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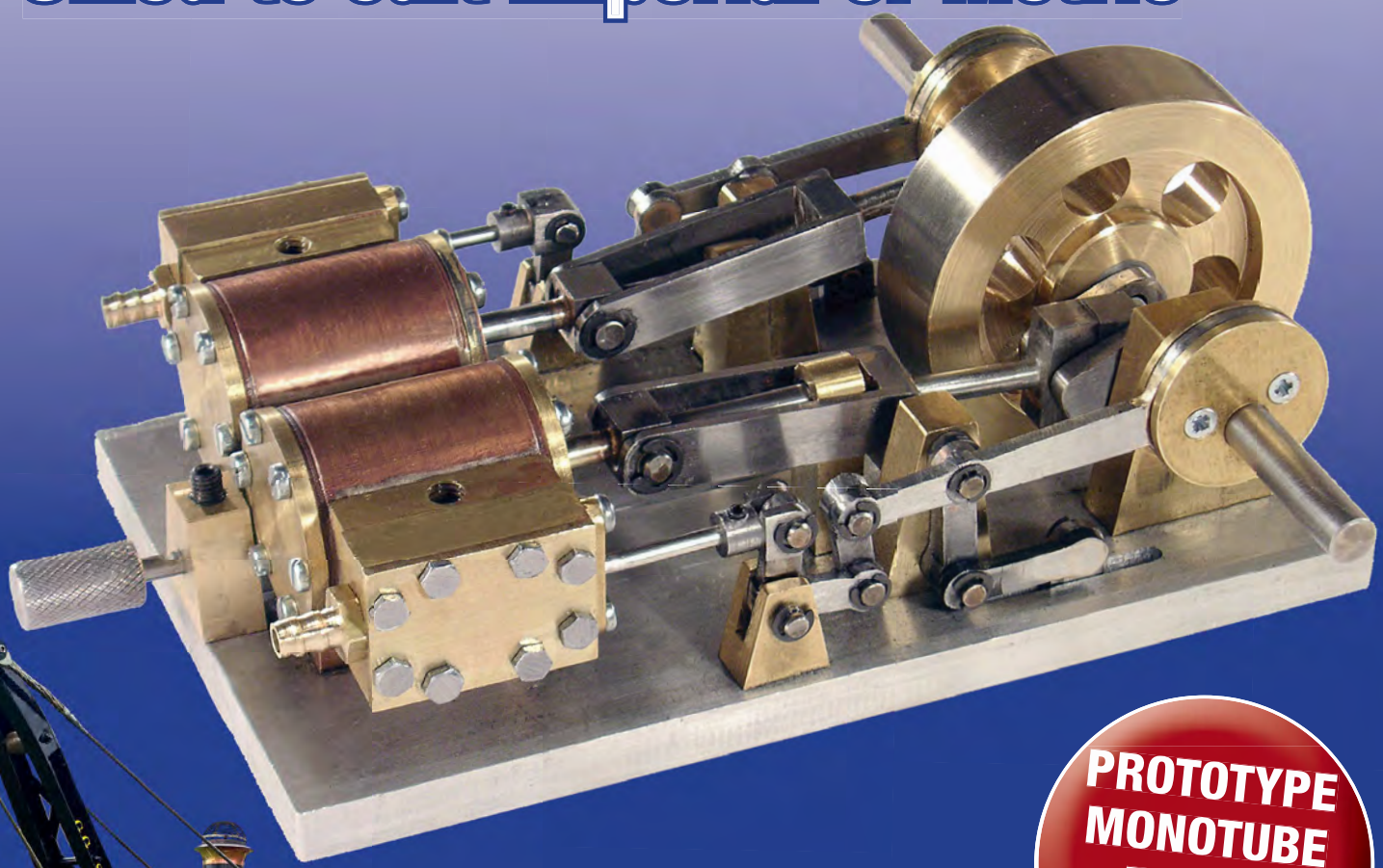

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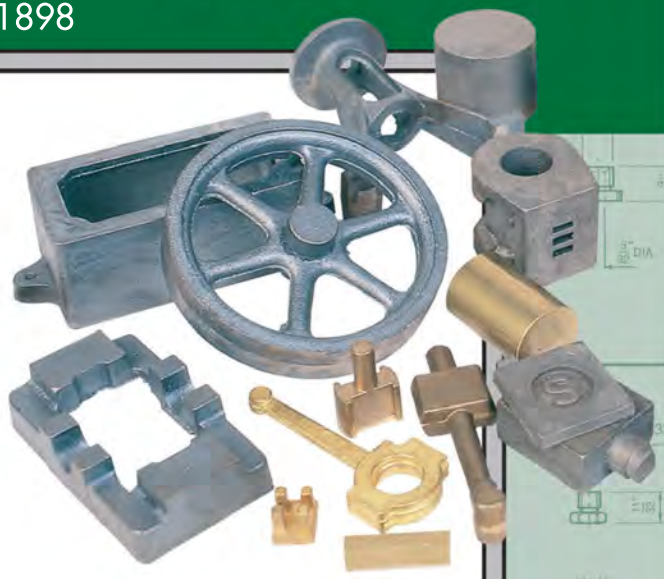

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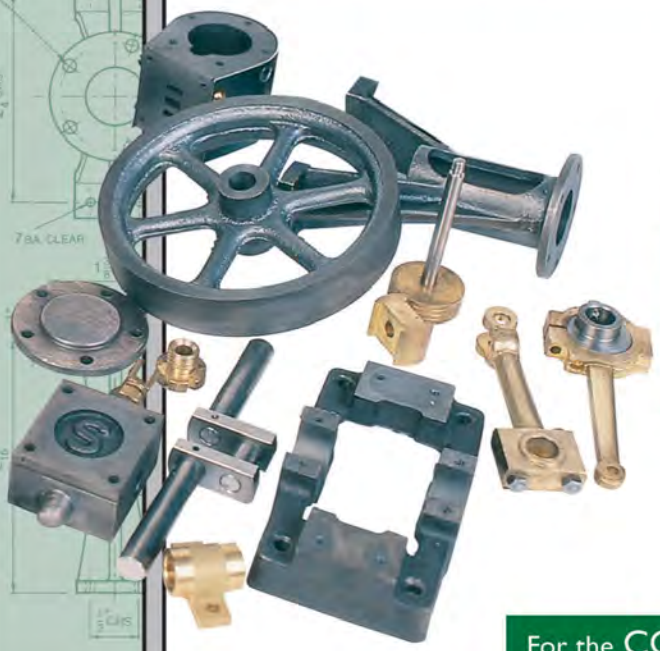

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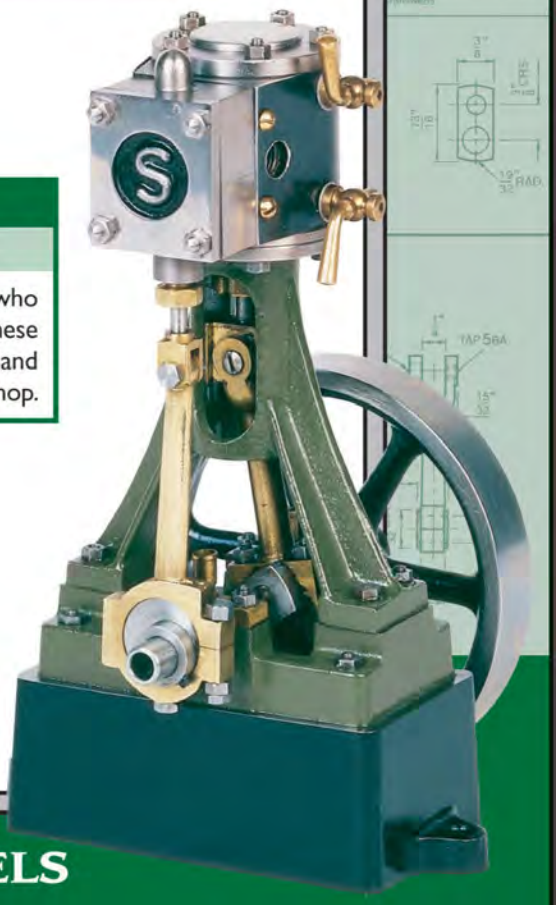

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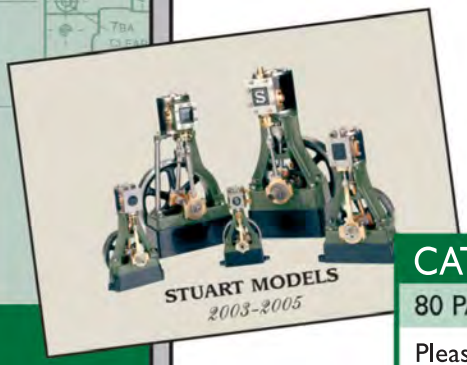

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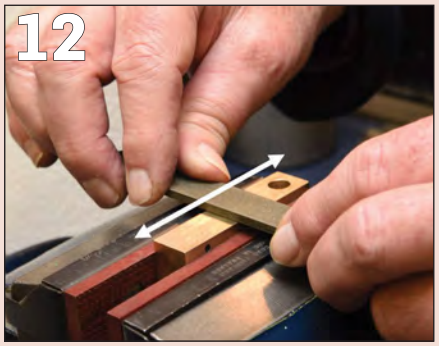

FRONT COVER

Jan-Eric Nyström recently built a small boiler in these pages. Now he has produced a small double-acting engine to give the boiler something to power – and he's catered for both imperial and metric dimensions...

Photo: Andrew Charman

EDITORIAL

An entry-level loco – and beyond...

Welcome to this month's EIM, and it's been another busy month – at times, too busy! Here in this bit of mid Wales we usually deal with winter weather without particularly worrying about it, but we are beginning to get a little bit fed up with the white stuff – we've had more snow this winter than in the previous six, and the latest dumping was over Easter Sunday!

This, combined with the inevitable chaos that comes with preparations for the wedding of the eldest of my offspring in mid April, has meant that your editor hasn't done all he planned to do in the last month! Sadly the garage workshop still has a load of rubbish blocking my way to the machine tools (it's no fun clearing out a garage when it's snowing...) and more importantly I haven't been able to make the railway workshop visit that I promised in the Next Month ad in our last issue. Rest assured it will happen – next month's edition will carry a behind-the-scenes look at the impressive workshops of Statfold Engineering, a new player on the heritage engineering scene and offering a wide range of services from full-size locomotive rebuilds to parts for our models.

I have been to Statfold in the last month – with my 'other hat' on, as editor of EIM's sister title *Narrow Gauge World* I was a guest at the official launch of the Statfold Narrow Gauge Trust. ▶

RIGHT: Inside the new Hunslet museum at Statfold. 'Gertrude' was repatriated, in sectioned condition, from Canada. Yes, the bubble car is a Hunslet!

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Engineering in Miniature – ISSN 0955 7644

Anyone who has visited the Staffordshire line will know that Graham Lee has built up an enviable collection of locos from around the world – for the first 2018 open day at the end of March he had some 19 engines in steam! Graham has now taken the eminently sensible step of forming the Trust and applying for museum status, and has built a Hunslet museum on a new mezzanine floor in Statfold's grain store exhibition centre – already a mecca for open day visitors.

Why am I telling you all this? Well in 2016 Statfold provided a new home for a gathering of miniature traction engines, and the Miniature Steam Weekend is now an established part of the calendar, being held this year on 12th-13th May. Quite apart from the many models on display and in action, the new museum will be open and well worth a look. Details and a ticket order form are at www.statfoldbarnrailway.co.uk and note that you have to pre-order your tickets – you can't just turn up on the day. It's well worth the effort!

We have had a very positive reaction to our new entry-level loco build series – Andrew Strongitharm is really getting into the Dougal project this month, building the boiler. Among those to get in touch have been a couple of model engineers who have previously built the loco, including noted miniature railway operator Bill Edmonson.

Bill is one of those who have built a Dougal with modifications, most notably replacement of the simple slip-eccentric motion shown in the drawings with more efficient Stephenson's Link gear. Drawings for this motion had been produced for Bill by no less than Martin Evans, a legend of the model engineering movement.

The drawings were shared over the years with others building the loco, one of whom was David Goadby. While we were aware of the Stephenson's link mod, David told us of a number of other modifications he made to his loco, including enlarging the firebox, altering the crown to a squarer design with crown stays (another Martin Evans mod), adding two extra boiler tubes and a superheater tube, fitting a combined blast pipe and blower to a design by Laurie Lawrence and adding cylinder drain cocks .

As you can see this entry-level project can become quite complex if the builder desires. David has agreed to put down his mods on paper, and these 'Super Dougal' features will appear in **EIM** towards the end of the year following the conclusion of Andrew's build series.

Meanwhile Bill has supplied us with a couple of pictures (left) of his locomotive, in its original form in 2006 with son Jack providing a suitably small driver and more recently. In the intervening period Bill has modified the loco to resemble the real thing – but he admits to not liking the prototypically correct green colour scheme as much as he did the black with wasp-stripe buffer beams...

All of which plays on the Ed's mind, knowing that in the currently stuffed garage lies a set of Dougal frames, donated to him some years ago, plus an entirely separate completed frame/buffer beam assembly, boiler copper and several castings, acquired from a certain online auction site a couple of years ago...

Making the most of...

One of the real pleasures of editing **EIM** is perusing the various club magazines that come in each month, and I was very much taken with a small item in the back of the latest Bournemouth SME newsletter from young member Joel Keen.

Joel is serving an apprenticeship with Rolls-Royce in Bristol and has been updating members on his progress – he has acquired what he describes as a "very small" desktop lathe and in his spare time is building a two-cylinder marine engine, and getting most of his material from the scrap bin of offcuts at college! That's ingenuity...

Andrew Charman – Editor

The June issue of **Engineering in Miniature** publishes on 17th May.

LEFT: Always good to see a miniature loco in action, and this one was in an evocative location, as one of the attractions at the Model Railway Exhibition held at the National Slate Museum in Llanberis, north Wales in mid February. The permanent displays at the museum, sited in the former workshops of the Dinorwic Quarry, will provide plenty to interest the model engineer, and include a sadly stuffed and mounted 5in gauge model of the Welshpool & Llanfair Beyer Peacock 0-6-0T. *Photo: Andrew Charman*

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A Burrell Crane Engine

This unusual 6-inch model is the result of one man's life-long ambition...

BY **AIAN BARNES**

There is something rather imposing about a Burrell road locomotive fitted with a crane whether it is a full-sized steamer or a 6-inch scale miniature and the engine owned by George Sonneborn is certainly a fine example.

Although George's home is in Germany he is no stranger to vintage rallies and events in the UK and his partially built crane engine was shown at the Great Dorset Steam Fair in 2011. Since then the superbly finished Burrell has appeared at the BSEPS rally at Shuttleworth Park, returned to the Great Dorset and is a regular on the European rally scene.

By his own admission the credit for the building of this superb engine is largely due to others and George described his role as that of 'Project Manager' rather than engineer or machinist. As he told me; "I think that during the course of the building of this engine I called upon the various services of more than 30 skilled craftsmen, technicians and engineers. I did make a list of those involved which had 34 names on it but there are probably a few more which had slipped my mind."

While the building of the Burrell may have been entrusted to others this in no way diminishes George's enthusiasm and interest in road steam traction although he does describe himself as a 'latecomer'. For many, an interest in steam starts with childhood models on the kitchen table but for George it started as an 18-year old on a weekend visit to the Lake District.

ABOVE AND RIGHT: George on the Burrell crane engine at Old Warden in 2013, and at right with the engine following its completion in 2012. *Photos: Alan Barnes and J M Candelay*

ABOVE LEFT: During the build stage, just after the wooden boiler lagging had been applied – note the temporary wheels attached, not strictly authentic but practical in the workshop!

LEFT: View inside the boiler barrel shows the carrot bolts to secure the cylinder block.

BELOW: The partially built locomotive in November 2010.

All uncredited photos courtesy of George Sonneborn

This was a school exchange visit to South Shields and when the family he stayed with learned of his interest in climbing they arranged the Lake District visit. However with no equipment available George had to watch other climbers in action which he admitted he found rather boring.

"Watching others tackling the climbs was a little frustrating but the family looking after me did not want to take the risk of their visitor falling off a mountain– understandable really. But the day certainly livened up when some time later I came upon what looked like a steam locomotive driving down the centre of the road.

"I found this quite amazing as I had never seen anything like this in Germany, after all, steam engines were supposed to run on rails. While the UK steam preservation movement was well established by this time the heritage movement in Germany was still very much in its infancy. True there were many classic car and lorry events but steam traction engines were few and far between."

George was so taken by the sight of the engine that his hosts arranged to spend the next day at a steam rally in North Yorkshire where he definitely became 'hooked' on steam. "The main problem in furthering my interest was the lack of events in Germany and neighbouring countries however over time some new vintage steam events were being arranged in the Netherlands which I made every effort to attend. It was at these rallies that I was fortunate to meet some of the well respected 'names' of the UK steam movement. Jane and Len Crane and the legendary 'Doc' Romanes were kind enough to allow me to help with their engines and to provide an enthusiastic youngster with the opportunity to get some hands-on steam experience."

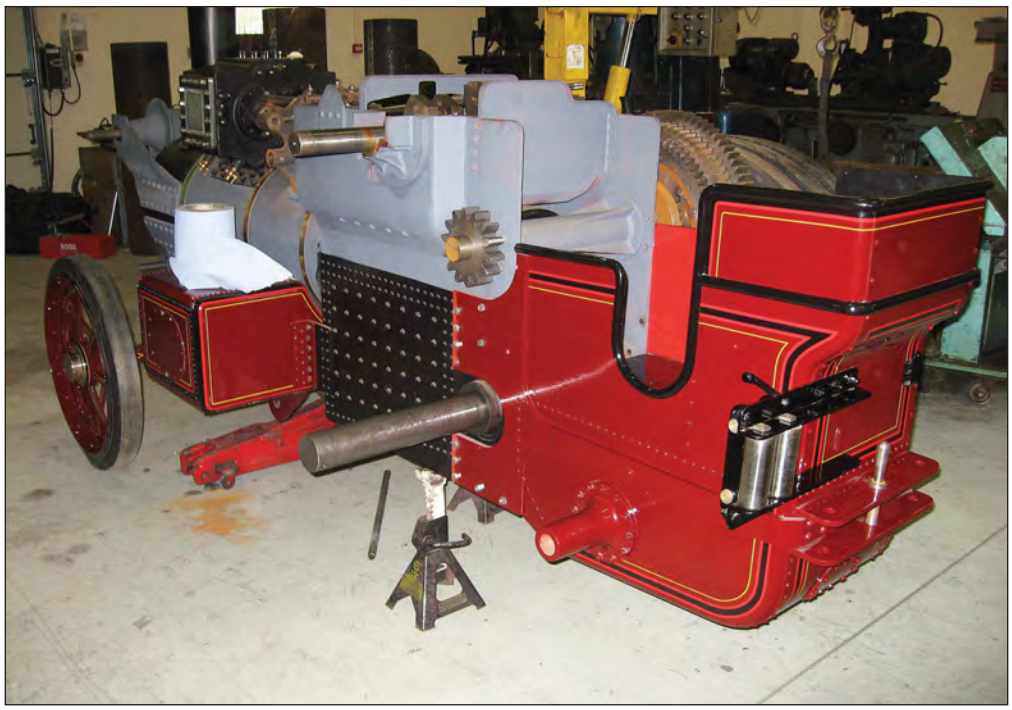
Hands-on experience

More experience came closer to home when George met Erhard Beloch who owned a number of road rollers and Fowler Road Locomotive Works Number 9904. "He was kind enough to provide the opportunity to learn about steam and improve my engine handling skills. I was also coming to the end of my training as an electrical engineer and this included the completion of a study of a large stationary reciprocating engine.

"My ultimate aim was to own a traction engine of my own and it really would have to be a road locomotive – nothing like aiming high! However I did have enough sense to realise that I had other priorities, supporting a wife and family and buying a house."

Most of George's footplate experience had been on full-sized engines but he also had some experience with a 6-inch scale traction engine which belonged to a friend. "I began to consider the possibility of a miniature engine and in 1995 the opportunity arose to buy a 5-inch scale Allchin traction engine which had been imported into Germany. Although it was a fine-looking engine it was not a DCC road locomotive and I continued my search for a more suitable model."

During a visit to the Great Dorset Steam Fair in 2000 George saw Richard Scourfield's 6-inch scale crane engine; "At that moment I decided that this was the type of engine that I wanted. As well as the look of it, the memories of my first footplate



experience on Len Crane's engine all those years ago came back to me."

George could not expect engines such as Richard's to come up for sale very often; "If I wanted such a model it would have to be built which presented a whole new set of problems. My training as an electrical engineer was not really applicable to steam engine construction and my spare time was limited which would mean a rather protracted build. After due consideration I felt that the best approach was to project manage the build and rely on the expertise of selected engineers."

Initial thoughts were to build a replica of the Burrell number 4039 which had been owned by Screen Brothers. This had suffered frost damage in 1945 and had been broken up some time later. "I obtained plans and drawings but was faced with the problem that the commercially available parts were not really suitable for that particular prototype. To have to produce new patterns and a large number of parts would also be very expensive."

George decided to use the Burrell castings produced by David Ragsdale for the basis of what he hoped would be an authentic-looking Burrell road locomotive fitted with a crane jib and which would be an amalgamation of Burrell designs. "As the engine would not be based upon a particular prototype I selected works number 4023, a number which was not allocated to a Burrell engine."

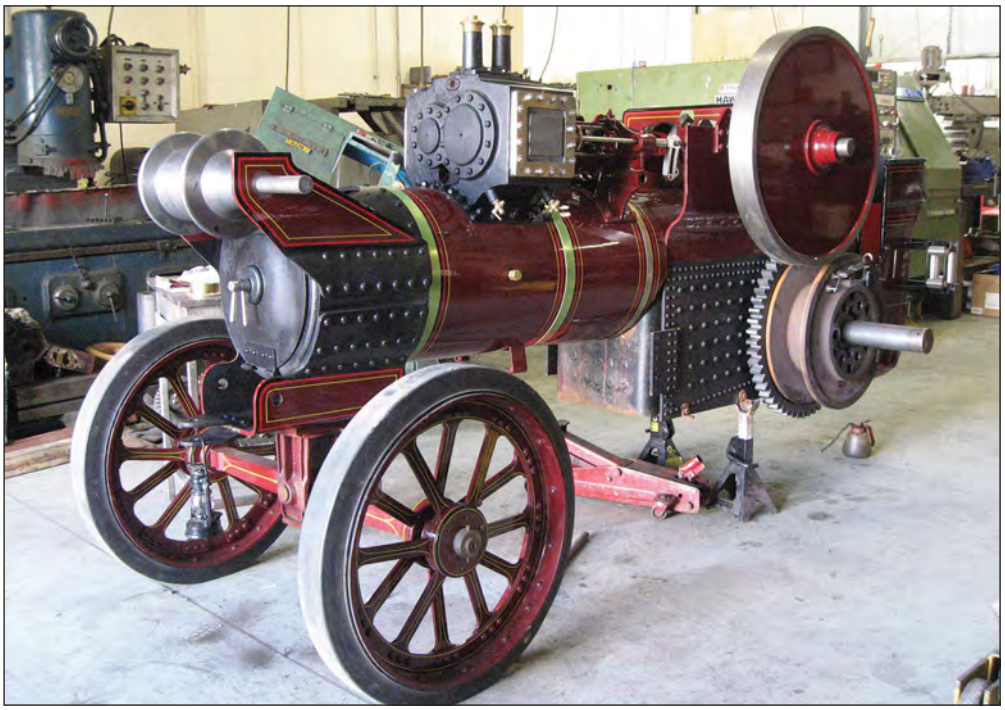
He next had to search for engineers to undertake the work and having no luck in Germany he spread the net wider and eventually found a company in Wales which agreed to build the engine with him acting as project manager. "I spent some time preparing and collecting drawings and other details, ordering the castings and the work on the build eventually started in 2008. Some special patterns did have to be made for some of the parts including the casting for the hinged chimney base."

