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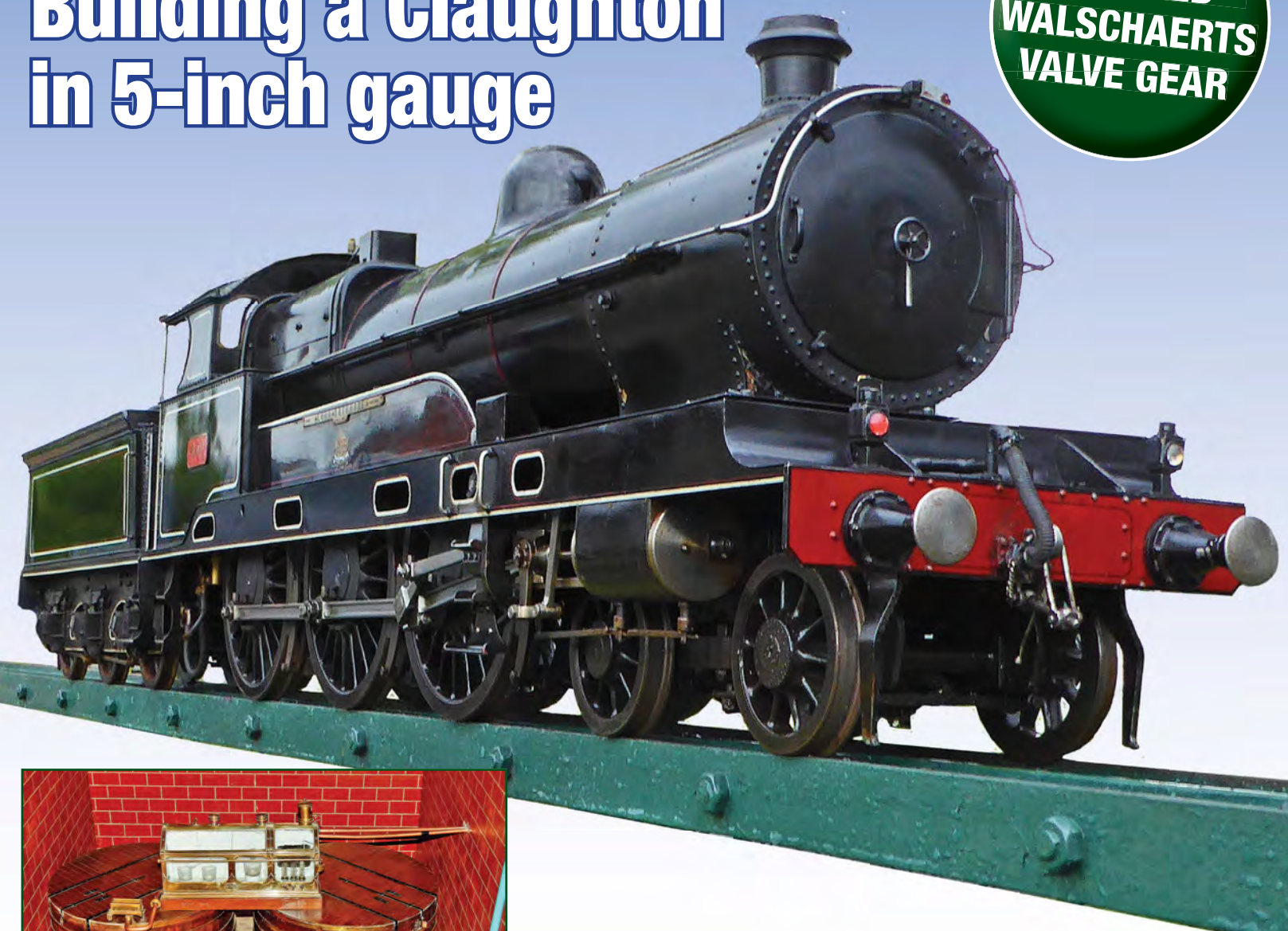
THE MAGAZINE FOR MODEL ENGINEERS

ENGINEERING in Miniature



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in 5-inch gauge**

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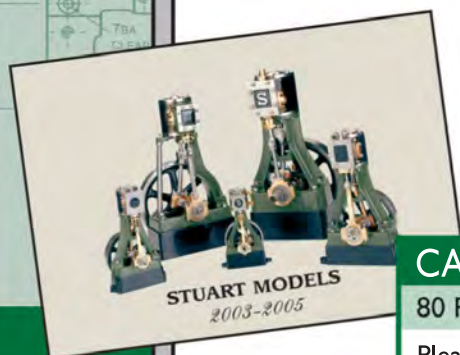


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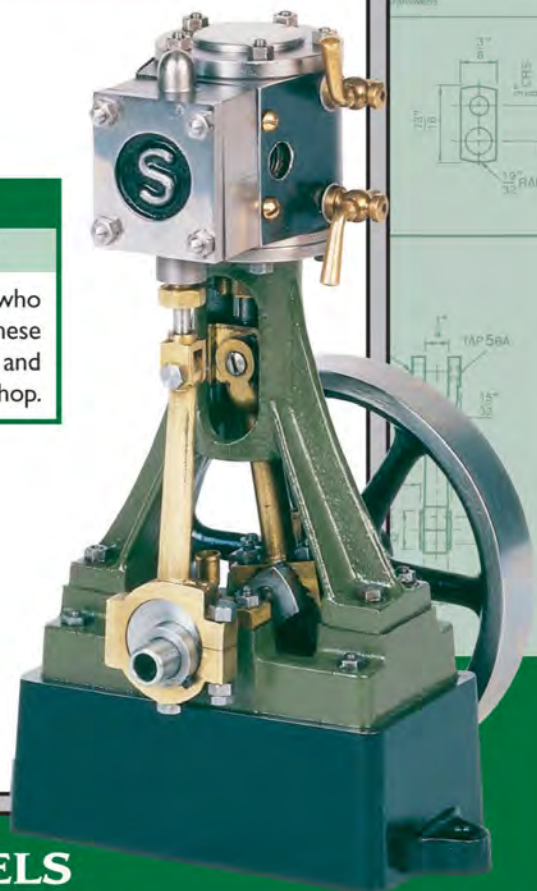
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A London North Western Railway Claughton 4-6-0 proved a fine subject for Mike Wheelwright's 5-inch gauge project locomotive which we will describe over coming issues.

Photo: David Baldwin

EDITORIAL

Tell us about the tools to do the job...

Welcome to **Engineering in Miniature**, my fourth issue at the helm and I think I'm beginning to get the hang of it now! More importantly, I'm getting a much better idea of what readers expect from the magazine - and better armed for the task of fulfilling such expectations!

This particular issue is to a degree locomotive-dominated, partly due to some cross-promotion with our sister titles, but also very much because the majority of features submitted to the magazine concern the building of model steam locomotives, and the majority of these rail engines. I don't have a problem with that, as such features are core to the magazine and we are glad to be able to run them.

There is, however, a great deal more to model engineering than steam locomotives! In discussions with readers I have particularly been asked about offering some guidance on the setting up of workshops, and the tools within them, and I'd very much like to offer more features on such aspects of the hobby. But looking at the article bank I inherited with my editorship, it's a bit bare in such things... So, if you are pleased with the workshop you set up to build your models in, or a particular tool you made for it, why not consider writing it up for your fellow model engineers? We pay for features you know...

Of course regular readers will point out that there should have been a workshop feature in this issue, as on this very page last

RIGHT: Aero engines certainly have their place in the pages of EIM - and we'd like to hear from the man behind this one! (See text)



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month I promised faithfully that the delayed visit to Statfold Barn's amazing premises would be in this issue, and it's not... I hold my hand up – I forgot that in terms of magazine production June falls very awkwardly, effectively the shortest month of the year in terms of available time to put an issue together – this edition had to be finished virtually as the May issue was reaching the news stands, and with a large family wedding to contend with as well, I simply ran out of time. Next month, third time lucky..

To return to the subject of the breadth of the hobby, other less well-documented areas also deserve their place within the pages of **EIM** – horology for example, and internal combustion models. On which note, if Manfred Grulke still reads the magazine could you get in touch? I have a good feature from you in the article bank but during the process of everything coming to me your contact details appear to have disappeared...

Calling young engineers

One major personal disappointment in putting this issue together was the fact that for the first time in many months we are unable to run the Young Engineers column, basically because over the past month we haven't received any news of the exploits of the younger members in our hobby.



It will have quickly become apparent that I am a great advocate for young people in engineering – I bore friends rigid with the example of my own daughter Megan, who just a few years ago had no idea she would have any interest in engineering until she was persuaded into the Welshpool & Llanfair Railway's workshop by the then engineering manager and quickly became enthused by engineering matters. She's since become a dab hand at engineering techniques her dad's not a lot of good at, such as welding, while also qualifying as a steam locomotive fireman on the railway.

We know there are examples across the hobby of young people doing great things, and we want to highlight their efforts. So if you are a young club member and you've produced something you are proud of, write and tell us about it – and don't forget to send some pictures in too! The same goes for club chairmen and newsletter editors – if the young people in your club are a shining example of future model engineering, point them in our direction...

Martin Gearing's Steam Plant

Having apologised for what you haven't got, and pleaded for what I want people to write, let's end on a much more positive note. Readers who have built the Steam Plant described by Martin Gearing in **EIM** between October 2016 and December 2017, will no doubt be pleased to hear that we will soon be adding a boiler to it.

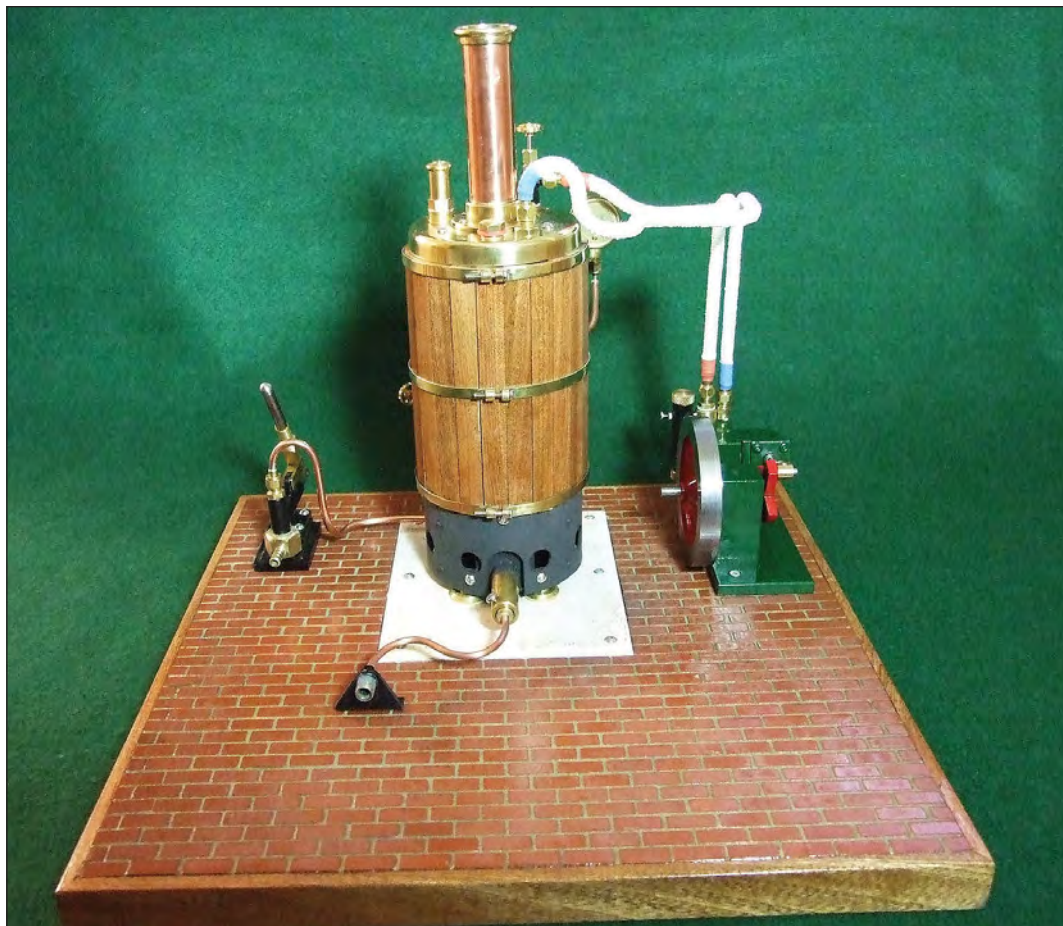
Martin offers his apologies for the delay in providing the boiler construction details to enable the Steam Plant to be completed – the delay came about because of the feedback from 'Guinea Pigs' who have built the boiler as originally designed after it was submitted for publication. Martin felt a revision of the design to make it a less demanding construction for the beginner was in order.

Also it was felt that the individual ancillary items were better purchased to enable the completed Steam Plant to be seen running as soon as possible! We hope that doing this might inspire builders to consider following it up with another more involved project.

We anticipate the description of the boiler appearing in these pages during the second half of 2018 – watch this space...

Andrew Charman – Editor

The July issue of **Engineering in Miniature** publishes on 21st June.



ABOVE LEFT: The editor's daughter Megan pointing out an axlebox she helped re-fit at the Welshpool & Llanfair Light Railway – her interest in matters steam engineering was something this dad never saw coming – but he's very pleased it happened...

Photo: Andrew Charman

LEFT: The new, simpler boiler design for Martin Gearing's Steam Plant, which we will be describing later this year. Martin tells us that the complete Steam Plant was made by Peter Wallace, a recent recruit to the hobby in his early 70s, having previously operated smaller-scale garden railways.

Peter had already made what Martin describes as "a very nice job" of building a Polly 2-6-2 Prairie kit, but wanted to produce something that he could say he had completely built himself. We think he's done a very nice job of this too, the brick tiled floor is certainly an excellent finishing touch to the model.

Photo: Martin Gearing.

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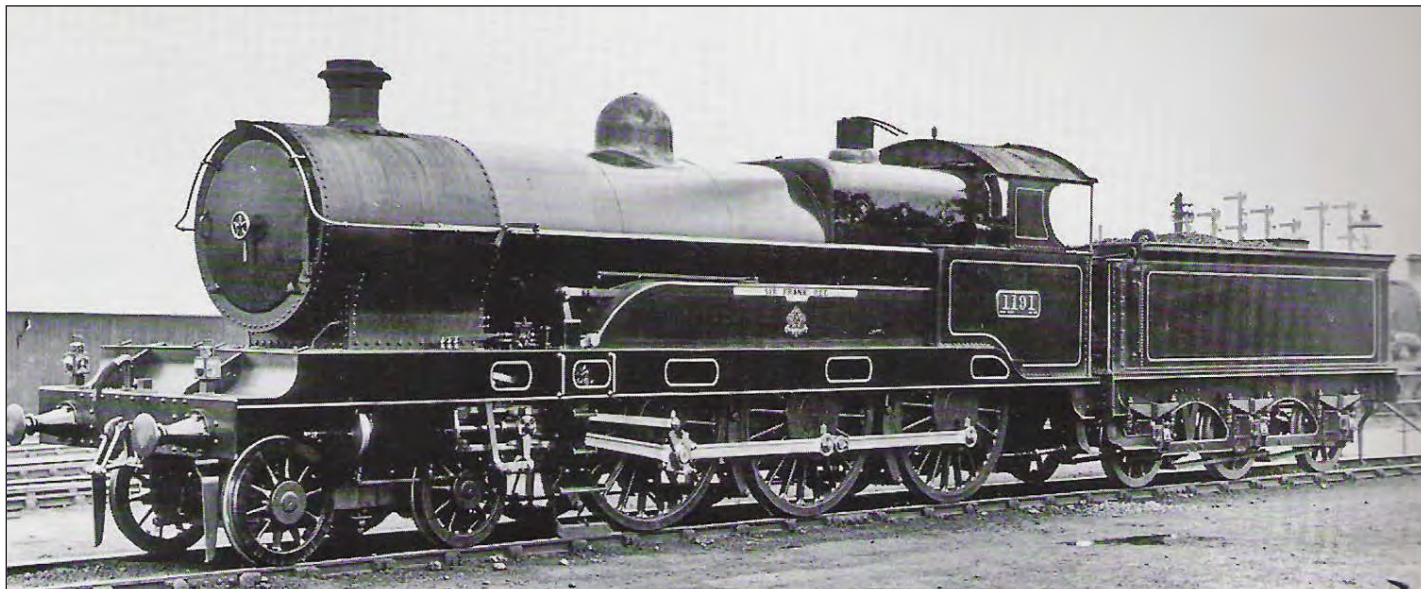
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A Distinguished Gentleman

Mike begins a description of the London & North Western Railway Claughton 4-6-0 No. 850 'Lord Rathmore' that he built in 5-inch gauge, a favourite on the club track.

BY MIKE WHEELWRIGHT – Part One of Five, The Claughtons



Why choose a Claughton? I have previously recounted my experience of creating a working Midland Railway Compound in 5-inch gauge (*EIM*, March & April 2017) and although these engines with their original late-Victorian finery were not without visual appeal the choice of making a Compound was really just a design challenge. On the other hand with the previous engine that went through my workshop the attraction was entirely emotional – a London & North Western Railway 'Claughton'.

I adore the black beasts turned out by Crewe, they really capture the stern elegance of Victorian simplicity, contrasting with the fairground-like gaudiness of many other railway engines of the time. I have a theory that the ornamentation of locomotive paintwork was inversely related to the dividends paid to the shareholders, just think about some of the impoverished lines south of the Thames, and in the rural counties, whose owners suffered the cost of lining out and maintaining in good order their complex paintwork. Maybe a nicely decorated engine was a welcome distraction from the daily grind of trying to keep the business afloat but of course had such a thing occurred on the North Western the flinty eyed accountants on the Locomotive Committee would have asked for costings, they did for everything else.

To understand the Crewe

ABOVE: LNWR Claughton 4-6-0 'Sir Frank Ree', built in 1913.

