napoleonic units, or 6cwt in Christian units. The three power trains had weights totalling half a ton so one of the things which I felt obliged to do was to carry out a minute inspection of the three sets of wire ropes. The mechanical work was quite straightforward, it just took time and eventually led to a satisfactory repair, a fact of which I was pleased to be reminded recently when I happened to meet their priest socially.

Having considered how I might arrange for automatic winding of the chime train I realised that I had in my workshop a motor which was geared to run only at around 24rpm. So I rigged it up to drive the spindle which used to be wound by the clock winder every day. This in turn acted upon the ratchet system, giving the characteristic 'click click click' noise as the winding took place. During the day the weight would fall from the roof of the clock chamber into an enclosed pit on the ground floor of the bell tower. So I had the opportunity to intersect it anywhere in its travel. I installed two limit switches (or electrical triggers), one at ground level and the other at eye level in the clock chamber. Striking the bottom one, this sent a signal to a black box in the clock chamber, which said "Wind me". The black box was designed with the savvy to reason: "Hold on a minute, the striking might be still taking place and we don't want to startle anybody in the tower!"

Thus I built in a 30 second delay, during which a buzzer sounded, announcing that the winding would be starting shortly. This happened and took about eight minutes until the weight tripped the upper limit switch, which stopped the process and reset things for the next cycle. I also installed a third (emergency) trip switch, just above the second one, whose function was to cut the power to the system in case of failure. So far as I know it was never used in earnest. In all this was an interesting project. It so happened on one of my infrequent visits to the church the warning signal sounded and I witnessed at first hand the sequence which did occur about every eight hours.

I did mention that the church is well endowed; they decided about three years ago to splash out on an auto-winding system for all three trains of gears, as well as having the face re-gilded at great expense. So my work became a mere memory, but an interesting interlude in the chapter of the most elaborate church clock which I have ever met. ■

The Atkinson Steam Wagon

by **Graham Sadler**

Continued from page 93, September 2016

A Problem

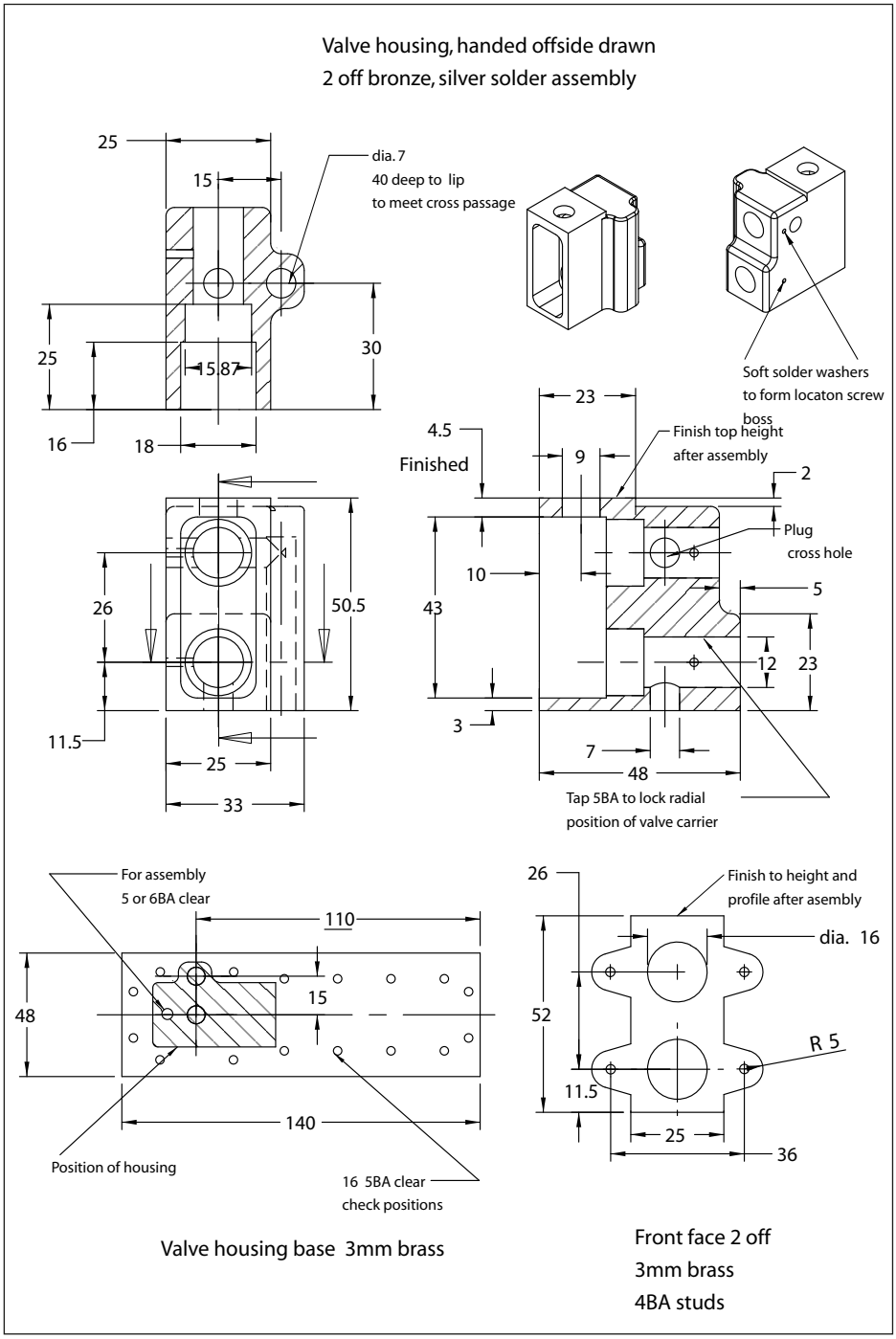
First of all a problem with the drawings in the August issue. My drawings were 'cut up' by the editor in order to improve layout and are thus shown on two pages. Consequently, the text top left on the mounting flange drawing on page 53 should be read with the drawing on page 50 (whoops! – sorry - Ed).

Order of Work

Although I said we would do the cylinders next, while preparing the text I realised I had overlooked the fact that the valve housing base is needed in the manufacture of the cylinders so we may as well start this assembly now. The cylinders and their associated components will need a lot of part finishing then revisiting. It will make things more difficult for us if each is produced fully on their own so we will need valve housing and base, valve assembly, cylinders, cylinder covers, inlet and exhaust manifolds etc. Consequently we will be going back and forward between components for the next few months but to keep the text simple and not dotted all over the place each group will be fully covered at one go. In order to get it all in perspective and not get mixed up a brief timeline is given here. A lot of the order of production is different from mine as you are getting the benefit of that wonderful thing – hindsight!

1) Valve housing body and base
2) Cylinder material reduced to 'squareish' block and bored
3) Mount valve housing base on cylinders and cut steam ways in cylinder
4) Make cylinder covers and fit cylinders to crosshead tubes
5) Valve guides, valves and ancillary components
6) Brazing valve housings and finishing their tops
7) Producing inlet and exhaust manifolds
8) Milling cylinder blocks into shape
9) Fixing cylinder cladding
10) Producing cylinder maintenance plug and mounting tubes.

In the prototype the housing was cast as a single piece with the cylinders, the valve housings being well back on the cylinders, resulting in the need for a very long hole to the front of the cylinder for the steam way, which was cored. I have seen a section of the engine from 1915 showing the housing



closer to the front of the cylinder but moving them forward would mean that they are hidden under the footplate and maintenance would be more difficult. I do feel that the positioning of the housings was a big failure in the design of the engine. Curious features of the very early engine design included the valve pushrods being fully enclosed in a tube and a total lack of any shuttle valves in the pistons! Atkinson had trouble getting these early uniflow experimental engines to work and tried a number of designs to relieve excessive back pressure.

Valve Housings

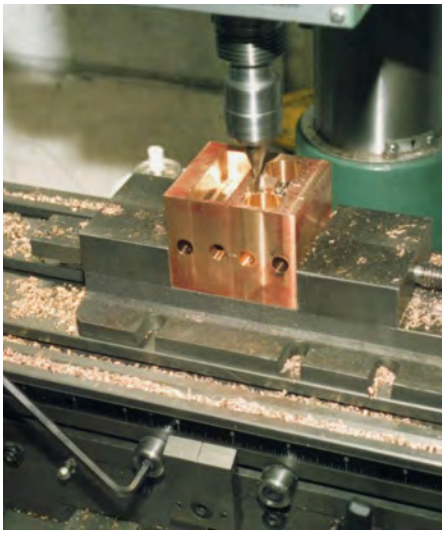
As our engine is to be made with only a single casting (offside engine mount) we will fabricate the valve housings from a bronze block, a brass base plate and a brass front plate all brazed together. The valve seats and guides are separate so can be replaced if needed. I have taken liberties with the external shape of the cylinders, not fancying the idea of drilling the long or angled steam ways and getting them to finish in the correct place, so we have a wide flat on the top of what should be a round top to the cylinders. In any case the

shape of the cylinders would have needed some modification to enable the housing to be bolted down with a much reduced mounting plate width causing probable fixing and sealing problems.

The original valves were hardened balls but I didn't fancy these due to not having much luck seating them and getting a good seal. They are replaced with a mushroom type which forms an excellent seal. Indeed, when the finished engine is on the bench being turned over with a spanner on the drive pinion securing nut, one needs considerable force on the end of the large spanner to turn it over due to the pistons sealing and acting as a compressor, there being a lovely POP as the valves open and pressure is relieved.

The design for the housings has been changed from my original design. I was concerned with getting a good seal to the valves, and considered a range of different materials for the seats, so my housings were made with removable seats fitted into the 15.78mm diameter pockets and the valve guide was a machined bronze tube guide brazed into the 12mm diameter part. The trouble with this was grinding the valves in place to seal them. It was difficult, to say the least! There were a lot of circular mating surfaces between valve stem and housing, all of which needed to be perfectly axially aligned and concentric – very time consuming. In addition, I had a disaster in steam with one of the valve seats popping out, which jammed the valve, bending the stem. This required a major strip down to cure the problem. So the new design uses a single removable tube containing a combined valve guide and seat which is locked into the valve housing. All grinding in can be done off the engine. I will be making new valve housings to this design for my own engine – one seat has already moved and there are three more which could follow.

Photograph 1– Boring the valve housing for the guide.



Photograph 2 – Cutting the steam inlet chamber – note table stops.

Main Block

Warning – these are handed components. The drawing shows the block for the offside and the deep steam passageway is towards the centreline of the engine.

Begin with two blocks of bronze or gunmetal large enough to finish at 50.5 x 33 x 48mm. At a pinch, a 50mm square would do but in this case the thickness of the top of the block would need increasing with a plate of brass on the top, brazed on during the main assembly - indeed the overall height would benefit by being increased to 52mm to give more metal for the manifold securing screws.

The first job is to square up the block and machine to the outside dimensions of 48 x 33 x 52mm by facing in the lathe or more conveniently by fly cutting. The only important relationship is between base and front face which must be square. Next, mark out the front face, paying particular attention to the centre of the holes for the combined valve guides and seats. Dot punch the wall of the cavity.