Skills envy

George admits that seeing the project progress over the next few years made him very envious of those people with the engineering skills to produce such excellent work. "In truth I can take credit for the concept for the engine and bringing together a highly skilled team to carry out the work. I will always be grateful for their dedication and their special skills involved in the building of my engine to the finest of standards – without them it would still be a pile of drawings."

The build took some five years to complete, the finishing touch being the superb painting and lining that was carried out by Adam Meredith. The finished engine made its first public appearance in 2013 and since then has been rallied regularly in Europe and the UK.

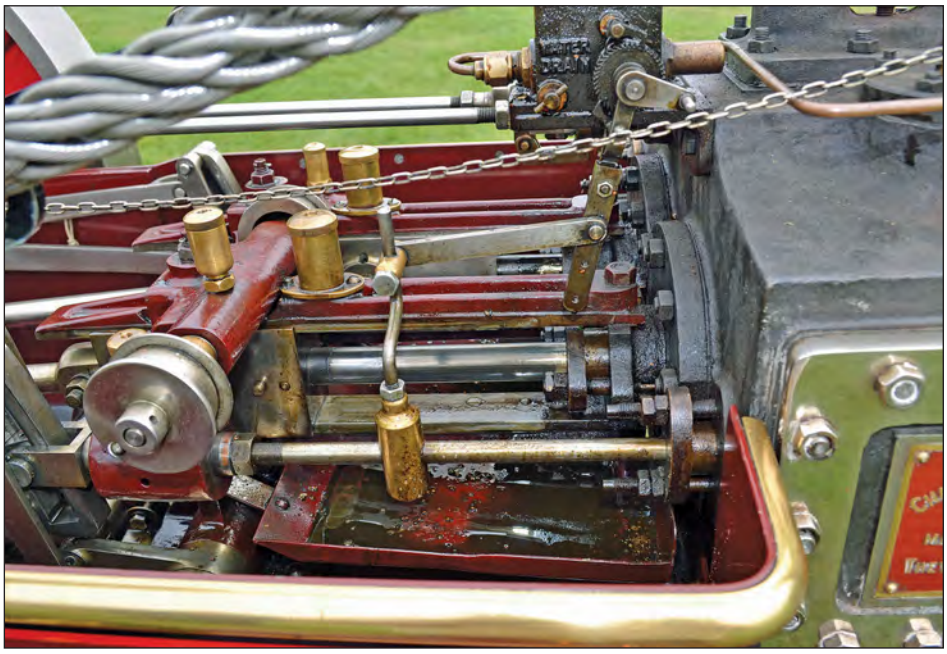
"Since the engine was completed it has performed very well and the only repair work needed has been adjustments to the big end but this was nothing serious. However I have made a few additions, including completing the oak toolbox on the tender and the adding of 'Working Position' brass plaques on the reversing lever, while the whistle and displacement lubricator have been upgraded. It will soon be time to freshen some areas of the paintwork as there are a few burnt spots and some scrapes caused by the crane fixing wires."

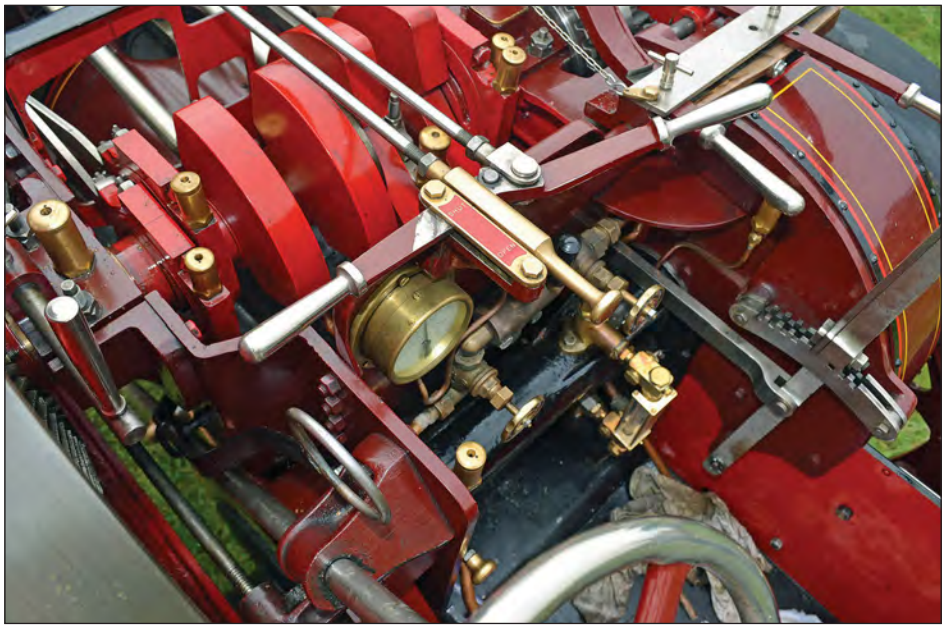


ABOVE: More progress by February 2011 – and the proper front wheels have been fitted!

RIGHT: Some excellent detail in the finished rear wheels.

BELOW: First steaming in Germany, with the late Udo Fisher on the footplate.



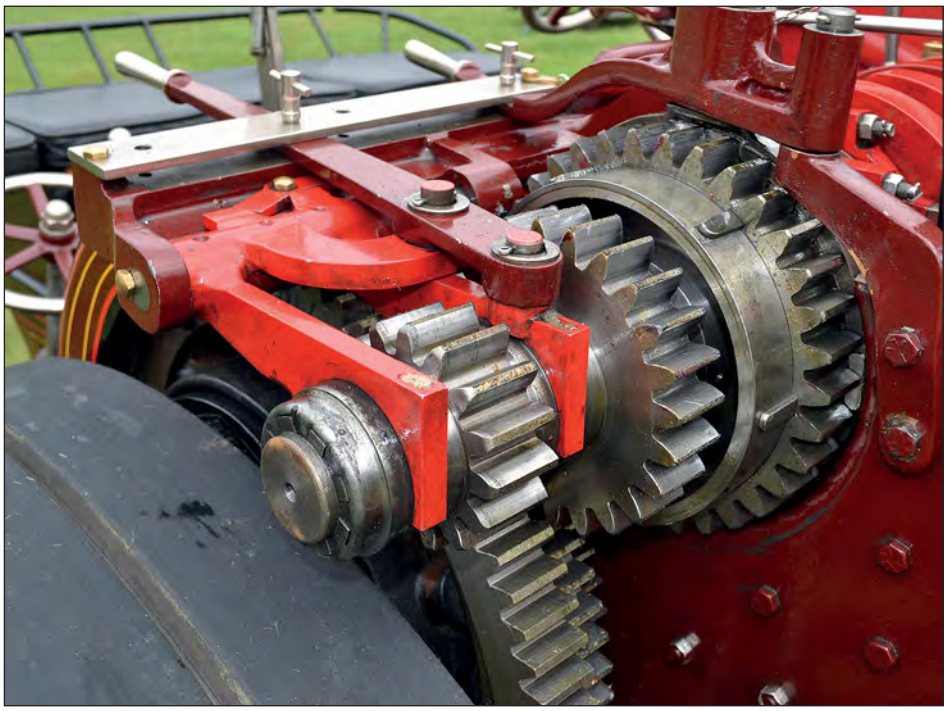


George adds that perhaps the most useful 'upgrade' has been one of procedure rather than anything mechanical. "I had always loaded the engine on to the lorry smokebox first which involved the removal of the crane. This practice was awkward to say the least and always needed a band of volunteers to help remove the jib.

"At one event a chap watched us sweating over our labours getting the engine loaded and having been entertained came over and asked why we didn't just reverse the engine onto the trailer without removing the jib. We tried it out and 'hey presto', life with the engine suddenly became quite simple! Nowadays I just have to put a tarpaulin over the crane jib".

Passenger hauling

He has also given some thought to carrying passengers and constructed a traction wagon fitted with a box. This folds out to form



seating which can accommodate up to eight adult passengers. The Burrell is also used with another heavy haulage type 'dolly' which carries a narrow gauge railway locomotive; "This was originally fitted to a children's roundabout and I have restored it as a suitable load for the crane engine."

George is happy with his project. "While the dreams of owning a full sized DCC road locomotive are still there I am more than happy to continue with my 6-inch scale version and will always be grateful to all those involved with the project and their hard work which resulted in such a fine engine."

My thanks to George for providing the details of the build and for allowing the use of photographs from his collection. EIM

FACING PAGE: Detail photos of the crane engine, taken by *Alan Barnes*.

ABOVE: With its wagon, the box opened to provide seats for passengers.

RIGHT: A 6-inch line up at Bochum in May 2015.

BELOW: The engine looks appropriate running at the Dresden-Pionier Eisenbahn line.

Achieving a quality surface finish

The latest in John's series aiming to make life easier both for new model engineers, and perhaps those with a little more experience too...

BY **JOHN SMITH**

Parts made by professional model-makers are often ground. Even a secondhand Jones & Shipman surface grinder would set you back around £6000; I hate to think what they are new; certainly outside of my league. But a nice finish can be achieved in the amateur's workshop without spending big money.

Step 1 is to use sharp tools to get the best finish that your machines can deliver. Step 2 is to use a little coolant (soluble oil in water) when turning mild steel – just an occasional dab with a brush on tool and workpiece. I also use coolant when turning cast iron, just to keep the dust down.

Lathe tooling has changed beyond recognition since I took up this hobby. These days we rarely have to grind tools from square HSS tool blanks and worry about clearance angles, top rake and all that palaver. A good set of tools with replaceable carbide tips, including a parting-off tool, takes away all that bother – the inserts being usable on all of the metals that we use.

Replaceable tips usually have a small radius, to give a fine finish. When it is important for a shoulder not to have a radius at its root, we still need to be able to grind a knife tool with a razor-sharp tip. I also find that V tools with an end radius of around 1/16th inch produce a nice finish in a radius turning attachment. I'll cover radius turning later in this series.

The other big change in the last 20 years or so is the ready availability of Dickson-type quick-change tool-holders. With these it is child's-play to set a tool at centre height or just a little under. Photo 1 shows the lathe tools that I use pretty much all the time. The indexable tools, which all take CCMT tips, are Glanze tools from Chronos, the parting-off tool from Greenwood Tools.

Keep it sharp

On the mill, sharp end mills will produce the best finish and you will always get a nicer finish when cutting with the side of an end mill than you will when cutting with the bottom. Always cut with the end mill rotating against the feed of the table, but when you make the final cut, let the end mill return over the workpiece at the same setting. 'Climb milling' (as this is called) will often produce the better finish.

For drilling, HSSCO drills (1mm to 6mm in 0.1mm increments and 6mm to 10mm in 0.1mm increments) will produce very good results – Greenwood tools again.

All machining leaves 'witness marks'. In the lathe, these can be removed by means of a strip of abrasive paper held between finger

PHOTO 1: Selection of John's most-used lathe tools – removable tips are a boon but must be kept sharp .

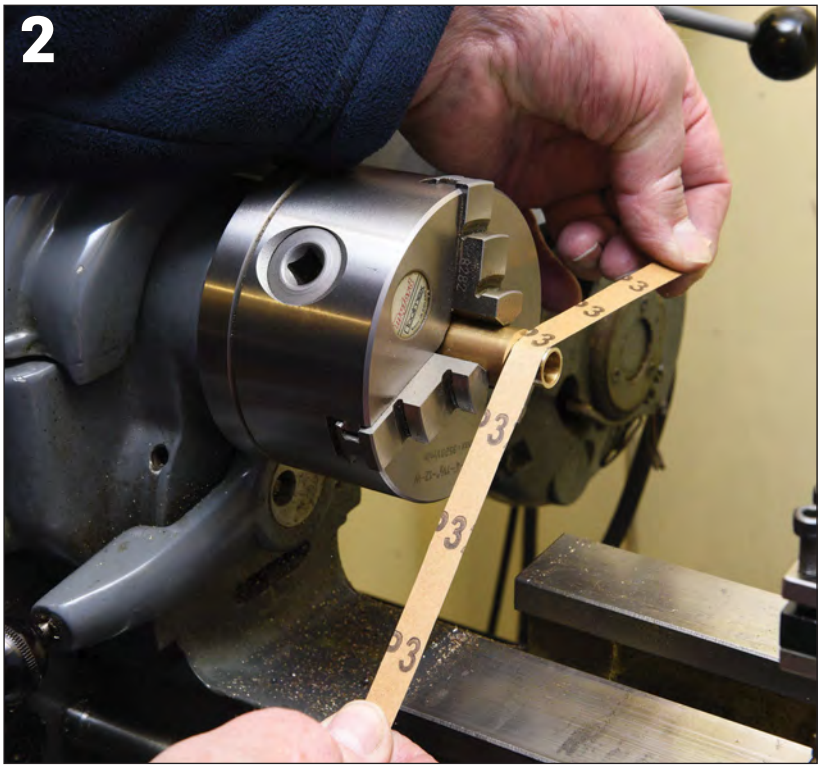


PHOTO 2: Abrasive paper helps remove 'witness marks', a job that certainly must not be carried out with the lathe running!

and thumb at both ends and rested on the workpiece with the lathe running; move the paper against the rotation of the workpiece (Photo 2 – my hands would not be as close as this to the chuck if the lathe was running!). When using a chuck to hold a previously-machined surface, place small pieces of shim between the workpiece and jaws to prevent the jaws from bruising the work.

For milled parts, draw filing will remove any deep machining marks (Photo 3). Move the file in the direction shown, applying downward pressure only when pushing the file away from you. Then rub the workpiece on a sheet of Wet & Dry on an old surface plate to produce something close to a ground finish. Start with 320 grit, finish with 800 grit.

Polished performance

I find that a couple of sheets of plain paper under the Wet & Dry can often give the best finish. Have some polishing paper in stock; this can be obtained online from firms catering for the jewellery trade. The edges of very thin components can be finished on the Wet & Dry by holding the part against a piece of steel or brass flat (Photo 4).

The edges of sheet material can be finished by using a large parallel or an angle plate sitting on a piece of cardboard on the abrasive paper to keep the sheet material vertical. Use some cardboard between the workpiece and guide to prevent any scratches (Photo 5).

Sometimes we have to file very small radii on components. This is a hard task to carry out satisfactorily by hand and by eye. I find that mounting the part on a jig and using Wet & Dry held against a vertical surface works well (Photo 6), use of a radius gauge helping to achieve a perfect result.

Small holes can be deburred using a sharp countersink held in the hand or in a small chuck. The sharp edges of holes larger than about 6mm diameter can be dealt with quickly by a deburring tool. For sharp edge removal on rectangular parts I find a No. 4 cut needle file works well, Vallorbe of Switzerland making very nice ones.

Exhibition standard work can be achieved easily by these means. EIM

COMING NEXT MONTH - THE ART OF MARKING OUT...

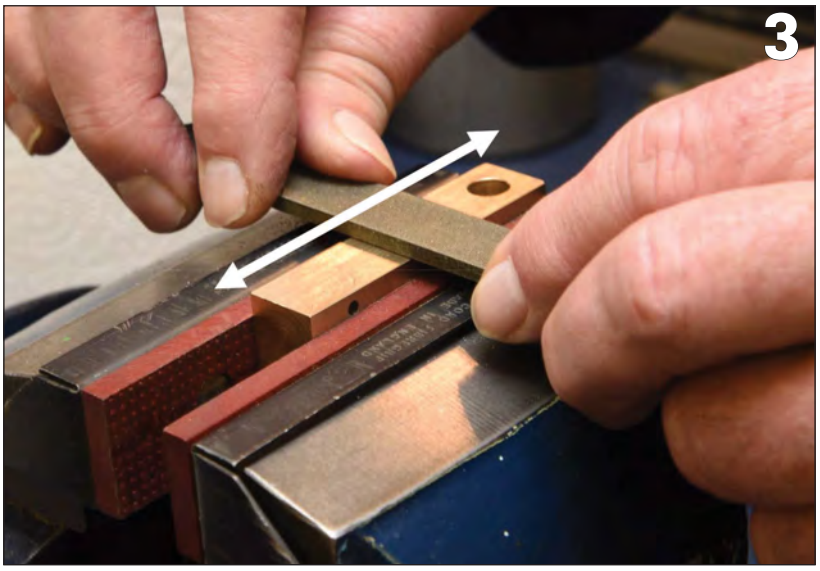
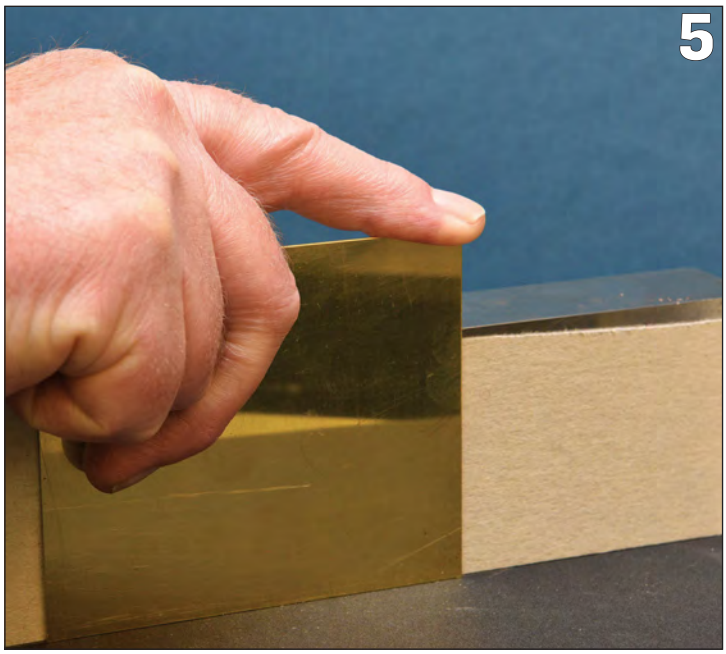


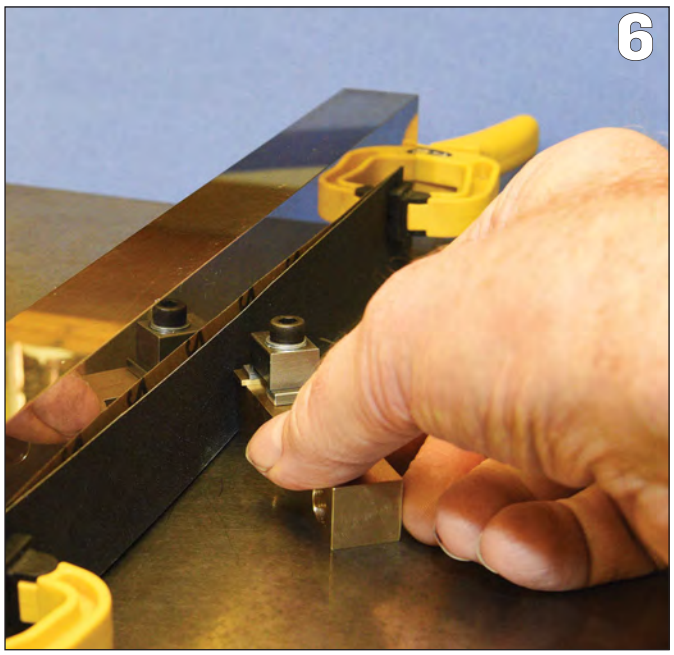
PHOTO 3: Draw filing is a technique to remove the deeper marks that can be left by machining.

PHOTO 4: Use a piece of flat to help rub smaller parts on Wet & Dry.

PHOTO 5: For cleaning up sheet, an angle or parallel is a great aid.

PHOTO 6: For filing small radii, a jig is the way forward.





A Double-Acting Engine

Jan-Eric's recently built boiler, described over the last couple of issues, needs something to power, so this month he begins construction of a small steam engine.

BY **JAN-ERIC NYSTRÖM** – Part one

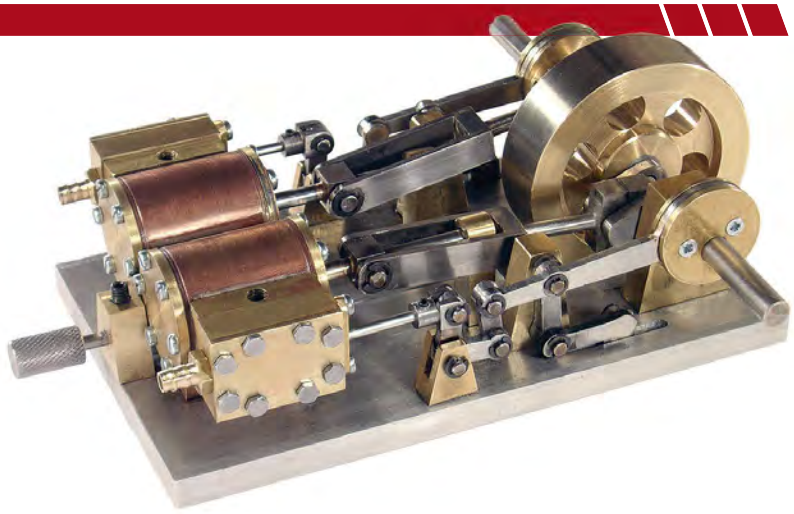
Before we begin...

Even though this project is relatively simple, it may not be the very best 'first project' for a total beginner in model engineering. Since most of the straightforward turning and milling operations are not described in detail in this article, some previous experience is suggested. It is assumed that the builder has the basic knowledge to mark out, turn, drill, bore and mill pieces to the size specified in the drawings, as well as perform silver soldering.

Some hints and ideas for specific machining techniques will be presented. Personally, I have used some 'quick-and-dirty' techniques, not always the most exact. Experienced builders may ignore these, if they are used to better methods or have more sophisticated tools.

A lathe with three- and four-jaw chucks and a mill (alternatively, a milling attachment on the lathe) are necessary for this project, as well as a drill press, bench and angle grinders and the usual hand tools found in most model engineering workshops.

No esoteric tools are needed – you can manage without a rotary table, for instance. High precision is required only in a few places – these are indicated in the text, as well as methods to achieve it.

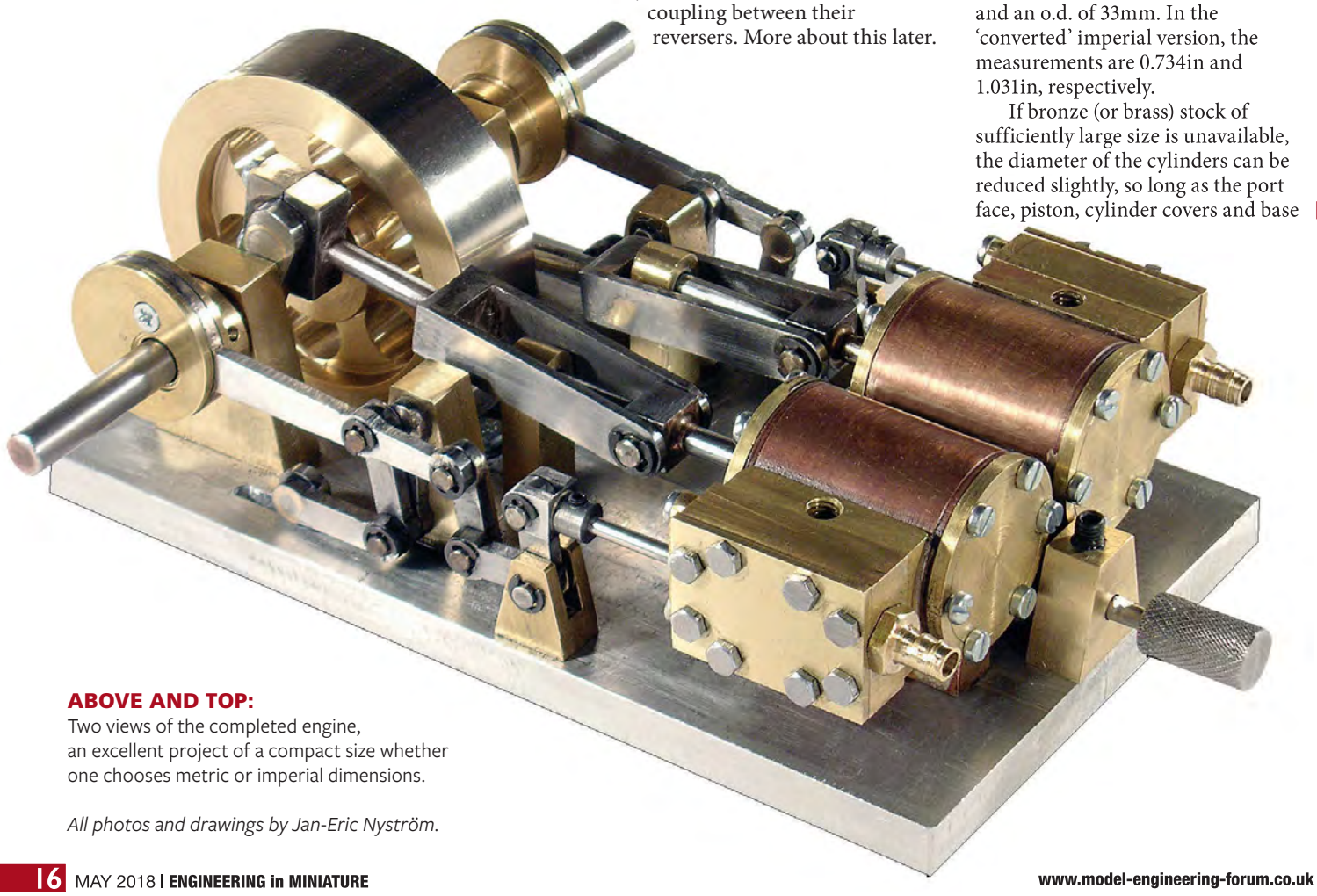


In order for a steam engine to be self-starting from all positions, it needs to be both double-acting (i.e. the cylinders receive live steam in both ends), as well as have two cylinders 90 degrees out of phase. Thus, this design consists of two identical, but mirror-image, single-cylinder engines. They are interconnected only by a threaded joint in the main axle and a coupling between their reversers. More about this later.