BELOW: Mike's 2008-built 5in-gauge Claughton, seen here on the Nantwich track of the South Cheshire ME.

All photos by Mike Wainwright unless stated

mentality it is worth noting that one single major component, a connecting rod, was used on 2300 locomotives, that's standardisation for you, British Railways did not even reach half that number of engines.

The bug of designing my own models bit me at my third engine when I had a go at a 5in narrow gauge Hunslet 4-6-0T as built for the War Department, it was really just a glorified industrial engine, very simple with bags of space between things so my gaffs on the drawing board did not produce too many 'fouls'. She ran very well, in a quarry-like way, swaying about pulling quite a

load while making lots of noise from the long chimney.

'A real engine'

Fired with success I thought I would have a go at a real engine, something I could admire, something North Western and big enough for a few trolleys, a 4-6-0 would fit the bill. Don Young had just published his design for 'Etna', a LNWR 4-4-0 Precursor, and the corresponding 4-6-0 Experiment class looked like the obvious choice. It was effectively just a stretched Precursor with an additional axle and coupled wheels six inches smaller, nearly all of the





design work had been done for me, the boiler only needed extending a bit at each end and most of the castings were the same, all I had to find was a set of smaller coupled wheels from another model.

It seemed like a 'piece of cake' but I didn't get far with thinking things out before the nature of the full-sized engine and its reduction to model proportions began to dawn on me. The Experiments, and the later superheated variant Prince of Wales class together totalling 350 engines,

ABOVE: The class member that inspired the model, No. 650 'Lord Rathmore.'

BELOW: The model locomotive on display at the Wimborne SME show.

were really an attempt at producing a 4-6-0 by lengthening the basic Victorian inside-cylinder 4-4-0, similar engines were turned out by other companies and although they could be made to work the arrangement was far from ideal.

The use of inside cylinders meant keeping the front axle drive of the 4-4-0 so the middle axle of the longer coupled wheelbase ended up under the ashpan. The definitive 20th century 4-6-0 had outside cylinders driving the centre axle and the wheelbase was

further forwards so the firebox lay behind the middle axle with the grate sloping up over the rear one. The Experiments had to get by with shallow fireboxes and scanty ashpans, all-in-all a much more difficult proposition for the fireman, to the extent that the performance of these engines was regularly outclassed by the smaller 4-4-0s.

It was fairly obvious that this inconvenience in full size would seriously compromise performance in $\frac{1}{12}$ scale and I regretfully abandoned the idea of a model Experiment. With the inside-cylinder 4-6-0 out of the question I moved on to the next creation of the Crewe drawing office, a considerably bigger 4-6-0 with a more conventional ashpan, the Claughton. It was certainly a picture of statesmanlike dignity with a boiler of a useful size but being powered by four cylinders it fell into the 'more difficult to do' category occupied by Pacifics and Great Western express engines. Nevertheless I decided to see if I could make something of it.

Claughtons from Crewe

No. 2222 'Sir Gilbert Claughton' appeared in 1913 when C J B Cook was Chief Mechanical Engineer and Sir Gilbert the Chairman of the Board and, following the custom of the Company, the class was named after the first engine. The design was prepared in the aftermath of a locomotive exchange with the GWR in 1910 during which 'Polar Star' worked north out of Euston and 'Worcestershire' (an Experiment) moved over to Paddington in place of the Star.

It is not too difficult to predict the result of comparing a state-of-the art four-cylinder engine having long-travel valves and a carefully designed 225psi superheated boiler with a locomotive of short valve travel using 175psi saturated steam from a boiler with a restricted ashpan and not easy to fire. Despite the unfortunate outcome for Crewe I can see how the exchange was beneficial to both CMEs, the GWR's Churchward was under pressure due to the cost of his four-cylinder engines so he could demonstrate the principle of "you get what you pay for" whereas Cook was able to argue a case for loosening the purse strings at Euston to allow for the construction of better engines.

Sadly the North Western did not benefit greatly from the experience as it seems Cook and his designers failed to identify what it was that made the GW engine so much better. Crewe's answer to the Stars was certainly a big engine but other than overcoming the grate problem of the previous 4-6-0s not much else



changed, the low pressure of 175psi was repeated, albeit with a generously sized superheater (a good bit more than Swindon's low degree arrangement) and nothing was done to improve valves and their events, travel was actually less than on the preceding classes. The four cylinders of 16 x 26 inches with 8in diameter piston valves above were arranged alongside each other in line with the bogie and all drove the leading axle so the typical inside cylinder front spacing was required.

The boiler was, however, moved back sufficiently for the firebox to lie behind the middle axle. This front-axle drive layout has often been criticised but the only real disadvantage is its longer wheelbase as short connecting rods are not much of a problem despite Gresley's abhorrence of them, and the almost perfect dynamic balance with negligible hammer blow is a valuable advantage.

For the first (and only) time the LNWR used Walschaerts valve gear but in contrast to the GW engine it was arranged externally and was reasonably accessible. The outside valves were driven directly and the inside ones from rocking levers ahead of the cylinders so the only motion work between the frames was the inside connecting rods and even these were relatively visible as they were not buried beneath the smokebox.

Retrograde step

The big drawback was the continued use of small laps and short travel valves, 45/16ths was a retrograde step from the 5% in travel of the George V design of three years earlier, which if not exactly long was going in the right direction. The 8in valve diameter for 16in cylinders was adequate but it should be noted that on the Stars they were an inch bigger with slightly smaller cylinders.

The boiler was an elongated version of the one carried by the previous 4-6-0s but it incorporated a Belpaire type firebox of 31 square feet grate area. Cook had proposed a larger boiler but engine weight was unacceptable to the permanent way people so a reduced version was 'cobbled' together using existing flanging blocks for the inner firebox. This was unfortunate as of course the absence of hammer blow should have permitted a heavier axle loading but this was unknown territory at that time. In fact the boiler was quite a good steam raiser and it only came into question as a result of the excessive steam demand put on it mainly due to rapid valve ring wear.

Setting aside everything else the overall design was compromised by its modest steam pressure and poor



ABOVE: Views at Worthing (by David Baldwin) and Nantwich.

BELOW: Mike takes the regulator of the locomotive that he built.

cylinders. By 1920 the class numbered 130 engines becoming the mainstay of the West Coast services but their lives were relatively short and they were displaced by Royal Scots in 1927. Fresh out of works they could deliver 1300 DBHP (brake horsepower at the drawbar) as demonstrated with a dynamometer test run up Shap bank but after a few thousand miles things

began to deteriorate seriously. The final nail in their coffin was the high maintenance cost stemming from design details carried over from the previous century so by 1930 their conversion to 'Baby Scots' had begun.

Coming next month...

Mike gets down to the major design considerations of his model.

EIM



The art of marking out

John continues his series of best practice techniques with some workshop basics...

BY JOHN SMITH

Marking out is yet another dying art, due to the widespread use of CNC machines in industry. However, we will keep it alive!

Most marking out is done on a surface plate, using a height gauge with the workpiece upright against an angle plate (or resting on a previously-machined surface) and the surface of the workpiece coated in blue marking-out fluid applied by brush or spray (**Photo 1**). A surface plate which is 12 inch/300mm square – or larger – is ideal, as sometimes you will want to place a sizeable rotary table or angle-plate on it (holding the workpiece) and still have plenty of room to work with the height gauge.

Excellent surface plates and height gauges can be had secondhand on the eBay online auction site; they can also be found regularly on specialist engineering auction sites such as Peaker Pattinson. Buying a used height gauge is perfectly acceptable, it will be as good as new once you have had the scriber re-ground.

When marking out the position of a large hole on a virgin or machined surface, try to keep the scribed lines inside the hole diameter so that, after drilling/boring the hole, there are no visible scribe marks. This is not practical when marking out the

position of very small holes, but there are ways to avoid visible scribe marks on the workpiece:

1. Mark out the rear of the workpiece, for example the underneath of a footplate or the inside of a side-tank.
2. Don't mark out the workpiece at all; just mark out a drilling jig (**Photo 2**). These are perfect for the vertical rivet holes in a side tank and for the rivet bolt holes in footplates. Just mark out and drill the bottom rivet hole in the tank, pop a rivet or a drill shank through both the jig and bottom hole, use a square to position the jig in a vertical position, clamp it to the tank and drill away.
3. Don't mark out twice when once will do. For example, spot holes in a main frame through the holes in the brackets which attach to it.

Sharp punch

One dodge I use when marking out is to scribe the horizontal holes a little more deeply than the vertical holes. I then move the tip of a really sharp centre punch down each vertical scribe mark until it drops satisfyingly into the horizontal scribe mark. A gentle tap on the punch follows and the centre pop is inspected.

I use an old 85mm camera lens for this task, the optics being brighter and crisper than those of most loupes.

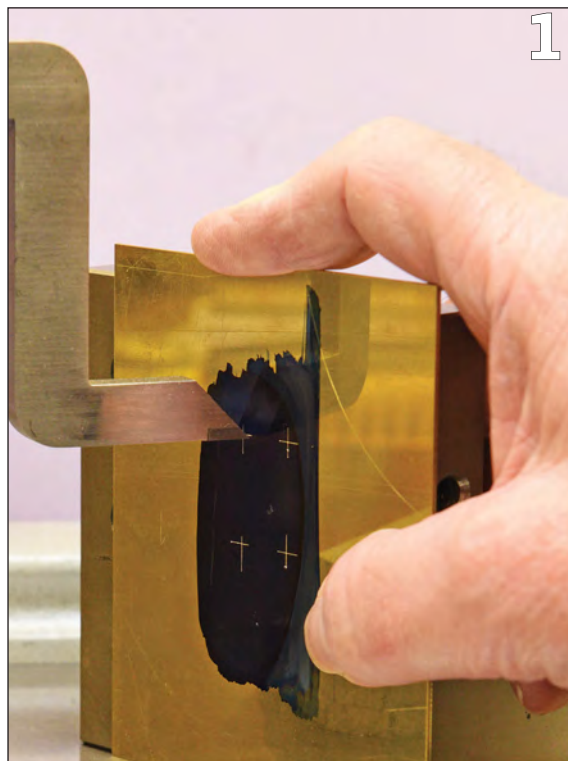


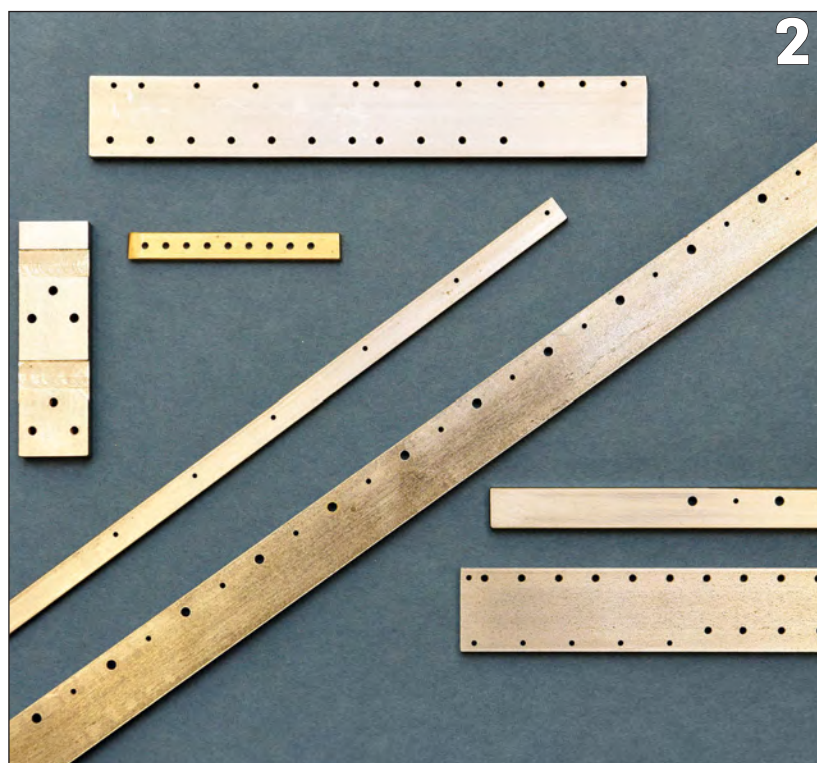
PHOTO 1: Blue marking fluid aids vision on surface.

Look through the rear of the lens; this will give you a larger image and also give you more working room between the front of the lens and the workpiece.

PHOTO 2: Drilling jigs create accurate series of holes.

PHOTO 3: Angling centre punch helps with slightly off-target marking.

If the centre pop is in the right place, the punch is replaced and given a smart blow. If the centre pop is slightly 'off target', the punch is held at an angle (**Photo 3**) and tapped to push the centre pop into the right place. Finally, the punch is given a sharp blow in the vertical position. The resulting centre pop might not be particularly pretty, but it will be accurately positioned.



Tool setting, and marking out with precision using a vertical mill

If you need to bore a hole in the lathe to a precise depth (say 0.500 inches) in relation to the machined end of the workpiece in the chuck, take an arbitrary feeler gauge of (say) 0.006in thickness, set the leadscrew hand-wheel to precisely 119 (assuming a leadscrew pitch of 0.125in), advance the boring tool using the top slide to just touch the feeler gauge held between tool tip and workpiece (**Photo 4**), then lock the top slide. You then know that four revolutions of the hand-wheel will give the bore a depth of precisely 0.500in. I would normally bore the hole to within a few thou of the desired diameter by boring to a depth of 0.495in, leaving 0.005in for a finishing cut. It's very similar if you use a metric lathe.

On the mill it is very similar. Set the Z-axis hand-wheel to 97 (if the Z-axis leadscrew has a pitch of 0.100in and you are using a 0.003in feeler gauge), bring the tool down using the quill movement mechanism to touch the feeler gauge held between tool and workpiece, then clamp the quill. You now know that when the Z-axis hand-wheel reads zero, the end mill will be just grazing the surface of the workpiece.

The vertical mill, particularly one with a DRO (digital readout) for X and Y axes, can be used to accurately spot all the rivet and screw holes in a workpiece made from sheet material – such as a tank or tender side, or a bunker rear (**Photo 5**). This process is often called 'jig-boring'. The first benefit is accuracy, the second that your workpiece does not end up with a lot of visible scribed lines made by

your height gauge. A metric centre drill with a point diameter of 1mm is ideal for this purpose as the drill is just below $\frac{3}{64}$ in diameter and so can be used to spot holes for $\frac{3}{64}$ in D rivets.

The first thing to master is the use of an edge finder. The most common edge finder has a machined end (often of 0.200in diameter for an Imperial machine) which is attached to the body of the edge finder by means of a spring such that end and body can be co-axial or not.

To set the X axis, push the end of the edge finder so that it is offset from the body and move the X-axis hand-wheel to advance the edge finder to the machined reference edge of the workpiece, with the mill running at a slowish speed (say 400rpm). As the table is advanced, the end of the edge finder becomes more and more co-axial with the body until the edge is reached, at which point the end steps out (**Photo 6**). The X axis DRO can now be set to zero.

It's a good plan to move the edge finder away from the edge of the workpiece, flick the end to push it out of being co-axial with the body, and then move the table very slowly in again to check that the end steps out exactly at zero on the DRO.

This technique is repeated for the Y axis. With the edge finder removed, the table can be advanced exactly 0.100in towards the workpiece in both axes. When this point is reached both axes can be zeroed again on the DRO. This is the 'origin' – the point at which X and Y axes cross.

Using a table of hole coordinates, it is then a simple task to position the

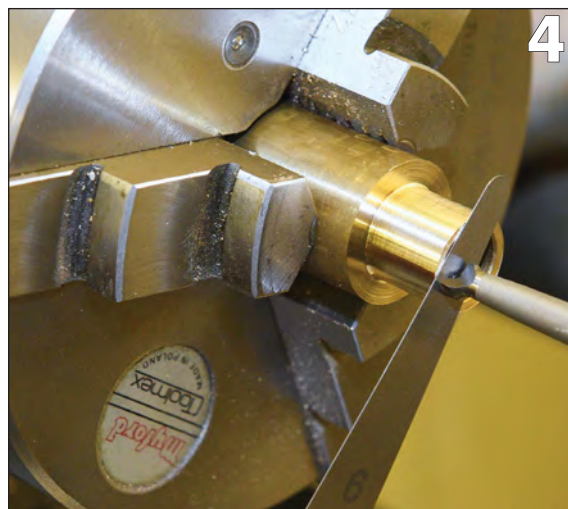


PHOTO 4: Feeler gauge aids precise depth finding.

PHOTO 5: Vertical mill useful as a spot drilling aid for a line of holes.

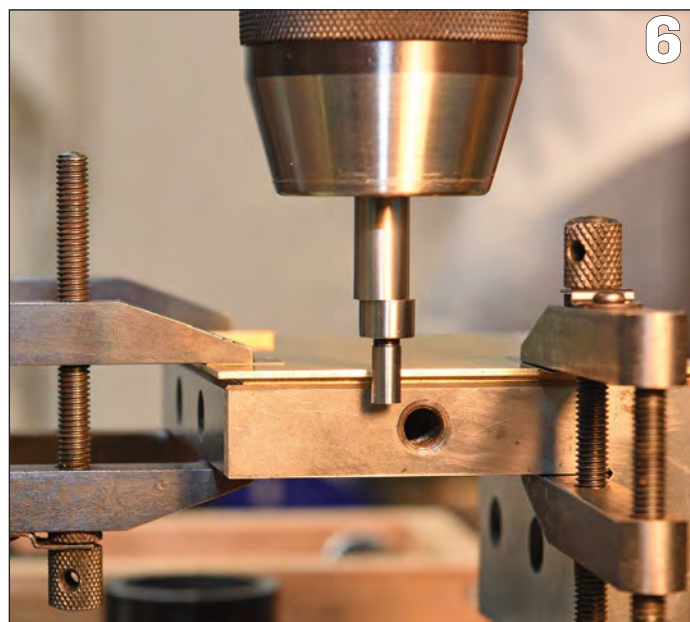
PHOTO 6: Use of edge finder to set DRO correctly.

table to the coordinates of each hole with respect to the origin (using the DRO) and to spot each hole using the quill lever. There are just two things to remember:

1. Set the quill stop so that the drill cannot put unwanted countersinks into the workpiece.
2. Put a sacrificial sheet of material under the workpiece to protect the surface against which the workpiece is clamped.