Set one hole true in the 4 jaw or angleplate and faceplate, the latter making the repeated setting up easier, with suitable packing to protect those beautiful surfaces. Drill and ream all the way through to 12mm diameter for the valve guides then bore the counter bore to15.87mm diameter, 25mm deep from the front face. Repeat for the other three holes (photograph 1).

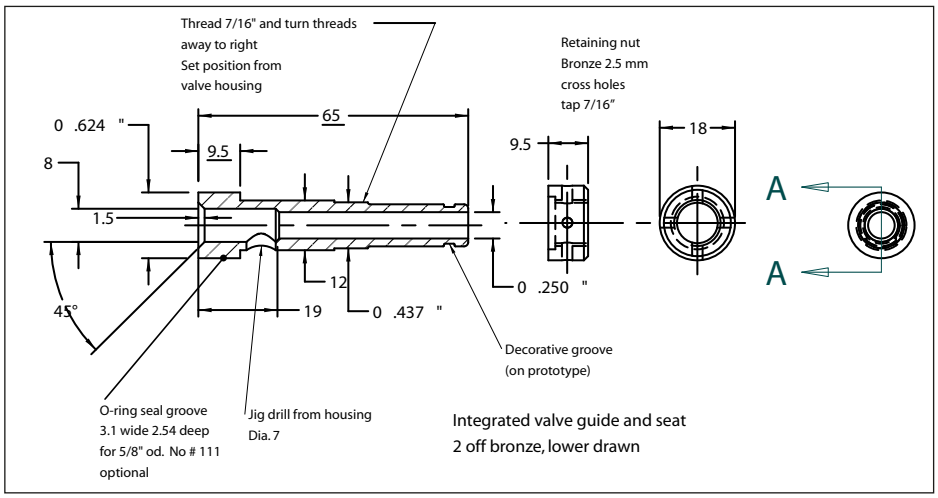
Then it's back to the miller to form the valve chamber. Photograph 2 shows both of these being done at the same setting, so each block supports the other which stops the possibility of deformation of the now thin side walls. Now it is time to drill the steam passages. Mark these out with care or set up vertical in the vice, pick up the edges with an edge finder and use co-ordinate methods to find the hole position. Fit the baseplate, align the base, clamp and drill both passages at the same time to ensure continuity of the holes. Do be careful with the depth of the long ones and where they meet. Turn short plugs to fill the cross hole which is drilled from what will be the flat side.

The outside profile is a bit cosmetic but the back profile is stepped in the prototype although not as large. The steam ways in the prototype both went through the back of the block going round the valve guides in what must have been a very complex casting core print! I used a slab mill for this with a radius end edge, a cheap club purchase (photograph 3), but best to use a combination of ball end slot drill and end mills. The outside, remember, will be painted so a dead smooth finish is not desirable. The inlet flange at the top is left for now but its position can be established by milling the 2mm deep step at the back end. A ball end cutter or radiused fly cutter to leave a fake fillet would be useful here. Do nothing to the inlet mounting pad as yet. Round all the external corners except for the front and top inlet flange and base.

Front and Base Plates

Make the front face a tad too wide, so it can be filed exactly to match the block after brazing, and make it a bit too high as well. Bore the holes first then profile and tap for the studs. Now is the time to make the baseplate which is a tad under 140mm long x 48 x 3mm brass. Do not drill any holes except the single 5 or 6BA countersunk brass screw to align and hold the housing to the base during brazing. Correctly orientate and temporarily fix the two together so that the outline of the housing can be scribed onto the base plate. This will allow the marking out of the 5BA mounting bolts to be established from the drawings for the cylinders which will be shown soon. These un-dimensioned holes should be as close as possible to the steam way and valve housing, with just enough clearance to get the spanner in. This is as

Photograph 3 – External profiling.



far as we can go with the valve housings for now. Do not braze together until after the mounting holes and steam ways are produced in the cylinders. This makes it easy to get them in the correct place but for completeness we will assume that this has been undertaken.

Assemble the block to the base with the single brass countersunk screw. The valve guides should be on the centreline of the base. Check that the steam ways line up and do a little filing with needle files to sort things out. Before we braze up we need the valve guides.

Combined Valve Guide and Seat

Start by producing the locking nut and the PTFE sealing washers so that later the housing can be assembled onto the guide while still in the lathe to give the exact position of the reduced diameter at the end. This will preserve the cast appearance as much as possible. Drill, tap for 7/16" x 26 or 32, round the end, then mount onto the dividing head to drill the tightening holes, back to the lathe, part off, round, part off etc.

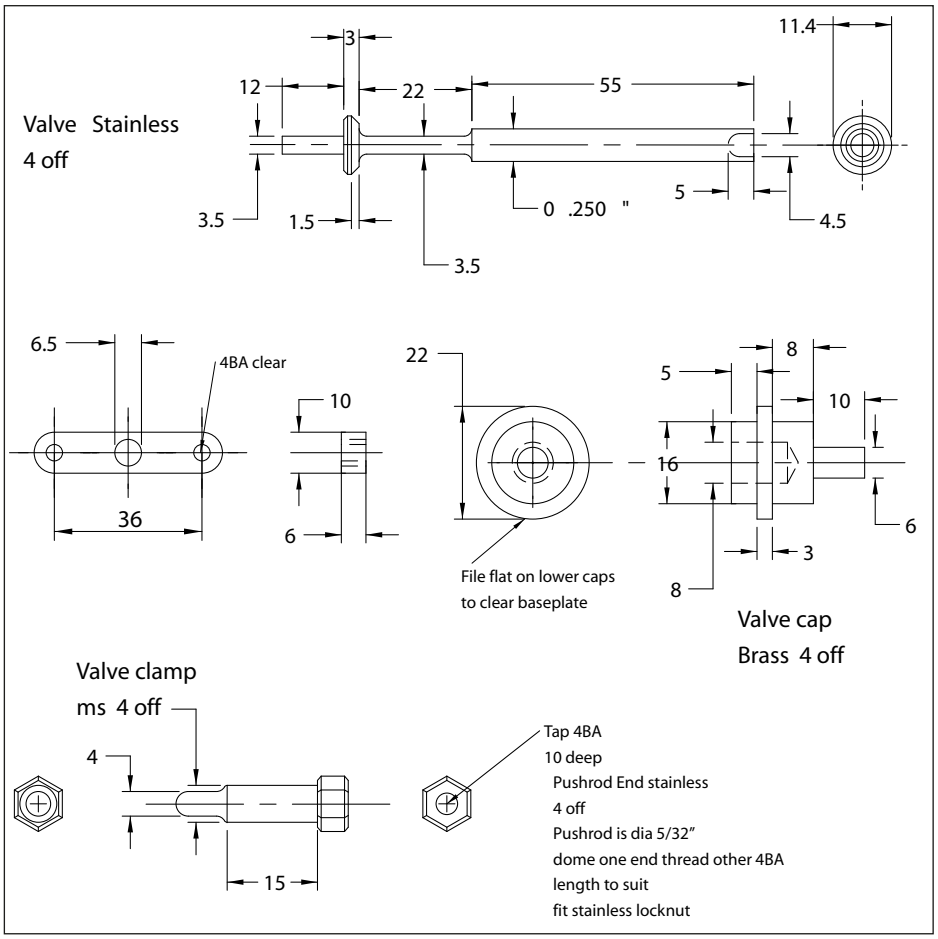
The guide itself is turned from good quality bronze. Sealing in the housing is with a PTFE washer at each end. Note the top and bottom guides are slightly different due to the step in the housing. Mount in the chuck and turn the outside step to a close fit in the housing at12mm diameter and 53mm long and the boss to 15.85mm, just below 5/8". For sealing, the details are on the drawing for an optional O-ring but, in my opinion, it would make the seat weak as there would only be 1.4mm of metal below the groove. I will be using 0.5mm thick PTFE washers and gasket goo.

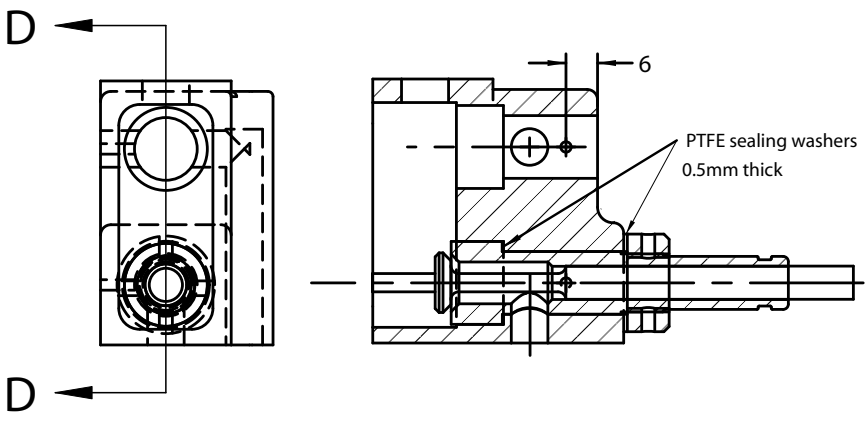
Assemble the housing in place without removing from the chuck to mark the inner end of the 7/16" thread for the nut. Turn down to size and thread this 1 mm longer than your mark to give a full thread at the face of the housing. Now add the sealing washer and the nut, tighten up and position a thin round nose tool at an angle at the edge of the nut. Use the DRO or leadscrew handwheel to record the position. Move the tool to the right, remove the nut then just turn away the threads to the position just found.

Finally, put in the small decorative groove at the end as found on the prototype and round the outer end. Part off at 65mm long and reverse, holding in a collet if possible to give a secure but gentle grip. Concentricity is not an issue with the outside diameter already produced. Face the end to leave the end piece 10mm long. Now carefully centre, drill in stages and ream to 1/4" diameter. Here again, the standard imperial diameter gives us a little more strength than the metric 6mm. When drilling bronze its best to put a flat on the drill lip into the flute to stop it digging in or, as an alternative which I tend to use, to tighten the tailstock barrel lock to make it stiff to turn the feedscrew. This, along with a slow feed, will stop most dig-ins. Now drill out the steam clearance to 8.5mm and not more than 19mm deep to the edge of the drill lip, i.e. the full diameter depth. Set up a sharp boring tool at 45° and turn the angled seat no more than 1.5mm long.

Valves

The valves are turned from stainless steel with the long bit towards the tailstock, making use of a centre at the end. Produce this close to the chuck and rough out the spindle to 7mm then withdraw from the chuck for another cut. When doing this sort of thing always use the same key hole in the chuck and don't rotate the bar as you pull it out, in order to maintain the correct position of the centre. To finish to size, a precision running fit in the guide at 1/4" diameter, use a half centre well lubricated and sharp tools to get a very close fit between the shaft and the bore of the valve guide. Turn the angled seat now just over 1 mm long then put a few 2mm wide x 0.8mm deep grooves along the length to provide a labyrinth seal (take off the sharp corners of the tool to reduce stress concentrations). I did consider putting O-ring seals on the valve but it would leave little metal and it would need a much stronger return spring to seat the valve due to the drag of the ring, and thus result in more load on the camshaft and so on. There is very little leakage past the valve stems. Reduce the diameter close to the head then withdraw from the chuck again to remove most of the waste close to the chuck, leaving the head 4-5mm thick at this stage. Saw off, grip by the shank, preferably in a collet, then gently face and centre. Finish the small extension (but go easy with this the grip is delicate on the valve stem) which is there to locate the return spring to seat the valve. I used a bronze spring from the assortment box but a stainless one would be better. Reverse





Partial section of valve housing assembly

on soft packing or collet and produce the socket by drilling into the centre hole then use a round end D-bit (I again used one made to make 3/32" rivet snaps). Finish the rest of the components, studs, bridle and end cap, which are simple tasks.