The cylinders

The cylinders are best made from solid or hollow bearing bronze stock, but brass can also be used if bronze is unavailable. The overall dimensions of my prototype were chosen based upon a 22mm i.d. by 34mm o.d. piece of continuously-cast bronze I happened to have handy. Machining the very rough surfaces smooth, the cylinders turned out to have a bore of 23.5mm and an o.d. of 33mm. In the 'converted' imperial version, the measurements are 0.734in and 1.031in, respectively.

If bronze (or brass) stock of sufficiently large size is unavailable, the diameter of the cylinders can be reduced slightly, so long as the port face, piston, cylinder covers and base ▶



ABOVE AND TOP:
Two views of the completed engine, an excellent project of a compact size whether one chooses metric or imperial dimensions.

All photos and drawings by Jan-Eric Nyström.

Metric vs imperial measures

Since I live and do my model engineering in Finland, where imperial measurements are virtually non-existent (used only in some threaded fittings) and all raw material is metric (except for some pipes), I of course work in metric, of both necessity and convenience. However, this engine can be built using imperial stock, in two different ways:

One method is to build the engine in the same size as the metric version by using imperial measurements throughout, dividing one millimetre by 25.4. The left column in the table lists the inch equivalents of the dimensions found on the drawings. Choose the nearest available size of raw material, such as ⅛in steel plate instead of 3mm, 5/16in axle instead of 8mm, and so on.

However, this method will necessitate adjusting some interacting measurements, which can be a hassle. It is mainly the stock for the axle, the piston and the valve rods that will have to be chosen carefully, and the O-rings and their seats that have to be adjusted to fit available stock sizes. The 3mm thickness of most of the levers can be converted to 1/8in (which is exactly 3.175mm) without much other adjustment than the length of their bearing pins and the position of the bearing blocks. The pins could be ⅛in. The 10mm thickness specified for the base and the bearing blocks can be reduced to either ⅜in or even 5/16in.

A simpler way

The second, much simpler method is to consider one millimetre on the drawing as being equal to 1/32 of an inch. Because 1/32in actually is 0.79375 mm, this will of course decrease the size of the engine by a little more than 20 per cent. Since the original prototype was built to an arbitrary size, this will not pose a problem; the new base size will be around 3.3 inches by 5.6 instead of 4.1 inches by 7.1in. The reduced size is not yet awkwardly small, and such an engine can be built using the very smallest hobby lathes and mills, such as the Unimat machines. Compare the size of the metric engine (light grey) and the 'converted' imperial one (dark grey) in the diagram below, both shown actual size.

The practicality of this unorthodox 'conversion' is evident: For instance, instead of drilling and reaming a 4mm (0.15748in) hole, you'll make it 4/32in, i.e. ⅛in, a common imperial reamer size. No problems should be experienced obtaining suitable raw materials – small, square and round stock is usually available in 1/32in or at least 1/16in increments. The 8mm main axle would become 8/32in, or simply ¼in. The table provides all such converted measurements in both decimal and fractional inches. Couldn't be much easier, could it?

For the above reasons I have not specified thread sizes, O-rings and bearing diameters in the drawings. In the article text I do mention what I've used in my own metric prototype, but you must choose what is available in your area. If you use PTFE-coated bearing sleeves, the holes must be drilled and reamed according to manufacturer specs – if you turn your own bronze bearings, you can ad-lib the dimensions. Screws and bolts can be BSF, BSW, BA or metric, depending on the taps and dies you have available. The only requirement is that they fit in the available spaces.

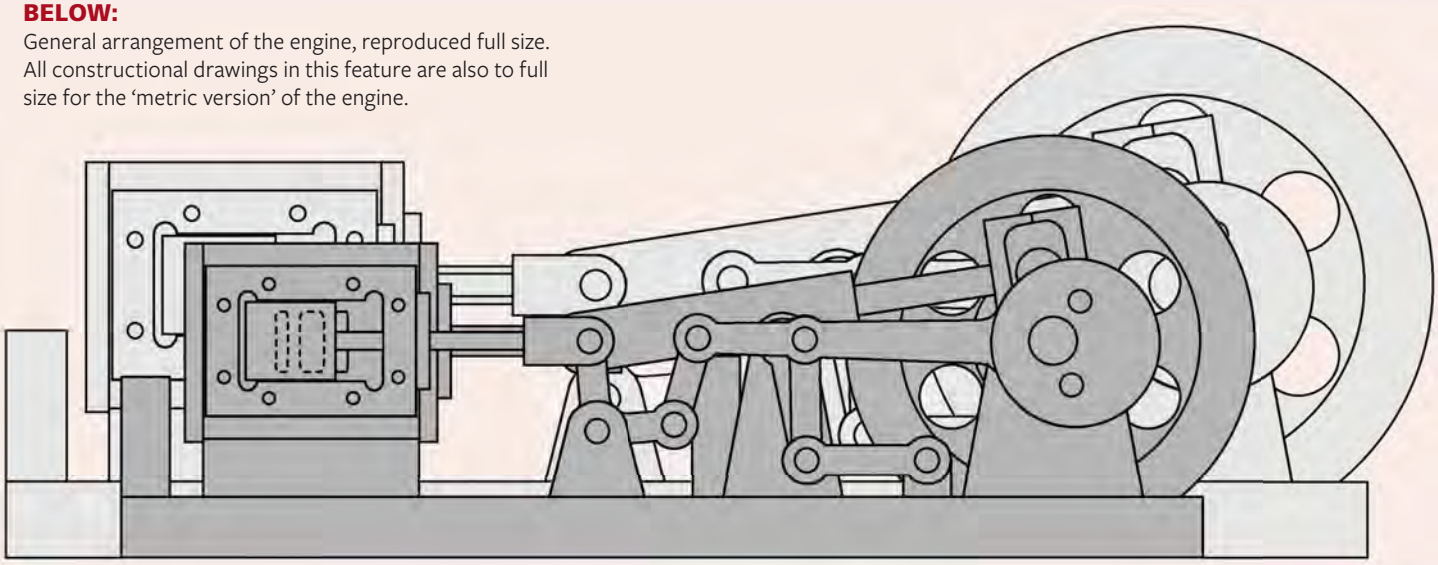
Conversion table – metric to imperial

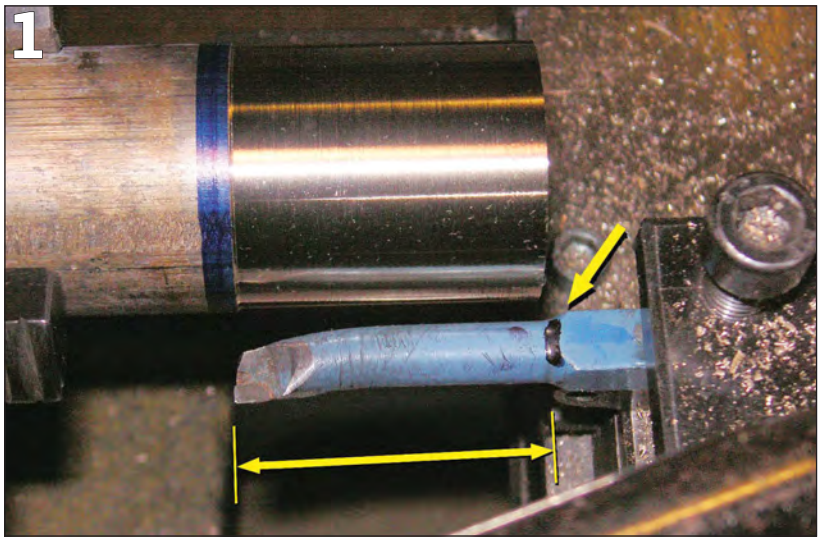
One millimetre actually equals 0.03937 inches, and the left column in this table reflects this, rounded to three decimal places. In the right two columns, one mm on the drawing is 'converted' to 1/32 of an inch, i.e. 0.03125in. This makes the use of imperial-sized raw material, as well as fractional drills and reamers, more convenient. Note that if these measurements are used, the engine will be some 20 per cent smaller than the metric version. An asterisk (*) in the last column indicates that some raw material (round, square or flat) may have this dimension in the converted size.

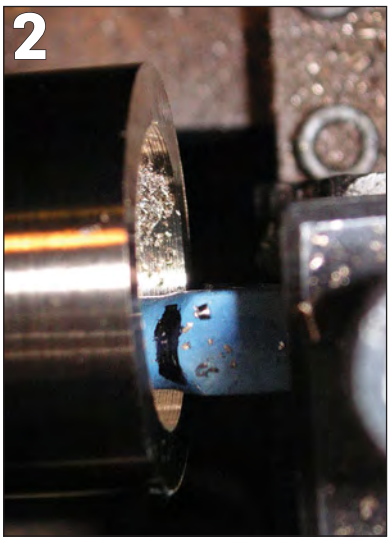
Real inches	mm	Converted inches	
		Decimal	Fractional
0.020	0.5	0.016	1/64
0.039	1	0.031	1/32
0.059	1.5	0.047	3/64
0.079	2.0	063	1/16 *
0.098	2.5	0.078	5/64
0.118	3.0	094	3/32 *
0.122	3.1	0.097	n.a.
0.126	3.2	0.100	n.a.
0.138	3.5	0.109	7/64
0.150	3.8	0.119	n.a.
0.157	4	0.125	1/8 *
0.197	5	0.156	5/32 *
0.236	6	0.188	3/16
0.240	6.1	0.191	n.a
0.276	7	0.219	7/32
0.315	8	0.250	1/4 *
0.319	8.1	0.253	n.a.
0.354	9	0.281	9/32
0.394	10	0.313	5/16 *
0.398	10.1	0.316	n.a.
0.413	10.5	0.328	21/64
0.433	11	0.344	11/32
0.445	11.3	0.353	n.a.
0.472	12	0.375	3/8
0.512	13	0.406	13/32
0.528	13.4	0.419	n.a.
0.531	13.5	0.422	27/64
0.551	14	0.438	7/16
0.575	14.6	0.456	n.a.
0.591	15	0.469	15/32
0.630	16	0.500	1/2
0.689	17.5	0.547	35/64
0.701	17.8	0.556	n.a.
0.709	18	0.563	9/16
0.728	18.5	0.578	37/64
0.748	19	0.594	19/32
0.787	20	0.625	5/8
0.866	22	0.688	11/16
0.906	23	0.719	23/32
0.925	23.5	0.734	47/64
0.945	24	0.750	3/4
0.984	25	0.781	25/32
1.024	26	0.813	13/16
1.102	28	0.875	7/8
1.122	28.5	0.891	57/64
1.142	29	0.906	29/32
1.181	30	0.938	15/16
1.220	31	0.969	31/32
1.256	32	1.000	1
1.299	33	1.031	1-1/32
1.319	33.5	1.047	1-3/64
1.339	34	1.063	1-1/16
1.378	35	1.094	1-3/32
1.417	36	1.125	1-1/8
1.496	38	1.188	1-3/16
1.575	40	1.250	1-1/4
1.713	43.5	1.359	1-23/64
1.772	45	1.406	1-13/32
1.831	46.5	1.453	1-29/64
1.890	48	1.500	1-1/2
1.969	50	1.563	1-9/16
2.047	52	1.625	1-5/8
2.244	57	1.781	1-25/32
2.677	68	2.125	2-1/8
2.835	72	2.250	2-1/4
2.913	74	2.313	2-5/16
3.110	79	2.469	2-15/32
3.268	83	2.594	2-19/32
3.425	87	2.719	2-23/32
3.543	90	2.813	2-13/16
4.173	106	3.313	3-5/16
4.882	124	3.875	3-7/8
7.089	180	5.625	5-5/8

n.a = not applicable

BELOW:
General arrangement of the engine, reproduced full size. All constructional drawings in this feature are also to full size for the 'metric version' of the engine.







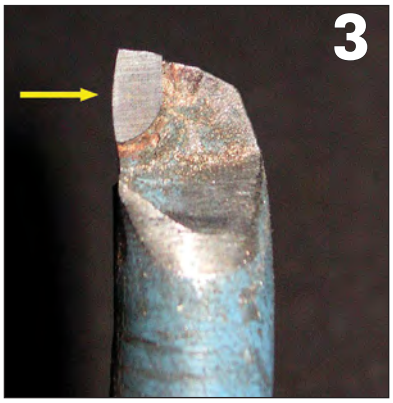


PHOTO 1: Boring tool shaft marked with felt pen...

PHOTO 2: ...to ensure feed stopped at correct point..

PHOTO 3: Slight curve ground on boring tool avoids ridge marks on work.

PHOTO 4: Using live centre in the tailstock as support prevents the parted-off piece flying away.

PHOTO 5: Care taken to ensure port face milling is parallel to cylinder bore.

are modified accordingly. If you do that, make certain that the height of the piston rod from the base, and the distance between piston and valve rods will not change. Taking this into account, you can even use plain round, 1-inch diameter brass stock for the cylinders in the converted version, not even having to machine the outer diameter. More about this later.

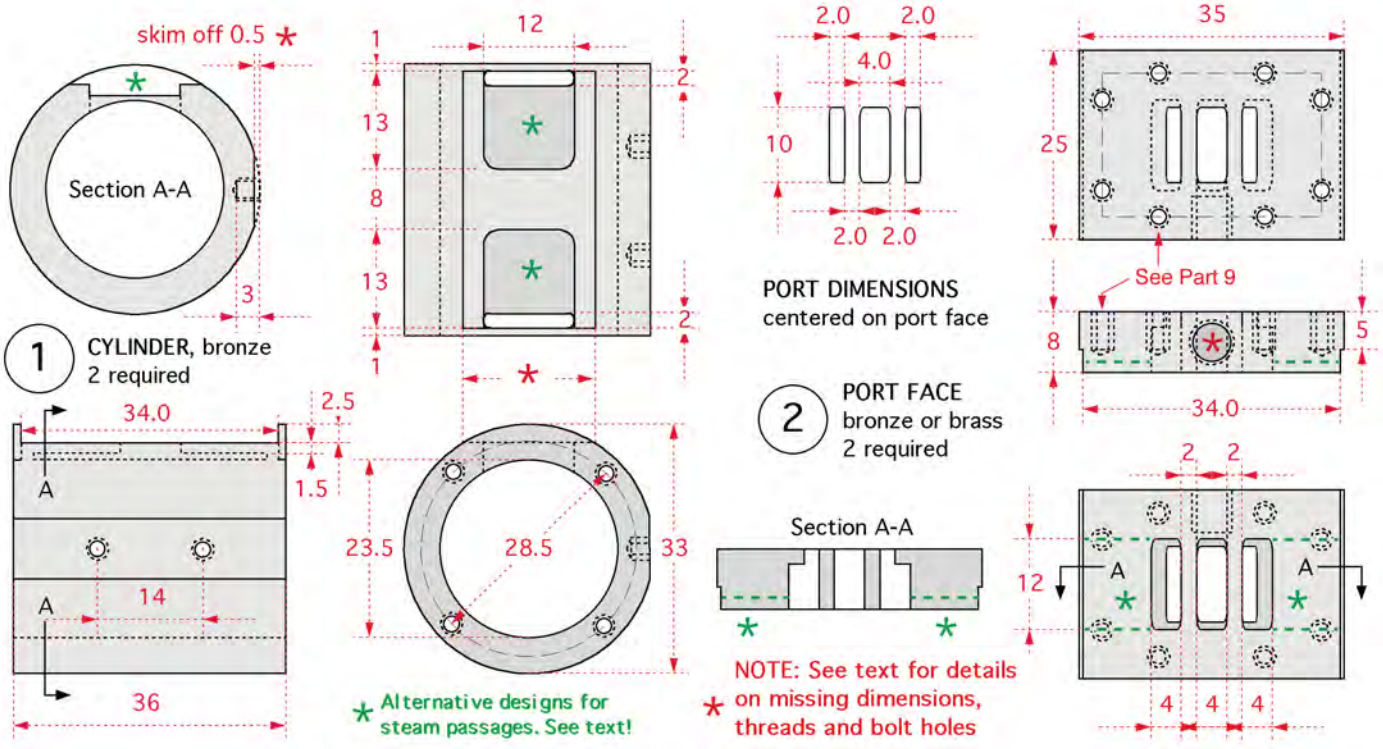
The steam passages, which in full size practice are 'cored' into the cylinder casting, are here constructed in miniature by splitting the assembly into two parts; the cylinder proper, part 1, and the port face, part 2. The latter has the actual port openings milled into the top, while the passages to the cylinder ends are milled into the cylinder itself. This does away with the sometimes awkward angular drilling of steam passages specified for miniature cylinders.

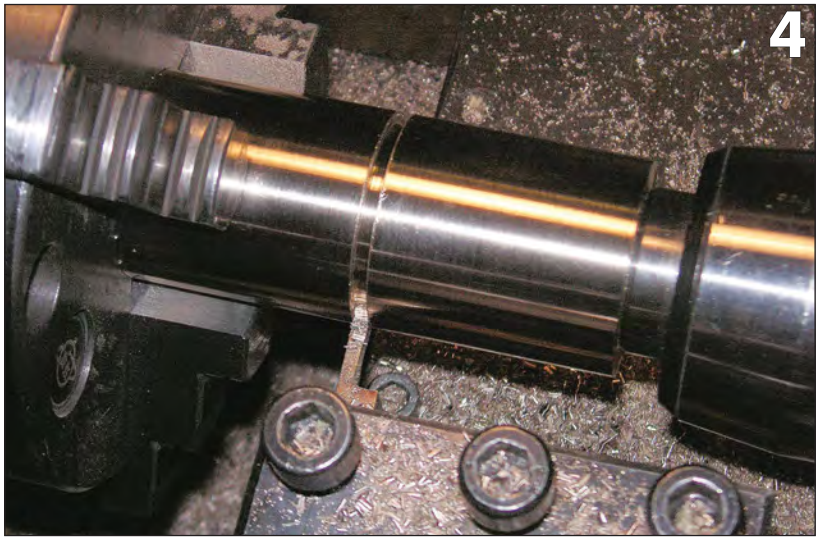
I started by chucking a piece of stock, some 6mm/0.25in longer than the two cylinders together, marking the parting allowance in the centre with a felt-tip pen, then turning the outer, and boring the inner diameter only to half the length of the piece. Marking the shaft of the boring tool, Photo 1, enabled me to stop the feed at the right point, Photo 2, without resorting to counting revolutions on the feed handwheel…

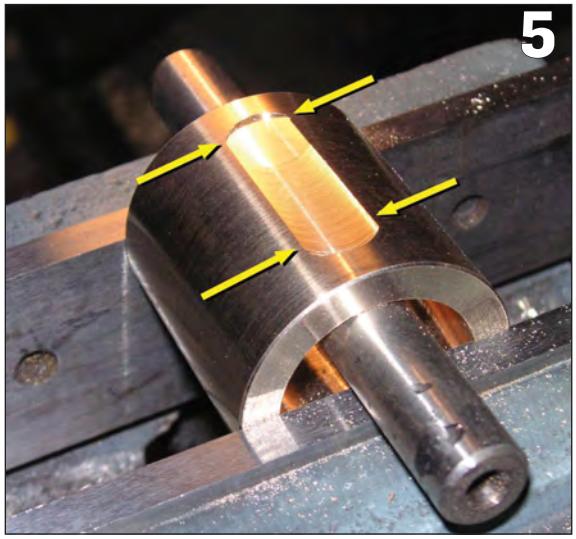
For the very last finishing skim, I ground my boring bit to a slight curve, Photo 3. This avoids the tiny ridges you often get when boring with the tool point. The curved edge of the tool should only be used for skimming cuts, since it may chatter when making a deeper cut. However, you can still use the point of the tool by turning the tool holder slightly counter-clockwise so that the tool's curved side stays clear of the bore.

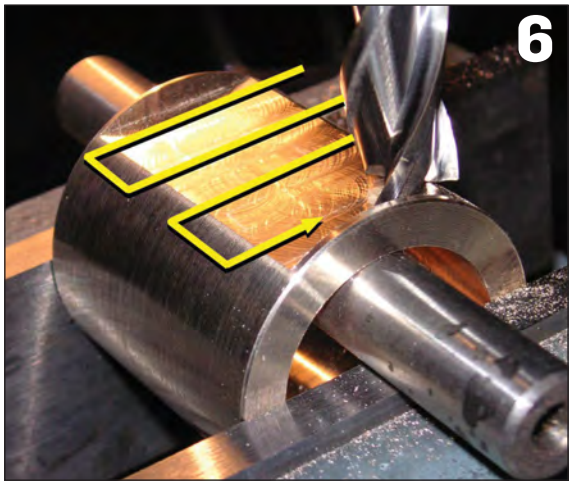
When the first half of the cylinder tube was done, I turned the workpiece over in the three-jaw chuck, and repeated the above for the second half. Leaving a little ridge at the centre mark enabled me to part off at the right place with a narrow parting tool.

Note in Photo 4 how I have supported the workpiece with a live centre in the tailstock – in this way, the parted-off piece won't fly away when it breaks off! The cylinder pieces will still be slightly over-length, so you









can face both ends to a smooth finish, and at the same time get the proper length. I used a honing tool intended for small internal combustion engine cylinders to get the inner surface really smooth.

Of course, both cylinders can also be turned individually; that is a matter of taste. However, the method I used eliminates the risk of running the boring tool into the chuck…

Milling for the port face

Next, a flat on which to seat the port face should be milled into the cylinder. In order to get the cut absolutely parallel to the cylinder bore, I used a dowel to help position the workpiece in the milling vice. Taking a skim cut, noting that the width of the cut was the same at both ends, at arrows in Photo 5, I was satisfied that my tilting vice was set exactly to 0°. (The angle markings on the vice aren't really exact enough to trust here.) Another way of checking that the cylinder is parallel to the mill table is to use an indicator in the spindle, if you happen to have one.

Photo 6 shows how I milled the flat on the cylinder. I took shallow cuts using a zig-zag feed. You can use digital or vernier calipers to check the resulting cut depth (by actually measuring the 'remaining' height of the workpiece, then subtracting this height from the original cylinder diameter). With a final skim cut, I finally got to the exact depth. Another indication is that the flat will have a width of about 17.5mm when the cut is 2.5mm deep.