I have used a vertical mill without a DRO successfully to spot holes (by using the hand-wheel scales), but it is a much more error-prone process requiring a great deal of concentration! And don't forget to always approach each hole position from the same direction, to avoid backlash error.

COMING NEXT MONTH - PRECISION BORING...



A Double-Acting Engine

Jan-Eric finishes the cylinders and starts on the motion for his small steam engine.

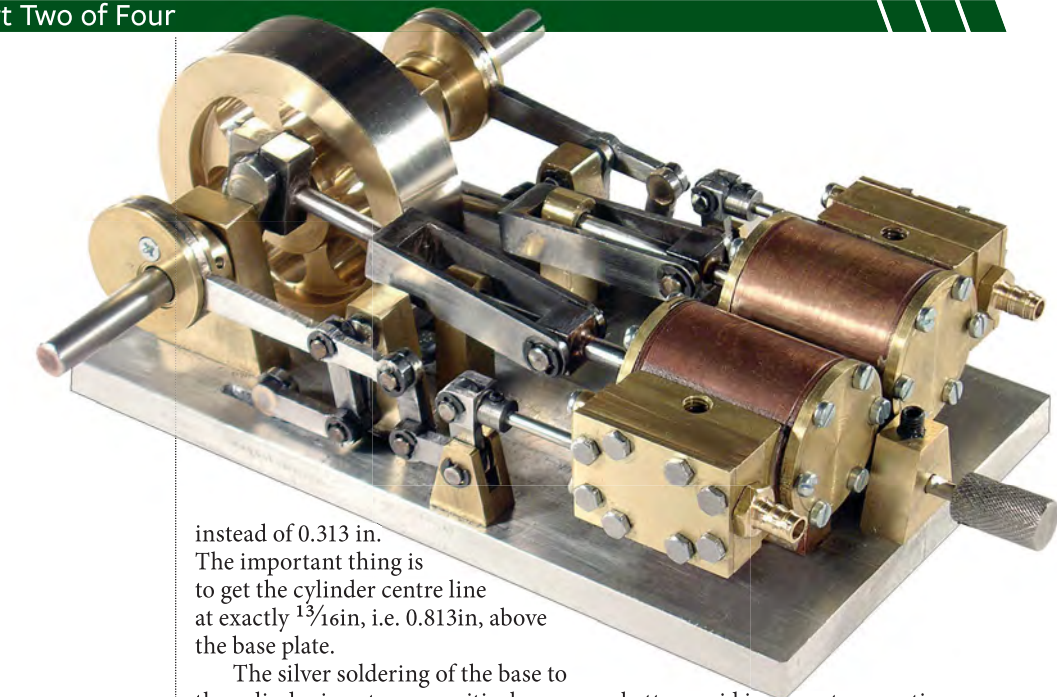
BY JAN-ERIC NYSTRÖM – Part Two of Four

EDITOR'S NOTE: Last month Jan-Eric began construction of his small engine which he describes as a simple project, perhaps not for complete beginners but certainly suited to model engineers of limited experience. While the drawings are sized for a metric model, Jan-Eric also described last month how the model can also easily be scaled down to easily suit imperial dimensions. Details of how to obtain last month's issue can be found at the end of this article.

Cylinder base

The base, Part 6, is made of brass. It has three threaded holes that will enable the cylinder to be firmly attached to the engine base plate. I used M4 bolts for this, but any thread of roughly that size will be fine. For silver soldering, the base should be attached to the cylinder with two small screws – steel will do, since they will not be in contact with steam or water. The dimensions of these screws (thus also the holes and their recesses, as well as the threads in the cylinder) are not critical, they are just for holding the pieces together during soldering – I chose M3.

The base might be made a little oversize in height, and milled to exact size after the entire assembly has been soldered and accurately measured – that's what I did. Note: If you used 1-inch stock for the 'converted size' cylinder, this is a necessary step; for such a cylinder, the base needs to be higher than in the drawing; 0.328in



ABOVE: The finished engine.

All photos and drawings in this feature by Jan-Eric Nyström. All constructional drawings reproduced full-size for the metric version of the engine.

instead of 0.313 in.

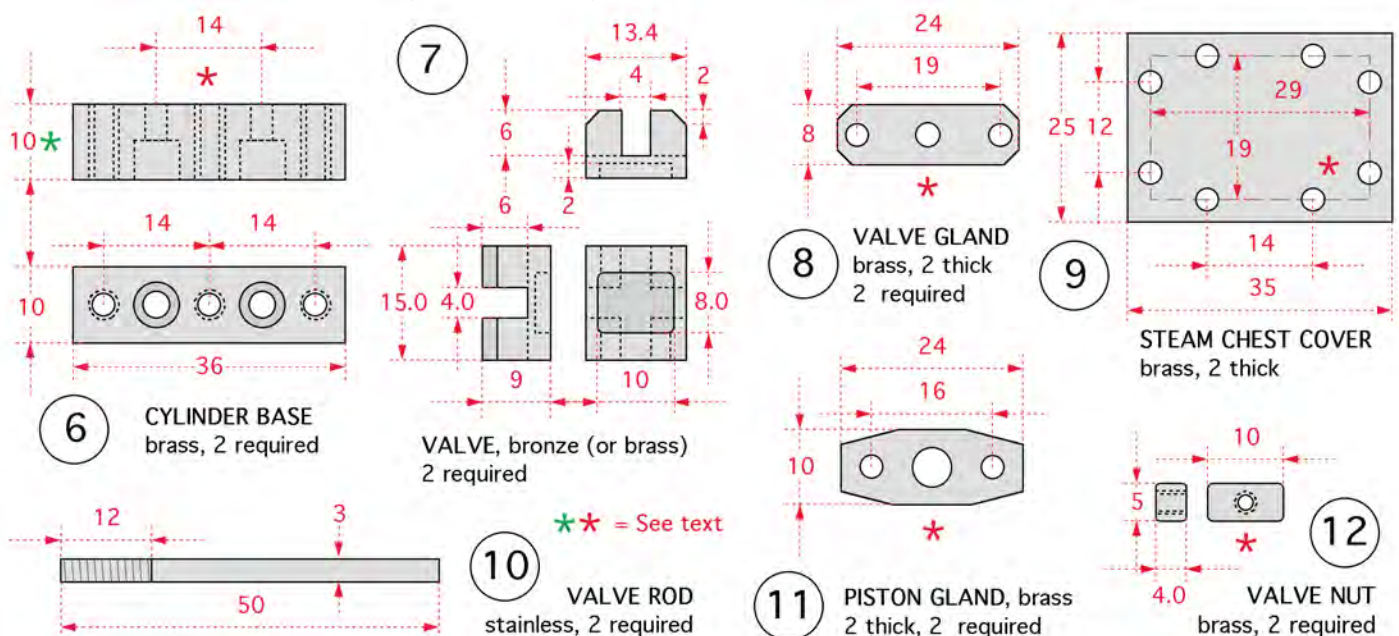
The important thing is to get the cylinder centre line at exactly $1\frac{3}{16}$ in, i.e. 0.813in, above the base plate.

The silver soldering of the base to the cylinder is not a very critical operation, since the base is held in the correct place by the screws. This operation can be done by simply placing the assembly on a firebrick. Never clamp a workpiece to be silver soldered in a vice – the heat will cause expansion, and being clamped, the object will be severely distorted!

When the part has cooled, pickle for 10 minutes in 10% sulphuric acid. Ordinary 35% battery acid, as sold in car parts stores, diluted with two parts of water will do fine. The common admonition regarding diluting sulphuric acid ("always pour acid into water, a drop at a time") applies to concentrated acid – the already dilute

battery acid is not as reactive, so you don't have to fear 'an explosion'. If incorrectly mixed, water added to concentrated acid starts to boil instantly, and will spatter the acid around. In any case, be careful so you don't splash any acid around, regardless of concentration – even diluted, it will burn eyes, skin and clothes. You may not even notice small splashes on your clothes, but in a few days, holes will appear almost magically, especially on cotton!

Citric acid is safer in this respect, but it may be harder to find – try speciality food stores; citric acid is often used in juice and jelly making. Another usable pickle is the 'dry acid'



used in spas and pools (sodium or potassium bisulfate). A 10 to 15% solution of either chemical works well, but acts more slowly than sulphuric acid.

I use silver solder sticks having a flux coating that crumbles easily, so it can be powdered, mixed with water and applied to the surfaces before heating begins. Separate flux powder or paste in conjunction with bare wire works just as well. Check the manufacturer's specifications, and use only compatible materials!

Soldering the port face

Since the steam passages are enclosed between the cylinder and the port face, we need to ensure proper capillary penetration of the silver solder, so that it seals the three port holes from one another, and the outside. This is accomplished by the six punch marks mentioned above: by looking at the assembly from the side, with a bright light behind it, you should see a hairline crack, uniform in width, interrupted only by the little punch mark dots.

After this check, I thinly fluxed the top surface of the cylinder and the bottom of the port, then re-positioned them for soldering. This needs to be done exactly, since there are no fasteners keeping the two parts together during soldering. A couple of punch marks in the 'lips' on the cylinder ends may be helpful, if the fit is very loose. Note also that the steam exhaust hole in the side of the port face should face away from the base already soldered to the cylinder – an error here can be corrected only by plugging the existing hole, and drilling and threading a new one!

In **Photo 1**, I'm heating the assembly. The cylinder rests in a 'cradle' of angle iron held in the bench vice – here, we need the cylinder top to be exactly horizontal. If not, the port face piece may slide away from its carefully adjusted position. I used two hand-held disposable-cartridge torches (one was not enough). A more substantial flame from a larger propane torch would get the parts to soldering temperature much faster, but then there is the risk of the flux 'puffing up' and moving the port face. Pay close attention to this possibility!

Apply the solder through the centre (exhaust) port hole only, taking care not to nudge the port face. Thanks to the clearance provided by the punch marks, the solder will flow all the way to the outside by capillary action, and will emerge as a narrow silver line at all the edges of the solder area. If you don't immediately see the silver line, the temperature is either too low, or you have used too little solder. Here, we should use an ample

"We should use an ample amount of both heat and solder..."

PHOTO 1:

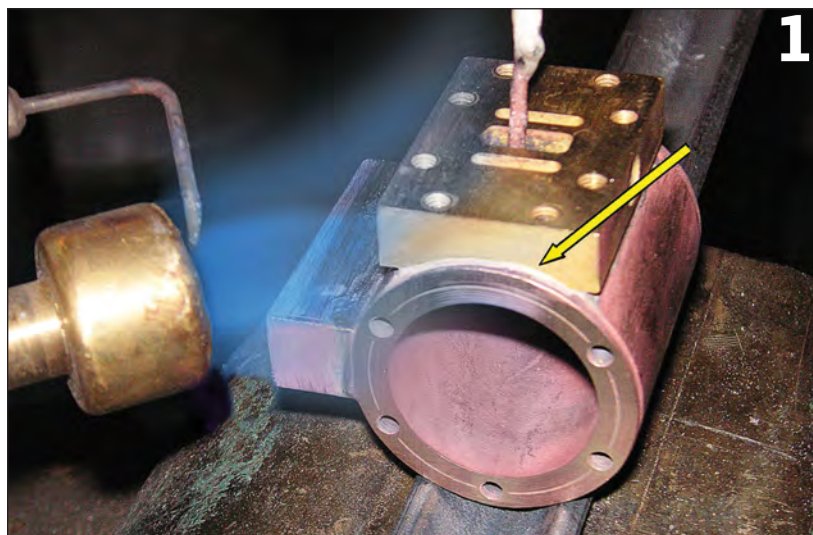
Silver solder is applied through the centre (exhaust) hole in the port face. The arrow shows where some solder metal may have to be added.

PHOTO 2: A

fillet of silver solder along the edge indicates a good joint.

PHOTO 3:

'Chain milling' the opening in the steam chest.



amount of both heat and solder!

The solder should, but may not, creep all the way to the cylinder top edges (at the arrow in the picture)

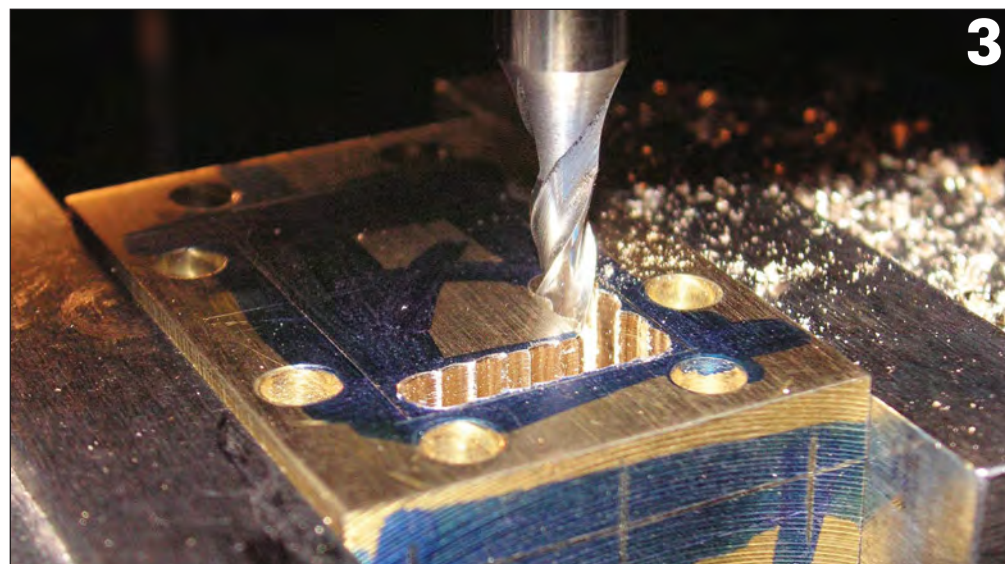
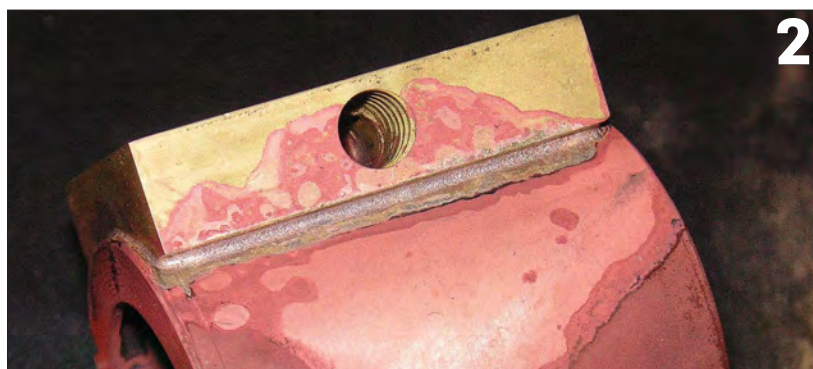
– you can add some solder here, after ensuring that it has first flowed all along the straight, horizontal part of the seam.

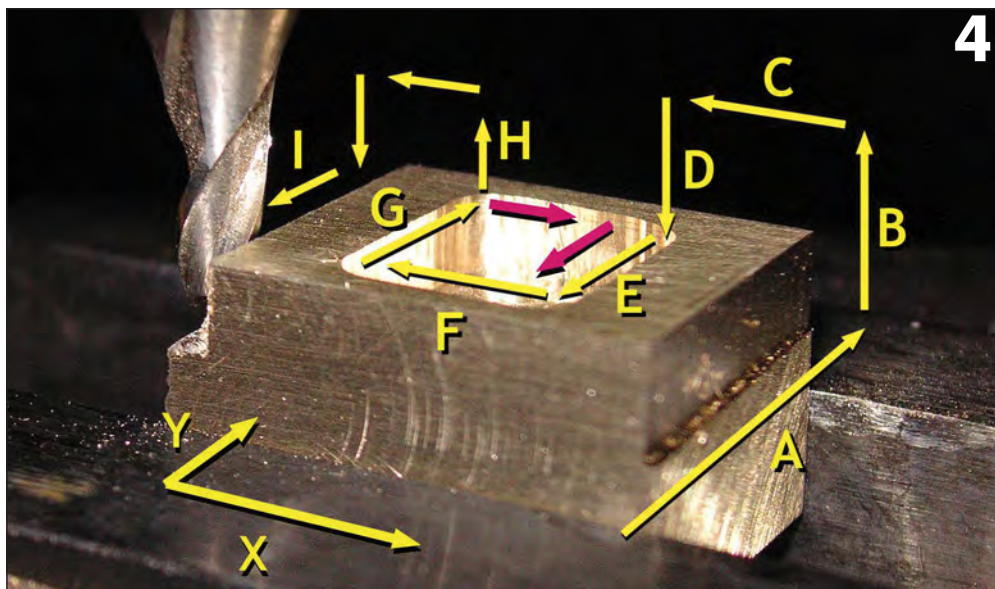
After pickling, check that the joint is good all the way around, with a largish fillet, as in **Photo 2**. This proves that there was enough solder metal used to seal the entire area between the cylinder and port face. If there are voids hidden inside the assembly, there may be a leak between the steam and exhaust ports, and we

don't want any of that! So, if there are any defects in the seam, you will have to re-heat and add more solder.

The steam chest

The making of the steam chest, Part 5, can be done as an X-Y milling operation. I preferred to use slot mills (also called centre-cutting end mills) for the entire operation rather than drilling and filing the rectangular opening. I did some 'chain milling', i.e. plunging the slot mill into the workpiece in overlapping places, separated by half the width of the bit (something you cannot do with a drill), as seen in **Photo 3**. This was





faster than straight milling by slowly advancing the X and Y along the edges of the hole. The latter I did only as a final skimming step, taking the whole depth of the cut in one pass with a 3mm slot mill which was just long enough for the depth.