Drill the 2BA tapping hole (which is used to maintain the orientation of the guide for re-assembly) only at this stage on the axis of the bore about 6mm in from the back edge of the housing at the top and 11mm at the bottom. These are not shown in the drawings of the housing but the position is indicated in the sectional and pictorial drawings. Push the combined valve guide and seat into place and tighten the ring nut. Go in with the tapping drill again to leave a location dimple in the guide. It is now possible to drill through the steam ways into the guides to provide steam access – take care not to go past the centre of the guide tube or it will be seriously weakened. After brazing up (see below) the housings and filing the sealing plug flat, the holes can be tapped, and a brass washer soft soldered in place to represent a boss for a turned pointed 2 BA bronze bolt to fix the orientation of the guide, which of course must be marked for future identification. Now we put the housings on one side to do the cylinders, and until stages 2,3 and 4 from above are completed.

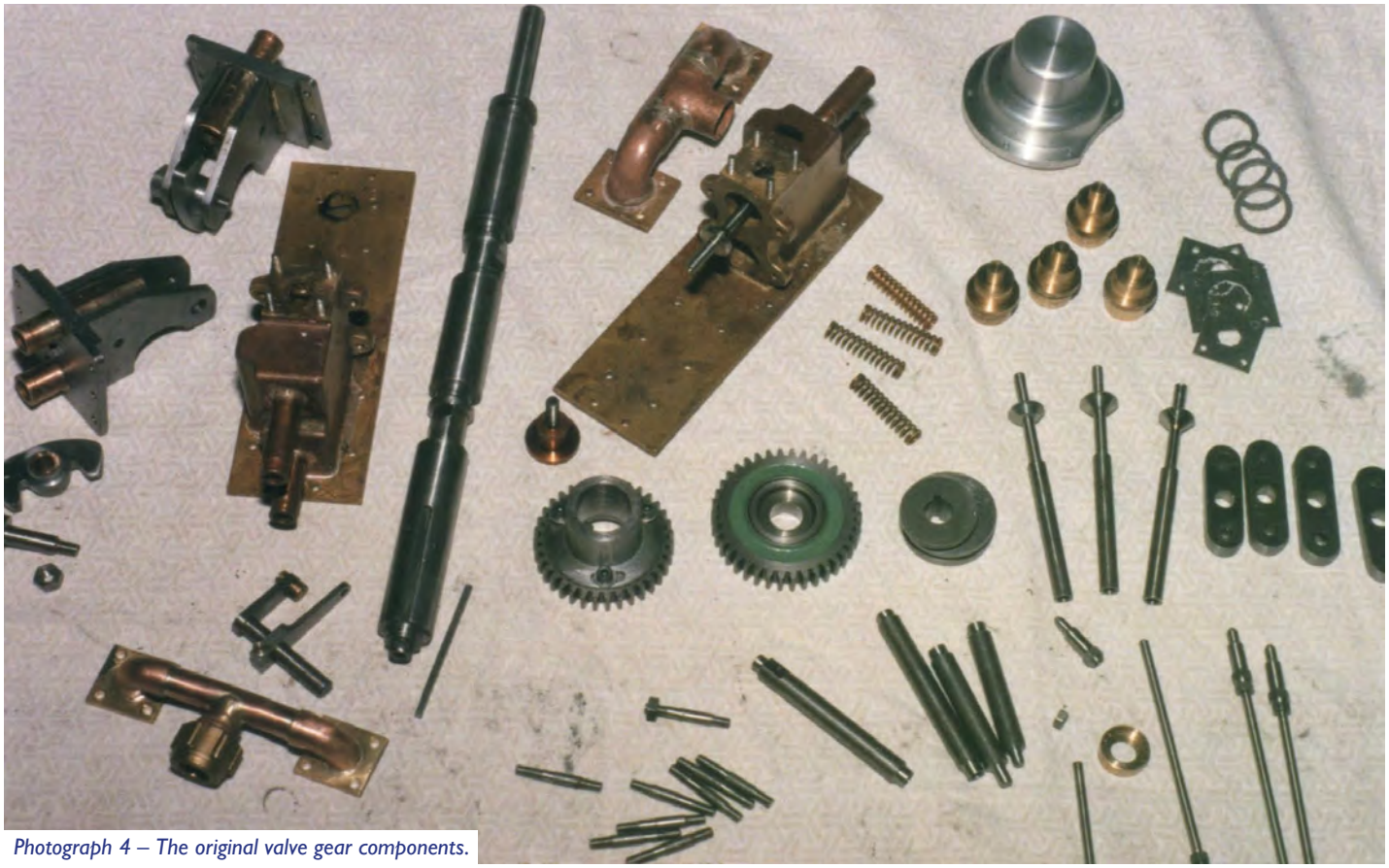
Finishing and Assembly

It's a long while since we worked on these bits! Pickle the components, flux and wire the front plate in position or fix with a stud through the bore. Insert the plug for the cross hole and when satisfied braze the lot in one go, being generous with the fillets to simulate a casting. After pickling clean, the front plate can be filed flush to the edges of the main block so it looks like a single piece. Do nothing to the top yet as we will finish these flat in the same plane when the housings, cylinders and crosshead guide assembly can be mounted on the miller and skimmed flat, which will make the inlet (and exhaust) manifold a lot easier to produce and fit. (I know this from experience....)

Bolt them housings down onto the cylinders for testing. Make up gaskets for the manifold and front caps and assemble all in place. Rig up a valve between compressor and inlet and slowly open it. Any valve which doesn't seal can be anointed with very fine lapping paste, and the valve extension gripped in a pin chuck, held in a tap wrench. It may be easier though to remove the guide and valve as one to grind in the vice. You should aim to get a nice even grey finish on the valve. Take great care not to get the paste into the valve guide bores – be sparing with it. I didn't do this until the engine was finished. Big mistake – a lot more difficult!

One of my seats was too far out to lap in so I had to make a piloted cutter to sort out the problem (due to the old design not this one) and had to use the cutter again when the seat popped out. When the finished engine is turned over by hand, the compression is incredible and there is a real pop when the valves crack. One thing that did surprise me was the force needed to push the valves open against 60lb of air. Because of this the push rods have been increased from 5BA to 4BA – 1/8" to 5/32". Photograph 4 shows all the original complete valve gear group and manifolds. Note the old and redesigned ring seat next to the push rods.

To be continued


Photograph 4 – The original valve gear components.

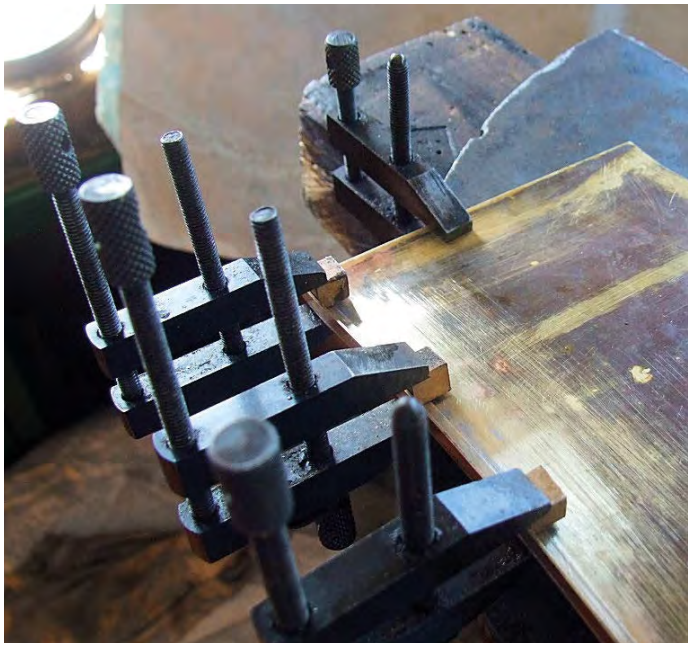
Buillding the LNWR Coal Engine in 5" Gauge – Part 8

Hotspur describes more features of the locomotive

Continued from page 78, September 2016

Unfortunately last time I had to leave the fitting of the cab roof incomplete so I have added another picture of the construction here and can give the final details. I had drawn attention to the need to use a series of small blocks when clamping the roof angles together for soft soldering and once this has been completed, the row of 19 rivets can be added.

The last activity is to tin the contact surfaces all around the three sides that will be attached to the cab side and front angles so the two parts can be aligned for soft soldering together. I suggest this task is done with the parts on the chassis to ensure the squareness is compatible with the construction so far as this assembly should not be strained when it is in place. Hold the edges together using the clamps and start by soldering the front flange to make sure there is a parallel overlap. Once this has been soldered then each of the cab side panel angles can be joined in a similar way. There are no more rivets to be added and if any additional solder is applied from the inside the joint will require a minimum of cleaning up afterwards.