Note that if you use 1-inch stock, instead of the calculated 1.031in diameter for the cylinders in the 'converted imperial' version, the depth of this cut needs to be shallower. 2.5mm 'converted' as 1/32nds is 0.078in, but you'd have to make the cut only 0.063in deep, in order to keep the steam ports in the right position. The width of the steam channels in the cylinder and the port face should then also be narrowed slightly in order to better fit the smaller cylinder.

At this time, it is a good idea to also mill the other flat, 90 degrees apart from the first. This cut will enable the cylinder base to be accurately attached for silver soldering.

Placing a uniform piece of metal between the previously milled, large flat and the fixed jaw of the vice, I could then clamp the cylinder so the flat was accurately vertical, i.e. exactly parallel to the fixed vice jaw. Then, the top of the cylinder was exactly 90 degrees from the large flat, and could be milled. I skimmed off 0.5mm, which resulted in a cut about 8mm wide. See section A-A in the drawing of part 1.

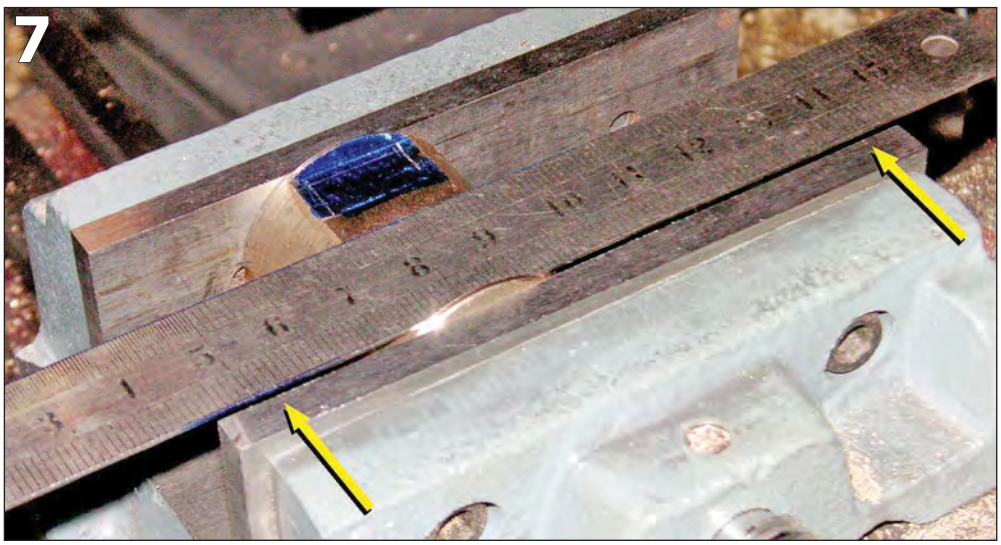
The two threaded holes (I used an M3 tap) must be carefully machined both while drilling and tapping, in order not to run into the bore of the cylinder – this would spoil the workpiece. Use a bottoming tap only (maybe even with its point ground off), since a tapered starting tap wrung too far into the hole may dent the cylinder bore! (Don't ask me how I know – but fortunately, a few minutes work with the honing tool removed those little dents…)

PHOTO 6: Shallow cuts in zig-zag direction to mill the face.

PHOTO 7: Blue permanent marker used to mark out steam passages on port face.

Steam passages

Next, the steam passages need to be marked out. A blue, 'permanent' felt-tip marker gives a nice, deep colour that shows the scribed markings well, and the colour can be wiped off with alcohol or acetone. Having removed the workpiece from the vice for marking, I needed to get it back in a level position. This was easy to accomplish by placing a steel ruler on the piece, and checking that the edge of the ruler was parallel with the vice jaw, Photo 7. ▶



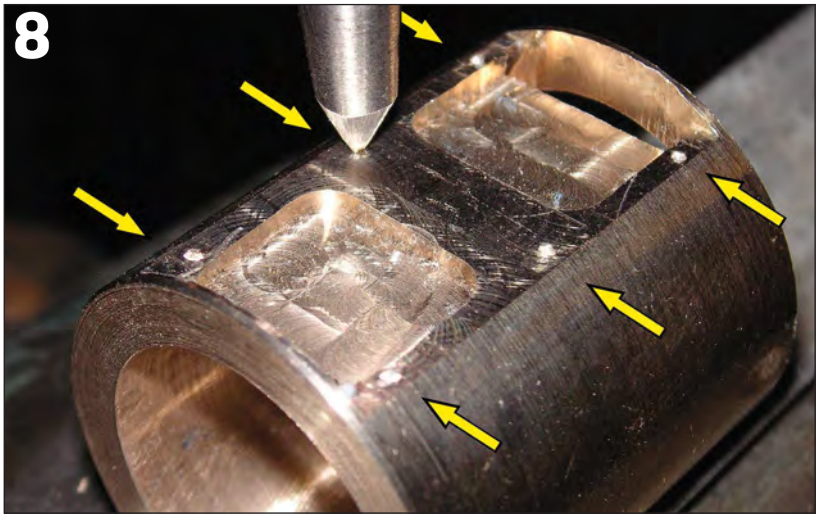


PHOTO 8: Six punch marks made to create clearance needed for silver soldering.

I milled the narrow, 12 mm wide, 'all-the-way-through' part of the passages first, with a 2mm mill bit, then the shallow (1.5mm deep) horizontal part, 12 by 13mm, zig-zagging inside the markings, with a mill bit twice as large. Here, you must be very careful not to take too deep a cut, since there will be very little material thickness left – only 0.75mm! (In hindsight, I realize that I could have milled the horizontal part of the steam passages into the bottom of the more substantial valve seat, instead of in the thin wall of the cylinder. If you wish to do so, you can adjust the design accordingly. The suggested changes are marked in green on the drawings.

Take care not to mill into the narrow, 1mm lips to be left on the edges of the cylinder. These lips will later guide the port face in place for silver soldering.

In order to prepare the slight clearance that is needed for silver soldering, I then made six punch marks as seen in Photo 8. These should be made as uniform as possible, with equally strong hits of the hammer on the punch. The cylinder could be placed 'resting' in a V-block or a partially opened vice jaw while doing this – do not clamp the piece into a vice, since it might then be distorted or scratched.

The port face

Marking out the positions of the ports on a workpiece with its outer dimensions already machined to size, I cross-hatched the areas to be milled, Photo 9, to ensure that I didn't accidentally mill in the wrong place… Taking a shallow cut is necessary, in order not to deflect or break the thin mill bit, which has the dimension of the steam ports, i.e. only 2mm. In the converted, reduced-inch version, this mill needs to be a mere 1/16in! Photo 10 shows this delicate operation.

Since the ports need to be of very exact dimensions, I took out the backlash from the feed table of the mill by first cranking it well outside the milling position, and then turning the X-axis handle in one direction only during the entire operation – very slowly when approaching the desired point in order not to overshoot – and then locking the X-axis firmly at each port hole location when the graduated collar indicated the correct position. The Y-axis handle can be turned in both directions, since the length of the port is not that critical – just don't mill outside the markings! You should not trust your scribed markings in the X-direction – here, only the handwheel's graduated collar enables you to get the precision needed.

At first, I milled the ports no

"A tapered starting tap wrung too far into the hole may dent the cylinder bore – don't ask me how I know..."

Accurate hole placement

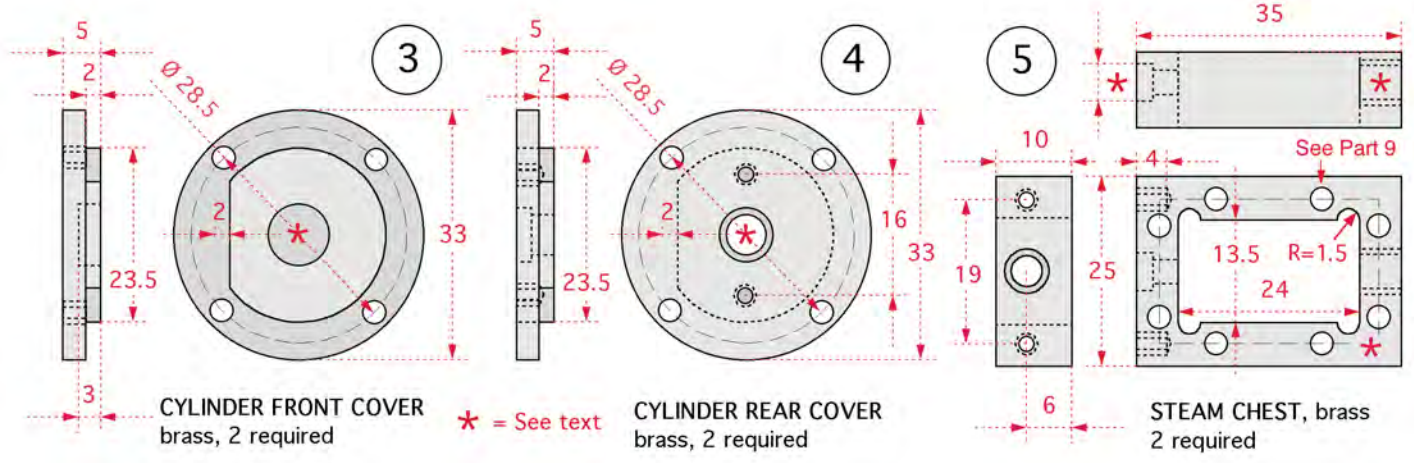
Some parts that are to be bolted together, such as the steam chest, its cover and the port face, need to have their bolt holes accurately spaced in order to align well. Here are a couple of methods that I've used successfully.

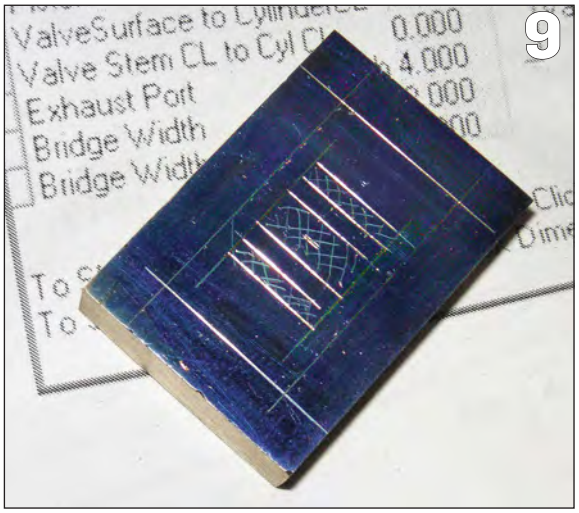
The first is to machine each part separately, using the X-Y feed on the mill, reading the graduated collars on the handwheels for spacing the holes. Here, any leadscrew backlash must of course be eliminated by always approaching from one direction only!

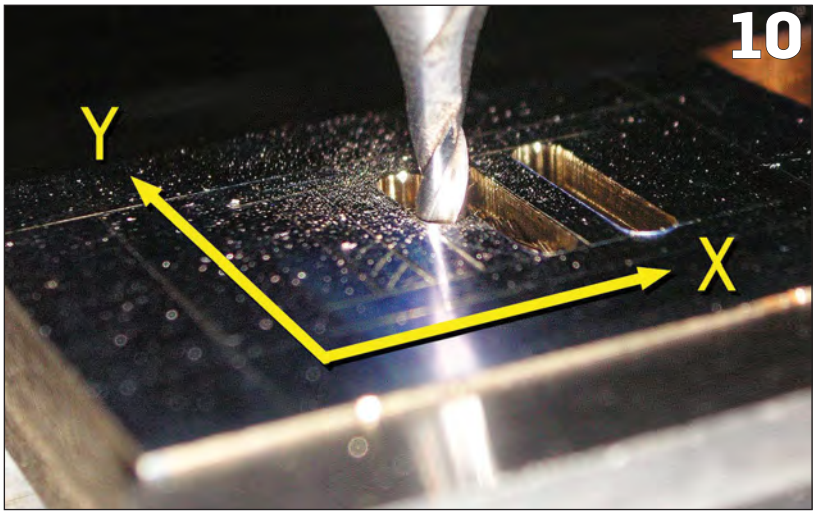
Another method only requires reasonably accurate marking-out and centre punching: The relevant parts are soft soldered ('sweated') together before drilling, in their final assembled position – note especially the placement of any asymmetrical parts.

The first drilling is made with a drill bit sized for the thread core (such as a 2.5mm drill for a M3 tap), after which the 'pack' of parts is re-heated and separated. The soft solder is scraped away while the parts are hot, and the slight residual solder vanishes by rubbing on emery paper. Then, tapping can be performed where needed, and clearance holes drilled with a larger size drill bit. In most cases, this method is exact enough. All parts should of course be marked so that they can be re-assembled as they were during drilling.

For the bolts securing the cylinder covers, it is best first to drill the holes in the covers using the tapping-size drill, then clamp the covers in the correct position on the cylinder, and drill the holes to be tapped into the cylinder using the cover as a jig. I've even used a few drops of quick-setting Super-Glue instead of clamping – this works well also, and the parts are easy to break apart. Glue residue dissolves in acetone. Finally, the holes in the covers are drilled to clearance size.







deeper than one third of the thickness of the workpiece, in three back-and-forth passes in the Y-direction, taking less than 1mm of depth on each pass. Very thin mill bits are often not long enough to cut the entire depth, and they will easily break if even slightly abused. So, turning the workpiece over, I took deeper cuts with a larger mill of 4mm, resulting in a cut profile as shown in the section drawing A-A of part 2. On the bottom of the port face, the tolerances need not be as tight, so milling inside the marked lines is good enough.

After drilling and tapping the holes for the cover bolts (M3, refer to the 'Accurate hole placement' box) and the exhaust tube (M6), I used emery paper (first no. 240 and finally no. 600), placed on a flat steel plate to sand the port faces smooth. One completed port face is shown in Photo 11. Note that my prototype differs somewhat from the drawings - in order to leave more metal around the bolts, I have enlarged the port face slightly in the drawing. As you can see, this necessitates milling a step into the bottom edges of the port face piece in order to seat it between the lips of the cylinder.

Cylinder covers

Making the cylinder end covers (parts 3 and 4) is rather straightforward. I took a piece of round brass, marked it, and roughly cut all four covers to size with a parting tool, Photo 12. Since it is a bit awkward to part off very deeply without using special tools (which I've not yet made or acquired, I must shamefully admit), I had to do the final parting with a hacksaw. Then I could finish the covers individually.

The cylinder covers have projections which fit accurately into the cylinder bore. Note that there is a cut-out to align with the steam passage in the cylinder. My prototype has six cover bolts, but four, as in the drawing, will be enough. In this way, you do not have to make one of the bolts a dummy – which I had to do in order to avoid threading into emptiness, i.e. into the steam passage… On the other hand, six bolts look more prototypical, so the choice is yours.

Note that there are no dimensions on the drawing for the hole in the rear cover – these dimensions depend on the size of the piston rod and the O-ring used to seal it. I used 5mm stainless rod, and a 2mm thick O-ring, i.e. having an outer diameter of 9mm. The through hole on my cylinder rear cover is 5.2mm in order to clear the rod, and the recess for the O-ring is 8.8mm in diameter and 2.5mm deep.

In order to achieve these dimensions with tight tolerances, and also keep the bottom of the recess flat, I used a boring tool. There should be enough compression of the O-ring so that it will seal well - about five per cent of the ring thickness, not the diameter. The depth of the recess must allow the ring to 'roll' a bit, as it should. Follow the manufacturer's recommendations for the O-rings used – also note that Viton rings will last much longer than ordinary nitrile rubber rings, which will deteriorate in heat. If you intend to run the engine on compressed air only, nitrile rings are okay.

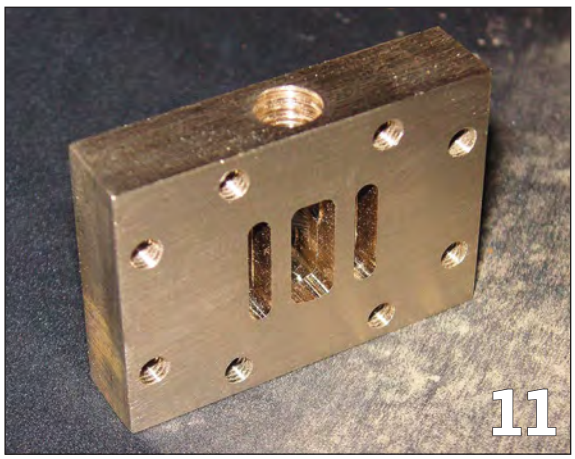
The front cover, part 3, has a central depression on the inside. This is sized to accept the locknut of the piston, so dimension it accordingly. I used an M4 nut, so in my prototype, the diameter of the depression is 8mm, the depth 2.5mm. EIM

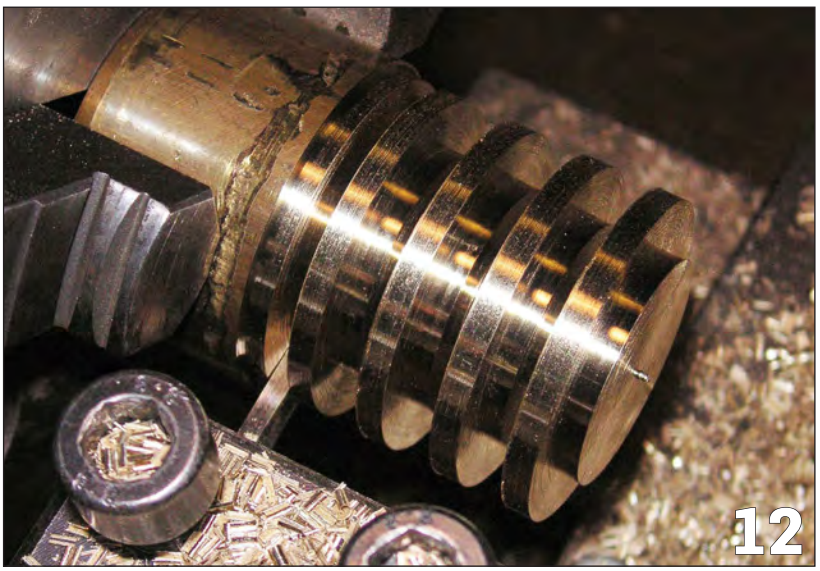
PHOTO 9: Cross hatching helps to clearly identify areas to be milled.

PHOTO 10: Milling the ports is a delicate operation!

PHOTO 11: Completed port face – now to make the one for the other cylinder...

PHOTO 12: First rough cut in creating the four cylinder end covers.





Coming next month – finishing cylinders and starting on the motion

Steam car to Sentinel

Our technical editor proposes boiler controls for his project to use a steam car engine to create a 7¼-inch gauge version of the geared Sentinel locomotive 'Nutty'.

BY **HARRY BILLMORE** Part Two of a series

The prototype 'Nutty' was a vertical-boilered geared loco built by Sentinel in 1929 for the London Brick Co. It is today at the Leighton Buzzard Railway.

I am prototyping a set of controls on this model that will hopefully form the basis of a monotube boiler control to prevent the biggest problem for this type of boiler, that of water carry-over – the water supplied to the tube partially flash boils then shoots a slug of liquid through the coils and then to the engine.

I am designing the control system to control both the pressure in the boiler and the water level, and to do this in a reasonably effective manner I will be using gas firing. The vertical fire-tube boiler for this project is from a late 1800s steam car, originally fired by petrol vapour through a special burner, the petrol supplied from a tank pressurised to around 30psi using air, then through a vaporizing coil and on through a jet to the burner plate.

I have decided not to replicate the original burner design as I don't fancy sitting just behind a pressurised tank of petrol near something that can create an explosive mixture very easily and is relatively difficult to control. I am however going to use propane running through a ribbon burner with a pilot light in the firebox and auto cut-offs using solenoid valves as well as a manual cut-off.

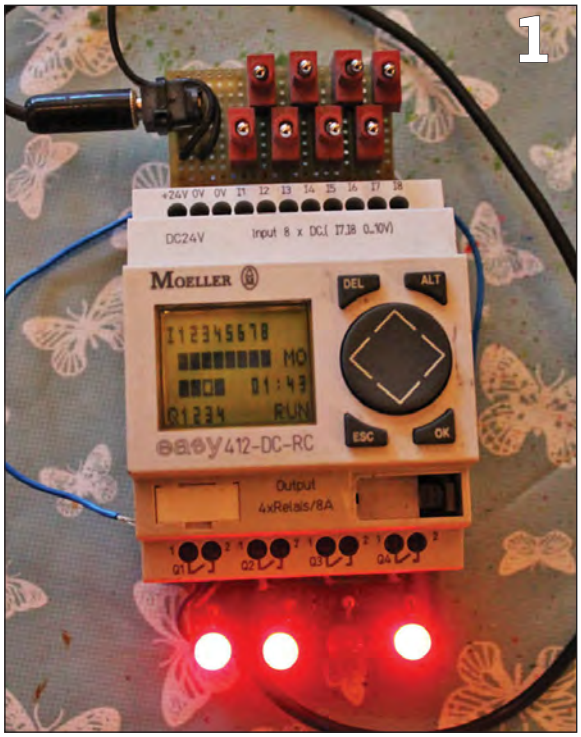
The water supply to the boiler will be from two high pressure 12-volt electric pumps, these will either be sourced from salvaged pressure washer parts or home made if the pressure washer bits cannot be persuaded to work. The level sensing will be of the resistive type with four sensors – I have developed the use of miniature internal combustion engine spark plugs slightly modified by removing the gap arm to increase the reliable resistance of the water. There will also be a pressure sensor on the pressure gauge take-off to control the boiler pressure, as well as a temperature switch as an automatic cut-off for the gas if the burners do not ignite from the pilot flame.

Operation cycle

The system will work by the pressure switch remaining at low voltage due to the pressure in the boiler not being high enough while the bottom water level sensor will be at high voltage – this will cause the gas valve to open, allowing the gas to the ribbon burners where it will ignite. This will cause the pressure to raise until the pressure switch moves to high voltage as the correct pressure is reached. This will then close the gas valve turning off the burners until the pressure drops below the threshold where the pressure switch goes to low voltage again, which will then open the gas valve again and so on.

The water level will be controlled by the four resistive sensors. The significant difference between the resistance of steam and water allows a voltage divider to be used, producing a high voltage or a low voltage signal. The resistance across the terminals in water is 11.5M Ohms – the high voltage signal occurs when there is water across the terminals of the sensor and low voltage when there is steam or air.

The reason for using four sensors



is so that there is a low-water shut off for the gas at the bottom of the column, a sensor for one of the pumps, then a sensor for both of the pumps to come on and a final pump shut-off sensor at the top of the column. I will also be using a manual sight glass as well as manual switches for the pumps as back ups in case the computer system fails.

Adding the brains

For the brains of the control system I am using a Moeller 412-DC-RC control relay which is programmed using ladder logic on the screen with the buttons on the front. I have made up a simple test rig for the inputs and outputs, this unit allows for up to eight inputs and four outputs. This equates to four water sensors, one pressure sensor and one temperature sensor with the outputs consisting of two pumps and one gas relay valve.

The control relay is very well supported online, with ladder logic being a reasonably sensible programming language for performing basic control functions such as this. The program that I wrote for this application is shown below however it does not yet include the time-sensitive gas cut-off as I am still working that one out, so there is every chance that it will be modified as I test it further and discover it doesn't work quite as planned!

I1 = Low water
I2 = pump number 2 on
I3 = Pump number 1 on
I4 = Pumps off
I5 = Pressure Switch
I6 = Temperature Switch

Q1 = Pump number 1
Q2 = Pump number 2
Q3 = Gas valve

Program:
+I1 - -I5 ----{Q3
+I3 - -I4 ----{Q2
+I2 - -I4 ----{Q1

What this means is that I1 has to be at high voltage (+I1 as opposed to -I1) and I5 at low voltage (-I5 as opposed to +I5) for Q3 to be at high voltage and the gas valve to be open, if either of the inputs are at the other state than as above then the gas valve will be shut.

The same is true for the two water pump controls, if I3 is low or I4 high, then Q2 will be low and therefore pump number 2 will not be running.

Thanks to Robert Wilhelm of www.stanleymotorcarriage.com for the pictures of Stanley boilers. EIM

■ Part one of this series appeared in the April 2018 issue of **EIM**. A digital copy can be downloaded or a printed version ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by phone, 01778 392484. The build series will continue in future issues of the magazine.