The corners of the opening do not have to be filed square if the mill is allowed to 'overshoot' in the corners, as shown in the drawing. The slide valve needs to move all the way across the opening, so you cannot leave any rounded inside corners – but round 'outside' corners, like these, are okay!

Valves need exact work

The valves, Part 7, require precision in the milling work just as the port faces,

since the dimensions directly affect the steam distribution. Again, using the graduated handwheels on the mill helped – **Photo 4** shows how I did it:

First, I machined the piece to the exact width, 13.4mm, but left it a bit over-length. Starting from the right (follow the arrows in the photo), I positioned the mill to cut slightly into the right edge of the workpiece, and zeroed the collar on the handwheel – of course, I had taken out the backlash first. Milling in the Y-direction only (arrow A), I made a cut along the edge.

Then, I raised the spindle (arrow B), moved the X-handwheel exactly the dimension of the valve edge surface plus the diameter of the mill (arrow C), locked X, positioned Y for

the cut and lowered the mill back again (arrow D). Next, I could mill the first inside edge by moving Y (arrow E). Coming to the corner, I locked Y and moved X, carefully, in the forward direction only (arrow F), until the next corner was reached.

Now, locking X and moving Y, I got the other inside edge precisely (arrow G). Then, I could go backwards in the X-direction (first red arrow), taking care not to overshoot the first edge E, which was already milled. After this, it was a quick job to mill out the interior of the recess (second red arrow and some more twiddling in X-Y), then raising the mill (arrow H), then positioning Y and X, the latter now reading plus the mill diameter, and finally milling the second outside edge (arrow I).

All these cuts were only 2mm deep (the total depth of the recess in the valve), so they could be made in one pass – very slowly. By using the graduated collars of the handwheels, I could do the entire operation without scribing any marks on the workpiece. If you intend to employ the same technique, it might be a good idea to use a bit of scrap metal for practice, first – at least I did! (That sounds much better than to say that the first workpiece turned into scrap, right?)

PHOTO 4:

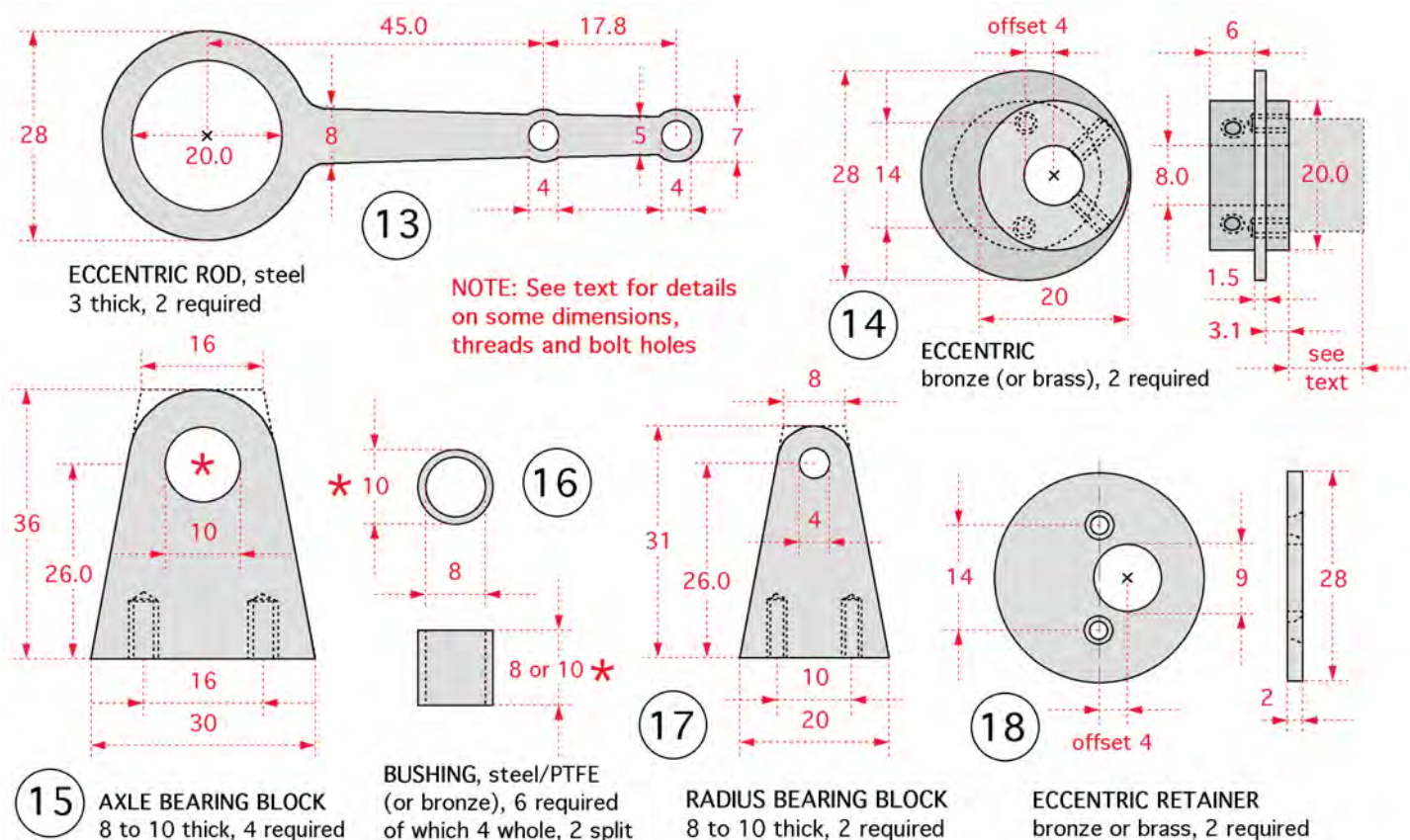
The valve is machined by X-Y milling. The order of the movements is indicated by letters and arrows, explained in the text.

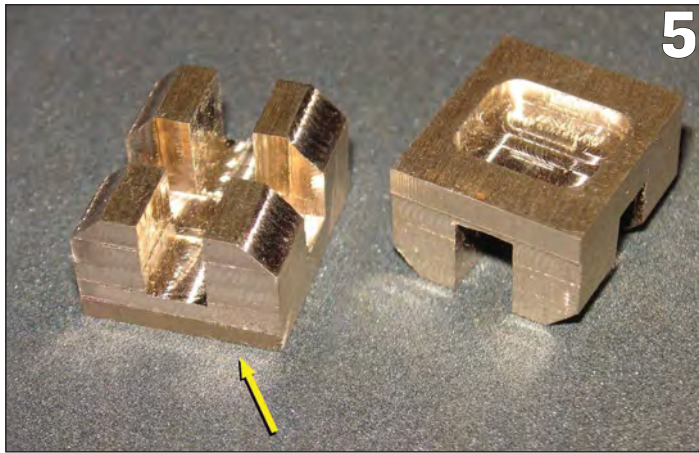
PHOTO 5:

The finished valves. The arrow indicates the carefully milled edge.

Top side of the valve

Turning the valve-to-be over, the milling of the 'cross' was straightforward. Here, a 4mm slot mill was used, giving the exact width with one pass. Care must be taken to





position the cuts exactly in the middle of the workpiece. **Photo 5** shows the finished valves. Here you can see that I took care not to mill the sides all the way down, but left a bit of the edges that were so exactly 'X-Y milled' earlier, at the arrow. Finally, I bevelled the edges by tilting the vice to 45 degrees. This bevel will enable the live steam entering the steam chest to flow more freely over the valve, to the other side of the chest.

To complete the parts needed for the valve, the valve nuts, Part 12, were made by milling a piece cut from 5mm square brass rod. This nut should fit exactly in the slot in the valve, but still be able to move freely. Therefore, after milling to almost the right 4mm thickness, I thinned each nut to the exact dimension by rubbing it on a piece of emery paper, frequently testing the fit until it was 'just right', i.e. an easily moving, but not yet loose fit. If the nut is too thick it will bind, if it is too thin the valve events will be off because of sloppy motion. The valve rods, Part 10, are threaded to fit the valve nuts. The difficult parts are done!

Photo 6 shows the steam chests, valves and valve nuts. These are all rather finicky parts, considering their small size and the tight tolerances! More than a tenth of a millimetre (4 thousandths of an inch) in cumulative errors, and the engine may not run as smoothly as intended...

The steam chest covers, Part 9, need no closer description. I used the covers to hold the steam chest in the four-jaw chuck for the drilling and boring of the recess for the valve rod O-ring. **Photo 7**. Note the roughly hewed, very tiny boring tool, ground from a 6mm square HSS tool bit – the actual cutting edge is only about 1mm wide, but that little edge is ground and stoned to a very fine finish!

Again, no dimensions for the valve rod hole are given in the drawing of the steam chest. Since I use a valve rod 3mm in diameter, and an O-ring 2mm thick, i.e. with an outside diameter of 7mm, the through hole in the chest is

3.2mm, and the recess is 6.8mm, 2.5mm deep. This provides a good O-ring seal, but the valve rod still slides easily.

The 'glands' for both O-ring seals are simple pieces of brass plate, Parts 8 and 11. The centre holes are the same diameter as in the cylinder cover and steam chest, i.e. they also have some clearance for the rods.

Eccentric work

I've chosen to make the eccentric rod integral with the strap, Part 13. The rod can of course be made from a piece of plate, bored and milled all around. Instead, I chose a built-up method, silver soldering a straight piece of steel to a circular one – which actually is a plain, 3mm thick hardware-store steel washer of suitable outside dimension, with only the inside bored to size (these washers were fortuitously found in my scrap box!). The result after silver soldering can be seen in **Photo 8**. To get a nicer, tapering shape to the rod, I milled the edges to scribed marks, **Photo 9**.

After this operation, very little hand filing (or grinding with a Dremel-type miniature tool) will be necessary; just rounding the slight corners that are left after the milling, as seen in **Photo 10**. The 4mm holes in the rod (as well as in all other levers) ▶

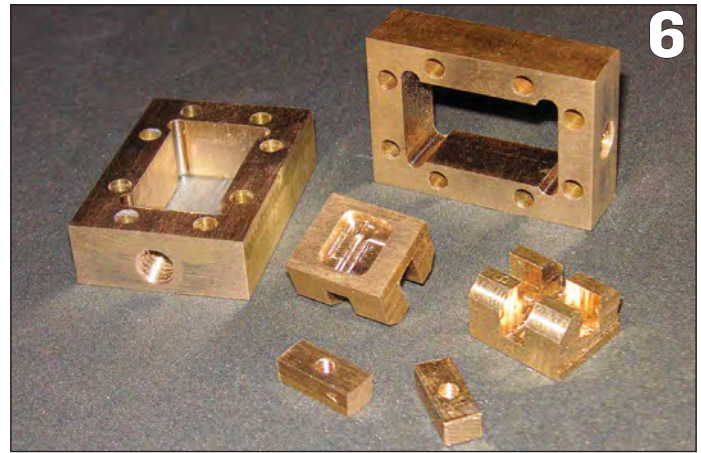
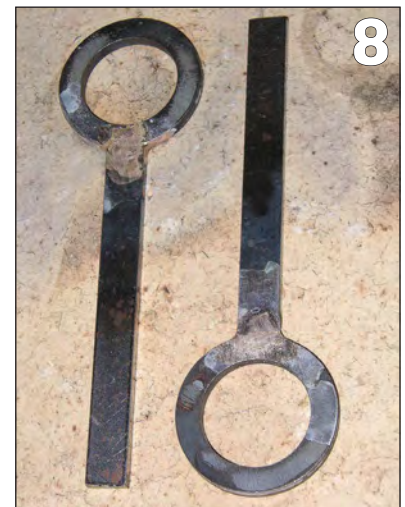


PHOTO 6: Parts for steam chests and valves.

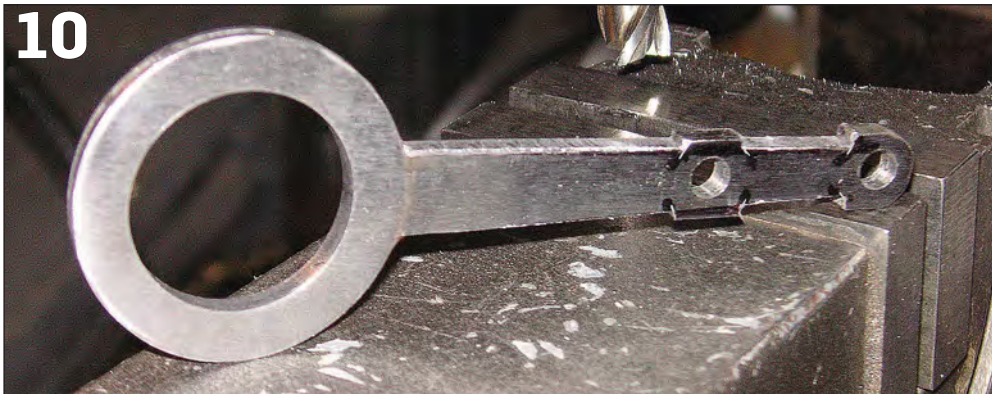
PHOTO 7: Boring the O-ring seat in the valve chest.

PHOTO 8: The eccentric rods, silver soldered from two pieces.

PHOTO 9: Milling outline of eccentric rod to scribed markings.



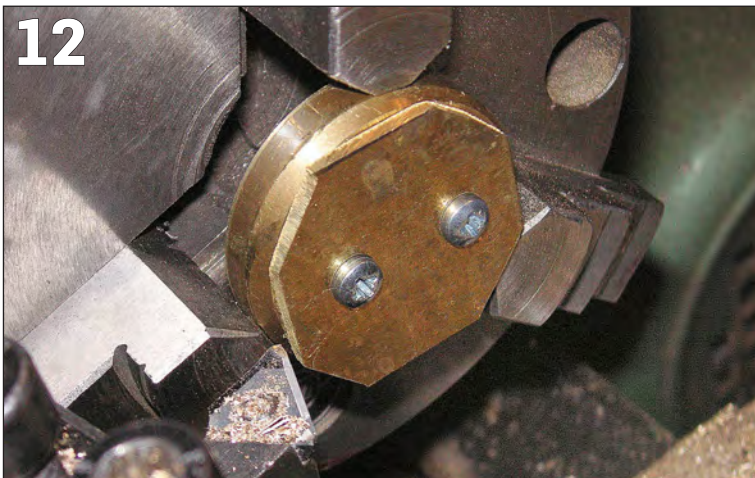
10



11



12



13



You could also make an off-centre collet to hold the eccentric for this operation – then you'd be certain that both eccentrics are identical...

PHOTO 10: The eccentric rod is almost finished, it needs only a little filing.

PHOTO 11: Holding the unfinished eccentric by its spigot in a four-jaw chuck.

PHOTO 12: Roughly cut eccentric retainer ready to be turned to size.

PHOTO 13: The hole in the retainer is opened up using a slot mill.

were drilled undersize (3.8mm), and reamed to the exact dimension. This will provide the necessary precision, so that the valve gear will work as intended, without lost motion.

The eccentrics themselves are split into the main body, Part 14, and a retainer, Part 18. This is necessary since the eccentric strap is not split in the usual way. I first turned the concentric diameters of the eccentric body. A 'holding spigot' on the 3.1mm end, some 15mm in diameter and 10mm in length, is needed in order to provide a means for holding the piece for eccentric turning in the four-jaw chuck, as seen at the arrow in **Photo 11**. I had marked the offset centre with a punch mark, as exactly as I could, and took care to get this to run as true as possible before starting the turning of the 6mm end. Of course, you could also make an off-centre collet to hold the eccentric for this operation – then you'd be certain that both eccentrics are identical!

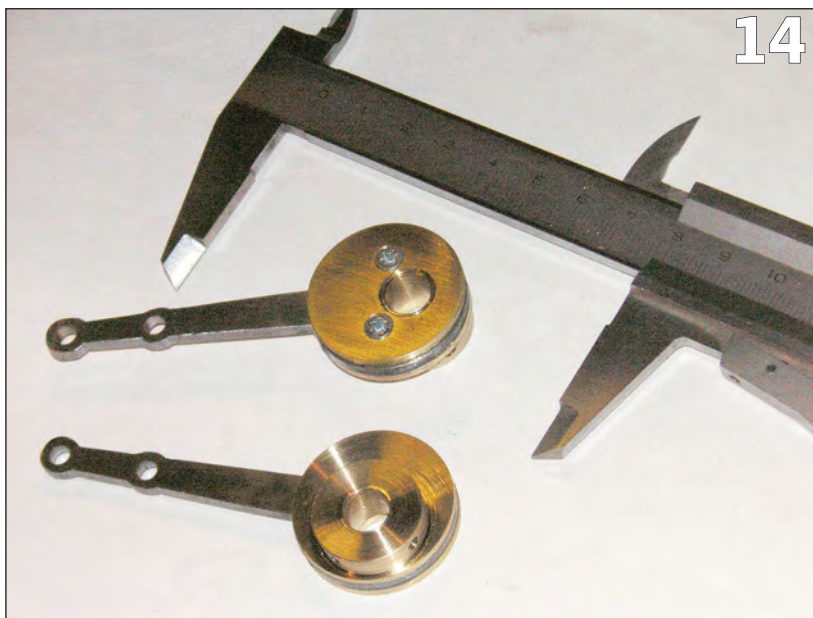
The axle hole was centre drilled, then drilled undersize, and finally reamed to 8mm size without removing the workpiece from the chuck. Next, I could take the piece to the drill press vice and drill the two holes for the retaining grub screws, 90 degrees apart. I then attached the eccentric to a piece of axle stock, and removed the holding spigot on the 3.1mm side.

The retainer plate was roughly cut, drilled and countersunk for the screws, and attached to a piece of round brass (drilled and tapped M3 just as the eccentric, 14mm between holes) to get the outer diameter turned, **Photo 12**. After this, the plate could be attached to the eccentric, now held in a three-jaw chuck by the 6mm end. Then, a slot mill, smaller than the axle hole, was used to open the axle hole in the retainer plate, **Photo 13**. A centre drill can also be used. If the three-jaw chuck is in good condition, the hole in the plate should coincide perfectly with the hole in the body of the eccentric.