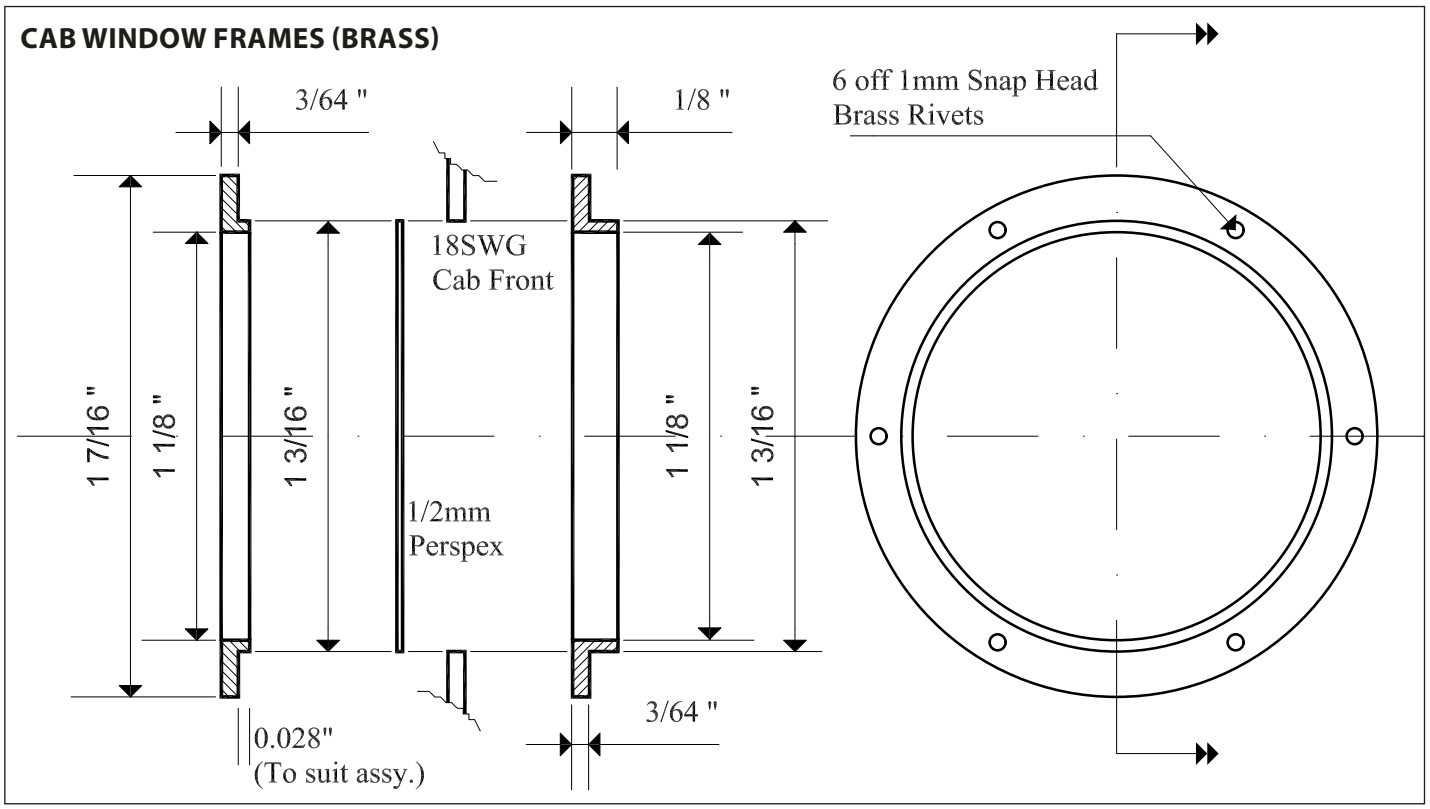


Soft soldering the upper angle to the rear of the roof with a selection of toolmakers clamps and small blocks to ensure close contact.

Spectacle Plate Windows

To complete the cab, I am going to describe how to add the windows to the spectacle plate. This is something I have done before but I am not fitting the windows to this cab front at present because there will be some adjustment to the opening for the boiler later on and the windows will be in the way of holding the assembly and could be damaged. Incidentally, I see from the original drawings I did for the Coal Tank that I got the sizes wrong so the drawing here is correct and the CT drawing has been amended.

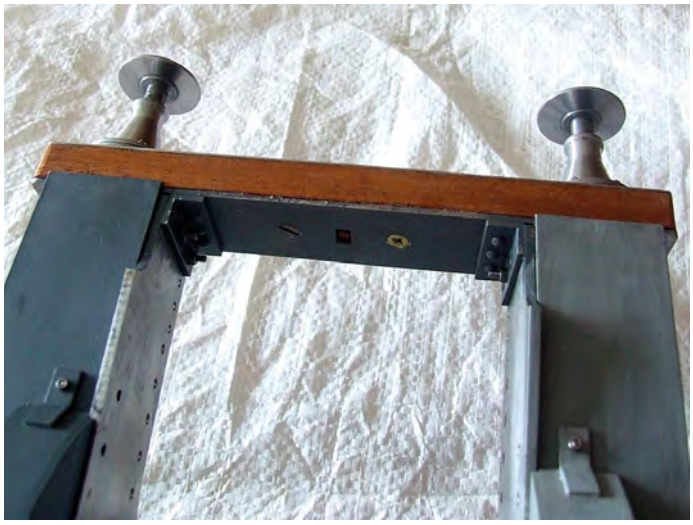
The starting point is to make the rings in pairs with the flanged one on the outside, the inner one having a very small shoulder to register in the 1 3/16" hole diameter in the 18SWG brass plate. I will use ½mm Perspex for the windows and so this leaves just 0.048" minus 0.020" for the rebate. However, do check your material before machining. Hold the short end of 1½" diameter brass securely in a 4-jaw chuck to face one end square so it will later be able to sit upright on your drilling machine table. Turn it round to machine the other end and turn the outer and inner



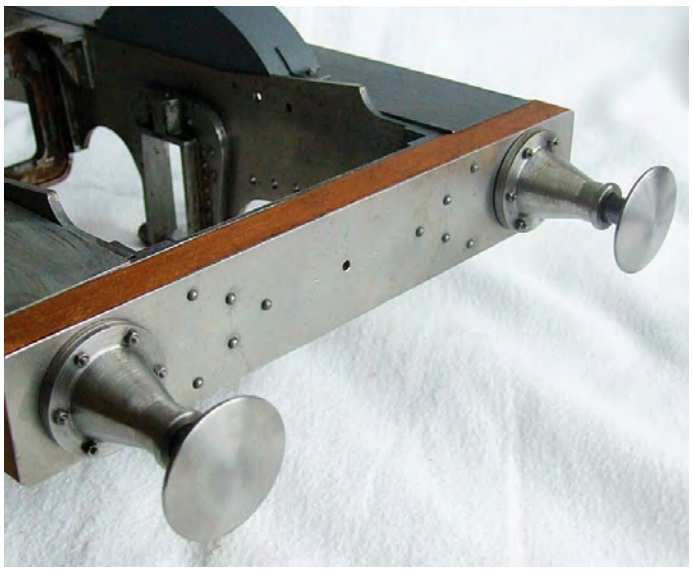
diameters for a length of about 1¼" and go on to machine the outer flange. Mark off the position of No 1 jaw before removing the material.

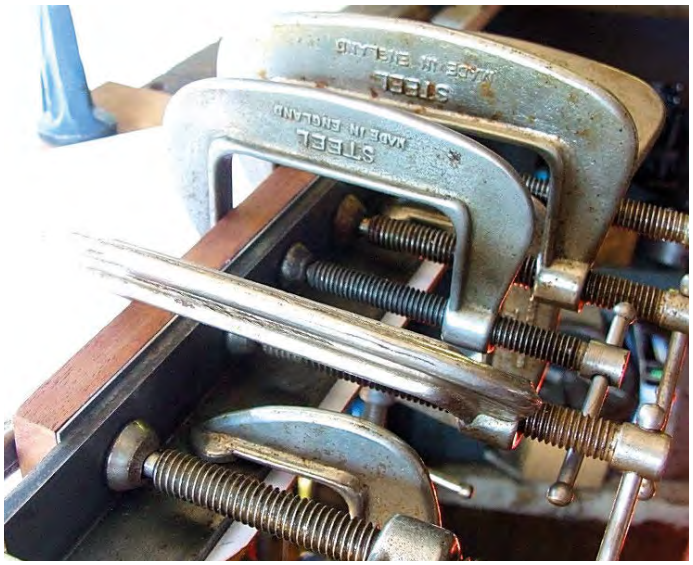
Hold the brass in your vice and mark out the first set of six equi-spaced 1mm rivet holes by hand as this is quite easily done. Start with a pencil, then a scriber and a small pair of dividers. Finally, mark the centres but do make sure your punch has a flat on one side to avoid damaging the side of the front window. Those who use a rotary table will get a more precise result. Previously I had used 1/32" rivets on the Coal Tank but I think now that this size is rather too small and fiddly. Drill each of the holes between ½" and ⅝" deep and then return the material to the 4-jaw chuck using the reference jaw to help set up the concentricity with a dial gauge. The drilling depth should be sufficient to use a narrow parting tool and produce the two matching rings. Both pairs of rings need to be marked with a faint scribed line at the bottom of the circle which is to be hidden underneath on assembly but you should ensure they are aligned on assembly. Part-off the outer one first and while the material is turning you can deburr the outer corner off the ring. The inside burr can be removed with a very fine curved file.

I put the rebate shoulder on the inner ring and relied on the rivet holes through the cab plate to locate the front one. The intention is to ensure the shoulder provides a small amount of 'squeeze' on the plastic disc on assembly. I can also suggest a source for the plastic to be used. Speak to Peter Wood who can be contacted on 07954 148323 or via email at peterwood.pdr@blueyonder.co.uk (with the usual commercial disclaimer). Needless to say, once the spectacle plates have been installed no hot work should be attempted on the assembly.



Two views of the front buffer beam with the Bowen-Cooke buffer assemblies in place and just the hook slot to complete.





Firmly clamping the front steel plate to the wooden buffer beam.

Front Buffer Beam

When I came to choose the prototype for the Coal Engine I decided I would build a later version of the locomotive, one that was in service in LMS days. This means that there are some features that differ from the Coal Tank design that I built initially but I did offer drawings in the series for the choice of front buffer assemblies. For my model I have decided on the taper shank Bowen-Cooke version which means the locomotive can be finished to suit the wide operating period from the 1920's through to the 1940's. Making the buffers was simple enough but quite time consuming although I took the shortcut of adding the buffer head to the stock by threading the end 5/16" x 40 and, when the back face of the buffer itself had been turned and tapped, screwing the stock in tightly before parting off the narrow buffer head. Then, reversing the stock in the chuck meant I could turn the front face of the buffer and this ensured the screwed joint became very tight. After adding the front radius and polishing the face, the surface did not show any sign of the thread that had been used.

I also used steel plate for the buffer beam front cover material, not just for cost purposes but for ease of painting. The rivet detail was also carried out with steel rivets this time. The more significant variation compared to the first build was that I used Hafixs adhesive instead of Araldite because I wanted to see what benefits would be available. Araldite is quite slow setting and a bit messy but I was unsure as to how well this professional 'glue' would work with the wood/metal joint. The front plate was attached first and left a full 12 hours to set without any problems. Then the beam was set up and drilled and reamed ½" diameter for the buffer stocks. After that the rear face of the wooden beam was marked out and shallow drillings were made to fit over the rivets ends on the beam support plate. The location for this attachment was very simple and I applied the same process but I was a little impatient to get on and add the corner radii and tackled this task too soon, so it came apart. Thankfully, applying more adhesive to the previously coated surface has worked and this suggests that joining a permeable surface such as wood to a non-absorbent face (the metal) needs more adhesive than I had used. As a precaution I also added two small countersunk screws either side of the hook slot to keep the joint under permanent load while it set. These will be covered when the stiffening angle is added over the hook shank behind the beam.

The small 10BA countersunk screws and nuts that hold the two halves of the buffer stocks together are fitted flush on the back face so the use of more adhesive to fit the assemblies onto the buffer beam should hold the screws heads in case dismantling is necessary at any time later.

Next time I will describe the rear steps and the cab stanchion.