PHOTO 1: Moeller easy 412-DC-RC control relay with test inputs and outputs.

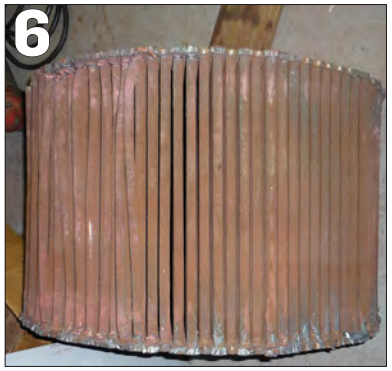
PHOTOS 2-3: This miniature spark plug had its contacts modified.

PHOTO 4: Original burner for Harry's boiler – the large air holes run all the way through the burner with the petrol vapour blown through a jet into the tube at top left before emerging from tiny holes around the larger air holes.

PHOTOS 5-8: Typical Stanley boilers – the cross section shows the large number of small vertical tubes and short height of the barrel.

These boilers were originally wire-wound to increase strength while reducing weight, but this led to a few explosions as the wire corroded removing the added strength from the barrel. Harry's boiler is a modern replacement with a thicker barrel and is therefore heavier but without the side effects of the boiler going pop when the wire corrodes through...

Photos courtesy Robert Wilhelm



A two-hole filing rest

Robert makes up a useful and quickly constructed workshop aid.

BY **ROBERT BAILEY**

This is a two-hole filing rest that was quickly made to satisfy the need to file the eight flats on a cylinder gland nut for a Stothart and Pitt engine that I was constructing at the time. I looked at the various filing rest devices and kits available on the market but they all appeared quite complicated and time-consuming items to manufacture.

Most of these rests require an angled slot to raise and lower the filing platform, which has its own leadscrew and graduated wheel for adjusting the cuts accurately. My device uses the existing vertical slide, which already has its own graduated dial – except that the one in the photograph does not.

The design uses ready-to-hand bar stock that is available in most workshops; I used 30mm square bright mild steel and 16mm silver steel. The needle roller bearings employed were also to hand.

Two holes were drilled and reamed, the silver steel Loctited in place and the bearings slid on. The device was then put in the vice and the nut filed to shape.

Ripe for modification

The device can be modified with two more holes drilled and tapped to keep the bearings from sliding about too much but I found it worked alright without. In use I found the rather bulky vertical slide did not get in the way of my hand as I am right-handed. One can also put different sleeves on the bearings, with a shoulder for instance, or other shapes as required.

The drawing and photographs should be self explanatory in making this a quick and easy permanent addition to the workshop inventory. The indexing for the eight sides was achieved using the 60-tooth bull wheel mounted in the Myford lathe headstock, in conjunction with a reversible detent, allowing half-tooth resolution on indexing. EIM

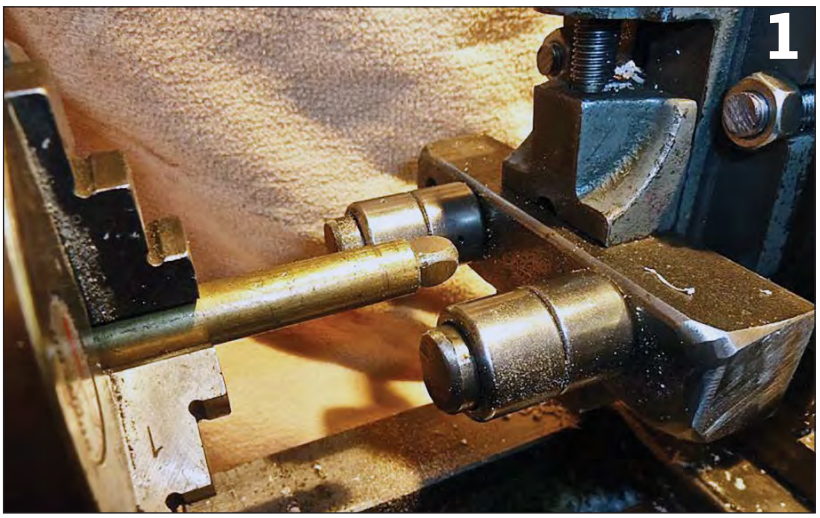
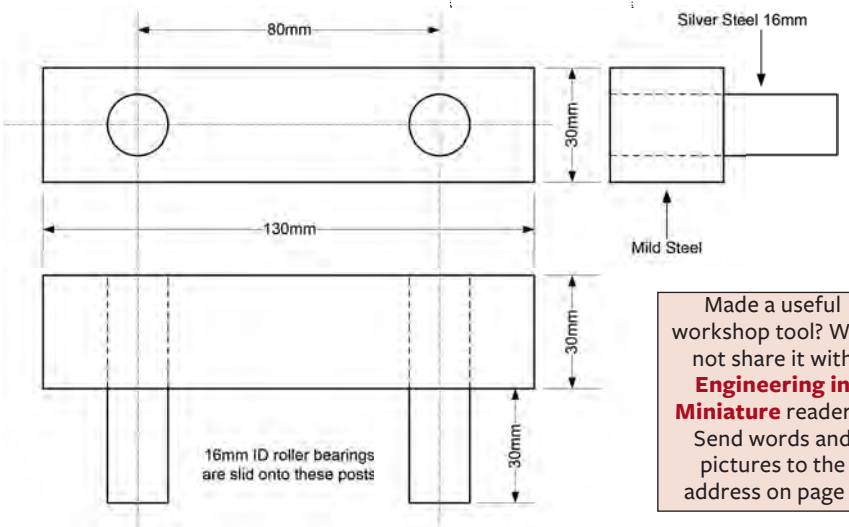


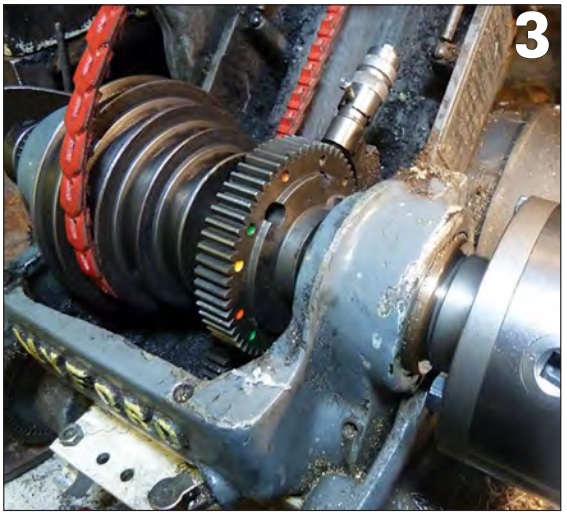
PHOTO 1: The filing rest fitted to the vertical slide.

PHOTO 2: The rest in use – the progress of the work may be controlled by adjusting the vertical slide.

PHOTO 3: A detent fitted to the crown wheel of the author's Myford lathe allowed the work to be indexed .

BELOW: Sketch of the filing rest – it can of course be modified to suit individual requirements.





Made a useful workshop tool? Why not share it with **Engineering in Miniature** readers? Send words and pictures to the address on page 3.

Dougal - a 5-inch Barclay

Young Sussex engineer Andrew makes an unorthodox start to construction of his entry-level locomotive project by tackling the boiler – and for a good reason...

BY **ANDREW STRONGITHARM –** Part Two of a series

Due to the enormous nature of the project that I was about to begin, it was suggested that I should start by building the boiler, which would have a saleable value in case I didn't complete any other part of the locomotive. This is exactly what I did and so after a few weeks of studying the drawings, which in those days didn't mean much to me, I cut the first sheet of 10 gauge (⅛in thick) copper plate on 22nd November 2009 to the correct size to form the inner firebox.

Within the club workshop, I found a piece of round steel of the correct diameter for the inner firebox, which I used to form the copper sheet around. This was the first of many individual pieces to be made and I remember proudly taking it home to show my parents that evening.

Following on from the inner firebox, the remaining boiler plates required three steel formers to be made before continuing. All three formers were produced out of ½in steel plate, which was filed or turned to shape while ensuring that allowance had been made for the thickness of the copper plate that would wrap around the edge. The former for the backhead was also used for the throatplate, by shaping the opposite end, thus saving me the time of making a new former from scratch. I rounded off one edge of every former so that when I came to form each plate, it didn't dent the soft copper. (Photo 1)

Fun with a mallet

With all the formers made and the copper sheet cut into roughly the right size for each boiler plate, the next job was one of the most fun involved with building the locomotive. This basically involved annealing every copper plate in turn and clamping them in a vice one at a time with their respective former, before hitting the plate with a hide-ended mallet to produce the desired flanged boiler plates. I had to repeat this process two or three times, as the copper work-hardened, before I was happy with the shape of each plate.

The annealing process required each copper plate to be heated to a bright red before being quenched in water to soften it. As I found out, when you strike the softened copper it gradually hardens so it will not form properly – further annealing is then required to keep it soft and malleable. I then cut off any excess material and cleaned up the edges of the flanged plates with a file so they were in line with the former plate and therefore a uniform ½in thickness. (Photo 2)

The holes for all the boiler tubes were then drilled into the relevant formers deliberately undersize to use as a guide, as well as any other holes for fittings that would need to be drilled into the boiler plates. I added an extra hole for a blowdown valve, located at the bottom of the backhead, ▶

The prototype 'Dougal' loco is a 2ft 6in gauge Barclay 0-4-0 built in 1946 for the Provan Gasworks in Glasgow and today resident on the Welshpool & Llanfair Light Railway in mid Wales.

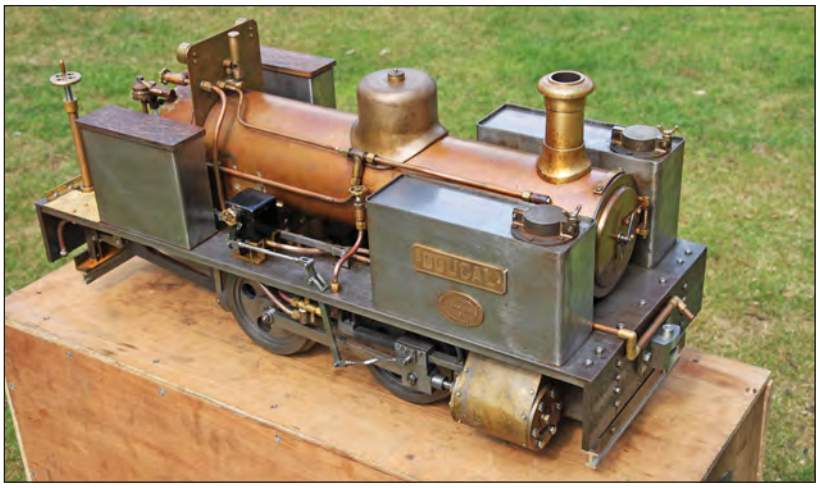
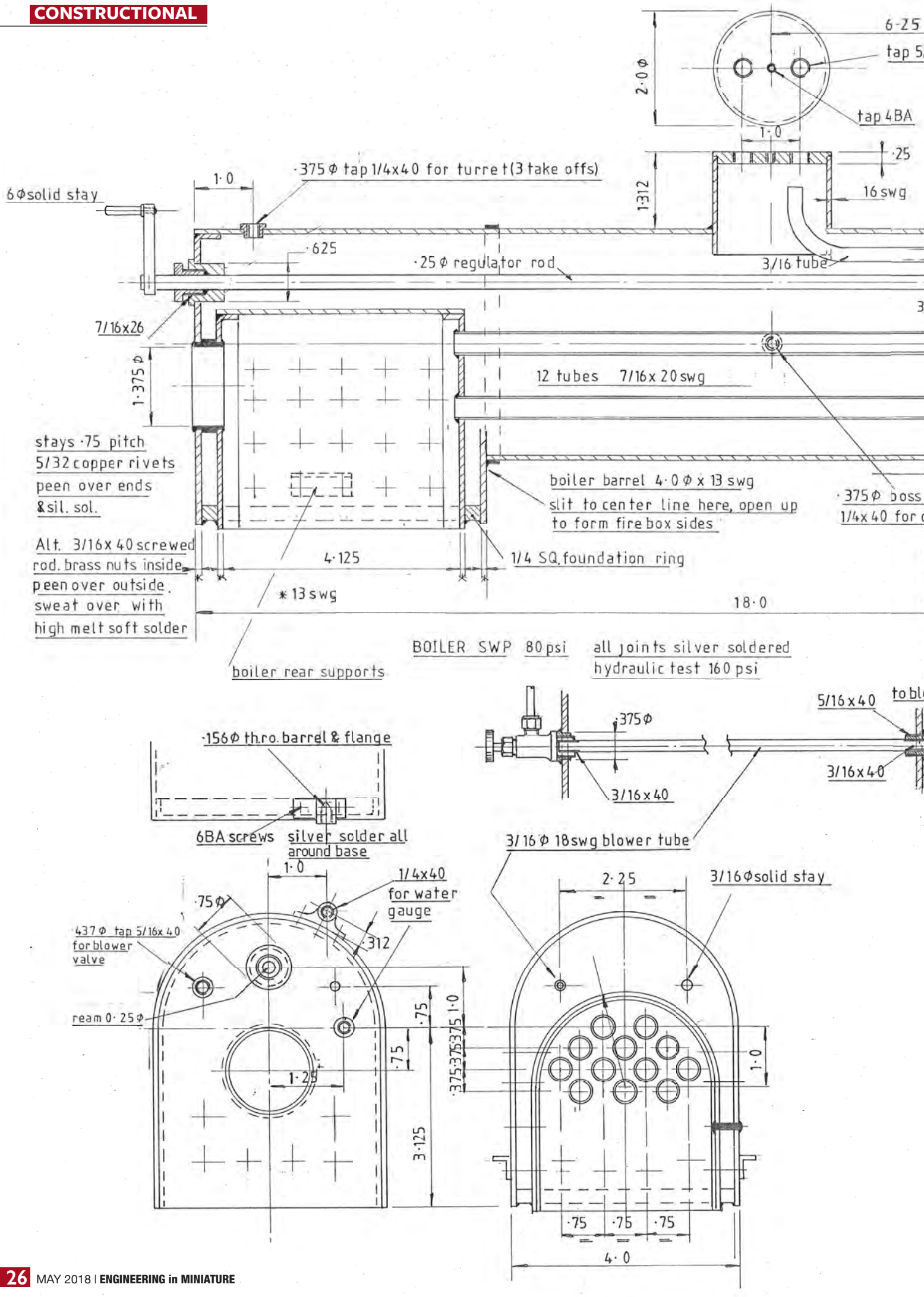


PHOTO 1: Steel formers for firebox, front tubeplate and backhead, edges rounded to avoid denting soft copper.

PHOTO 2: Annealed copper plate beaten into shape around formers to produce completed boiler plates.

All photos in this feature by Andrew Strongitharm


6 Φ solid stay
1·0
·375 Φ tap 1/4x40 for turret (3 take offs)
·625
·25 Φ regulator rod
7/16x26
1·375 Φ
stays ·75 pitch
5/32 copper rivets
peen over ends
& sil. sol.
Alt. 3/16x40 screwed rod. brass nuts inside peen over outside. sweat over with high melt soft solder
4·125
* 13 swg
boiler rear supports
12 tubes 7/16x20 swg
boiler barrel 4·0 Φ x 13 swg
slit to centre line here, open up to form fire box sides
1/4 SQ. foundation ring
18·0
BOILER SWP 80 psi
all joints silver soldered
hydraulic test 160 psi
2·0 Φ
1·0
tap 4BA
·25
16 swg
1·312
3/16 tube
6·25
tap 5
·375 Φ boss
1/4x40 for
·156 Φ th.ro. barrel & flange
6BA screws
silver solder all around base
·375 Φ
3/16x40
5/16x40
3/16x40
3/16 Φ 18swg blower tube
1·0
·75 Φ
1/4x40 for water gauge
·437 Φ tap 5/16x40 for blower valve
·312
ream 0·25 Φ
·75
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3·125
·375 ·375 ·375 1·0
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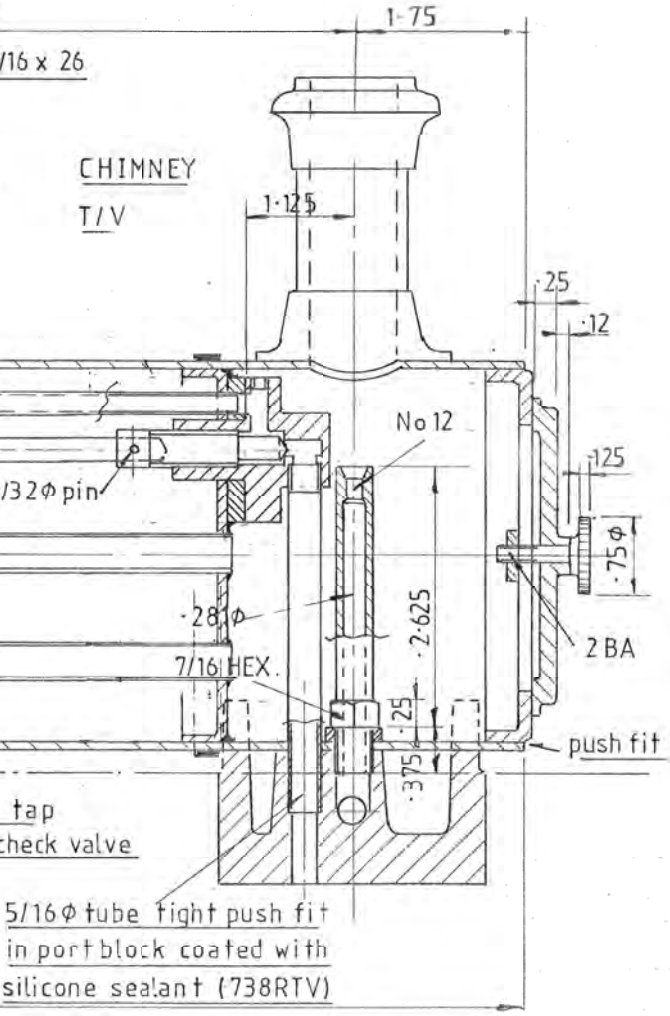


as one was not shown on the drawings. As 'Dougal' is not superheated, there are only 12 small boiler tubes to fit and these had 10 thou steps, about ¼in long, turned into each end to stop them falling out of the tube plates whilst they were being soldered together.

Having spotted the location of each tube, from the former plate, the holes for the tubes were then opened out using a hand-held battery drill in 0.1mm increments until the tubes were a push fit into each tubeplate.

PHOTO 3: Various small bushes on backhead and front tubeplate machined from phosphor bronze bar.

PHOTO 4: Thick-wall tube formed the basis for the inner dome.

The final job was to file three notches at approximately 120 degrees to each other around the circumference of each tube hole, using a three-cornered file to aid the flow of solder through the joint.

I used two different types of solder for the construction of the boiler, C4 and Easy-flo 2, both manufactured by Johnson Matthey. The C4 has a higher melting temperature than the Easy-flo 2 so was used in soldering bushes to the tubeplate and backhead plate. These would be exposed to further heating in construction, potentially melting items previously soldered with the Easy-flo 2, which was employed on the rest of the boiler. Throughout the soldering process, I used Thessco Y Flux.

Before each soldering session took place, I submerged the pieces to be soldered in dilute sulphuric acid to ensure they were as clean and as free from contaminates as possible. Any dirt or oil on the copper could prevent the solder from flowing round the joint properly and could lead to a weak and porous joint.

A bevy of bushes

Small bushes for the various boiler fittings were made for the backhead and front tubeplate out of PB102 phosphor bronze. To aid the soldering process, each bush was threaded externally with a 40tpi thread and the relevant boiler plate threaded internally to suit. These threads can be quite loose to help the solder flow but provide sufficient strength to hold the bush straight and square during soldering. These were soldered into the individual plates prior to each plate being soldered into the main boiler assembly (Photo 3).

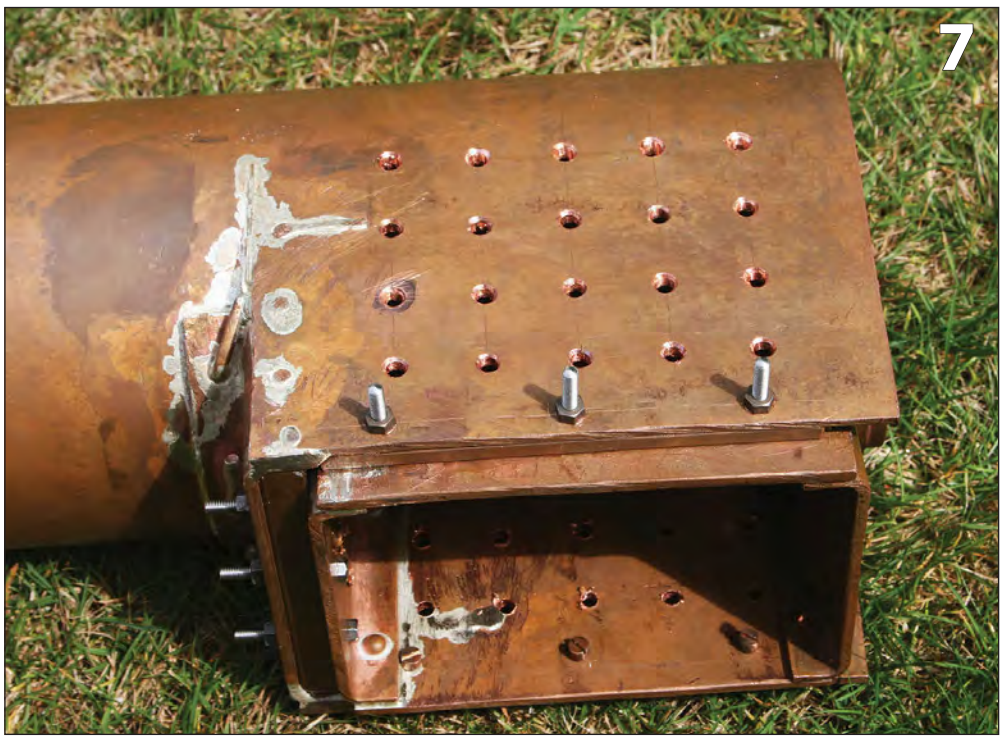
I then focused my attention on making the bushes that would accept the regulator tube fittings, which I turned and bored on a Myford ML7 lathe, as well as making a larger bush for the dome. While turning them, I added a groove to accept a silicone O-ring which I used to seal the fittings to the bushes soldered in the boiler. These fittings would need to be taken on and off many times while setting the loco up and the use of an O-ring avoided the need to keep re-sealing them with traditional flange sealant.

I set up a dividing attachment on the lathe to drill and tap the 10 5BA holes around a Pitch Circle Diameter (PCD), which would be used to attach the regulator fittings to the boiler. At the same time, I also drilled and tapped the bush for the dome, which is much larger in diameter, these were 4mm. The two regulator bushes were soldered into the relevant boiler plates straight away, while the dome bush was put to one side until the outer wrapper and barrel were ready.

While the dividing attachment was set up, I took the opportunity to make the flanged fittings that would be held by these bushes, although these were drilled clearance size on the same PCD. The two regulator flanges were only ⅛in thick and I have subsequently had problems with the strength of these threads. If I was to produce this again, I would make the flange slightly thicker and possibly use larger diameter threads.

The inner dome was constructed out of thick-wall 1¼in copper tube with a cap turned and soldered into one end. An identical flange with clearance holes on the same PCD as those in the dome bush was then soldered halfway up the copper tube, thus creating the face which would later be bolted down to the boiler bush (Photo 4).

The firehole ring was turned out of thick wall 1½in outside diameter copper tube with steps turned onto



each end to help locate it and to keep the right gap between the firebox door plate and backhead whilst soldering. This was also soldered into the firebox door plate with C4 solder.

As all the individual boiler plates and inner firebox were now formed, it was time to start assembling everything. Using engineer's clamps to hold it all in place, I drilled through and physically bolted the inner firebox wrapper to both firebox plates using fabricated 4BA PB102 bolts. I also fitted the tubes into both tubeplates (Photo 5). This formed the first major soldering job to be tackled, which involved soldering the firebox tube plate into the inner firebox wrapper and one end of the tubes into the firebox tubeplate. I deliberately left the firebox door plate off as I would need access into the firebox for fitting the stays at a later date.