The plate can now be removed from the eccentric body, and the hole enlarged to its final size on the drill press. The assembled eccentrics and rods can be seen in **Photo 14** – a test that everything moves smoothly without binding is in order now! The ordinary, 150mm calipers give a scale reference; these parts are pretty small – and will be still 20% smaller if built in the 'converted' imperial size...

Bearings and bushings

The material for the axle bearing blocks, Part 15, can be almost any metal, since there are bushings to take the wear. The machining is simple, marking the outline on the workpiece,



then sawing and finally milling to the line. The top of the bearing blocks can be curved, as in the drawing, or left angular, as in my prototype – this is a matter of taste only.

Care must be taken that the height of the axle hole is exact – 26mm in the metric version, or $26/32\text{in} = 13/16\text{in}$, i.e. 0.813in in the 'converted' version. The actual diameter of the hole depends on the axle and available bushings. I used 8mm steel rod for the main axle, and the bushings have an outer diameter of 10mm. Adjustments will have to be made for axles and bushings in imperial sizes.

I've used low-cost PTFE (Teflon) coated steel bushings for bearings, Part 16, but bushings can also be fabricated from bearing bronze. The length of the bushings should equal the thickness of the bearing block. Two additional, same size bushings, but split into two, are used for the main rods, as described later.

The bushings are pressed into the reamed holes in the bearing blocks using the mill vice, **Photo 15**. This ensures that they enter parallel to the bore. You should obviously not use a vice with serrated jaws for this operation, since that will dent and

destroy the bushing! A bushing, which fits very loosely on its axle before it is installed, will be slightly compressed when entering the hole and will then have the right inner diameter. The thin PTFE coating on the inside of the bushing is self-lubricating, so no oil holes are necessary. A drop of oil at infrequent intervals is useful, but not absolutely necessary when running the engine for longer periods. **EIM**

If the bushings are turned from bronze, they should be a press fit in the hole, or, alternatively, secured with Loctite. An oil hole with a tiny oil cup might be appropriate for a plain bronze bushing.

The smaller 4mm axles in the other bearings are made from drill rod (silver steel). The radius hanger bearing blocks, Part 17, have no bushings. The speed and angular movements are not great, so the wear is minimal.



PHOTO 14:

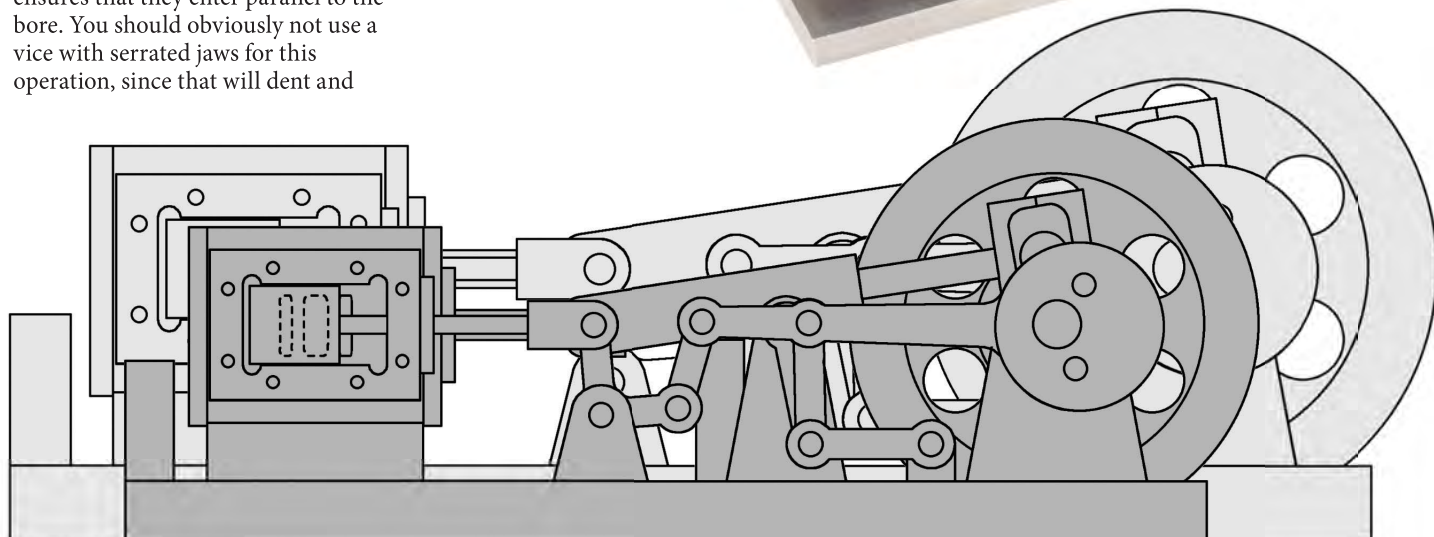
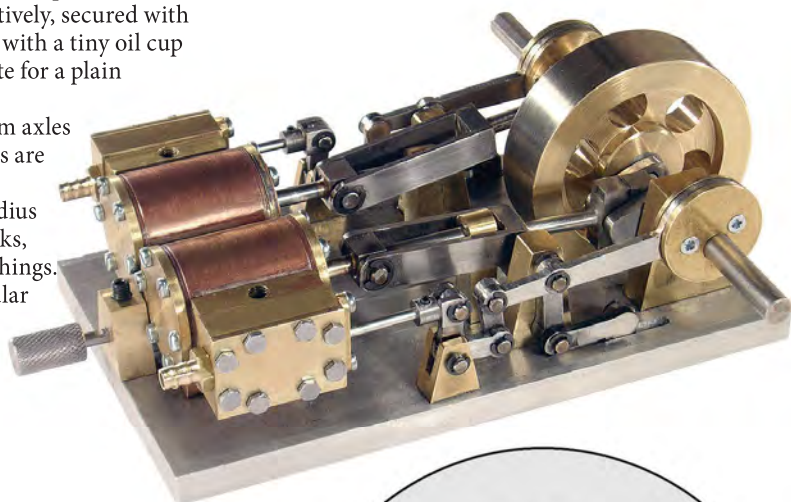
Two eccentrics with their rods. 150mm calipers included for size comparison.

PHOTO 15:

Pressing bearing into axle bearing block in smooth-jawed vice.

■ Part one of this series appeared in the May 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 - PISTON, ROD AND CRANK...



A whisky distillery in miniature

Alan learns the history of a somewhat different model with a great deal of heritage...

BY ALAN BARNES



It is arguable whether a model some 50 feet in length and 10 feet in height should be described as a 'miniature' but the one-sixth scale model of a whisky distillery displayed at the Glenkinchie Distillery in East Lothian is undoubtedly impressive.

The highly detailed model distillery was one of several built for a specific purpose by one of the most historic names in model engineering, Bassett-Lowke. The Northampton firm was commissioned by the Scottish Malt Distillers to construct the model for display at the 1924-1925

ABOVE: The model distillery in all its glory – it is not small...

BELOW: Palace of Engineering at the British Empire Exhibition in 1924, from a contemporary postcard.

All photos by Alan Barnes unless stated.

British Empire Exhibition in London.

The aim of the exhibition was to celebrate the markets of the British Empire, improve trade relations, open new markets for Britain and the Dominion countries and promote Britain's industrial prowess. The idea of an exhibition had been considered in the early 1900s but was abandoned when war broke out between Russia and Japan in 1904. A second delay resulted from the start of the First World War in 1914.

The idea was resurrected in the early 1920s, funding put in place, the

site selected and the infrastructure constructed. The venue at Wembley Park was chosen due to ease of access and a 216-acre site was developed to include lavish display areas and even a new station to allow visitors to arrive in the heart of the show by train.

A large sports ground built within the exhibition eventually became the Wembley Stadium and was completed well ahead of the opening of the Exhibition. The stadium was built by Sir Robert McAlpine and a standard gauge locomotive used on the construction line survived to become part of the private railway collection at Fawley Hill that was owned by the sadly recently-deceased Sir William McAlpine, a noted rail enthusiast.

The British Empire Exhibition was opened on 23rd April 1924 by King George V. It showcased produce and manufactured goods from countries in all parts of the British Empire with custom-built Pavilions for a number of displays. These included the Palace of Engineering and the grand India Pavilion built by architects Charles Allem & Sons, which was modelled, in part, on the Taj Mahal.

British displays concentrated on textiles, chemicals and of course engineering, with almost every major company in the country represented. The exhibition ran for six months during 1924 and then re-opened again



in 1925 until finally closing in October 1925, by which time it was estimated that more than 20 million visitors had seen it. Yet despite the grand scale of the exhibition, support from companies and countries across the globe and the public support, the event made a financial loss of £1.5 million.

A number of companies which were exhibiting at Wembley commissioned Bassett Lowke to build display models – these included Cunard, Boots, Cardiff Docks, the Canadian Pacific Railway and the Scottish Malt Distillers. This last organisation had been formed in 1914 and considered that a scale model showing the workings of a modern whisky distillery would be a way to capture the imagination of the public and promote its product.

Joint design

The model was designed by James Risk, general works manager of the Scottish Malt Distillers. He was assisted by George Cruickshank who worked at the St Magdalene Distillery at Linlithgow. Their design brought together the main elements of a typical whisky distillery that was presented in a linear fashion allowing the production process to be followed from start to finish.

Risk and Cruickshank handed their drawings and details to model-making specialists Bassett-Lowke – while specialising in model railway locomotives and ships this firm had also created a number of other detailed scale models. The plans were certainly comprehensive and this was not just a table top ‘toy’ building. The model when completed was some 50 feet in length and ten feet high. Furthermore the model which Bassett Lowke was being asked to produce would also work and be capable of producing spirit – now there is an idea for the spare room!

It appears that during the exhibition the model was used for demonstrations of the process from the preparation of the barley grain through to the production of the raw spirit. However it is extremely unlikely that the whisky in this state would have been available for tasting as the few months’ duration of the exhibition would hardly have given enough time for the spirit to mature.

The interest shown in the various Bassett-Lowke models at Wembley later prompted W J Bassett-Lowke and his associate Edward W Hobbs to prepare what they described as “a Lantern Lecture – to give a full, true and particular account of the many-sided art of reproduction in miniature”. A set of 130 lantern slides were created along with a set of detailed notes that they considered to



ABOVE: The Glenkinchie distillery in the 1950s. Photo courtesy of the Glenkinchie archive

BELOW: Glenkinchie today retains its Victorian buildings dating from the 1890s – the entrance to the visitor centre is at centre and to the left is the distinctive brick-built chimney.

be “the finest and most comprehensive set of lantern slides ever collected to illustrate this fascinating subject”.

The lecture included “some of the latest models and reference and illustrations of the splendid model work there is to be seen at the British Empire Exhibition at Wembley”. The slides and notes were loaned free of charge to model engineering societies, schools and “any individuals who desire to give a talk on the subject of models and model making”.

It would appear that Bassett-Lowke built at least two whisky distillery models, the one now displayed at Glenkinchie and a second that can today be seen at the Scotch Whisky Heritage Centre in Edinburgh. Following the end of the British Empire Exhibition the Scottish Malt Distillers model was loaned to the Science Museum in London where it remained on show until 1948.

As Bassett-Lowke had produced a miniature distillery which actually worked the model was subject to

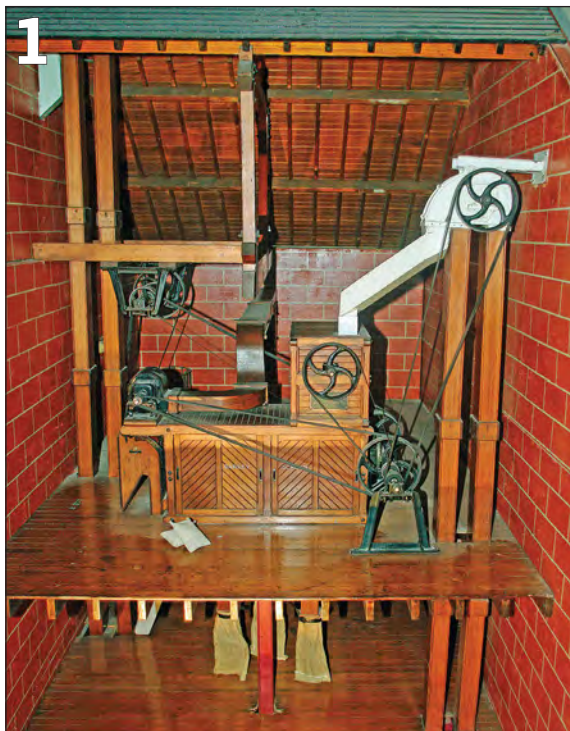
inspections, twice each year, by the Customs and Excise to ensure that it had not been used to produce illicit whisky! These regular inspections apparently continued even after 1948 when the miniature distillery had been dismantled and placed into store.

Hidden away

The model remained in store in London for the best part of 15 years until, in 1963, the Science Museum returned all components to The Distillers Co Ltd, which by that time had become the parent company of the Scottish Malt Distillers. Distillers appeared to have no plans or even any inclination to rebuild and display the model so it was put back into storage, this time in a barley loft at the Mortlach Distillery in Dufftown.

Tucked away out of sight, the model was largely forgotten about for another ten years and would perhaps still be in that barley loft had it not been discovered in 1974 by Alistair Munro, who at that time was the





manager of the Glenkinchie Distillery.

At Glenkinchie part of the distillery had already been given over to a heritage museum and Alistair thought that the model would make an excellent addition to the display. As Glenkinchie was no longer malting its own barley the old malting floors had been used for the heritage museum displays – these detailed the history of the distillery which had been established in 1837. Part of one of the old floors would make an ideal location for the Bassett-Lowke model.

It took more than three months of careful painstaking work to identify all the components of the model and establish just how the thing went together. Each part had to be carefully

checked over and those which needed any repairs identified.

Two years of repair, refurbishment and construction work followed as the model distillery was slowly erected on the malting floor. The work was finally completed in June 1976 and visitors were once again able to see the intricate details of the Bassett-Lowke model which had last been on display in London in 1948. However the reconstituted model was no longer in working order so the issue of regular Customs and Excise inspections no longer posed a problem.

The process

As mentioned the model traces the process of whisky production from

PHOTO 1: The journey of the grain begins in the receiving room where it is cleaned...

PHOTO 2: It will spend 10 to 12 days on the Germination Floor.

PHOTO 3: The pagoda roof was typical of distilleries though Glenkinchie did not have one.

PHOTO 4: In the Mill Room further dressing removed any remaining shoots.

PHOTO 5: Barley grist mixed with water in the Mash House.





the delivery of the barley, through the various stages and on to the production of the raw spirit. This process begins with the raw barley being delivered to a **Dresser** (Photo 1) which removes stones and unwanted debris. The cleaned barley is then delivered to the loft area to be stored on the **Barley Floor**. From there it passes to the '**Steeps**', large tanks in which water is added to start the germination process. The barley grain is taken from the Steeps and spread on the **Germination Floor** (Photo 2) where it will continue to germinate for around 10 to 12 days.

After germination the grain will be moved to the **Drying Floor** (Photo 3) where heat from the furnaces below passes through the barley. The dried grain then goes forward into the **Bins** where it is kept for between four and six weeks before being passed through another **Dressing Mill** (Photo 4) to remove the shoots and rootlets from the grains.

The grain is then ground and the resulting grist passed through to storage bins above the **Mash Tuns**. (Photos 5-6) Here the grist is mixed with hot water before passing into the Mash Tuns where the fermentation process begins. This process produces

very strong alcohol which is passed through to the **Still House** (Photo 7) where it goes through a double distillation process in copper tanks.

The vapour from the **Distillation Tanks** then passes to the **Worm Tubs** (Photo 8) where the vapour is cooled and the spirit which is produced passes through to the **Spirit Safe** (Photo 9). Here the quality and strength of the alcohol can be measured and then it goes into the wooden **Spirit Receiving Tanks** (Photo 10). The process ends with the spirit being casked and then nature will be allowed to take its course as the spirit is left to mature over several years before eventually being bottled, sold and of course drunk.

Having seen the process in miniature a guided tour of the main distillery will show visitors how the real thing works and it comes as something of a surprise to learn that there are very few differences today compared to around a century ago.

I found my visit to the Glenkinchie Distillery thoroughly absorbing and anyone with an interest in Scotland's industrial heritage will consider a visit worthwhile. The model distillery is stunning, the tour of the main distillery is fascinating and there is the



PHOTO 6: In the Tun Room wooden fermentation tanks dominate the scene.

PHOTO 7: The spirit is produced in the copper stills of the Still House.

PHOTO 8: The spirit cools in the Condensing Worm tubs.

PHOTO 9: The spirit is then passed to the Receiving Tanks.

PHOTO 10: Finally the spirit is casked and left to mature over years.

added bonus of being able to enjoy a 'wee dram' of Glenkinchie's finest malt in the visitor centre! **EIM**

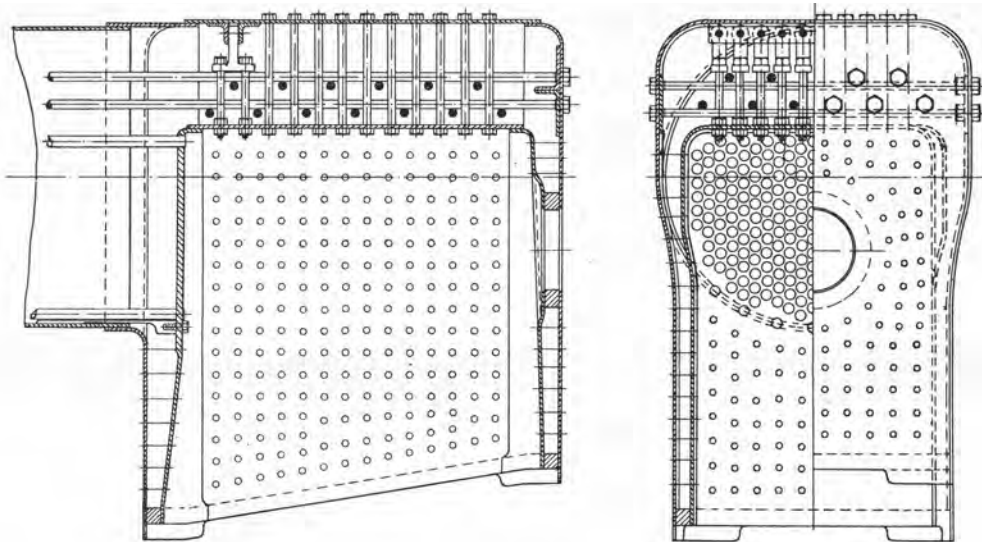
■ Alan gratefully acknowledges permission to use information and photographs from the Glenkinchie Distillery archives. Details of the Glenkinchie tours are at www.malts.com/en-row/distilleries/glenkinchie/



Feeding the fire...