To be continued

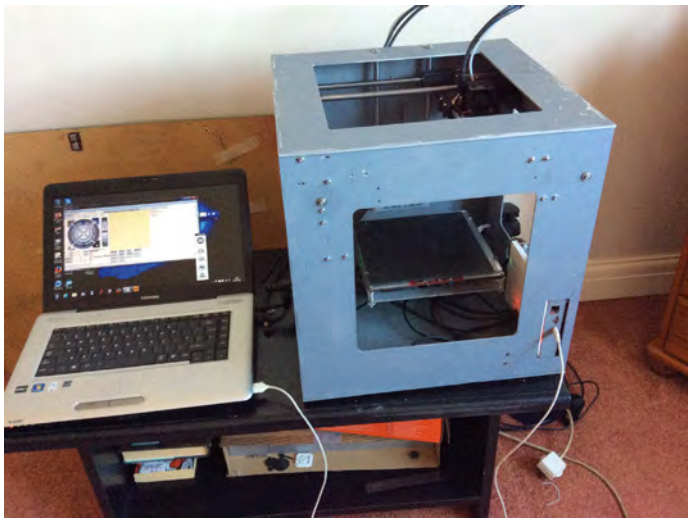
Building a 3D Printer

Roger Thornber concludes his series on 3D printing

Continued from page 97, September 2016

Now the printer is mechanically finished and we need to get it working, and to do this we need to change some of the software. Please remember that I am a rather antique aerodynamicist not a software engineer so there are more than likely more sophisticated ways of doing things.

The printer connects to a lap or desktop computer via a USB cable (photograph 8). This will supply 5 volts to the Duet board. Don't switch on the mains yet. The thing to do is to get the computer to recognise the printer. This is done through the Arduino software. Despite the demise of Reprappro the instructions for doing this are on the Ormerod 2 website. This will allow you to check the version of firmware that is on the Duet processor. The latest firmware is on the github website (you can get there via reprappro.com/software) and should be flashed into the Duet. Full instructions for this are also on the Reprappro site. The firmware has all the operating instructions. The system files then have to be copied onto the Micro SD card on the Duet board. There are several files within this folder which can be changed to suit the particular requirement and it is these that we will now look at.



Photograph 8 – The printer connects to the laptop via a USB cable.

Changes are made to the system (sys) file on the SD card. The SD card needs to be connected to the computer via an adaptor. Files can be opened in 'notepad' and then altered by deleting items and typing in new ones

On the SD card there is a folder called sys with a sub folder called config. Three lines in the config file need changing:

1 – Because of the layout of this printer the X axis motor needs reversing. Altering the line M569 P0 S0 to M569 P0 S1 does this (P0 is the X motor, P1 is the Y motor and P2 the Z motor).
2 – As the Z axis is direct drive rather than geared the Z motor also needs reversing so a line is added M569 P2 S0.
3 – The Ormerod IR sensor needs switching off so alter the line M558 P2 to M588 P0.

When the printer is switched on the axes start off at 0 ,0,0 but this can be anywhere. So the first thing to do is to make the hot bed home (or park) itself. Open the sys file and there are four sub files – homex, homey, homez and homeall. The file homey is fine and no change needed as it already operates with a microswitch. The files homex and homez however need changing as on the Ormerod they are operated by the proximity sensor and this needs turning off. The first section of each line is the command and the text after the semicolon is for explanatory purposes and has no effect (a 'comment').

Change the homex file to read:

```
G90                 ; set movement to absolute mode
M558 P0             ; switch off proximity sensor
                    ; make sure it is off
G92 X0              ; set X=0
G1 X-240 F2000 S1   ; this means that the bed is asked
                    ; to move 240mm but will reach
                    ; the microswitch first (because
                    ; 240 is always larger than the bed
                    ; to microswith distance)
G92 X0              ; set position to X=0
G1 X3 F200          ; move axis away from X=0
G1 X-5 F200 S1      ; home again, slower to give more
                    ; accurate position
G92 X0              ; set position to X=0
G1 X5 F200          ; move X away from microswitch
G92 X0              ; Set position to X=0 - this is the
                    ; parked position
```

Change homez to read:

```
G90                 ; set movement to absolute mode
M558 P0             ; switch off proximity sensor
G92 Z0              ; put Z=0
G1 Z-240 F1500 S1   ; this means that the bed is asked
                    ; to move 240mm but will reach
                    ; the microswitch first (because
                    ; 240 is always larger than the bed
                    ; to microswith distance)
G92 Z0              ; set position to Z=0
G1 Z3 F200          ; move axis away from Z=0
G1 Z-5 F200 S1      ; home again, slower to give more
                    ; accurate position
G92 Z0              ; set position to Z=0
G1 Z5 F200          ; move Z away from microswitch
G92 Z0              ; set position Z=0 – this is the
                    ; parked position
```

For consistency change homey to:

```
G90                 ; set movement to absolute mode
G92 Y0              ; set position to Y=0
G1 Y-240 F2000 S1   ; this means that the bed is asked
                    ; to move 240mm but will reach
                    ; the microswitch first (because
                    ; 240 is always larger than the bed
                    ; to microswith distance)
G92 Y0              ; set position to Y=0
G1 Y3 F200          ; move Y axis out
G1 Y-5 F200 S1      ; home Y again, slower to give
                    ; more accurate position
G92 Y0              ; set position to Y=0
G1 Y5 F200          ; move Y away from microswitch
G92 Y0              ; set position Y=0 – this is the
                    ; parked position
```

There is a website which details all the commands which must be typed in upper case. For instance G1 means move and F is speed of movement. If all is correct the printer should home with X and Y at the rear right and the bed at the bottom and be 5mm away from all the microswitches. The file homeall should be changed to contain the above.

Raise the bed using the Z cursor to about 1 inch below the Y cross slider rod and level the bed using the adjusting screws so that 1 piece of 1 inch square just passes under the rod at all four corners of the bed. One of the many secrets of good printing is a level bed so take some time over this. Move the hot head so that the nozzle is roughly in the centre of the bed. Now move the bed up until a piece of paper just slides under the nozzle. This is best done with the hot head heater on in case there is a blob of plastic

on the nozzle which would give a false reading. Get the Z position ('get position' button on Pronterface) which should be about 180-190mm. Note this down (call it H).

Before printing starts we want to raise the bed a distance 'H' from the home position and then reverse the direction of the Z axis motor so the bed goes down to build up the layers.

As mentioned earlier the solid object created from our CAD program is converted to an stl (Standard Tessellation Language) file which defines the outside surface of the body as a series of triangles. A slicing program can then use this to define the motion of the head in tracing the outside lines of the object before filling in to make a slice of the solid. These are produced as G-code files. These files will initially define the various parameters for the printing process such as speed, layer height etc. There are several slicer programmes but slic3r is probably the best to start with. The RepRapPro documentation shows how a set of parameters suitable for the Ormerod can be passed into slic3r. This program allows you to change the initial G-code program (printer custom G-code). So this is changed to:-

```
G1 ZH F1500          ; where H is the height measured
                     ; previously
G92 Z0               ; makes Z=0 ready to start
                     ; printing
G28 X0 Y0            : makes sure X,Y are at the corner
M569 P2 S1           ; reverses Z motor so plus is
                     ; downwards
```

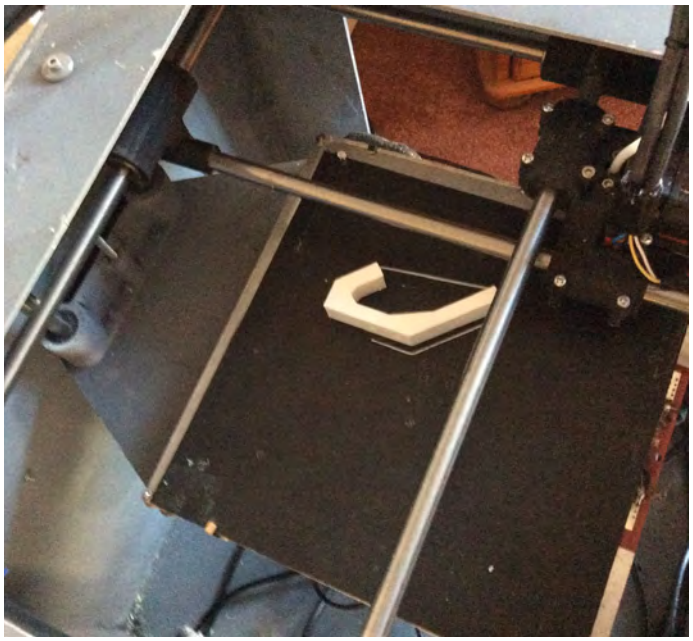
If you already have G-code such as the snowman on the SD card you can add these lines by opening the snowman file on notepad and adding the above lines.

Photograph 9 – The snowman.

Above (photograph 9) is the first trial print of the Reprappro 'snowman'. I use this as a test piece as it has some features such as the eyes mouth and stick that are a good indication of accuracy and being thin does not use much material and is relatively quick.

One final picture (photograph 10) shows an oriented coathook that has been printed automatically without any manual intervention.

Well that just about finishes my ramblings. It is unfortunate that the demise of RepRapPro makes this a more difficult project as the internet will have to be searched for equivalent of some of the original Ormerod parts. Try checking the RS website (uk.rs-online.com) as they did use to have a large number of Ormerod kits in stock.



Photograph 10 – The coathook.

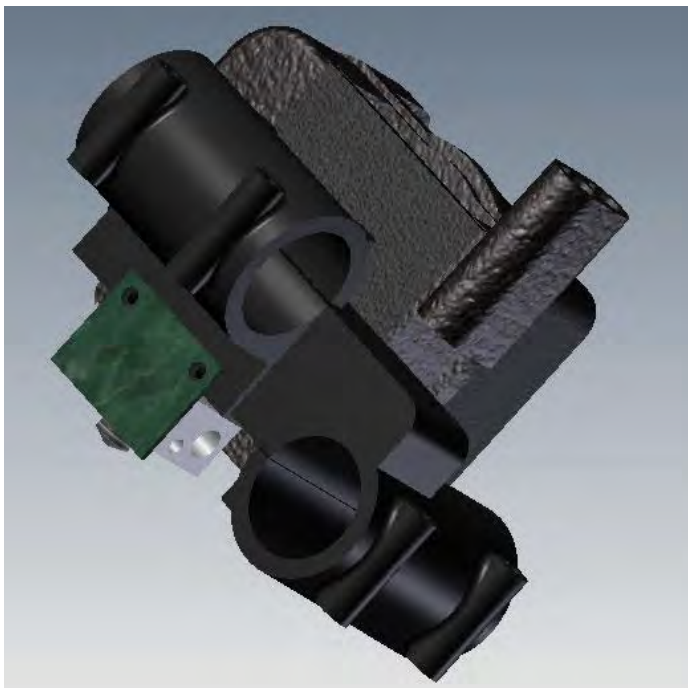
Afterthoughts

In previous articles I have shown a microswitch on all axes. However I have been having difficulty with consistency in Z height which has affected the quality of printing. I have, rightly or wrongly, put this down to the switching point on the Z axis microswitch varying. Note that we are looking for an accuracy of better than 0.1mm.

I have therefore reverted to using an IR probe to set the Z axis zero. A suitable circuit board is available from Dave Crocker (who, as DC42, has done a lot of work on the firmware for the Duet board). The picture (figure 10) shows this board mounted on the X-Y slider. Three extra wires are needed but if you use two 6 core cables from the hot head there are enough. Ideally the board bottom edge should be 1.5mm above the tip of the nozzle. This can be achieved by adjusting the nozzle. The firmware already provides for an IR probe and it has the benefit of being able to use automatic bed compensation. Operating instructions are on the internet.