Next I turned my attention to the outer firebox wrapper and barrel. To simplify the boiler manufacture I bought an 18in length of 4in outside diameter seamless 10 gauge copper tube. This was used to form the outer firebox sides, boiler barrel and smokebox all in one go. Making the boiler out of one long tube saved the need for a separate barrel and firebox and therefore avoided the need for the complex soldered joint between them. By cutting along the tube by the length of the firebox I was able to open it out and straighten the sides to form the outer wrapper.

Dead centre

The dome hole was then marked centrally in the top of the barrel using a surface plate and cut and filed to shape. This had to be pretty much perfect as the alignment of the dome would be very noticeable once the loco was finished (Photo 6).

I then marked and drilled out the holes for the side clacks, which likewise had to be on the centre line of the barrel. Next, I fitted the throatplate to the outer wrapper and again drilled and fitted bolts between the throatplate flange and the outer wrapper sides. This was then soldered in together with the clack bushes.

Now that I had parts of the inner firebox and the outer shell soldered, it was time to marry them together. By placing the inner firebox and tubes inside the outer wrapper and barrel I was able to align the inner and outer fireboxes to the correct height.

With most of the boiler structure now up together, it was time to start fitting all 49 stays! The firebox contains 20 each side together with three on the throatplate and six on the backhead. I manually marked the location of every stay with a pair of digital calipers and a scriber before

centre punching each one. I then used a battery drill to drill through both firebox wrappers, whilst everything was held together with engineer's clamps (Photo 7).

I used 5/32in copper rivets for the stays and these worked very well, although holding them in place prior to soldering proved tricky as they kept falling out. To overcome this, once each rivet had been pushed through its hole, I bent each one over using a pair of pliers. Before soldering the stays, I fitted the two sides and front piece of the foundation ring, as these would be soldered in place at the same time. A piece of 3/8in square copper bar was used for the foundation ring and this was milled to size as required. Because of the awkward nature of the foundation ring I had to be careful to ensure that plenty of solder flowed around it (Photo 8 and 9).

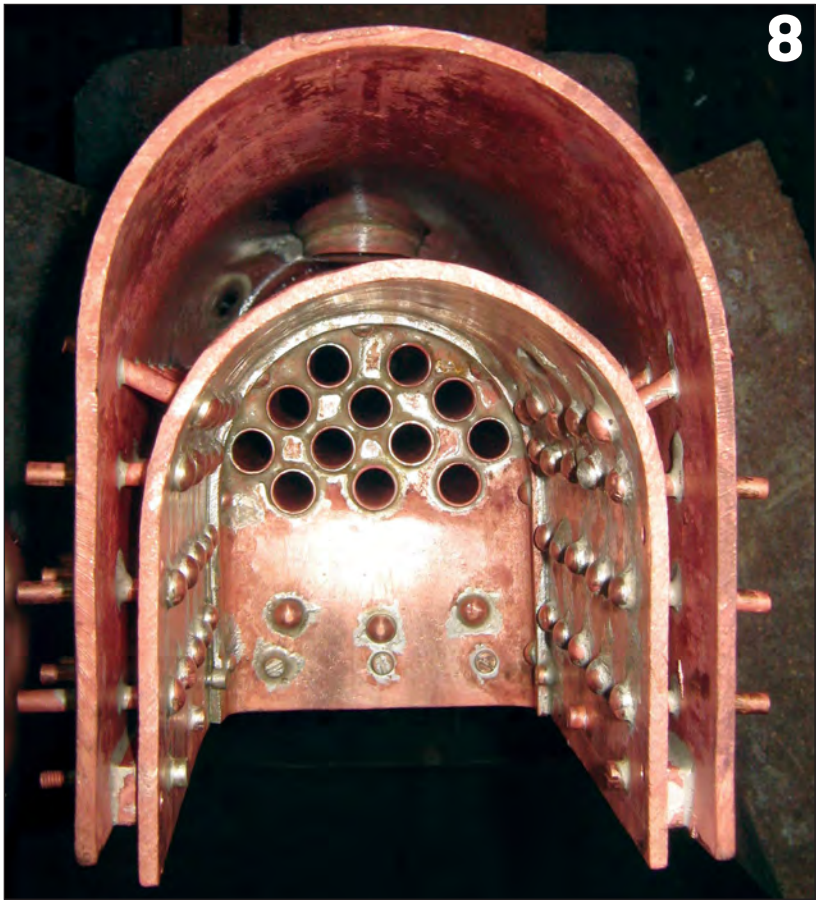
Once all the stays had been soldered, the next soldering job was fitting the firebox door plate to the inner firebox and since I had already drilled and bolted this in position when assembling the inner firebox components, it was simply a question of placing it in situ and bolting them together. Then I had to fit the backhead to the outer wrapper, cutting out the space for the firehole ring and fitting the backhead stays. Filing out the firehole ring was a tricky operation as the height was predetermined since the firebox doorplate was now fixed in. Once the hole was almost out to size, I had to keep offering up the backhead to the ring and gradually filing out any material stopping it from fitting.

Tricky operations

The final two soldering tasks left to complete were the backhead and front tubeplate. The latter also had the added complexity of being located 3in down inside the barrel as the very front of this would later become the smokebox (Photo 10). Initially it was too tight and I had to very carefully hold it in the lathe, with the former inside to help keep its shape and turn the outside down. When soldering the backhead, I had to be extremely careful not to melt anything which had been previously soldered around it (Photo 11).

One idea that I won't be using again is to employ foil solder around the stays. This was suggested to me by a fellow club member and in theory meant that I wouldn't have to add any additional solder once everything was hot. I meticulously punched out squares of the foil solder and placed two pieces under the head of each stay. When I came to heat the boiler to solder the stays, the amount of solder from the foil was inadequate and every stay had to be 'touched in' by hand with more solder.

"One idea that I won't be using again is to employ foil solder around the stays..."



Now that the boiler was all soldered together, the next task was to fit the two longitudinal stays which run the length of the boiler from the backhead to the front tubeplate. The left-hand stay, as you look at the backhead, is 3/16in x 1/16in gauge copper pipe to take the steam supply for the blower, while the right-hand one is solid.

I made the fittings out of PB102 phosphor bronze threaded internally to accept the longitudinal stays and ▶

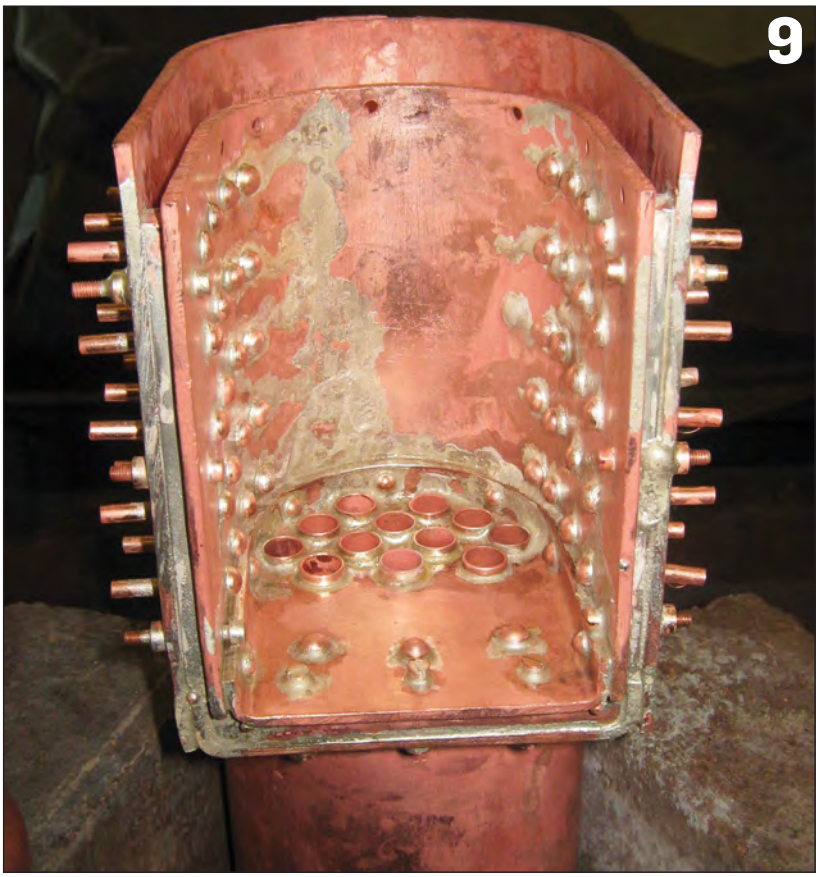


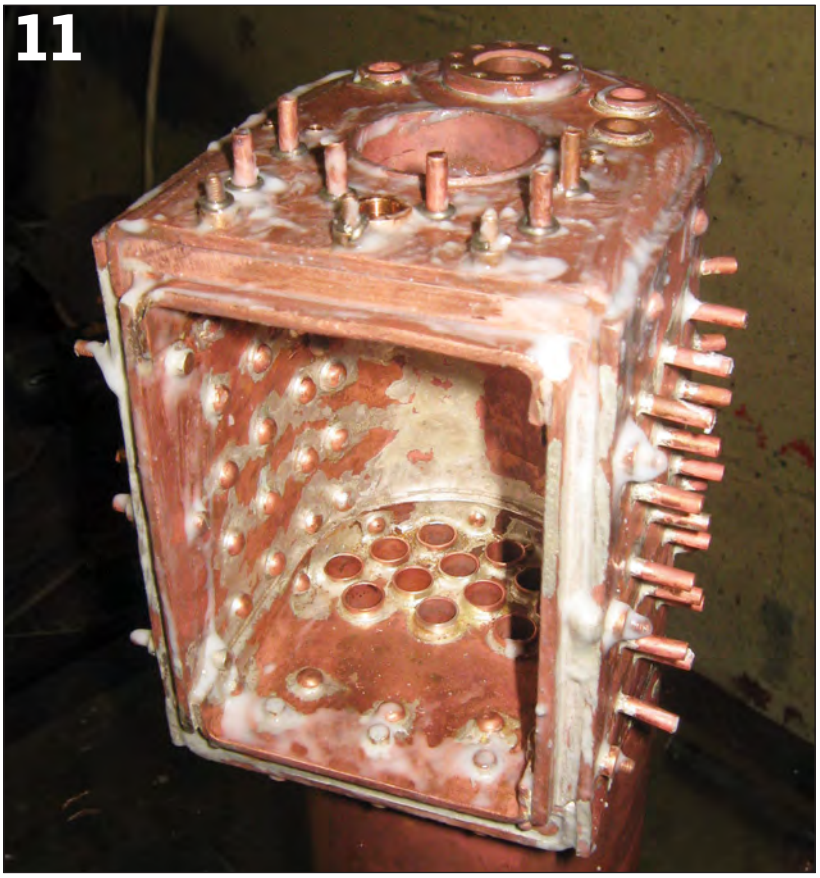
PHOTO 5: Firebox bolted to wrapper and tubes fitted into their plates.

PHOTO 6: Outer firebox sides, boiler and smokebox all formed from one piece of copper tube – essential to get dome bush precisely on centre line.

PHOTO 7: Drilling for the stays is a job where accurate marking pays great dividends.

PHOTO 8: Copper rivets proved highly suitable for stays but were tricky to hold while soldering.

PHOTO 9: Square bar milled to size forms the foundation ring.



externally to screw into the bushes soldered into either end of the boiler. With these stays fitted and sealed up with PTFE tape, I made a number of threaded bungs to seal the remaining empty bushes as well as a pair of blanking plates to cover up the regulator bushes. These blanking plates would be bored out later and form part of the regulator assembly.

I was now able to fill the boiler with water for the first time, attach a hydraulic test pump and see what happened! With no water coming out of anywhere, I concluded that all was well and started to tidy the boiler up. This involved cutting off and then filing the ends of the rivets used for the stays and any lumps of unnecessary solder.

The final job was to etch the boiler's unique number onto the backhead and present it to my club's boiler testers for a formal, twice working pressure, certificated test.

I'm pleased to say that the results of this test showed that everything was satisfactory and a certificate was duly issued – just over nine months after I had begun my project, a major component of my locomotive was complete (Photo 12). EIM

PHOTO 10: Soldering in the front tubeplate proved a challenge due to its location three inches inside the boiler barrel.

PHOTO 11: Soldering of backhead required care to avoid melting previously attached parts.

PHOTO 12: Finished boiler – satisfying stage of the project .

REEVES MODEL ENGINEERS 2000

Drawings in this series reproduced with kind permission of A J Reeves. Drawings, castings and material for this build project are available from A J Reeves.

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■ Part one of this series, introducing the loco, appeared in the April 2018 issue of **EIM**. A digital copy can be downloaded or a printed version ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by telephoning 01778 392484.

Coming Next Month...

"This may sound very fussy but I can assure you it makes future assembly and disassembly so much easier and quicker..." – Andrew turns to construction of his loco's frames.

From Grip to Clamp

After describing last month how he converted a pair of Mole grips into a milling table clamp, Norman finds another way to turn the DIY staple into a piece of useful workshop equipment.

BY **NORMAN HURST**

A year or so ago, there was an American carpentry programme called the *New Yankee Workshop* on one of the UK Freeview channels. I noticed that the carpenter in these programmes used a type of clamp that I had never seen before. It was quick to operate and seemed to have a good clamping force. From the television screen it appeared to be based on the Mole grip system.

I searched through all my catalogues but I couldn't find it anywhere – I didn't know the name of this type of clamp so that made it difficult to check. I noticed that the carpenter was using at least two of these clamps, either for clamping work to the bench top or 'ganging' two or more work pieces together for cutting to shape, for example for 'handed' shapes. The jaws of the clamps appeared to be fitted with rubber or other protective faces to protect the surface of the wood.

I have recently been doing some woodwork and I thought that this type of clamp would be useful for carpentry; however I find that I am now also using them for metalwork – but more of that later.

Following my success with the milling table clamp, I felt that it might be possible to copy these woodworking clamps, so I went ahead and made a couple; one being shown in Photo 1. From the television screen, the items appeared to be about nine or 10 inches long, so that was the size that I decided on. Mole grips are readily available and I bought two 'budget' type grips for a few pounds. For the construction, all my dimensions and shapes were guessed, but were approximately based on what I had seen of the television items.

The grips that I bought were the type 1 clamps; i.e. with the fixed jaw riveted in position (Photo 2). As with the milling table clamp, the rivets need to be removed. In this case that involves four rivets per clamp – these comprise the two securing the fixed jaw, the one acting as the jaw swivel and the operating one attached to the trigger. Again, the removed jaw should be retained to later act as a drilling jig.

Construction

On the television clamps, the 'post' that holds the lower jaw was shaped and appeared to be integral with the clamp body frame. I felt that a solid square bar welded to the frame would be suitable and that was how I made it. Of course, the post doesn't have to be square, it could be oval or rectangular, but square will usually be most convenient for our construction.

"Mole grips are readily available and I bought two 'budget' type grips for a few pounds..."

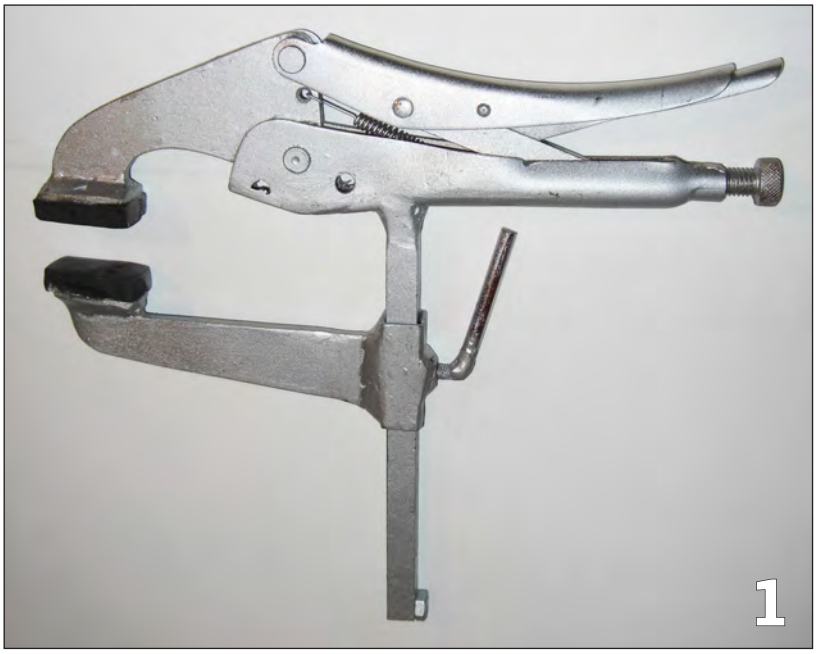


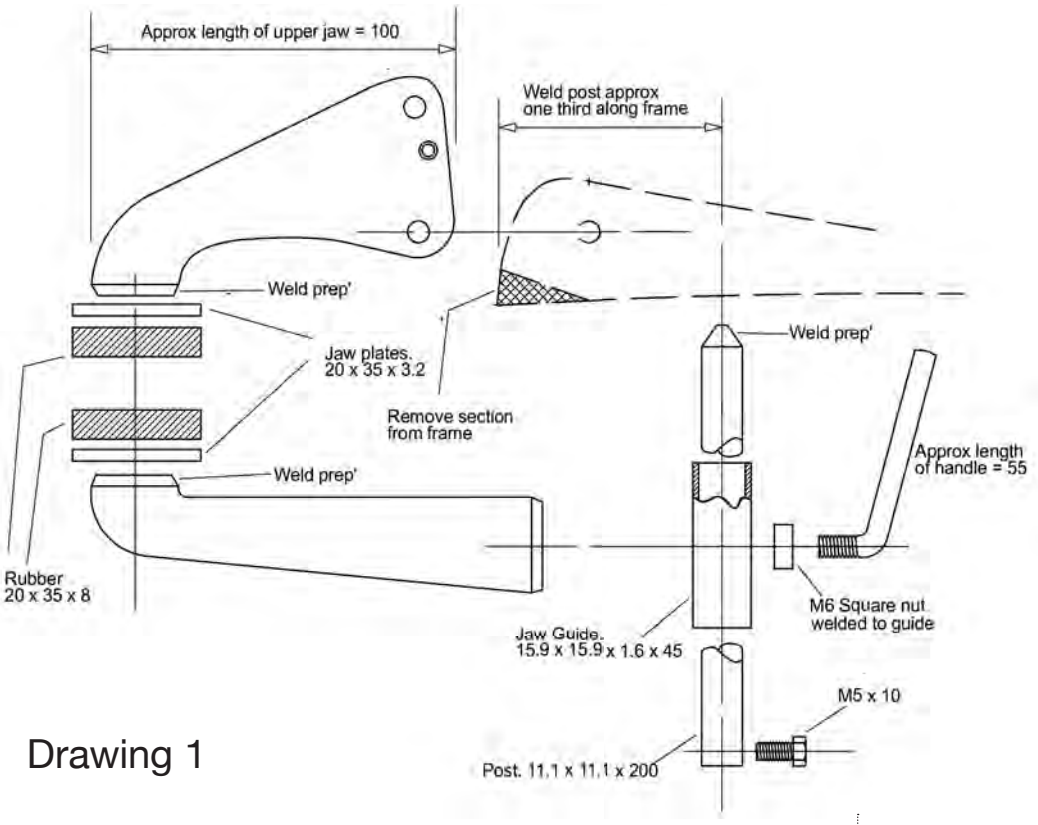
PHOTO 1: Another design of clamp cleverly created from a pair of Mole grips.

PHOTO 2: Type 1 grips with a riveted fixed jaw used for the conversion.

I didn't know what size or length to make it, but that question was answered by my available material. In my scrap bin I happened to have a length of 7/16in (11.1mm) square steel bar, 340mm long. I cut that in half to make the post for each clamp. The width of the clamp frame at that point was about 14mm so an 11.1mm post seemed to be a suitable size. Mine looked slightly shorter than the originals, but in use have proved to be satisfactory for my purposes. I also had a length of 5/8in (15.9mm) square steel box section tube with 1/16in (1.6mm) wall thickness which I used for the jaw guide. Ignoring the slightly rounded corners, this gave an internal dimension of 12.7mm square. I thought that using the 11.1mm bar (the male) would give a 'sloppy' fit, but in practice this has again proved to be satisfactory.

The width between the frame was approximately 5mm, so to make the jaws I needed steel plate slightly smaller than that. I had a couple of short lengths of steel channel which measured at 4.57mm thickness and on trying a section of that for size it proved to be suitable. The shape of these jaws is shown on Drawing 1. This drawing gives details of the components and dimensions that I used for the clamps, but with a couple of minor modifications.

The thickness of the jaws is not shown as this will obviously depend ▶



Drawing 1

on the dimensions of the constructor's Mole grips. I would suggest that a card or plastic pattern be made of the top jaw with its jaw plate and rubber face and with the two hole positions marked or cut; this would be offered up to the dismantled Mole grip to establish how low the rubber grip will be when finally assembled.

The way that I often cut shapes is to use patterns as male stencils, I draw the shape on a card, lay it on the material to be cut and spray over the top with white car primer paint. Photo 3 shows three of the four required shapes positioned on the flange of the channel. The card shapes are held down with weights to prevent them being moved by the blast of the spray and to prevent paint from getting under an edge of the card.

Photo 4 shows shapes being roughly cut on the band saw. The rough cut shapes were then finished by grinding and filing. At this stage, the bottom jaw should be left about 5mm or 6mm over length.

The top jaw will be drilled with the three holes using the original jaw as a drilling jig. Weld 'preps' should be ground on to both the top and bottom jaws in the positions where the jaw plates will be welded. These jaw plates were made from ⅛in (3.2mm) steel and were welded at 90 degrees to each jaw, as shown on drawing 1.

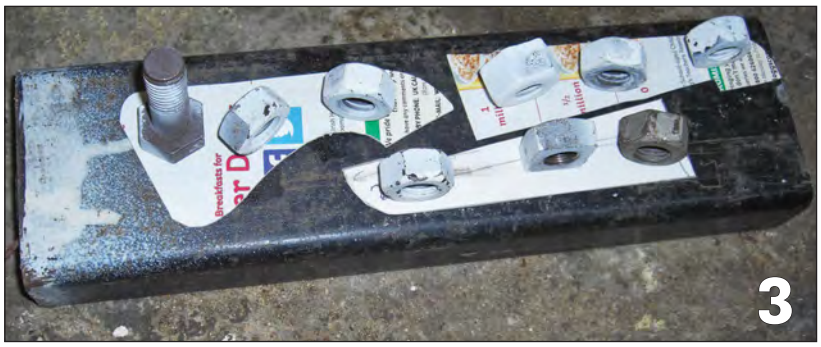


PHOTO 3: Card templates to the correct shape laid over the metal to be cut and spray painted.

PHOTO 4: When removed the required shape is clearly marked on the steel for rough cutting with the band saw.

Rubber or not

For the 'rubber' jaw faces, I cut pieces from a portion of obsolete barge fender rubber that I happened to have and these were fixed onto the jaw plates with Araldite. There is probably a better adhesive for this application but Araldite has proved to be completely satisfactory on my clamps. If the fender type of rubber cannot be located, some other material could be experimented with – perhaps large pencil erasers. To avoid confusion, I have used the word rubber as this is the common term for the material used, although – to the purist – it will probably not strictly be that material...

One end of each post was drilled and tapped to take a small hexagon or round-headed screw. The only purpose of this is to prevent the lower jaw from falling off when its securing handle is undone. Photo 5 shows the prototype components; the dismantled items are on the left and right and the new components are on the board. The two items at the top of the board are an M6 screw and a length of 6mm diameter bar. These were welded together to make the securing handle.

The underside of the clamp frame was lightly filed to remove the silver-coloured coating and the post was welded to the underside at about a third of the way along the length of the frame and at approximately 90 degrees to its underside.