Our series unlocking the intricacies of the hobby for beginners concludes a study of the boiler, by looking at its ends – this month, the firebox.

BY ANDREW CHARMAN



Last month we made a concise study of the boiler, the heart of any steam locomotive. In this and the next issue we will look at its two ends, the fire and smokeboxes.

The **firebox** is of course where the fire is laid to produce the gases that heat the boiler water and turn it to steam. It is actually two boxes, one placed inside the other. The inner one, which contains the fire, is surrounded by the outer, which directly connects to the boiler and thus forms a jacket of water to be heated around the fire. Full-size locos usually have steel outer boxes and either steel or copper inner ones. On early designs the firebox top,

or **crown** was semi-circular until Belgian engineer Belpaire invented a more efficient design that the Great Western Railway's Churchward introduced to the UK. Its crown is flat and the sides slope outwards, creating a larger heating area at the top where rising heat has the greatest effect.

Filling the gap between the two boxes at their base is the **foundation ring**, a bar which on full-size locos is made from steel. A second ring at the rear forms the **firehole**, while the two boxes are braced around their sides and top by many securing bolts made from either copper or steel and either welded in or screwed in and riveted

over the top. These are the **stays** – they are a crucial part of the boiler construction and a regular cause of problems, usually through leaks.

The drawing at left shows the layout quite clearly, while referring to the feature in last month's issue on the building of the boiler for the Dougal project provides clear photos of traditional firebox construction.

The front 'wall' of the inner firebox is the **tubeplate**, on which are mounted the tubes that run through the boiler to the smokebox, as described last month. The open area at the base of the inner firebox, meanwhile, is filled by the **grate**, on which the fire sits.

Grates in model locomotives tend to be one-piece items but on full-size engines even the simplest versions use a line of cast-iron bow-shaped **firebars**. These can be lifted out to help drop the remains of a fire into a receptacle below, the **ashpan**.

Fire risk

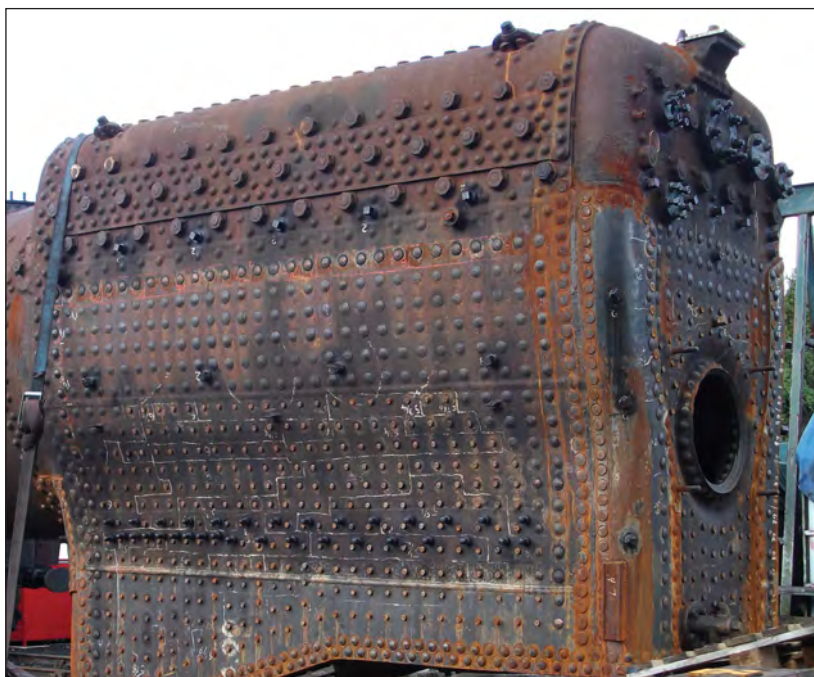
As its name suggests, the ashpan catches the ash that falls through the grate from the fire, to avoid any chance of hot coals dropping onto the track and posing a fire risk. Full-size ashpans are fitted with side or lower doors to empty the ash and they also have doors on the front and back – the **dampers**. These are used to create an air path through to the fire.

Many fireboxes in full-size engines include a **brick arch**. Made of firebricks it slopes upwards and backwards from just above the fire and improves heat generation, mainly by forcing the heat generated at the front of the fire to flow back over the flames before entering the boiler tubes.

The firebox is fed through the firehole in its rear, which is sealed by the **firedoors** – these come in various forms, but the most common are twin sliding doors operated by a single lever. Below or behind these doors is normally fitted a **affle**, a plate that can be raised to partly cover the hole, allowing cold air to get to a fire that needs calming a little. This can also offer protection against a fire 'blowing back' onto the footplate – a sudden rush of air from below the grate, or an opened smokebox, forcing flames through the firehole door. On a full-size loco this can be a dangerous and frightening experience, as this fireman can personally testify! **EIM**

ABOVE: The general layout of a typical Belpaire-type firebox. Note the shape of the inner and particularly outer fireboxes, and the many stays – the very long vertical examples are the crown stays

LEFT: The distinctive shape of a Belpaire firebox is clearly visible on this example from a full-size locomotive.



Dougal - a 5-inch Barclay

With the boiler complete young Sussex engineer Andrew begins construction of the chassis of his entry-level locomotive project.

BY ANDREW STRONGITHARM – Part Three of a series

EDITOR'S NOTE: As Andrew begins to build the chassis of his locomotive, it's worth pointing out that the drawings accompanying this series are the originals from when the model was first designed some years ago.

Like any good model engineer Andrew has adapted these to suit his methods, particularly in fabricating components rather than purchasing and machining cast examples, so in places the described construction will be different to the drawing. For example Andrew used an half-inch steel plate for his centre stretcher whereas the drawing shows a cast version available with the other castings from A J Reeves.

The chassis construction began almost immediately after the boiler was finished. I ordered the castings that I thought I would need from A J Reeves in one job lot and picked these up in person.

I ordered the following cast parts in gunmetal: cylinders, cylinder covers, port/saddle block, steam chest, outer dome and eccentric straps, and the wheels in cast iron. It was the latter that would become a big problem later in the build. The first job was to sit down with the drawings and mark out all the holes that would need to be drilled into one of the 3mm steel plates that would become one of the frames. These marks would be used as a guide to drill from and I used a very good quality steel rule, engineer's square and scribe to do this. In addition I double-checked these dimensions using a very good quality dial caliper.

Drilling the frames

After the holes had been marked I placed both sheets of steel together so that one was behind the other and ensuring that they were perfectly in line, held them with an engineer's clamp at each end. I was then able to put the frames under a pillar drill and roughly drill a hole where each hornblock cut out would be and a third in the middle of the area which would form the cutaway under the firebox. These holes were drilled clearance size for 2BA bolts and were designed to simply hold both sheets firmly together whilst the main frame holes were drilled.

Using the club's Bridgeport milling machine, I held one end of the

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.



ABOVE RIGHT:

The finished locomotive before painting.

BELOW AND NEXT PAGE:

Frame following assembly with buffer beams, centre stretcher and hornblocks.

frames in the vice and the other end was accurately levelled using a clamp set, which in turn was used to bolt down the other end of the frames to the mill table. Starting at the left hand end (front end) of the frames I commenced drilling the holes from a fixed datum point, so if an error occurred during this process I had a point to start back from.

Having drilled the first hole, I used the machine's digital read out (DRO) to move between holes, being careful to drill each one to the correct size as shown on the drawings. In addition I noted each DRO reading for each hole on the drawing in case I needed to refer back. This operation had to be completed in two halves because the frames were too long and exceeded the travel of the mill table. Once all the holes had been drilled, I put some more bolts through the frames to enable me to remove the ones that I had put in initially.

I could now roughly cut out the location of the hornblocks and the aforementioned area beneath the

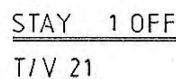
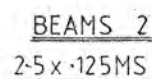
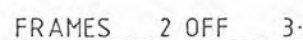
firebox using a hacksaw. Then using a long-series end mill with the frames anchored in the mill vice and with two steel plates clamped either side for rigidity I squared off the hornblock cut-outs ready to fit the hornblocks themselves. Straight afterwards I also finished off the cut-out under the firebox using the more traditional method of hand filing. It was now possible to separate the frames and de-bur every hole with a hand-held countersink.

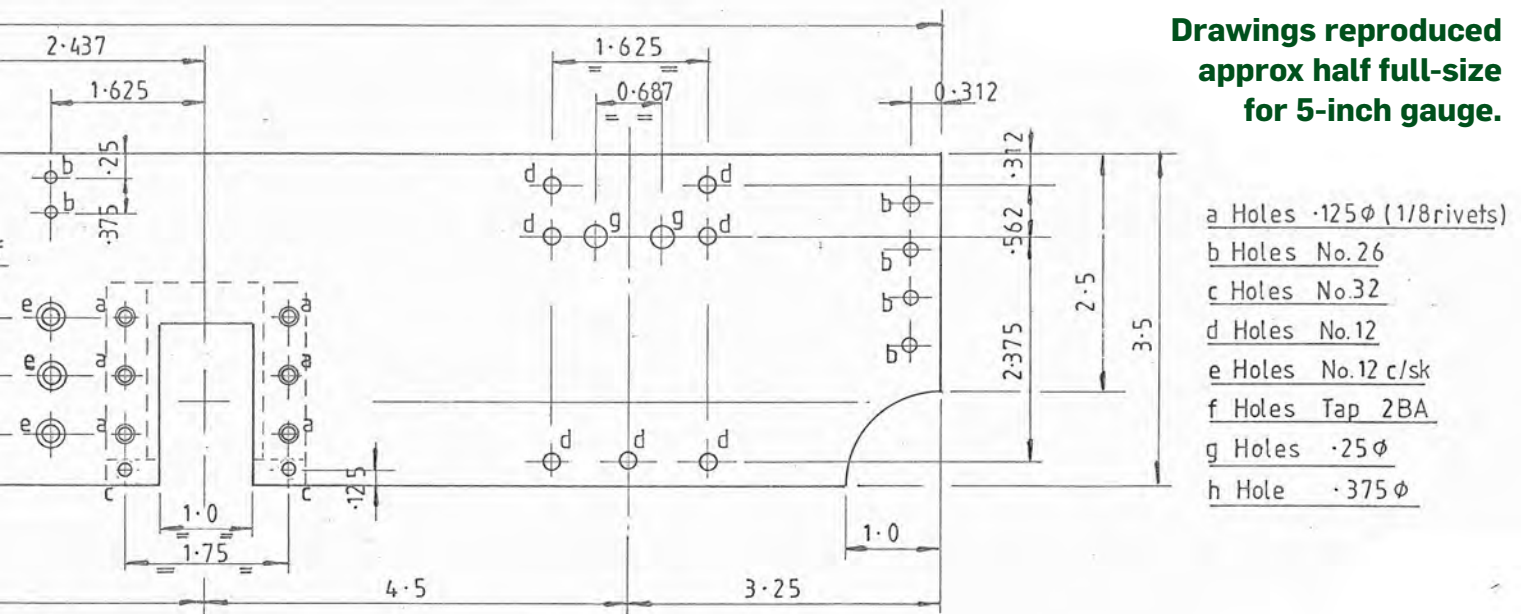
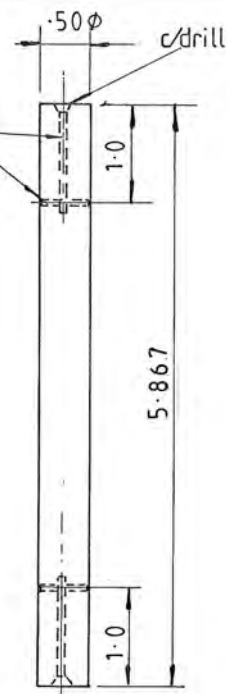
Buffer beam angle

Two pieces of 3-inch black steel angle were obtained for the buffer beams and I cut the majority of one side of each angle off as this would form the top face to bolt the running plates down to. I then milled the remaining angle to length.

Using a $\frac{7}{8}$ in end mill, I milled two slots into the back, the full depth of the angle, into which the frames and pieces of angle used to attach them to the buffer beam would be fitted. I then drilled the eight fixing holes for these






$$\underline{5 \times .125}$$


AXLE 2 OFF
BMS

C.I. m/c at $\sqrt{}$

angles, 4BA clearance size, into the front of each buffer beam together with 2BA clearance holes for the bolts which would eventually hold the couplings on.

Next, I cut up four pieces of $\frac{1}{2}$ in steel angle, the same depth as the front of the buffer beam, clamped each in turn within the $\frac{5}{8}$ in slot and using the already drilled 4BA clearance holes, spot drilled four holes through from the buffer beam. With the angle still in place I then fully drilled each hole for 4BA tapping before finishing off each with a 4BA thread. By using this method I ensured the four holes in the angle would be exactly in line with those in the buffer beam and that the frames and buffer beams would be square to one and other.

The frames were then inserted into the remaining slot and using the same method as described above the holes in the frames were spotted, drilled and then tapped into each angle. Now I was able to assemble the buffer beams and frames, and check that they were straight and square by use of a 24in x 18in surface plate.

I then moved on to making the

centre stretcher which was deliberately fabricated from ½in steel plate for weight and strength – Reeves does offer a cast iron version as per the drawings. Two slots were machined to allow the eccentric rods to pass through it. This stretcher was bolted to the frames by means of countersunk 2BA high-tensile bolts, the method of spotting, drilling and tapping being identical to that used to attach the frames to the angle brackets on the buffer beams. The reason for using countersunk and high-tensile bolts is for strength and because they cannot protrude from the outside of the frames as non-countersunk bolt heads would foul the backs of the wheels.

Own-design couplings

For the two couplings, I produced my own design using a 4in diameter piece of aluminium cut in half. These were a fairly simple shape with large flats machined either side of a $\frac{1}{4}$ in slot, which would accept a coupling bar. I left part of the radius of the material in the middle of the block to give a rounded front to the coupling as per the full size. A $\frac{1}{4}$ in cross hole was

drilled through the slot for a pin to secure a coupling bar in place. The two pins were made out of stainless steel and each one had a 2.5mm cross hole drilled at the bottom for an R-clip to stop the pin from vibrating out of the coupling. Four 2BA fitted bolts were made, again out of stainless steel, to bolt the couplings to the buffer beams. Since the couplings would ultimately be taking the full weight of any train, the bolts had to be strong enough to support this.

The hornblocks, horn keeps and spring keeps were the next three parts to manufacture. The hornblocks are also available as gunmetal castings but again I made mine out of more 1/2in steel angle, spotted, drilled, tapped and bolted to the frames using the same methods as already mentioned. Because it is never intended to remove these, each bolt was secured by a locking nut and high-strength 271 Loctite thread locker.

Once secured, these hornblocks were machined in situ, square across the frames using a similar clamping method to that used to initially machine the cut-outs in the frames. It is essential that both axle boxes are





dead square across the frames to ensure the axles turn freely and the axle boxes can move up and down in the hornblocks.

The spring keeps were made out of $\frac{1}{2}$ in square steel and I milled two $\frac{3}{8}$ in counter bores into one face on each of them for the top of the springs to locate into. I made these counter bores to a slightly larger diameter than the springs, so that they would slide easily within them. The spring keeps were then welded to the top of the hornblocks, making sure that the spring counter bores were facing down! At this stage I had already calculated an approximate finished weight for the locomotive of 120lbs and therefore selected eight coil springs of suitable diameter and gauge.

The horn keeps were thin strips of $\frac{3}{16}$ in x $\frac{1}{8}$ in steel bar drilled out for 8BA clearance and then nutted and bolted to the frames beneath the hornblocks. Since these are ultimately removable, I letter stamped each one with the position on the locomotive where it comes from. For example my method is LL = left leading, LT = left trailing, RL = right leading and RT = right trailing. This may sound very fussy but I can assure you it makes future assembly and disassembly so much easier and quicker.

The four axle boxes were the next parts to machine and these were made out of square meehanite (very good quality cast iron), which a fellow club

member kindly donated to me. Each axle box was machined externally to size on the aforementioned Bridgeport mill. Once all four were exactly the same size, I then levelled each in turn with the end of the mill vice and machined the slide ways using two fixed settings on the DRO.

Machine with care

By using the end of the mill vice as a datum point you can therefore ensure each axle box to be the same if machined with care. If you use this method, be careful to place an identically sized piece of material in the opposite end of the vice jaws (another axle box would be fine) to prevent the jaws from tapering and therefore not holding the work fully.

Once the slide ways were finished and tested in each hornblock, another two counter bores were inserted into the top face of each axle box to support the other end of the springs. This would ensure that they didn't fall out while the locomotive was running. I then moved back to the Myford lathe and bored each axle box over size and inserted a steel bush inside which could easily be replaced if the axle boxes ever wear out in future. Each bush was secured using Loctite 648 retainer, which can be later removed using approximately 200 degrees centigrade of heat.

The axles themselves were made out of $\frac{1}{2}$ in silver steel and I first

“They cannot protrude from the outside of the frames as non-countersunk bolt heads would foul the backs of the wheels...”

centred them using a BS2 centre drill before very carefully drilling a $\frac{1}{16}$ in hole, 1in deep (using a top quality HSS drill with copious amounts of oil) into each end. This hole met with a cross hole in line with where the centre of the axle box would sit on the axle. This meant that I would be able to lubricate the axle boxes by oiling through the centre of the axle as well as provide a means of holding the completed wheel sets in the lathe between centres.