Note also that the position of the support for the cables has been changed. ■

FIGURE 10 – HOT HEAD WITH SLIDER AND IR PROBE



Building the LNER/BR Y4 in 5" Gauge

Doug Hewson makes a start on the boiler fittings

Continued from page 89, September 2016

Regulator Shaft

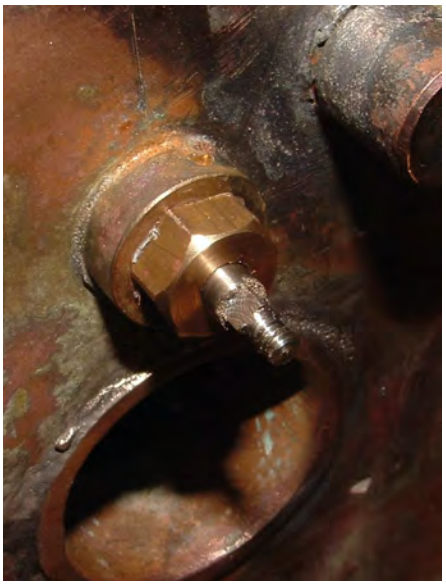
Before we move on we will make the regulator shaft and handle. The shaft is made from a 9 1/16" length of 3/16" 316 stainless steel rod and it needs a round and a square on each end. I am sure a lot of people will just file the square but it is a very satisfying job and much nicer to machine it and it is quite a simple job. Once you have machined a square this way I do not think you will ever file one again! I make lots of brake shafts for my wagons and they have a square on each end and after a tip from George Gibbs I have always used the same method. This is to use the vertical slide and a piece of square bar as a register. The bar I used is 5/8" square and 2" long with a 1/4" Hole reamed through on the centre line but half inch bar will do just as well. That was used for my 1/4" brake cross shafts so I adapted this by making a split collet to fit inside with a 3/16" hole reamed through. The only thing you need to remember is that when gripping the 3/16" rod you need to position the collet so that the split is down one side otherwise you will not be able to tighten the shaft properly. To make it a dual purpose jig you will first need to centre the bar in the four jaw chuck, or use a self-centring four jaw, centre and drill through 15/64" and then ream through 1/4". Just near one end you need to drill across and tap a hole for a 4BA Allen screw to hold the rod in place. You can then make a collect for the 3/16" bar from some 1/4" BMS bar. To finish off, scribe a line all the way around the block about 1/2" from one end, i.e. where you can see it when in it is in the vice as described below.

Before you bolt the vertical slide in place you need to use the 3 jaw chuck and turn the 1/8" diameter on both ends of the shaft and then these ends can be used as a register when machining the squares. Now you can fit the vertical slide with a Myford or similar machine vice attached (handle upwards of course). Pop the 3/16" rod in the new jig with about 1/2" protruding and fit that in the vice so that the line you scribed around earlier is level with the side of the vice jaw. As the vice has some draw on it from the casting process you can set this very accurately as if you push it in too far the line will begin to disappear. You can see this better on the photograph. Put a 1/4" or 5/16" end mill in the chuck. Move the cross slide so that the end mill just touches the side of the 1/8" diameter piece turned on the end of your rod. Without moving anything else, wind the vertical slide up out of the way and then move the shaft towards you so that the square which you are about to cut will be 1/8" long. Lock the cross slide. Now wind the vertical slide down gently across the end mill and it will cut one side off the shaft flush with your 1/8" round. Loosen the vice and then turn the square 90° and repeat three times to machine the other three sides. End of story. To machine the other end, I put a small toolmaker's clamp on the first square and then put the rod back in the jig and lined up the clamp so that it is as vertical as I could set it by eye. Half a degree either way does not matter. You can now machine the square on the other end in the same way.

Remove the burrs and then poke the shaft through the regulator bush and engage it with the crank on the bottom of the regulator. You should have about 3/4" protruding. You now need to make a small bush 1/8" thick from 1/4" stainless bar and slide that on to the shaft. If you have a depth gauge you can measure to see how deep the hole in the bush is with the collar in place and that is where it needs silver soldering on to the shaft. This will then be fitted with a 3/16" "O" ring and it should leave a thread or two showing when you have screwed the gland in place later.

Regulator Handle

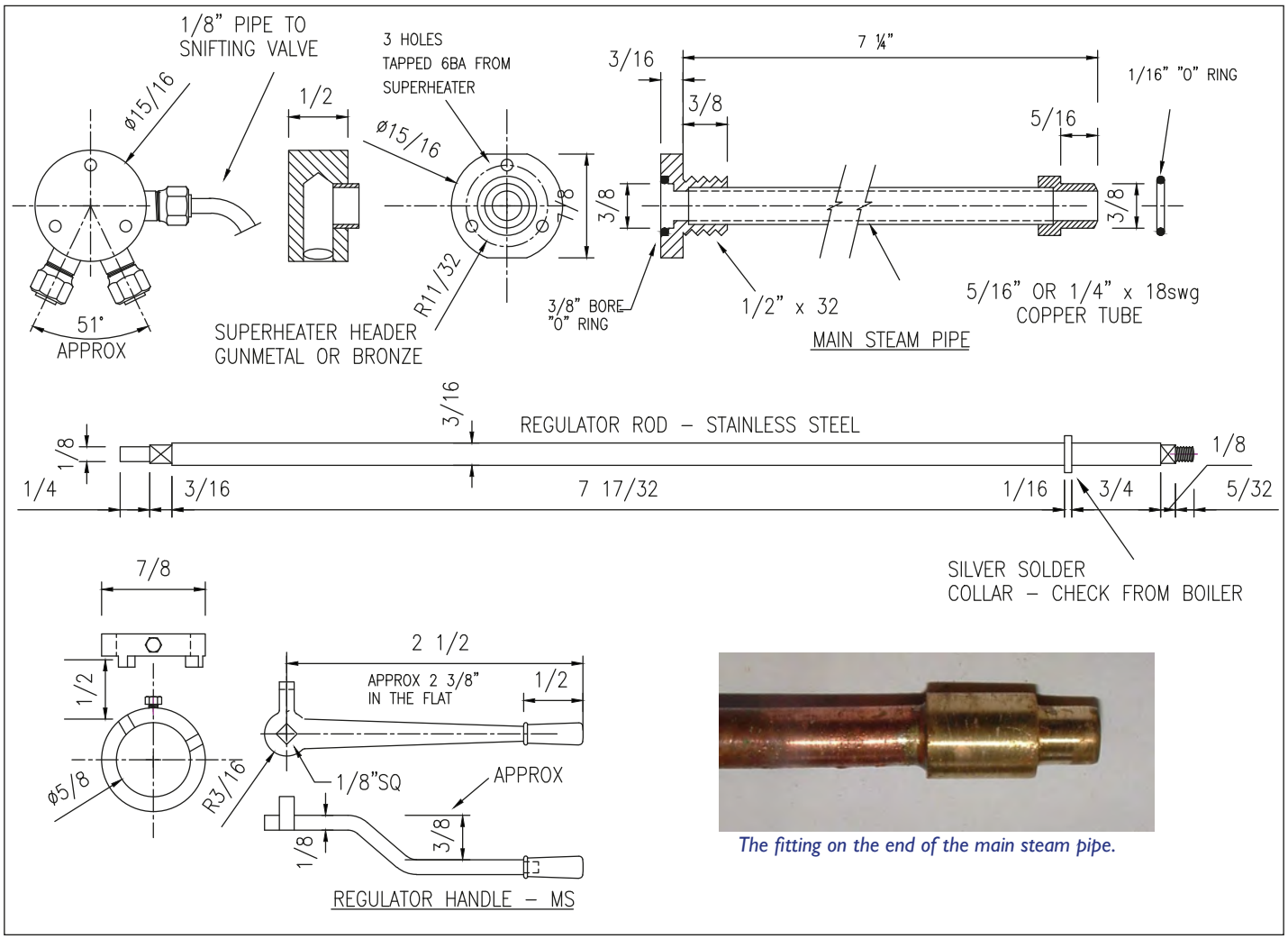
Of course you will now need a handle for the regulator. I made mine from a scrap piece of 1/8" plate left over from something or other. Mark a centre line for the handle leaving enough width to make the boss of course. This is then just a simple filing job and I am sure you will be used to that by now. However, use a good needle file and take it easy as the handle needs to be a perfect fit on the shaft. For making the handle for the end you can use the same method as I described for the reverser (but smaller!) and again it would be very nice to make this in stainless steel and then you can give it a little polish. Once I had completed my handle, or nearly so, I found that I could not bend the stop tag on the top, so I silver soldered a separate one on there. You also need to make a stop bush to fit on the regulator bush – that is why it is so thick. Mine was made from a piece of 3/4" brass bar and it needs to fit on the bush on the backhead. The stops then need filing out as shown on the drawing. The bush is tapped for a 5BA screw to hold it in place and adjust it. With the regulator in place you can fit



The shaft and nut in place ready to receive the handle.

Machining the square on one end of the regulator shaft after having turned the 1/8" piece on the end first. Note the way that the shaft is held in a square bar to index it. The scribed line around the square can clearly be seen which positions it up to the side of the vice jaw.

Filing the stops on the regulator stop collar.



The fitting on the end of the main steam pipe.

the handle and then look at the regulator disc and make sure it is closed. The handle stop needs to be positioned so that the regulator handle is against the stop when the regulator is closed, if that is not obvious! Of course the other stop needs to stop the regulator when fully open.

The completed handle in the closed position.

Main Steam Pipe

I then turned my attention to the front end of the boiler to make the main steam pipe. This takes steam from the regulator to the cylinders so needs to be quite a large bore pipe.

I first made a fitting for the rear end of the pipe to fit in the regulator. You will remember that there is a boss on the front of the regulator which has a ⅜" hole reamed in it. The brass fitting can be made from ⅜" brass bar. Centre the end and drill down to 5/16" depth with a ¼" drill. Now turn down a 5/16" length to ¼" diameter.

With the pipe now fitted into the regulator the tube was checked for the cutting off point.

Part off to leave 3/16" from the shoulder and reverse in the chuck. Drill down to ⅛" depth with a drill to suit the steam pipe and then drill through the remainder with a ¼" drill. This can then be silver soldered on to a length of copper tube for the steam pipe. You can now poke the tube into the front steam pipe bush and into the socket in the front of the regulator. There is no need to fit the "O" ring just yet but make sure that the tube with end is fully home. You can now mark a line around the tube just inside the bush at the front, in other words so that it is about 1/16" in from the face of the bush. Cut the pipe off there.

Making a start on the front fitting.

Silver soldering the front fitting on to the tube.

Next is the fitting to screw into the front bush. This is made from ⅞" brass bar. Turn down a ⅜" length to ½" diameter and thread it ½" x 26 to match your bush. Centre and drill down to a depth of ¼" with a 5/16" or ¼" drill to match your steam pipe. Part off at just over 3/16" from the shoulder and then hold the fitting in a tapped bush. Face the front to true it up and then centre and drill ⅜" for a depth of about 5/32" and then drill the remainder out at ¼" diameter. This fitting can then be silver soldered on to the front end of your steam pipe. You can now screw it in to the front to engage with your regulator and it should tighten up without moving the regulator body. Make sure it is tight and then mark a couple of horizontal lines across the face about 1/16" from top and bottom. You can now remove the steam pipe and file flats on the two marked lines to fit a convenient spanner size. The lines are just there as a guide and not for filing to.