The top jaw was assembled with the spring and two pivot rivets in position. The dimension was then taken between the post and the jaw rubber; this dimension being used to establish the final length of the bottom jaw – allowing for the wall thickness of the jaw guide and the weld.

The bottom jaw was shortened to its correct length and welded to the jaw guide. I happened to have some square M6 nuts which I had taken from a dismantled piece of equipment. I used these to weld to each of the jaw guides; the jaw then being drilled through with the tapping size drill and tapped M6. An alternative method for making a nut would be to cut a small square piece of steel approximately 10 x 10 x 4mm and weld it to the guide. The tapping-size

hole would be drilled right through the square piece and the guide wall and then tapped. I copied the television type of lower jaw securing handle, but a wheel grip, tee grip or any other type could be used.

With the prototype in use, it was found that the frame 'nose' between the post and the upper jaw plate, sometimes caused an obstruction (Photo 6). This was overcome by cutting away a triangular section (drawing 1). The resulting open part of the frame was filled in with a small piece of steel – Drawing 2 shows the method that I used.

The cut was made with a hacksaw. A small piece of steel (A) slightly longer than the length of the cut was made. The edges of the cut were filed back at an angle to make weld preps and the steel piece located in position (B) with the ends slightly overhanging. The assembly was welded (C) and then cleaned up with a file (D). The overhanging ends were sawed off and filed flush. An alternative method would be to glue the piece of steel flush in position with Araldite or equivalent.

In drawing 1, I have lowered the upper jaw plate more than the prototype to improve the design and overcome the obstruction fault. When finally assembled, both of my clamps were finished with a spray coating of silver Hammerite.

Widespread uses

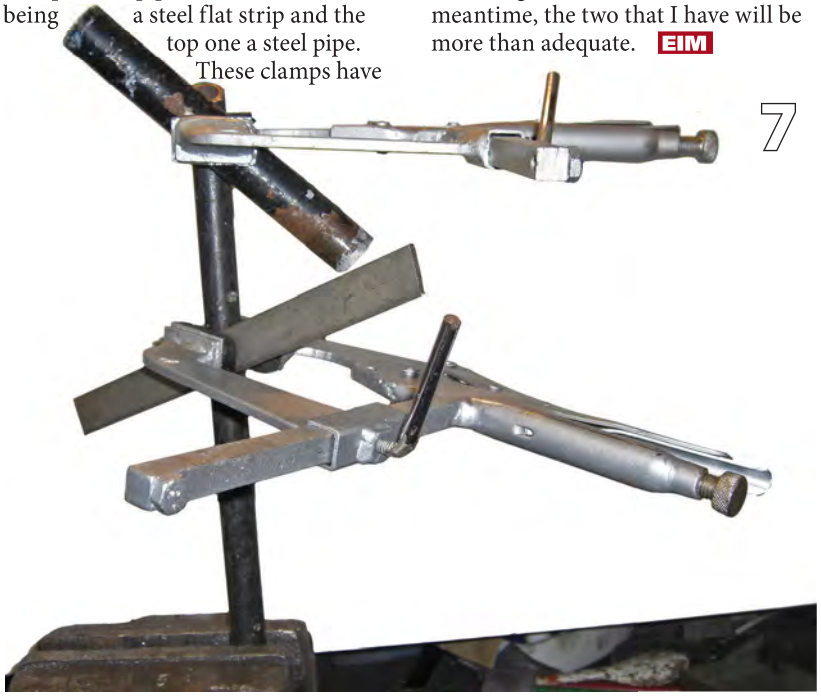
As mentioned previously, I originally made the clamps for woodworking. I used them once or twice for clamping steel work pieces prior to welding and I then noticed that I could clamp in positions which would be difficult if using G-clamps. One such job was making hand rails with flat fixing plates welded to them; the plates being easily clamped to the tubular rails for tack welding.

I then found that I could clamp round items together, bars or tubes for example. I assume that this clamping success is probably due to the gripping effect of the rubber and to the fact that the jaw faces can be kept approximately parallel to each other. A test rig in Photo 7 shows items clamped to a pipe; the bottom one being a steel flat strip and the top one a steel pipe. These clamps have been remarkably successful and I use them now more than G-clamps. When clamping for tack welding, care has to be taken to avoid burning the rubber, but again, I have not found this to be a problem. In the future I may make some larger versions, but in the meantime, the two that I have will be more than adequate. EIM

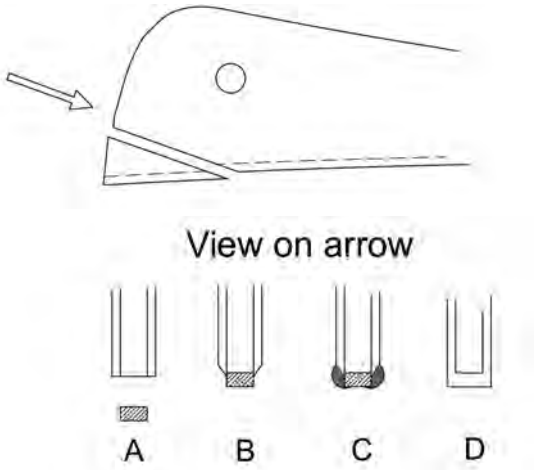
PHOTO 5: Prototype compontents ready for assembling.

PHOTO 6: Using prototype version revealed a potential obstruction from the frame nose, sorted by removing a triangle of metal .

PHOTO 7: Two of the clamps in use – suitable for a myriad of workshop applications.



Drawing 2



Basics of the boiler

Our new series helping to unlock the intricacies of the hobby for beginners focuses on the heart of our locomotives – the boiler

BY **ANDREW CHARMAN**

Experienced model engineers can turn the page – this series is strictly for beginners. Writers to the editorial office have made it clear that not everyone knows the intricate details of steam locomotives, and some are simply too nervous to ask those who clearly know a lot. We aim to help!

This month we take a quick tour of the boiler. Now we are talking full-size practice here – knowing how the 12-inch version works makes it far easier to understand how model ones do – and in most scales coal-fired model boilers are basically simplified miniature versions of the real thing...

The boiler is a tube, full-sized versions usually made of steel, whereas for models copper is the norm. Smaller and narrow gauge locos usually have parallel boilers while in larger engines it generally tapers, narrower at the front. Invented by Great Western Railway Chief Mechanical Engineer G J Churchward, the parallel design makes it easier for the footplate crew to see the road ahead, and reduces the amount of water surging forwards when the loco goes downhill – such surging can uncover the crown (top) of the firebox and overheat the boiler. A taper boiler also weighs less at the front, just where the heavy cylinders are sited, making equalising the weight on each axle easier.

Drawing the draft

The boiler attaches at the rear to the firebox, at the front to the smokebox. The smokebox is sealed, creating a vacuum, and the exhaust steam from the cylinders sent through it up the chimney. This creates a draught, drawing hot gases from the fire in the firebox through tubes that run through the boiler, and heating the water that surrounds them.

On a full-size locomotive there can be more than 150 boiler tubes, typically all of the same diameter. Superheated engines (*we'll look at this process in another episode*) also have up to 20 larger flue tubes, mounted higher on the plate than the main nest of tubes. These provide the space in which to place elements of the superheater system.

The boiler tube is encased in lagging to help keep heat in – once asbestos was used for this job, today with asbestos being a recognised health hazard glassfibre matting is the norm – on model locos wood is often used. The lagging is kept in place and protected from the elements by steel sheets, which in turn are secured by steel boiler bands.

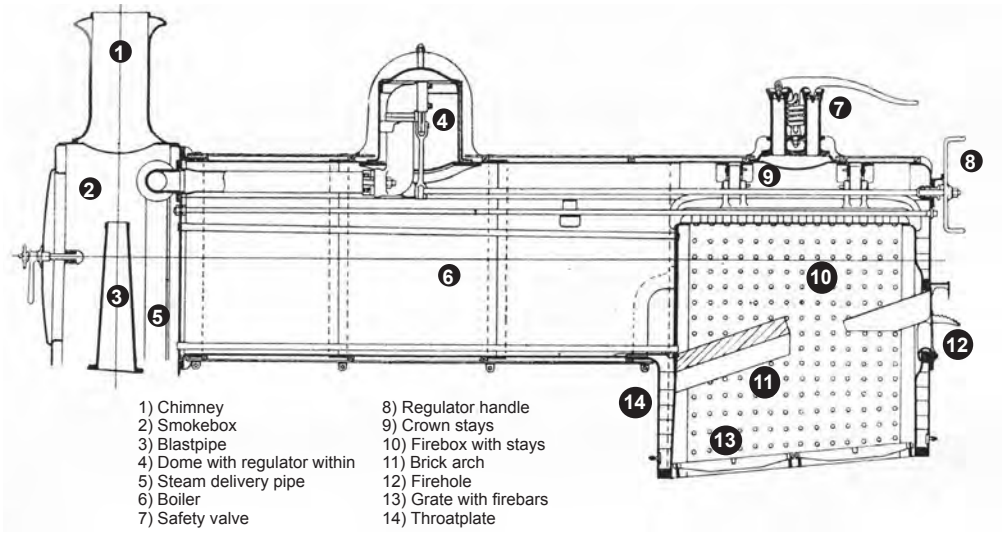
Full-size locomotive boilers are fitted with several threaded washout plugs. Mostly located around the firebox and at the smokebox tubeplate end, they are removed to allow access to the inside of the boiler for washing out – this has to be carried out at regular intervals to remove the scale and sediment that builds up in the barrel – just like it does in your kettle. Leaving this in the boiler could result in blocked pipes and such like. Most locomotives are given a treatment in their feed water to help loosen this scale from the metal surfaces.

A few of these plugs have a hollow core, which is filled with molten lead alloy which is then allowed to cool. These 'fusible plugs', usually found in the top of the firebox and high on the front tubeplate, are a safety measure. Should a shortage of water uncover the crown of the firebox, causing it to overheat, the lead in the fusible plug melts, causing a rush of water and steam into the firebox and warning the crew to drop the fire immediately.

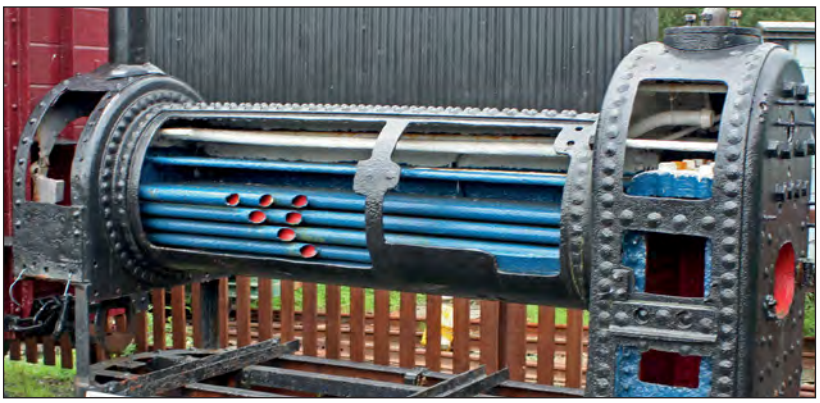
The prime protective device mounted on top of the boiler is the safety valve or valves. Most full-size locos have two, some as many as four. When steam pressure reaches a certain level, the valve opens and vents the excess to the atmosphere, known as blowing off. Without it, the pressure continuing to build would inevitably lead to a boiler explosion...

The other signature feature on many, but not all, boilers is the dome. Looking a bit like a hat placed a certain distance along the upper surface, this is effectively an area for steam to collect and be taken off for routing to the cylinders. The controls for the regulator, effectively the accelerator pedal, are routinely mounted in this space.

That's all for now – next time we'll look at smoke and fireboxes... EIM



ABOVE: The general layout of a typical locomotive boiler. Traction engine boilers are built to generally similar principles but don't tend to have domes, the cylinders mounted atop the boiler barrel.



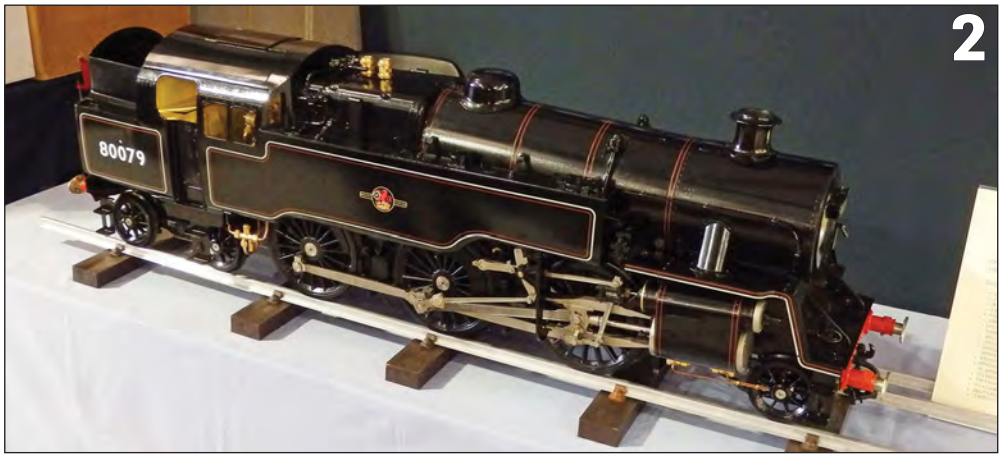
RIGHT: This life-expired boiler from a narrow gauge quarry Hunslet loco has been sectioned to show its internals – note the tubes painted blue.

Large Scale Model Rail

Heavy snow flurries did not deter Phil and his trusty camera from attending the **EIM**-sponsored Midlands Garden Railway Show at the Fosse on 17th-18th March.

BY **PHIL PARKER**


1



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Organisers of the Midlands Garden Railway Show, known to many as Large Scale Model Rail, faced an unusual challenge this year, as the 'Beast from the East' returned to dump a load of snow on the Midlands. Certainly some visitors were deterred from making the journey to the Warwickshire Exhibition Centre, especially on the Sunday, but plenty still did and were treated to a wide-ranging exhibition.

Together with our sister magazine *GardenRail*, **EIM** is a sponsor of the show, and with good reason. While the event's core subject matter of the larger modelling scales, O Gauge, G Scale, Gauge 1 and 16mm, are paradoxically at the small end of our market, we are seeing increasing amounts of proper engineering in these scales. Notably as well as the 14 model railway layouts across the various gauges on show at the event, there were also four displays present from model engineering societies.

The pictures on these pages illustrate some of the highlights from the exhibition, and should they encourage you to add the show to your diary, next year's dates have already been released – plans are underway for the 2019 exhibition which will take place on 16th and 17th March, again at the centre near Laemington Spa – details will be at www.largescalemodelrail.co.uk

PHOTO 1: Saturday lunchtime was certainly busy from the vantage point of the restaurant. Our correspondent tells us that he enjoyed his vegetable chilli very much while taking this picture...

PHOTOS 2 & 3: Among the larger-scale exhibitors present was Silver Crest Models with its Kingscale range of ready-to-run locomotives – the new 5-inch gauge BR Standard 4 2-6-4T and in 2½-inch gauge (now known as Gauge 3) the Britannia and Duchess Pacifics and 14xx tank loco.

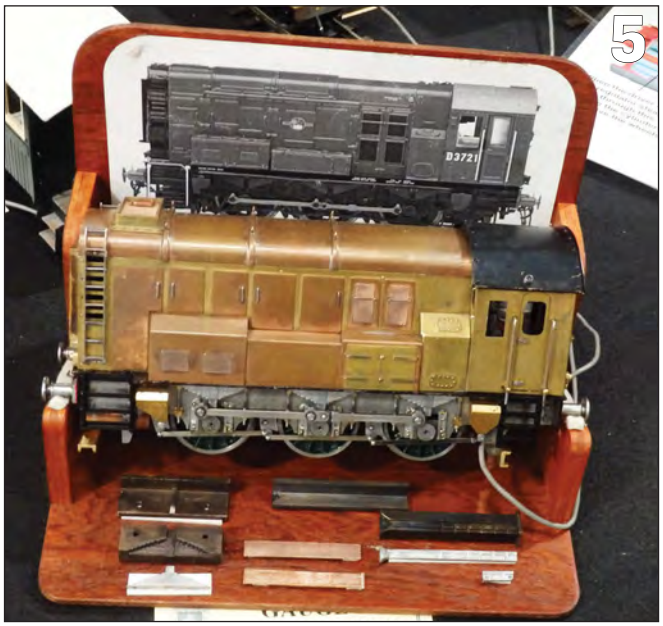


PHOTO 4: Very early prototype in Gauge One, very modern techniques. Built by David Viewing these models combine 3D printed parts with additional etched and cast components. Each required much research before an accurate plan could be drawn up.

PHOTO 5: Among model engineering societies exhibiting was the Coventry MES, this under construction Gauge 1 08 shunter part of the club's display.

PHOTO 6: Also on the Coventry stand was this vertical-boilered locomotive 'Llawrtdd.'

PHOTO 7: The 'Smoghampton' layout features models in the rare today Gauge 2 (2-inch gauge) and dating from before the First World War. These terrific tinplate engines are electrically powered, pickup is via stud contact.

PHOTO 8: Among a selection of 16mm scale locos on the Bromsgrove MES stand was this freelance, coal-fired engine, 'Galahad', built by Ian Moone.

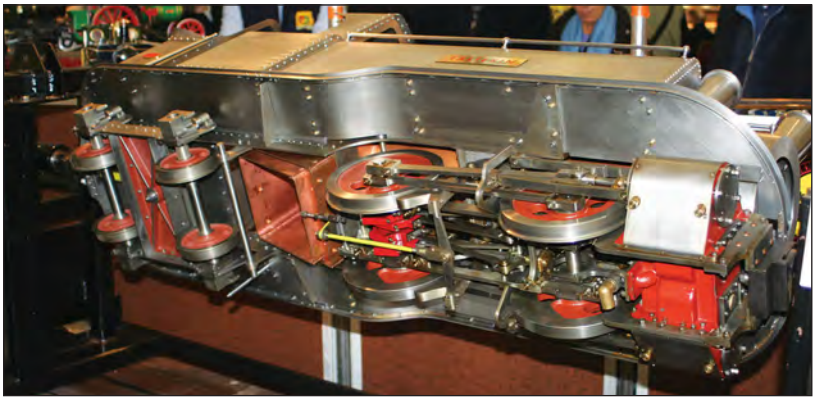
PHOTO 9: Also on the Bromsgrove sat this novel and impressive combo, featuring an early Baltimore & Ohio Railroad loco 'Atlantic'.

PHOTO 10: More 3D printing technology from ALD Models – BR 02 diesels in 4mm, 7mm and 10mm scales and even 5-inch gauge.

PHOTO 11: On Sunday the Warwickshire 16mm scale layout unofficially celebrated one of the earliest manufacturers in the scale, Archangel, with locomotives and some rarely seen goods wagons in operation.

PHOTO 12: Why the steam blower on this 16mm Darjeeling loco? Because it is coal fired – model engineering, just on a smaller scale.

Calling all articulated loco owners...



RIGHT: This 5in gauge single Fairlie 'Taliesin', displayed by Peter Pardington at the London show in 2012, is wanted by the WHR, but so is so much more! *Photo: Andrew Charman.*

Opinions or information to share? A point to make? **Engineering in Miniature** welcomes letters on all model engineering subjects. Send your letters to the editor at the address on page 3.

Models wanted at WHR

As many of you will know, up in the Top Left hand Corner (TLC) of Wales lies one of the gems of our railway heritage, the Ffestiniog Railway and its complimentary Welsh Highland Railway. The line is host to a number of original loco designs in the way of single and double Fairlies, Garratts and their more modern counterparts of bogie diesels. As this year is the 21st season since the revived Welsh Highland Railway commenced running, a coming-of-age birthday party at our Superpower Gala on14th-16th September seemed to be a good idea.

Ten years ago we celebrated the 50th birthday of the production of the last Garratt built by Beyer Peacock, the firm that did the most to promote this type of loco and as we have both the first and last of those Beyer Peacock engines, we put on a celebratory event and had a really good time. We ran five gauges in live steam on that occasion, with standard gauge, 2ft, 15-inch, 7¼in and 5in, quite apart from the static exhibits and table-top displays present.

So what do we do this time? Well we decided some while ago that the development of articulated locos is rarely mentioned and so this year we look forward to seeing anyone who has a loco of interest which demonstrates the articulated principle.

So if you have an original Roland Emmet, a Mallet, Shay, Heisler, Kitson-Meyer or even an American Triplex, or any form of modern traction that is articulated, and are interested in displaying it at our event, we would love to hear from you. Models under construction will be equally welcome as folk just don't understand how things work!

Due to development in the last 10 years at our Dinas site, we are not able to say yet how many locos will be able to steam and if we can fit in a running line – watch this space!

If you have an unusual articulated loco, and remember that all modern Diesel, Electric and various Hybrid types also tell the story, and you would like to join in our celebrations, then please contact me at; dkent@ffwhr.com for more information.

Dave Kent –Exhibits Co-ordinator

Recalling a lifetime in engineering...

On The Right Lines – A Model Engineer's Story

by Chris Rayward

I recently had the pleasure of reading this new book by Chris Rayward, who as many readers will know was Technical Editor of EIM for about 13 years. The title gives you a clue to the contents which recall events in his life that led him to become a quality model engineer, writer and consultant on engineering and model engineering subjects.

Chris recalls growing up in the post-war years of austerity and how these events with considerable support from his family and father in particular enabled him to become a qualified engineer. It covers the times the family lived in Australia after moving there to hopefully enjoy a better life.

A return to England and his progress through the world of work, the highs and the lows, will hold many memories for other people who journeyed along similar lines, it certainly did for me. The people he met and worked with provided Chris with a good store of interesting stories and anecdotes which illustrate the world of work during the early 1960s and which continue to this day.

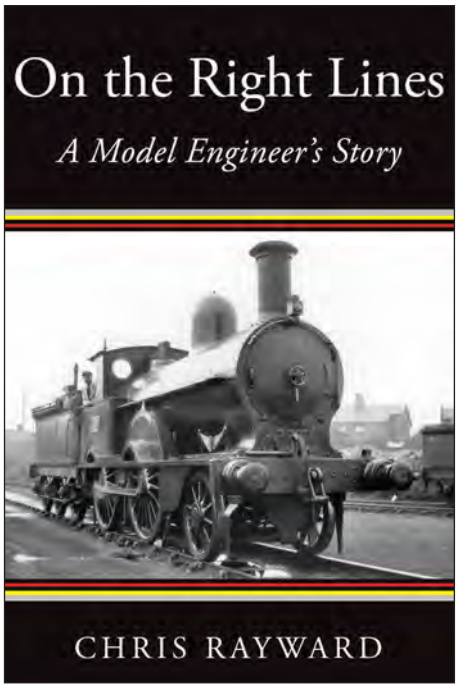
Travelling the world as an onboard ship's engineer provided Chris with that breadth of knowledge and ability to cover a wide range of eventualities that are not always present in a land-based work place. Add this experience to his passionate desire to be creative and 'build things' and you can fully understand how his early working life was a major influence for future years.

Chris is very generous with his praise for the tremendous support his wife Heather has given him over the years and like many families, adversity is met with that great resolve to overcome the difficulties that embrace the generation brought up during and just after World War 2. Whenever a new house move was necessary because of changing work issues, first priority was to ensure there was space for a workshop so that he could continue with his boyhood ambitions to build high quality models.

Like everyone, retirement loomed large and the question of what to do without the social aspect of a regular workplace setting. This is where model engineering and consultancy experience provided that important link to the future.

Chris is adamant that so many of his work colleagues retired without that continuing link which means they did not enjoy their retirement simply because there is only so much gardening and decorating that can be achieved as people get older. They simply passed on because they did not have that stimulation of having something to do.

This book explores these questions very well and I am sure many parallels will be drawn by similar-minded people. Written in a nice easy style this story is to be read sitting comfortably with a good cup of coffee or something stronger and just relaxing in the world of memories and experiences we all have. It is thoroughly recommended. ***JA***



Simple project proves a success

Bournemouth Club hopes to encourage new blood with its locomotive build.

Compiled by **ANDREW CHARMAN**

Another month and another host of club magazines dropping into the editorial inbox, both electronically and physically – all contain something of interest and some thought-provoking stuff.