Roughly $\frac{1}{8}$ in in from each end, I turned a 4 thou deep by $\frac{1}{4}$ in long ‘Loctite groove’ on both axles. These allow the wheels to locate on the axle whilst also allowing the Loctite 648 retainer to properly set in the groove between. As a small digression, when you use a Loctite retainer in particular it is essential to ensure no air is present otherwise it will not properly cure. Only a very shallow groove is required to trap the Loctite (roughly 3-5 thou deep), however do not attempt to use a Loctite retainer without the aforementioned groove otherwise it will not cure properly and therefore have considerably less strength. **EIM**

ABOVE LEFT:

The typically industrial-type coupling blocks were designed by Andrew. Bolts holding footplate down are temporary.

BELOW:

View in the workshop as the build progresses. Frames shown with axleboxes and axles in place.



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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Previous Episodes...

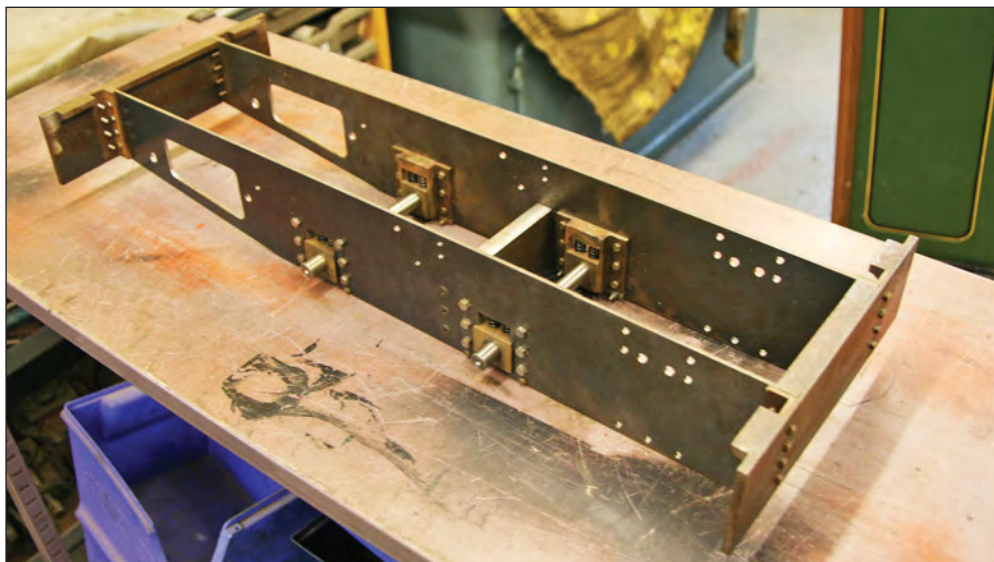
Introducing Dougal
Building the boiler

April 2018
May 2018

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Coming Next Month...

“It was at this point that I noticed that the boss wasn't central with the hole for the axle...” – The wheels cause Andrew some challenges...



Walschaerts motion – but it's very easy...

Bernard begins an in-depth study into a propulsion system core to many locomotives but which still causes nightmares for many a model engineer...

BY BERNARD FARGETTE



At first sight, Walschaerts motion has something mysterious about it; how does this series of connecting rods and links manage to give the valve proper movement to admit the steam at exactly the right moment into the cylinder? In addition to the change of direction of travel, this Walschaerts valve gear allows a variable expansion of steam in the cylinder, that is to say that one can stop the admission of steam before the piston has reached the end of its travel, which allows the steam already present in the cylinder to expand, increasing efficiency.

One can only admire the ingenuity of the Belgian engineer Egide Walschaerts who invented this system of motion in 1844, at the very beginning of the development of steam locomotives.

When I showed my engine and its valve gear to a railway enthusiast friend and electrical engineer, he immediately imagined an electrical system, or rather electronic control for the valve to replace all this complicated assembly of connecting

ABOVE: Seen here is perhaps the most famous example of Walschaerts motion. Photo: Eddie Bellass

BELOW - FIGURE 1: The general arrangement of a Walschaerts valve gear.

rods. Of course, it is possible, but the fascination with the movement of the rods would be lost. It would be as easy to build an electric locomotive, if one likes to use such processes.

I would like to try to give the reader an insight into this mysterious valve gear, from the simplest to the most complicated of explanations. The title of this article paraphrases that of a book published in France in the 1950s; *The radio, but it's very easy*, in which the author, E. Aisberg, started from the simplest component, the

diode, then worked through the triode, then the penthode, to finish at the most complicated assemblies; the superheterodyne radio set of this period, transistors have not emerged from the laboratories at that time.

Figure 1 shows the arrangement of the valve gear with the name of each of the interconnecting rods.

Let's start with the basics; a simple D-slide valve such as that of **Figure 2**, where the width of the pad is equal to the width of the port **P**. From its centred position, a small displacement ►

FIGURE 1

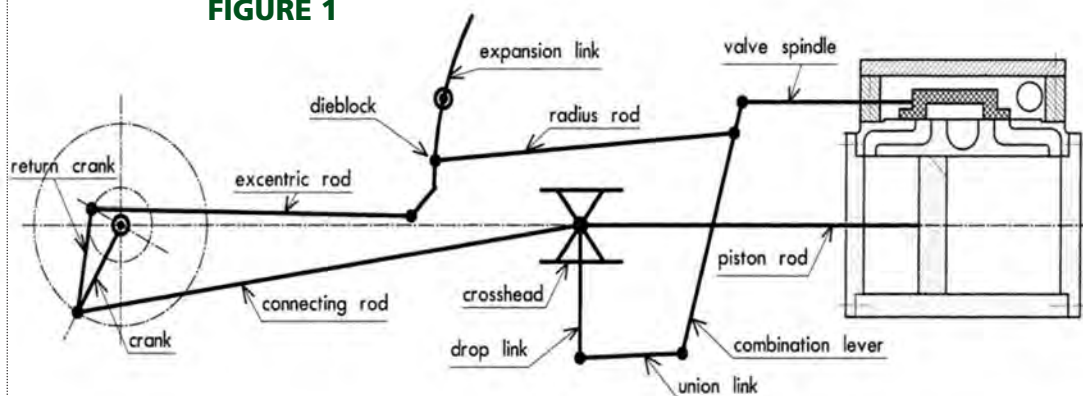
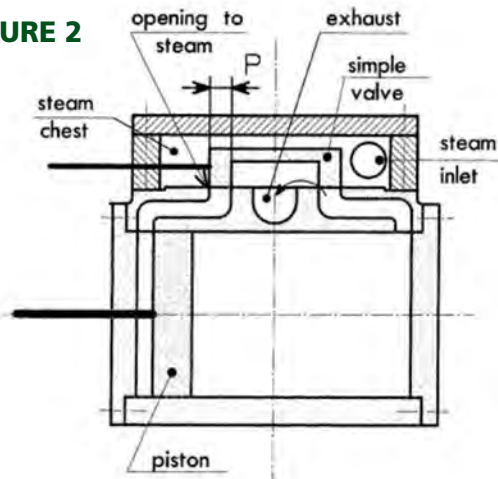


FIGURE 2



of the valve to the right will allow the admission of steam into the left-hand side of the cylinder and exhaust out of the other, which will push the piston to the right and vice versa.

To move such a valve, it is required to have an eccentric set at 90 degrees

to the crank (forward in the desired direction of travel) on the crank axle of a locomotive with internal valve gear – or a pin on the return-crank which is set at 90 degrees to the crank, for a locomotive with external valve gear, as shown in Figure 3 (in the

FIGURE 3

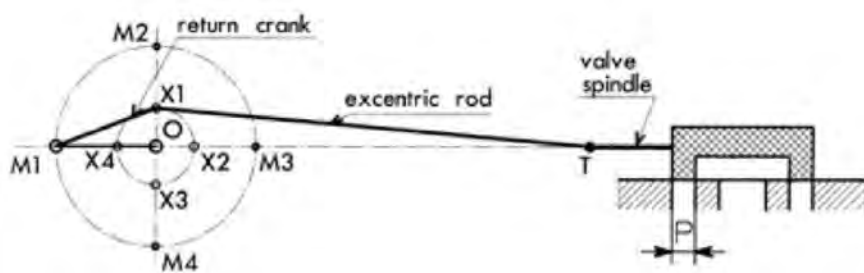


FIGURE 4

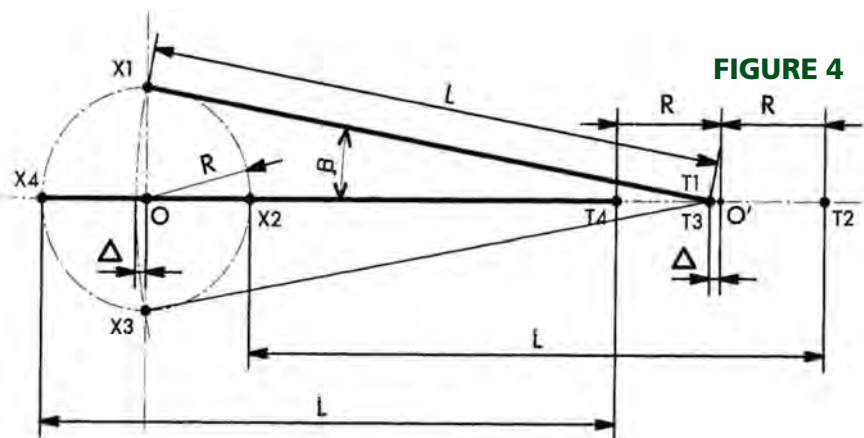
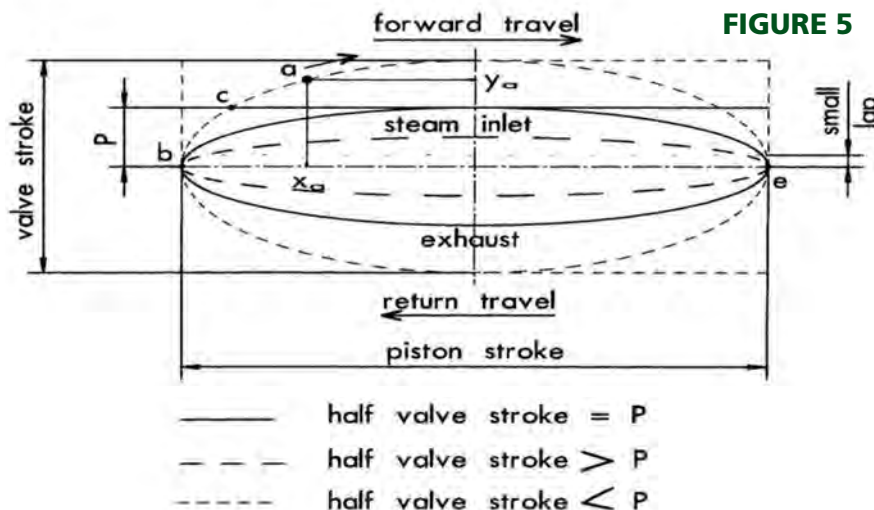


FIGURE 5



ABOVE RIGHT:

Close-up of the 'business' end, in this case on a narrow-gauge locomotive.

FIGURE 2:

Cylinder fitted with a simple D-slide valve.

FIGURE 3:

Direct control of the simple valve by an eccentric or return-crank. X1, X2, X3 and X4 are the successive positions of the eccentric pin when the crank pin goes from M1 to M2, M3 and M4. This diagram only shows the valve gear.

FIGURE 4:

Deviation Δ in the crank connecting rod system due to angle β .

FIGURE 5:

Elliptical diagram in the case of the simple valve. The 'small lap' only slightly modifies the admission phase. Then avoids a cross linkage of the steam from the ports to the exhaust, when the valve is in the centred position (Figures 2 and 3).

following description, all the figures will represent the right side of the engine, facing front towards the right of the picture, with the piston at the rear dead point: crank pin in M1).

With this geometry (a 'no lap' valve), the port is open during the full forward stroke of the piston and the exhaust throughout the return stroke.

Unfortunately with this simple system, it is found that if the return crank is in position X1 or X3, the length of the valve rod is set so that the valve is perfectly centred on the ports, the opening of the ports will not be the same on each side due to the angular change β (X in X2 or X4) as shown in Figure 4.

This disruptive effect will be more pronounced if the radius R is large compared to the length of the connecting rod L . This is the oblique deflection of the rod which is found in any system; a connecting or eccentric rod. The following diagrams will neglect this disruptive effect (i.e. will assume a rod L very long compared to the crank), except where the corrective device is specified.

Valve gear steam diagram

To represent the succession of the different phases of the steam in the cylinder; admission, exhaust, compression, expanding... we use sketches or diagrams to follow these phases during one turn of the wheel.

Among the different diagrams proposed by various engineers and scientists who studied this question (Zeuner, Reuleaux, Reech...), we have chosen to present first the elliptical diagram, the easiest to understand because it is based on Cartesian coordinates. Its disadvantage is that it can not be drawn only 'with the ruler and the compass' like any good geometric sketch and therefore does not allow for precise measurements.

So what does this elliptical diagram look in the case of our simplified valve gear (Figure 5)?

The position of the piston described by the line xa (abscissa) is carried on a horizontal axis, the

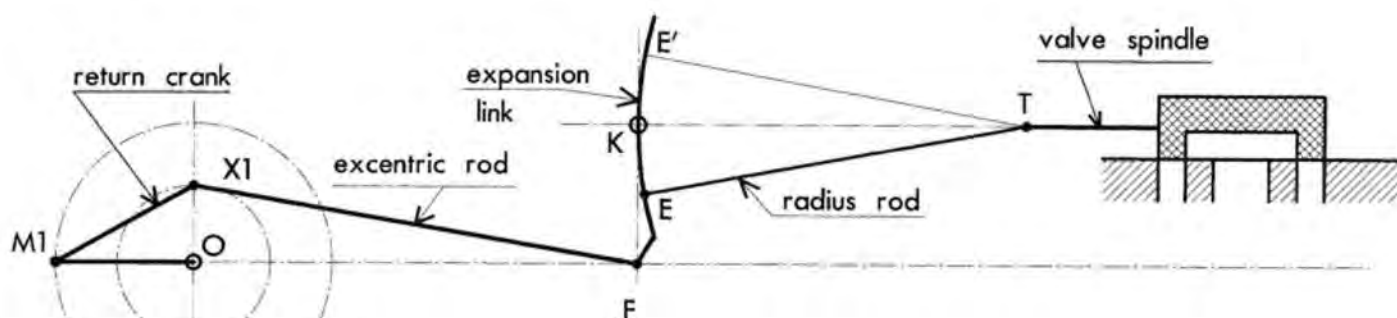


FIGURE 6

position of the valve described by the line **ya** (ordinate) on a vertical axis. The representative point **a** of these different positions then describes an ellipse (a 'crushed' circle, because the valve's stroke is much smaller than that of the piston).

As shown by the dashed line in **Figure 5**, the half-stroke of the valve is greater than the width of the port. It can be seen that the point **a** has passed from **b** to **c**, the valve will be moved quickly by fully opening the port before the piston itself has moved much, and will be closed quickly at the end of the piston travel. This is the advantage of a so-called 'long-stroke' valve gear in real locomotives, in which the steam must move quickly over considerable distances.

However, in the case of our engines in miniature, to make for easier machining, the widths of the ports cannot be reduced in the same proportions, the width of these ports are thus oversized, and the steam paths reduced accordingly. The valve stroke is usually set to fully open the ports, but no more; represented by the ellipse in a continuous line. This limited stroke of the valve also makes it possible to reduce the disturbances induced by the parasitic movements, such as the obliquity of the connecting rods or slip of a dieblock.

Forward and reverse

Such an eccentric (or return-crank) can only move the engine in one direction. So how do we make provisions for a reverse motion?

1 - Two eccentric systems

A first solution is to mount a second eccentric shifted by 90 degrees, but in the other direction and to take the movement either on one eccentric or on the other. At first, this problem was solved by two connecting rods with vee-shaped open ends, one or the other only being engaged. This system was then improved by the use of a link allowing a combination of more or less the movement given by each eccentric as in Stephenson's, Gooch, or Allen valve gears.

2 - Simplified Walschaerts valve gear

Another solution is to retain a single eccentric or return crank, but to have the valve controlled by means of a expansion link, such as that shown in **Figure 6**.

The oscillation movement of the link around the point **K** with the dieblock in the low position **E**, will drive the engine forward, in the same direction as a direct control of the valve by the eccentric, while the dieblock in the up position **E** will

drive it reverse. Note also that the valve stroke is reduced, compared to that given by the direct eccentric, and this in a proportion KE/KF , a proportion that must be taken into account in the calculations to get the right stroke of the valve.

This distribution is represented here (**Figure 6**) 'in line' or 'all square', that is to say that;

- **O** and **F** are on the same horizontal line in the axis of the piston rod.
- **K** and **T** are on the same horizontal

FIGURE 6: Simple valve control by eccentric and expansion link.