Superheaters

Before we make a start on the superheaters we will just have a word about them. I know very well that if you belong to a club there will be people who tell you that these are a waste of time. Having now had getting on for sixty years' experience I can tell you they are well worth every minute you spend on making them and on the Y4 they will transform your engine. I built my first Y4 to Ron Bray's original drawings, well loosely anyway, although I corrected a lot of the detail and added more but that is another story. The one thing I did copy were the superheaters and they were plain copper tube with brass return bends as generally described by LBSC.

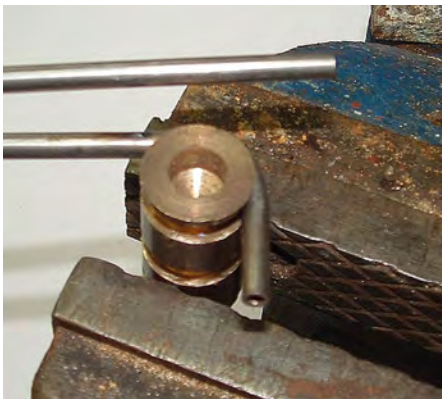
However, I do not think that LBSC ever envisaged the way we would use our engines. Once I had completed my Y4 I don't think that the boiler went cold for six months or more and all that time was spent shifting muck and ballast. In fact, one of our members calculated that the Y4 and the Gert we borrowed shifted the scale equivalent of 25,000 tons of soil and 15,000 tons of ballast as I insisted

Making the first bend on one of the superheater elements. For some reason the first one broke so I decided that it would be a good idea to heat the bending area to red hot and then it was fine.

that everything went by rail. At that time we had not even half finished the railway but it was great fun. When anyone new arrived on the scene the first thing we did was to teach them to drive both engines. The engines were sometimes in steam from 9am until well after dark (10pm). However, the copper elements only lasted for a year or so and burnt through so I made new ones but this time I copied them off a design I had seen in one of the magazines. These consisted of a tube in a tube. Absolutely useless, as one always got a shower on opening the regulator and we were always back at the water column.

I made another set but this time I had just acquired some 5/32" stainless tube from good old Whistons when they were on the go. At the time I did not know what I was going to do with the tube but then someone asked if I had tried bending it. "No" was the answer and then he said "Well, you can bend it double without it kinking" so I thought they might be ideal for superheaters, even though a bit on the small side. The tube came in 1m lengths so I did as suggested and balanced a length on my finger to find the middle and then bent it over a former which I had made and hey presto, it bent double with only the slightest kink. This was easily put right with a gentle squeeze in the vice. I pushed the tube through the flue until it hit the back of the firebox and measured what was sticking out and then transferred that measurement to the bent end and

The elements were now doubled back to give maximum length over the fire.



Making the bends in the elements for the unions.

bent the element back again so that the double bends would be over the fire. The tube was just long enough to meet the fitting at the front and I fixed those on with a couple of 5/16"x32 unions so that they could be removed individually if there was ever a problem. That was in 2008 and they are still in there! We now supply these elements ready bent and I think mine have done about 800 hours now.

However, the main point of this story is that I took the locomotive to Gilling for its first run with the new superheaters and the first thing I noticed was that I was not shovelling half the coal I used to do and only needed to go to the water column every 45 minutes or so instead of every half hour, if I was lucky, and I only have the water in the tanks. Since then I have improved my lubricator and that has added another ten minutes between water column visits. If I leave off shunting for a few moments the superheater glows bright red, so do not let anyone tell you that superheaters are no good, they are essential for an efficient locomotive.

Hot Header

The hot header is just a ½" length of the same brass bar. Face the end, centre and drill down to about 3/16" deep with a ⅜" drill and then another 7/16" further with a ¼" drill and part off just over half inch long. Turn this round and face the other side. Drill three no.30 holes in the face and then transfer these holes to the screwed in fitting and tap those 5BA. Make three stainless steel studs about ⅞" long with ¼" of 5BA thread on each end and screw these into the front fitting.

Drilling the header for the superheater unions.

Held in a tapped bush, the end was turned down to a push fit in the header for silver soldering.

All the unions in place ready for silver soldering.

The elements ready for a trial fitting.

You now need three ¼" drillings as shown on the drawing but do not take too much notice of the 51° angle on the drawing as a few degrees either way will not matter. The drilling on the right hand side is for the snifting valve connection (anti vacuum valve).

The three 5/16" x 32 unions required are made in a similar manner to the ones which you made for the steam brake cylinder. These three can now be silver soldered into the header but also you need to silver solder a length of ⅜" copper tube into the ⅜" hole at the back at the same time. This needs to protrude ⅛". Once finished, just try the header into the hole in the steam pipe flange and take a small skim off if you need to. When you fit the superheaters you need an O-ring to go on the end to push into the regulator and another one the for the header.

The elements were made as described above and you can now use your bending jig to form some bends on the ends to meet up with the unions. Incidentally, the jig for bending the elements was made from a short length of ⅝" brass bar with two grooves turned in it about 7/16" apart. This can then be used for the double bends for the second operation. The grooves need to be almost a push fit for the tube, well certainly a close fit, and the depth needs to be well over half the diameter of the tube, in fact nearly the full depth, and this helps to prevent the tube from kinking. The elements need cutting so that they just pop into the unions on the header and then you can make a couple of olives and silver solder them on. We will tidy up the other ends when we come to finish the pipework off in the smokebox.

To be continued

The hot header fitted ready for the trial fit of the superheater elements.

My original Y4 on the bench having its new superheaters fitted.

CLUB NEWSROUND

Compiled by **John Arrowsmith**

The big news this month of course is the change of ownership of Engineering in Miniature magazine. I appreciate it was announced in the August issue but this is the first time I have been able to comment. The new publishers at the Warner Group are a well-established company who have a range of other model and full-size railway oriented titles within their company so a model engineering magazine like EIM provides a superb addition to their portfolio. They have confirmed to Martin Evans our editor and to me that they will continue to support model engineering in all its forms and do all they can to maintain and improve the popularity of all events and exhibitions. A positive attitude like this can only be a good thing for the hobby.

Warner Group are planning to have a display at the major event this month which is of course the annual Midlands Model Engineering Exhibition at The Fosse. This again promises to be another great show with over 50 trade stands and over 40 club stands. I look forward to meeting many of you there again this year. There have been lots of activities on the club scene during the year and there is still a great deal of work being undertaken to improve facilities. However, there still remains the problem of everyone getting older and who will do the essential work of organising and maintaining the clubs and societies. Of course this leads to many discussions about the future which our new publishers are keen to support as much as they can.

A number of clubs are embarking on Training Days for members which are proving to be very useful and helping a wider group to be involved in steaming events. One such club is the St. Albans & District MES whose members enjoyed a good day at their Puffin Field track. Two club locomotives were in operation and six members took advantage of the day to learn the basics of driving a steam locomotive. Their new magazine editor Michelle Hyson has made some excellent changes to the format which has enhanced the already well-produced periodical. Members here have responded to the request for more involvement and it has been pleasing to the committee to see this increase in activity. I hope their two day September exhibition was well supported and provided the club with a good advertisement for their activities.

The model engineering section of the Furness Model Railway Society has had some success in getting two of their club locomotives back into operation. The Class 08 Diesel was found to have a non-operating motor which was acting as a brake so a new motor and some rewiring fixed this problem. The poor functioning of the 5" gauge steam locomotive was caused by the petticoat pipe in the smokebox not being the correct length. Modifications to this plus some valve gear work have resulted in this locomotive now steaming well and earning its keep. A third locomotive owned by a member is also in the workshop but only needs a successful steam test to ensure it is fully operational. They also have a problem with some rotting timbers on the signal box which may require some professional attention to correct it. A decision will be made on this after a survey of the work required has been completed.

The Grimsby & Cleethorpes Society have been improving the kitchen facilities in their club house. Members have fitted a new cooker which they hope will provide bacon butties etc. on work days! A new floor is also being fitted. Twenty-nine members enjoyed a day out recently at the Crich Tramway Museum in Derbyshire. They enjoyed riding on the trams which included a tram from the Grimsby & Immingham line which closed in 1961. A behind the scenes look at the workshop showed the restoration work being carried out and one tram in particular from London will cost around half a million pounds to complete. During their day they also made sure the Red Lion pub was well patronised!

Paul Gilby drives pupils from the Springfield School in Grimsby around the track.

Chris Ball driving at the Sweet Pea Rally at Fareham in June.

Members at the North London Society have been busy with various site projects which are now coming to an end. The re-sleepering of the ground level track has been completed and the major works to build a tunnel has also seen good progress. The inner brick surface has been completed and work is progressing well on the external overcoat. Somewhere in the region of 4000 bricks have so far been used in this project. An interesting evening talk about the renovation and rebuilding of GWR 2-8-2 tank locomotive no. 7200 was presented by Chris Parr who was the main organiser for this work. Members were told of the trials and tribulations entailed in this work. With a rolling chassis now achieved work starts on fund raising to complete all the boiler work. I liked the article by Ian Johnston who describes a Public Running Day at Colney Heath. The organisation sounds impeccable and well thought out which results in the public being entertained and well looked after. It really does make a difference to the visitors when they are welcomed by the club and their needs are fully catered for. This club's procedure could be the yardstick by which all clubs could operate; in reality I don't think that this is likely to happen but we can hope.

With the agreement to extend the track signed and sealed, the City of Oxford Society are now planning the work and sorting out the details. Harking back to my comment above about clubs thinking about their futures, the committee here are considering setting up what they call their Restorative Fund. This will be a sum of money put away to cover the cost of returning their land on which they operate back to its original parkland status. This would only happen if the membership gets to a point where it can no longer function due to lack of numbers. It is a daunting thought but one which must be considered by many clubs. I hope it never happens but no one can really be sure, can they?

It has been a busy year so far at the Stockholes Farm Railway with a number of visits from other clubs and societies including the NRM Miniature Railway Group and (complete contrast in scale) the N Gauge Society. They still have a number of requests to visit in the pipeline. Having been there myself I can vouch for the excellent railway and hospitality you receive when you arrive so no wonder it is popular. They have been hoping to complete the basic goods loop this year to further increase the variety of driving options. At the Macmillan Coffee morning a grand total of £410 was raised so well done to everyone who contributed. Two members have generously purchased and donated to the society a new hydraulic press for the workshop; this obviously has been gratefully received. They will be holding a Hallowe'en event at the railway on 29th October between 16:00 and 20:00.

At the City of Sunderland MES they have recently set up a new Traction Engine section of the club in response to the number of traction engines both already in the club and being built. It was approved by the committee and endorsed at the club's AGM where Mike Davison was appointed section leader. John Faulkner was also re-elected as Chairman for another three years. The club enjoyed a good exhibition at Doncaster with many favourable comments being made about their stand. Member Len Witt gained the Ray McMahon trophy at the exhibition with his 4" Burrell which was judged to be the Best Road Vehicle in Steam. The Open Weekend was also successful with a good selection of models on display both static and in steam.