If your club is not sending its magazine to us, we'd like to receive it. Also following the change in editorship at the start of the year it's worth checking your journal is going to the right place – I was recently forwarded a couple of club titles sent to our head office in Lincolnshire, whereas like many a freelance editor I work from home – the correct address is 12 Maes Gwyn, Llanfair Caereinion, Powys, SY21 0BD, or if sending by email to andrewcharman@warnersgroup.co.uk

As ever the recruitment of young people into the hobby remains a hot topic of conversation and not one confined to the UK – down in New Zealand the Editor of the **Otago ME** newsletter *Conrod*, Lachlan Clark, makes some interesting points. Stating that the challenge of attracting younger recruits has been around since the invention of the X-Box, computer and Playstation, Lachlan suggests that the hobby should try to replicate the 'instant gratification' that such devices provide.

"The thought of spending years building a model boat, scale layout, or live-steam locomotive is daunting to say the least," he says, adding; "the difficulty for many seems to be taking satisfaction out of the little wins. The firing technique used by loco drivers worldwide springs to mind; 'Little and often'. "

Lachlan suggests that the hobby should utilise technology to reduce construction times of models, lower build complexity and decrease the cost; "I believe we can tempt more people into the hobby who would have previously been put off by the time, cost, and effort involved."

Interesting, and perhaps controversial views – what do you think? Write and tell us...

LEFT AND BELOW: These three views of the Bournemouth DSME 'Ellie' project loco, this example built by John Hoyle, demonstrate the simple nature of the project, making a great way to introduce newcomers to model engineering.

Scaling down?

A trend of today's times replicated in our movement is downsizing. Where once 2½-inch gauge was very much the bottom limit amongst model engineering societies, today many include 16mm scale live steam in their ranks. One of them is the **Bournemouth DSME**, and your editor was therefore taken by an item in the society newsletter reporting that the March meeting was to include a presentation by Gauge 1 (45mm) modellers "showing us why we should expand the society's horizons to accommodate G1." The meeting was to include some excellent scratchbuilt locos including a coal-fired 9F 2-10-0. Wonder how it went – were the members convinced?

Meanwhile the Bournemouth

Group's small-scale project mentioned in our last issue is proving a great success. The club reports that 21 members have signed up to build the loco, including one living in Australia!

Project Ellie is intended to allow members to build a simple 16mm gas-fired steam locomotive at an affordable price – the club says that the total cost should be under £100. Although aimed primarily at those who have little or no experience in locomotive building, it is also suitable as a 'quickie' project for the more experienced. The course will provide the help and encouragement to ensure that even a raw beginner will be able to successfully complete their Ellie.

The project is being run in conjunction with Camden Miniature Steam Services, which has published a construction manual, *'Ellie' The Steam Tram*. Camden also supplies laser-cut parts for the chassis and bodywork, while the club is putting together packs of materials and components.

This is a highly worthwhile project – nothing is more encouraging to a fledgling model engineer than a completed model that they made themselves. Once they've made one, they will usually want to make something else! We will continue to follow this project closely.

Elsewhere, **Worthing & District SME** have had a busy winter that has included repairing or replacing six panels of track and its underframe on the north end of the curve that exits the tunnel on their Field Place line. The work included fitting new aluminium rail on the outside of the 5-inch track.

Other work carried out includes constructing two new passenger cars, and according to the club's newsletter one is close to completion. Meanwhile future planning includes the building of a new steaming bay adjacent to the existing roads – this summer project will start as soon as the ground is sufficiently dry.

The club is looking forward to hosting the 'Littlelec' locomotive efficiency competition – sister contest to the much better-known IMLEC and aimed specifically at smaller locomotives. Started at the Guildford Society and previously held at Worthing in 2009, the event will take place on 16th-17th June.

News from the **Guildford ME** concerns making it easier for potential visitors to find the club's track in the Surrey city. In future public open days will be promoted under the banner of the 'Stoke Park Railway' and the annual two-day open event held in July will now be called the 'Stoke Park Railway Gala Weekend'.

Like many others the club has been busy with trackwork over the winter, notably laying a new and complex mixed-gauge point at a location on the ground-level line where it will always be closely studied – right outside the clubhouse!

New lines

A major event in July will be the opening of the new West Shore Miniature Railway in Llandudno, the project of the **North Wales ME**. While according to the latest newssheet "Miracles have been achieved," in development of the site, there is still much to do before the opening ceremony, which your editor is looking forward to.

Regular working parties have been held throughout the winter on Wednesday and Saturdays, jobs underway including finishing and surfacing the steaming bay area, the installation of hydraulic rams to make movement of the traverser easier and safer, trenching and cable-laying from the electricity services cabinet to a container and steaming bays, finishing the station area (including adding fencing, seating; boarding and alighting arrangements), and installation and completion of the signalling system.

Roving reporter John Arrowsmith has dug up details of a proposed new miniature railway, which is always good news. The 7¼-inch gauge line is to be located at the village hall at Mawgan Porth near Newquay, and to be known as the Cornwall Miniature Railway. A planning application has been submitted for a route of half a mile, effectively a double oval with the line crossing its route at one point by means of a bridge.

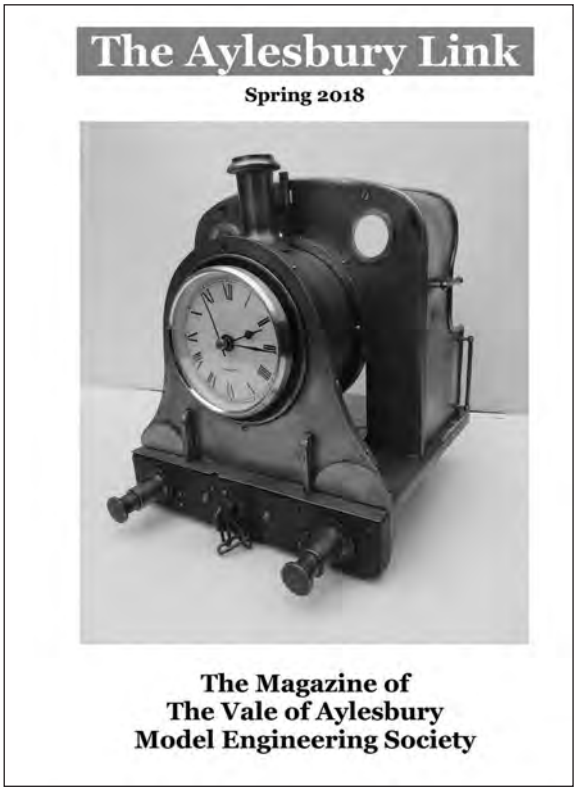
The application has attracted many supporters and some objectors, one supporting letter stating that the railway would help fill the gap left by the closure of the Dobwalls Railway in 2006, the well-known 7¼in gauge line with its US-themed locos also located in Cornwall.

Should planning permission be granted those behind the Mawgan Porth line would hope to open it in 2019. An existing 1954-built 'Royal Scot' is currently being restored for potential use on the line, while the group behind the project also own a third-scale narrow gauge outline 0-4-2T steam loco built by the Exmoor Steam Railway.

And finally – we were much taken with the cover picture on the **Vale of Aylesbury ME** newsletter – member Roy Urquhart took a pile of redundant bits that turned up at the clubhouse and turned it into an appealing novelty clock – great idea! EIM

BELOW: Major winter track renewals on the Stoke Park line at Guildford have included this impressive piece of dual-gauge pointwork.

BELOW RIGHT: Looking for a present? A novel idea on the Aylsebury club newsletter.



Southern Federation AGM

Many concerns, some familiar, some new, were discussed at length during a productive annual gathering of the Federation, this year held at the Cardiff ME.

BY **JOHN ARROWSMITH**

This year the Federation held its AGM on 10th March at the Heath Park headquarters of the Cardiff Model Engineering Society, members as usual laying on their excellent hospitality for the delegates and their families. The AGM of the Federation always includes the Young Engineer and Polly Trophy award, presented during the meeting and fully described on the next page.

The official meeting proceeded through the familiar sections including a very interesting presentation by Tony Wood from the Federation's insurance company.

BELOW: The fine 5in gauge GWR Castle of Ross Hopkins.

BOTTOM: Southern Fed secretary David Goyder has plenty of steam with his 5in gauge Midland 4-4-0.

Cause for concern?

Tony included the latest statistics relating to claims made against model engineering clubs and illustrated the level of compensation that has been claimed. Although on first glance this could give rise to concern about safety issues at some establishments, when the situation is looked at with a professional approach the overall record for public safety at events is very good when the number of clubs involved is taken into consideration.

The main message was that all model engineering clubs and societies should be continually vigilant when the public are involved with their activities. The best way to ensure your individual club is as safe as possible is to keep good records of public events, this way if something untoward happens you can show that all possible precautions had been taken. It was a good lesson to learn.

Proceedings continued with the election of officers which included a plea from the Chairman for more clubs to be involved in the organisation of the Federation. The present committee works very hard in representing the interests of all clubs and sometimes receives very little response to raised concerns or other important topics that relate directly to operations at model engineering clubs.

For example, new boiler examination paperwork is imminent which will probably raise a few groans about "not another review," but these things are not of the Federation's making so hopefully clubs will be understanding of the need to comply.

Braving the weather

The Cardiff club had opened its track and facilities to enable visiting locomotives to enjoy the excellent track in Heath Park. However, the incessant rain during much of the morning and early afternoon curtailed most of the action but some hardy souls did venture onto the track and enjoyed some good running time.

A superb buffet lunch ensured that no one went hungry and provided a good opportunity for model engineers from the different clubs attending to get together and have a good natter.

In concluding these notes I would like to offer my sincere thanks to Mike Williams, Chairman of Cardiff MES and all the members of the society for their excellent hospitality during the meeting and track operations, you did a grand job guys – thank you.

Young come to fore at Hereford club...

TOP: Young members from Hereford showed an impressive display of work.

ABOVE LEFT: Noah Eggar receives his trophy from Southern Fed Chair Bob Polly

ABOVE: The splendid glass trophy presented to Noah with examples of his work

BELOW: The award winners with Cardiff MES chair Mike Williams and Southern Federation awards officer Mike Chrisp r.

A highly pleasing aspect of the Southern Federation AGM meeting is the award of the Federation's Trophy and Polly Engineering prize to a nominated young person, for the contribution they have made to model engineering at their club.

This year the awards were dominated by candidates from the Hereford SME where 14-year old Noah Eggar was announced as the winner of the Young Engineer Trophy and Polly Engineering prize.

Noah was accompanied by no fewer than four other Hereford youngsters who between them demonstrated to the assembled meeting the range of skill and expertise they have developed through training carried out at the club – a small display of their work was on hand for AGM attendees to peruse.

With parents and mentors looking on these young people enjoyed their accolades and it is hoped that they will continue to progress within the model engineering world and help to reduce the advanced average age profile of membership which most clubs are suffering from at present.

Seaside steam for 70th

Definite progress is being made at the Littlehampton Miniature Railway, the Sussex seaside line, that claims to be the UK's oldest 12¼in gauge railway, having been under the custody of a heritage group since 2016.

Since diesel hydraulic loco 'Gwril' returned from loan, to its home at the Fairbourne Railway in January 2017 ex-Windmill Farm diesel electric 'Albert' has handled the summer traffic single handedly. However, two more internal combustion locomotives have since entered service.

A petrol hydraulic wooden-bodied tram – formerly named 'Tilby' – arrived from the Hastings Miniature Railway, after being regauged from 10¼ to 12¼ inches by builders RVM Engineering. The loco was rebuilt with a new and taller body by the LHR during the summer, renamed 'Daisy' and entered service on 15th October.

Latest addition to the fleet is 'Philippa', a diesel hydraulic loco completed by volunteer member Tom Sanders in November 2017 after a 14 month build from scratch. The loco is powered by a four-cylinder Kubota diesel engine powering two hydraulic motors and its compressor fitted with external connections, enabling it to supply air to the braking system fitted to the passenger carriages.

The railway will celebrate its 70th anniversary over the weekend of 23rd-24th June, having opened on 15 May 1948. The three resident IC locomotives will be joined by a loco from the Hotham Park Railway in Bognor Regis, while steam traction will be provided by the Fairbourne Railway's Darjeeling-styled 'Sherpa', making a return having run on the line in 2012.

Worthing & District Society of Model Engineers will bring their 5in gauge raised portable track, while there will also be model traction engines and a 5in gauge ground-level track.

The railway will be open from 10am each day – more details can be found at www.littlehamptonminiaturerailway.com/

Bearings firm aids young engineers

Miniature bearing supplier, SMB Bearings has backed a team of six young female engineers competing in F1 in Schools – an international science, technology, engineering and maths (STEM) competition for schoolchildren aged 11 to 19, in which groups of three to six students have to design and manufacture a miniature race car to strict rules.

Velocity Racing, a team of six girls from Inveralmond Community High School in West Lothian won the Scotland F1 in Schools regional final at their first attempt. SMB Bearings – which produces units for a wide range of applications from the automotive industry to miniature locomotives – has since supplied bearings to the team for the UK national final at the Silverstone race circuit.

"This team are great ambassadors for other young people to look up to," explained Chris Johnson, managing director of SMB Bearings. "We really see the value in encouraging the next generation of engineers from an early age, so it's an honour to play a small role in the success of Velocity Racing."

MAY DIARY

EVERY SATURDAY
(Weather permitting)

Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

South Lakeland MES Public running,Lightburn Park, pm.

Sussex MLS, public running, Beech Hurst, Haywards Heath, 2-5pm

EVERY SUNDAY
(Weather permitting)

Bournemouth SME Public running in Littledown Park 11am – 3.30pm. (Also Wednesdays)

Bradford MES public running, Northcliff Woods, Shipley, 1.30-4pm

Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

Canterbury SME (NZ) Public running from 1pm at Halswell Domain

Chingford ME running, Ridgeway Park, Chingford E4 6XU, 2-5.30pm

Fylde SME Public running at Thornton Cleveleys from 1pm.

Grimsby & Cleethorpes MES public running, Waltham Windmill, DN37 0JZ, noon-4pm

Harrow & Wembley SME public rides, Roxbourne Park, Eastcote, 2.30-5pm

Kings Lynn & District SME, Lynnsport Miniature Railway, 11am-4pm

Kinver MES Public running, High St, Kinver, Staffs 2pm – 4pm.

Lancaster Morecambe ME public running, Cinderbarrow Rly, Tarn Lane, near Yealand Redmayne, from 10am

Maidstone MES Public running at Mote Park, Maidstone from 1pm.

Portsmouth MES Public running, Bransbury Park, 2pm-5pm

Rochdale SME Public running in Springfield Park from 12 noon.

Ryedale SME public running, Village Hall, Pottergate, Nth Yorks (not 27th)

Sale Area MES Public running in Walton Park from 12 noon.

Southport MES Public running at Victoria Park 11.30am – 4.30pm

Sussex MLS, public running, Beech Hurst, Haywards Heath, 2-5pm

Urmston MES Public running in Abbotsfield Pk 10am – 4pm

Vale of Aylesbury MES Public rides, Quainton Rly Centre, from 12 noon.

West Huntspill MES public running, Memorial playing fields, 2-4.30pm

Wirral MES Public running, Royden Pk, Frankby, 1-3.30pm.

2 2 Bradford MES Boiler making by Chris Lyall, Saltaire Meth Church 7.30pm.

2 Chingford ME introduction to Edward Thomas loco, St. Edmunds Church Hall, Larkswood Rd, 7.30pm

3 Cardiff MES Forum, Heath Pk, email secretary@cardiffmes.com

3 Halesworth DMES meeting, Reydon, North Suffolk, 7.30pm

4 Portsmouth MES Driver instruction/ training & familiarisation of track, Bransbury Park, 6.30pm

4 Vale of Aylesbury ME, On and off the footplate by Bill Davies, Com Cntr, Prebendal Ave, Aylesbury HP21 8LF:

5 Isle of Wight MES Open Afternoon, Broadfields 2pm-4pm.

5 5 SMEE Steam plant for 9ft battleship talk, Marshall House, London SE24, 2.30pm. Pre-book only at chairman@sm-ee.co.uk

5 Tiverton MES Steam Up, Worthy Moor from 11am.

6 Asmanhaugh Light Rly Open Day, Norfolk NR12 8YW, 2-5pm

6 Frimley Lodge MR Public running 11am– 4pm, Sturt Rd GU16 6HT.

6 Halesworth DMES Steam Up frm 10.30am, Reydon, North Suffolk

6 Pietermaritzburg MES (NZ), Public running, Pietermaritzburg 3201

6 Plymouth Miniature Steam public running, Pendeen Crescent, Southway, Plymouth, 2-4pm

6 Top Field Light Rly public running,

Details for inclusion in this diary must be received at the editorial office (see page 3)at least EI address of every event being held. Whilst every possible care is taken in compiling this diary, we

Whitwell & Reepham Stn, NR10 4GA, From 12 noon

6 Tyneside SMEE Public Running, Exhibition Park, Newcastle upon Tyne, 11am-3pm

6 Welling ME public running, Falconwood, 2-5pm

6-7 Bedford MES public running, Summerfields Min Rly, High Road, Haynes MK45 3BH, 10.30am-3.45pm

6-7 Vale of Aylesbury ME Miniature Steam Gala, Quainton Rly Cntr, Bucks

7 Bracknell RS Public Running, Jocks Lane, RG12 2BH, 2-4.30pm

7 Bournemouth SME Public running in Littledown Park 11am – 3.30pm.

7 Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

7 Chingford ME public rides, Ridgeway Park, Chingford E4 6XU, 2-5.30pm

7 Grimsby & Cleethorpes MES public rides, Waltham Windmill, DN37 0JZ, 10am-4pm

7 Lancaster Morecambe ME public running, Cinderbarrow Rly, Tarn Lane, near Yealand Redmayne, from 10am

7 Stockholes Farm Railway Open Day, Belton, DN9 1PH, 11am-5pm

9 Chingford ME Steam loco maintenance, Ridgeway Park, Chingford E4 6XU, 7pm

9 St Albans MES 'The Panama Canal' by Richard Thomas, Christchurch Cntre, High Oaks, AL3 6DJ, 7.30pm

10 10 Cardiff MES Members Projects, Heath Pk

10 Worthing SME Midland Compound Large & Small by Mike Wheelwright, Field Place, The Boulevard, Worthing BN13 1NP, 7.30pm

11 Tiverton MES meet, Old Heathcoat School Community Centre, 7.30pm

11-13 Doncaster Model Engineering Exhibition, Doncaster Racecourse,10am-5pm (4.30pm Sun).

12 Bromsgrove SME open day. 16mm,G1,2½in, 3½in, 5in tracks. peter.maybury@outlook.com

12 Cardiff MES Steam Up and Family Day, Heath Park, 1pm-5pm

12 Worthing SME Maxitrak Day, Field Pce, The Boulevard, BN13 1NP

12 SMEE Polly Course, Marshall House, London SE24, 2.30pm. Pre-book only at chairman@sm-ee.co.uk

12-13 Statfold Barn Railway Giant Miniature Weekend, Tamworth. Pre-booked tickets only from www.statfoldbarnrailway.co.uk

13 Brighouse & Halifax ME public running, Ravensprings Pk, BHME.co.uk, 1.30-5pm

13 Hereford SME public running, Broomy Hill, HR4 0LJ 12-4.30pm

13 Worthing SME Public Running, Field Pce, The Boulevard, BN13 1NP

14 Cambrian ME meeting, 10.30am-1pm (ish) for more details contact Robin King, 01686 414939

15 Grimsby & Cleethorpes MES monthly meeting, Waltham Windmill, 7.30pm

15 Model Steam Road Vehicle Soc meeting, Model Night, Longford Village Hall, Gloucester, 8pm

16 Guildford MES bits & pieces evening, Stoke Pk.

17 Halesworth DMES meeting, autonomous model flying by Dave Lewis, Reydon, North Suffolk, 7.30pm

18-20 Echills Wood Railway Traction Engine Rally, Kingsbury Water Park, Warks

19 Cardiff MES 70th Anniversary Celebration, Heath Park, (members/families only)

19 Frimley Lodge MR Public running for Surrey Heath Show, 11am– 4pm, Sturt Rd GU16 6HT.

19 Romney Marsh MES Open Day, Rolfe Lane, New Romney, Kent

19-20 Riverside Miniature Rly Opening Gala, Riverside Pk, St Neots, Cambs

20 Guildford MES public running, Stoke Pk Railway, GU1 1TU, 2-5pm

20 Halesworth DMES Steam Up frm 10.30am, Reydon, North Suffolk

20 Plymouth Miniature Steam public running, Pendeen Crescent, Southway, Plymouth, 2-4pm

20 Rugby MES public running, Olney Lane CV22 5QD, 2-5pm

20 Tiverton MES Steam Up, Worthy Moor from 11am.

20 Tyneside SMEE Public Running, Exhibition Park, Newcastle upon Tyne, 11am-3pm

20 Vale of Aylesbury ME Diesel Day, Quainton Rly Cntr, Bucks,

20 Welling ME public running, Falconwood, 2-5pm

21 Lancaster Morecambe ME, building a 727 flight simulator, Tarn Lane, near Yealand Redmayne, from 10am

21 Pietermaritzburg MES (NZ), Meeting, Pietermaritzburg 3201

23 Chingford ME electric driving training, Ridgeway Pk, Chingford E4 6XU, 7pm

26-27 Rugby MES Open Invitation Wknd, Olney Lane CV22 5QD, 2-5pm

26-28 Riverside Miniature Rly public rides, Riverside Pk, St Neots, Cambs, 11am-4pm

26-27 Barnards Miniature Railway visiting engines Weekend, West Horndon, Essex CM13 3LX

26-27 Rugby MES Open Weekend, Onley Lane, 10am-5pm

27 Pimlico Light Railway public running (near Brackley) 3pm-5pm

27 Romney Marsh MES National 2½in Gauge Association Rally, Rolfe Lane, New Romney, Kent

27 Scottish MET public running, Weston Pickston Rly, 11am-4pm http://smet.org.uk

27 Top Field Light Rly public running, Whitwell & Reepham Stn, NR10 4GA, From 12 noon

27 Worthing SME Public Running, Field Place, The Boulevard, BN13 1NP

27-28 Bedford MES public running, Summerfields Min Rly, High Road, Haynes MK45 3BH, 10.30am-3.45pm

27-28 Cardiff MES Open Day, Heath Park, 1pm-5pm

27-28 GL5 Association Main Line Rally, Ryedale SME, Yorks

27-28 Hereford SME public running, Broomy Hill, HR4 0LJ 12-4.30pm

28 Bournemouth SME Public running in Littledown Park 11am – 3.30pm.

28 Bracknell RS Public Running, Jocks Lane, RG12 2BH, 2-4.30pm

28 Burnley & Pendle MRS public rides, Thompson Pk Rly, Burnley, 12-4pm

28 Chingford ME public running, Ridgeway Park, Chingford E4 6XU, 2-5.30pm

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28 Lancaster Morecambe ME public rides, Cinderbarrow Railway, Tarn Lane, near Yealand Redmayne, from 10am

28 Stockholes Farm Railway Open Day, Belton, DN9 1PH, 11am-5pm

30 Chingford ME electric maintenance, Ridgeway Park, Chingford E4 6XU, 7pm

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For full details, high resolution photographs and video see our website
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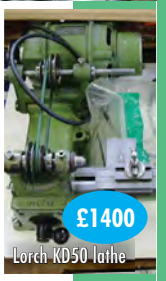

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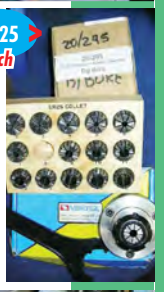

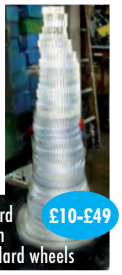

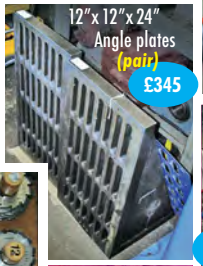

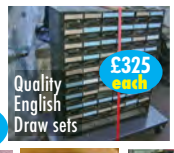

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