Another club who are considering their future is the Sutton MEC because the club site is now operating at its maximum size and there is very little room for any expansion. The membership continues to support the various activities enthusiastically so this is very gratifying for the committee. The ground level track has been re-sleepered using the now popular plastic sleepers and they are now reviewing their existing signalling equipment with the aim of replacing the old heavy light fittings etc. with modern high intensity LEDs. At their 81st Annual Exhibition the Sir Malcolm Campbell Challenge Trophy for Craftsman of the Year was awarded to Peter Civati for his Internal Combustion and Stirling Engines. ■

Len Witt from the City of Sunderland Society with his 4" Burrell which won the Ray McMahon Trophy at Doncaster.

YOUNG ENGINEERS

by John Arrowsmith

There have been lots of activities involving younger people at many clubs throughout the year but involving them still remains a difficult task. However, there is progress in many different areas. For example a young man of just 19 years of age has been promoted to Stationmaster at Howarth on the Keighley and Worth Valley Railway. What an achievement for this young man to have the confidence of the railway placed in him by this appointment at his age. This is the way forward both for fullsize heritage railways and model engineering clubs. Train your young people properly and they will take the challenge and become the backbone of your club or society.

I know this is happening in a number of clubs up and down the country but it is not yet in large enough numbers to make a significant difference. Give it time though and I am sure there will be a good result in the future. I know of two clubs where younger members are already getting involved in the organisation of club activities. They are planning exhibition displays for example and making sure each exhibit is correctly captioned. They help in the erection of portable tracks and the clearing up. Details like this are being logged in a diary so that when they apply for a job they can clearly demonstrate just what they have been doing and achieved, and this gives them the edge in a very competitive market.

At various shows and open days around the country you can see young people actively involved. During the Abergavenney Steam Rally I came across 9 year old Daniel Fazey driving a 4" Burrell around the site and into the grand parade like a veteran. Talking to his dad I learned he has been doing this since he was 4 years of age. At most model engineering clubs he would not be allowed near a steam locomotive let alone drive it on his own without supervision. This young man has obviously been given the correct tuition and shown how to maintain and operate an engine of this size and power. Consequently he is learning all there is to know at a young age about how to behave and operate safely in a what could be classed as a dangerous environment. I have read in a popular model railway magazine a letter by a secretary of a model railway club who bemoans the fact that they cannot have any younger members because legislation prevents attendance unless they are accompanied by parents or guardians and this of course is not always possible. He cites an example of a young person who lives 3 doors away from their club room but if he attends on his own he is asked to leave because he is unsupervised. I find this very difficult to understand because if this really is the case then no organisation of any kind can continue to operate. What about Scouts and Guides and the younger Beavers? They don't have dozens of parents attending every meeting. They go camping and have lots of outdoor events and, while they will have a number of adults supervising and helping, this is necessary to ensure safety because of the nature of the activity. I think a modicum of common sense needs to prevail here and as long as no senior member is allowed to be in a one-on-one situation at any time away from any other activity it should not be a problem. How can I say this? It is simply because I have checked it out with my local authority who actively encourage young people to get involved in model engineering activities by operating on these guidelines. So far it has worked extremely well with all the parents accepting this way of working. When our youngsters are on site there is generally just one parent supervisor who does just that. It works a treat without any problems whatsoever.

Nine year old Daniel Fazey with his 4" scale Burrell traction engine at the Abergavenny Rally.

This young man was enjoying himself driving dad's Manor at the Cardiff Rally in June.

I prepared this report in July before the Myford Lathe award had been made. I just hope at this time there has been a good response to what is a once in a lifetime opportunity. ■

OCTOBER DIARY

1 Avonvale MES. Public running at Hillers of Dunnington 11:00-16:00.
1 Ickenham SME. Public running 12:00-17:30.
1 South Lakeland MES. Public running, Lightburn Park 13:30-16:30.
1/2 Ryedale SME. Driver Training at Gilling.
2 Andover & District MES. Open Day 09:30-16:30.
2 Ashmanhaugh Light Railway. Public running 14:00-17:00.
2 Basingstoke MES. Public running, Viables Craft Centre 11:00-16:00.
2 Bournemouth SME. Public running, Littledown Park from 11:00 every Sunday.
2 Bradford SME. Public running, Northcliffe Woods 13:30-16:00.
2 Chelmsford MR. Public running, Meteor Way 14:00-16:30
2 Cheltenham MES. Public running, Hatherley Lane 14:00-17:00.
2 National 2½" Gauge Association Rally at Chesterfield SME 10:30-16:00.
2 Crawley MES. Public running, Goffs Park Light Railway 14:00-17:00.
2 City of Oxford SME. Public running, Cutteslowe Park 13:30-17:00.
2 Frimley Lodge MR. Public running, Sturt Road 11:00-17:00.
2 Grimsby & Cleethorpes MES. Public running, Waltham Windmill 12:00-16:00 every Sunday.
2 Harrow & Wembley SME. Public running, Roxbourne Park 14:30-17:00 every Sunday.
2 Kinver SME. Public running 14:00-16:30.
2 Leicester SME. Public running 13:00-17:00 every Sunday.
2 Malden SSME. Public running, Thames Ditton Railway 14:00-17:30.
2 Northampton SME. Public running, Delapre Park 14:00-17:00.
2 Norwich SME. Public running, Eaton Park 13:00-17:00.
2 North Wilts MES. Public running at Coate Water Park 11:00-17:00 every Sunday.
2 Polegate MES. Public running, Polegate Oaks 14:00-17:00.
2 Portsmouth MES. Public running, Bransbury Park 14:00-17:00.
2 Plymouth Miniature Steam. Public running, Goodwin Park from midday.
2 Reading SME. Public running, Prospect Park 13:30 -17:00
2 Rochdale SME. Public running, Springfield Park from midday every Sunday.
2 Rotherham MES. Public running, Rosehill Park 12:30-16:15 every Sunday.
2 Saffron Walden SME. Public running, Audley End from midday.
2 Sutton Coldfield MES. Publis running, Little Hay MR from 10:00.
2 Taunton SME. Public running, Vivary Park 14:00-17:00.
2 Teesside SMRG. Public running, Preston Park 13:00-16:00.
2 Tyneside SME. Public running, Exhibition Park 11:00-15:00.
2 Urmston SME. Public running, Abbotsfield Park 10:00-16:00.
2 Wimbourne MES. Public running 11:00-16:00.
2 West Riding SLS. Public running 13:30-16:30 every Sunday.
2 Brighton & Hove MR. Public running, Hove Park 13:30-16:30.
2 Leyland SME. English Electric Weekend & Alan Pridday Memorial Diesel Gala.
2 SMEE. Milling Course at Marshall House from 09:00
2 East Somerset SMEE. Open Weekend from 10:00
2 Bedford SME. Public running, Summerfields railway from 10:00.
2 Bracknell Railway Society. Public running, Jocks Lane 14:00-16:30.
2 Brighouse and Halifax MES. Open Day and public running, Ravensprings Park 13:30 -17:00
9 Bristol SME. Public running, Ashton Court 12:00-17:00.
9 Cambridge MES. Public running, Fulbrooke Road 13:30-17:30.
9 Canterbury MES. Public running, Bretts of Fordwich 14:00-16:00.
9 Cardiff SME. Public running, Heath Park 13:00-17:00.
9 Harlington LS. Open Day and public running, High Street 14:00-17:00.
9 Hereford SME. Public running, Broomy Hill 12:00-16:30.
9 Leeds SME. Public running at Eggborough 10:30-16:30.
9 Nottingham SME. Public running at Ruddington 11:00-16:00.
9 Sheffield SMEE. Public running, Abbeydale Park 13:00-17:00.
9 Southampton SME. Public running, Riverside Park 13:00-16:00.
9 Wirral MES. Public running, Royden Park 13:00-16:00.
9 Worthing MES. Public running, Field Place 14:00-17:00.
9 Surrey SME. Open Day and public running 11:00-16:00.
9 Vale of Aylesbury MES. Public running, Quainton RS 10:30-16:30.
9 Welling & District MES. Public running at Falconwood 14:00-17:00.
10 Erewash Valley MES. Evening meeting – 'The Lost Railways of Ilkeston'. 19:30 at The Moon at Spondon DE21 7NE.
13-16 Midlands Model Engineering Exhibition. The Warwickshire Exhibition Centre, Leamington Spa, CV31 1XN.
16 Chesterfield SME. Public running at Hady 12:00-16:00.
16 Fenland Light Railway. Public running at Mereside 10:00-17:00.
16 Guildford MES. Public running, Stoke Park 14:00-17:00.
16 Keighly & Halifax MES. Public running at Marley 13:30-17:00.
16 North London SME. Public running, Colney Heath 14:00-17:00.
16 Pinewood (Wokingham). Public running 13:30-16:00.
16 Plymouth MS. Public running, Goodwin Park from midday.
16 Rugby MES. Public running, Rainsbrook Valley Railway 14:00-17:00.
16 Worcester MES. Public running at Diglis 14:30-16:30.
16 Woking, Mizens Railway. Oktoberfest and public running 12:00-17:00.
22/23 Lowestoft Model Engineering Exhibition at Ormiston Denes Acadamy 10:00-17:00.
23 South Durham SME. Hallowe'en running at Head of Steam, Darlington Railway Museum 11:00-15:30.
23 Staines SME. Public running, Commercial Road 13:00-17:00.
23 Taunton SME. Public running, Creech St Michael 14:00-17:00.
28/29/30 Bromsgrove SME. Hallowe'en running at Avoncroft.
29 Bridgend MR. Hallowe'en running at Parc Slip from 14:00.
29 Coventry MES. Hallowe'en running 18:30-20:00.
29 Hereford SME. Hallowe'en at Broomy Hill 14:00-18:00.
29 Eastleigh Lakeside Railway. Hallowe'en Specials 18:00-20:00.
29 Evergreens Light Railway. Open Day at Stickney 10:30-16:00.
29 Fenland Light Railway. Hallowe'en running, Mereside Drive 14:00-20:00.
29 Millerbeck Railway. Hallowe'en running 11:00-16:00.
29 Sale Area MES. Hallowe'en running 12:00-16:30.
29 Stockholes Farm Railway. Hallowe'en running 16:00-20:00.
29/30 Burnley & Pendle MRS. Public running, Thompson Park 12:00-16:00.
30 Belfast & County Down MR. Hallowe'en running, Upper Gransha Road 13:00-17:00.
30 Frimley Lodge MR. Hallowe'en running, Sturt Road 17:30-19:30.
30 Langford & Beeleigh Railway. Hallowe'en at Maldon 10:00-17:00.
30 Stroud SME. Public running, Stratford Park 14:00-16:30.

Details for inclusion in this diary must be received at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of where every event is being held. Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions.

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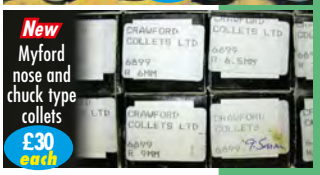

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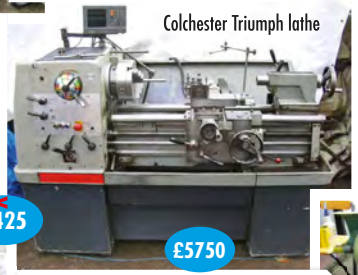

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