RIGHT: The Walschaerts motion in action – the position of the radius rod, ringed in the upper picture, differs depending on whether the locomotive is running forwards or backwards. Photos: Andrew Charman, originally published in The Steam Locomotive Driver's Manual, Haynes Publishing 2015

All diagrams in this feature by Bernard Fargette

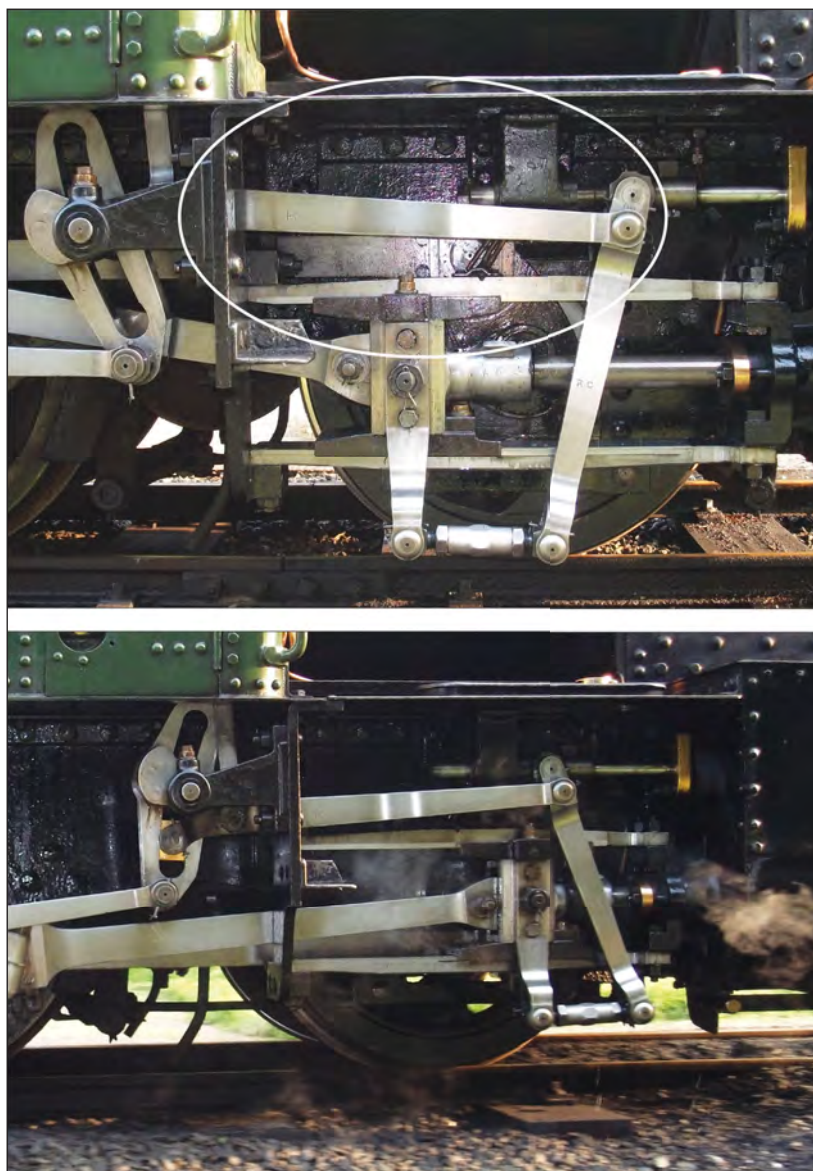


FIGURE 7

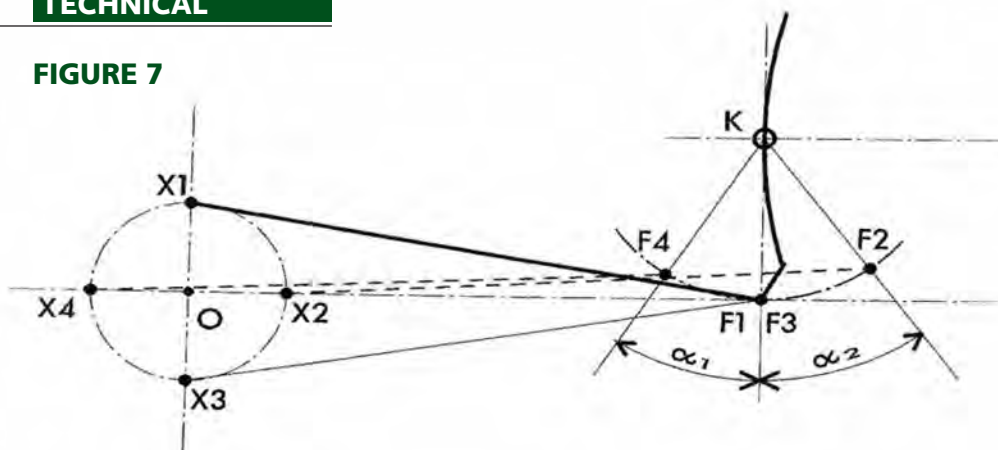


FIGURE 8

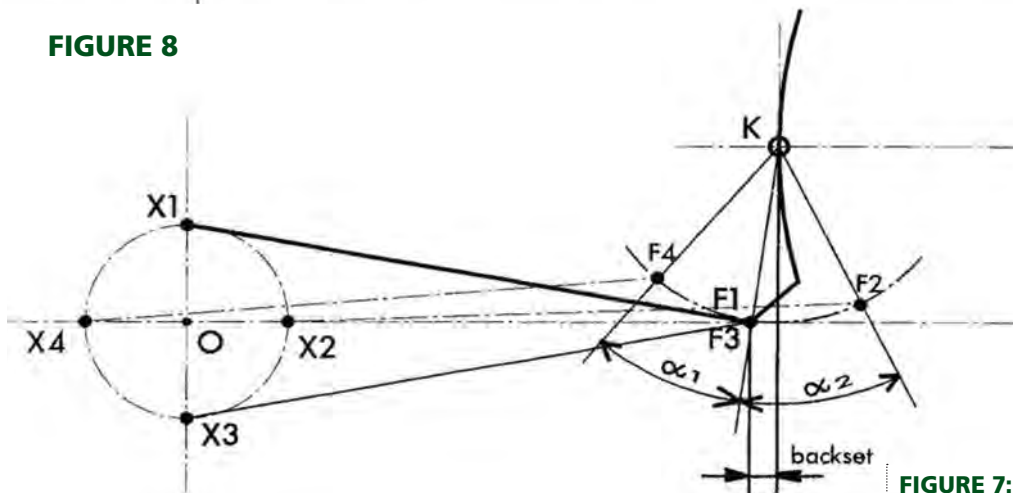


FIGURE 7:

Walschaerts link without backset. Angles α_1 and α_2 are unequal.

FIGURE 8:

Walschaerts link with backset. Angles α_1 and α_2 are equal.

LEFT, BELOW:

Examples of Walschaerts motion, on the North Yorkshire Moors Railway. Photos: Andrew Charman



line in the axis of the valve rod.

Furthermore, the length of the radius rod **TE** must be equal to the radius of curvature of the link slot. Thus, with the link in the centred position (the centre of curvature of the link at the point **T**), the dieblock **E** can move along the link without the point **T** moving, and therefore the valve, has not moved.

In motion, we can change the amount of travel of the valve and even go into reverse without moving the regulator by bringing the point **E** more or less close to **K**.

On a locomotive this arrangement is highly practical because the valve may be located above the cylinder, without the inclination of the valve face and connecting rods as for other valve gears.

A friend of mine had made a 5-inch gauge locomotive with this simplified valve gear, but it has the drawback of high steam consumption.

3 - Backset

With this valve gear, if we want the valve to move the same amount to the right and left around its mid position, it is necessary that it swings with the same angle α to each side of its central position, which is not the case when the angle **OFK** is a right angle, as shown in **Figure 7**.

It is necessary to move the point **F** towards the back of a certain value to find an equal angle of swing each way. This is known as the 'backset' (**Figure 8**) that catches the obliquity defect of the eccentric rod.

It should be noted here that in order to avoid excessive interference effects, the angles α around the mid position of the link must not exceed 25 degrees. **EIM**

Bernard will continue his study in a forthcoming issue. **EIM** technical editor Harry Billmore contributed to the English translation of this feature.

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A twitching mother

The latest in Dave's automaton series is all of a twitch...

BY DAVE ROWE



My stepson gave me a commission and provided a magazine which illustrated what I should make. The accompanying text began "Most mothers would like to have a trap" What? Read again. Then it dawned. He wanted a moth trap, so moth

enthusiasts must be calling themselves 'mothers'. He is also a twitcher, in other words an obsessive birdwatcher who progresses through the world like a very nervous meerkat.

The following Christmas I thought he deserved this automaton which, as it was for an adult with

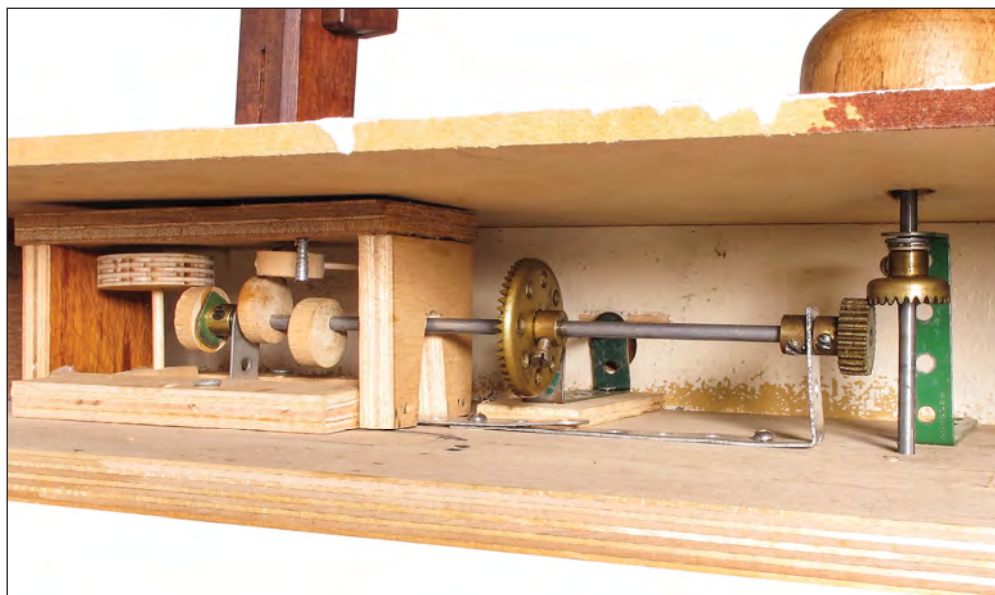
absolutely no interest in things mechanical, did not have the educational viewing window which is important for children.

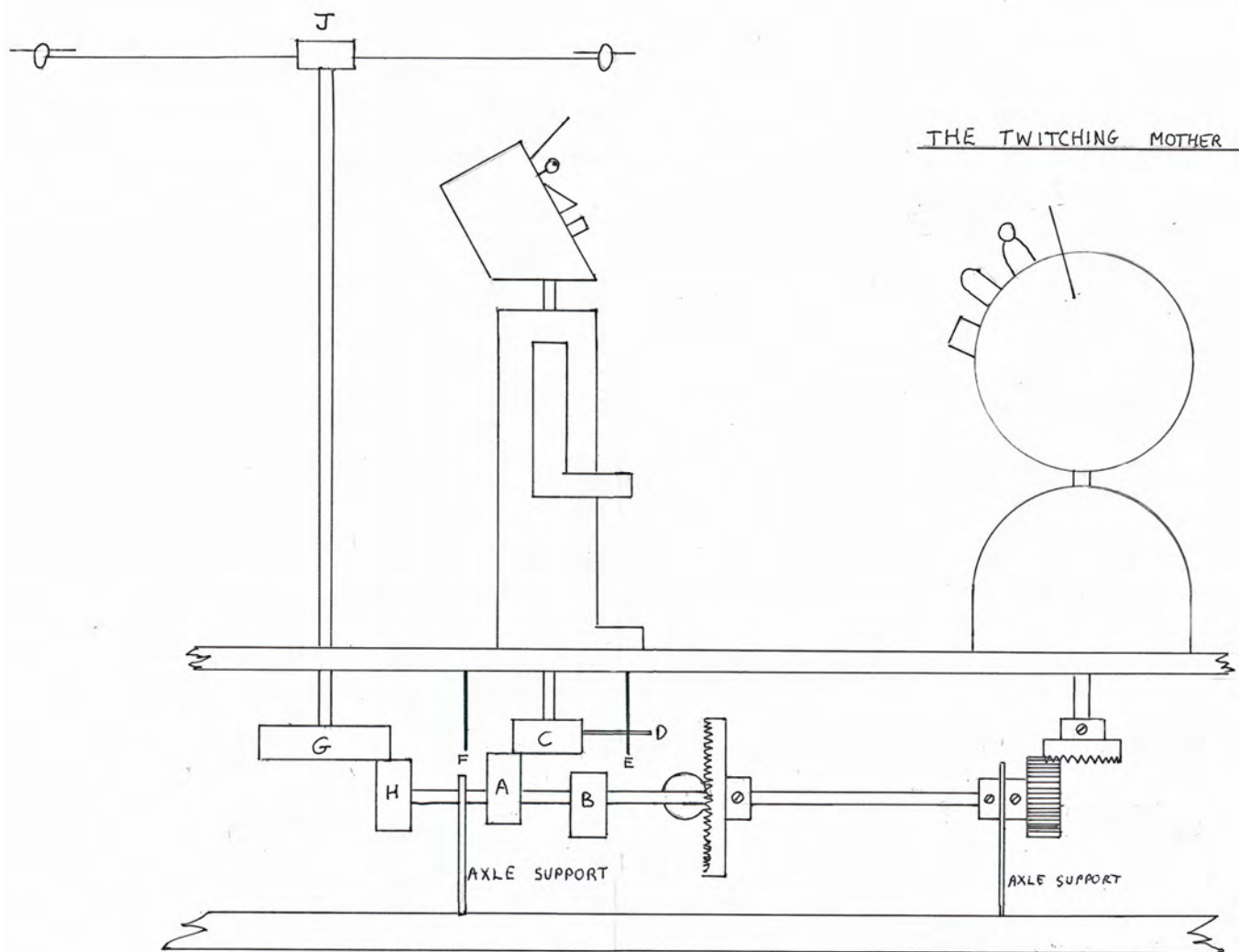
No window meant I could use old oddments of Meccano from my boyhood, and that the workmanship need not be first class as it would be concealed forever (that was so, until a certain editor decided otherwise).

Building the automaton

The basis was a 12mm plywood base, 9mm sides with rebates to take a 6mm ply floor and a 3mm ply front which has the crank. The sides continued up to support a one-piece acrylic cover. This acrylic was necessary because, although the gift was for an adult, he had three energetic young sons and the model had important 0.5mm wires.

The crank started as a 50-tooth Meccano gear wheel. I turned-off the teeth, drilled and tapped a 3mm hole near the perimeter and a 25mm length of 3.2mm brazing rod with a threaded end completed it. The rear of its axle carried a 15-tooth pinion which meshed with a 50-tooth crown wheel





on the Meccano axle running across the model.

A crank on the side of the box and connected directly to the shaft would result in much too fast an action so it needed to be slowed down with gears. It would, I thought, be more aesthetically pleasing to have the highly polished crank in front of a 45mm square of brass sheet and set against the mahogany veneered woodwork.

Under the 'mother' a 25-toothed Meccano crown gear turns a vertical axle via a 25-toothed pinion.

The mother was turned from a 55mm diameter piece of hardwood handrail. A pair of 25mm long, 9 mm diameter wooden beads set halfway into the head with black, large-headed pins formed the eyes, the nose was shaped from dowel and the mouth was 11mm dowel drilled out 7.5 mm, the idea being to indicate that he was going "Ooooh"!

Delicate work

The cap peak was from 0.5mm ply set into a slot cut by a junior hacksaw blade. The only difficult part of the project was, for me, making the moth from the softest down as found at the base of some feathers. The moth was glued to the end of a 200mm length of

0.5mm brass wire. This, as it turned out, gave a most realistic fluttering movement to the rotating moth.

The twitcher was cut from mahogany and the arms added. For the eyes I used large-headed pins but this time chose white ones and added a spot of black paint to represent the pupils. They looked even better when partially inserted leaving 3.5mm of shank – eyes popping out of his head. His binoculars were two 12mm lengths of 5mm diameter dowel and separated by a 5 x 6mm little block.

The transverse Meccano axle has two slices of 18mm dowel, both drilled eccentric and set at 180 degrees to each other on the shaft (A) and (B). A length of 3mm dowel extended from his head right through to another slice of 18mm dowel, this one drilled centrally (C). The simple action is that first one cam then the other comes into contact with (C) and twists his head 180 degrees. Part C needs a piece of cocktail stick (D) to protrude at 90 degrees from the side. Two stops (E) and (F) limit the head's movement to 180 degrees.

At the base of the shaft carrying the birds is a 33mm x 9mm disc (G) which rests on a fourth slice of 18mm dowel (H). At the top, a fifth slice (J) carries two 0.5mm brass wires, each

with a bird on the end. The birds had 1mm ply wings slotted into a 2mm ply body.

Further possibilities

The chance that there is another twitching mother who merits an automaton is about zero, but the mechanism has other possibilities. What about a plane spotter who is mad about butterflies? How about a fanatical tennis spectator at Wimbledon whose head swivels with the match?

Two snail cams (or a double snail cam) could be lifting little rods which fall into a piece of 0.5mm plywood to give the 'ball on racket' pock-pock sound. You would have to experiment with the best size of ply to produce a good pock noise – it would be like tuning a drum.

At a Formula One race a keen spectator's head turns to the right as he hears a car approaching then snaps to the left as it passes by him. There wouldn't have to be a visible car if you could get that Doppler "eeeeoooooww" sound, but on the spur of the moment I can't figure out how to easily produce that noise.

How about five meerkats all on the lookout for danger? Two simple little cams and so many possibilities... **EIM**

ABOVE LEFT:

The completed Twitching Mother, a simple but effective automaton.

LEFT: Inside the box, the mechanics of the model.

ABOVE:

Drawing of the Twitching Mother. Refer to text for letters.

Photos: Andy York, drawing by Dave Rowe

A Savage traction engine

Brian's second major engine build saw him double in scale to 6-inch, and construct his impressive Savage engine 'by the book' – literally...

BY ALAN BARNES



Brian Porritt from Ramsgate in Kent has certainly had a varied working career with experience in a number of industries including building and construction and also commercial fishing.

His first job when he left school was as a carpenter but it was in the late 1960s when he 'went to sea' and

spent 28 years as a successful commercial fisherman. Having to keep his own trawlers in first-class operating condition was crucial to the safety of both himself and the other members of the crew and over the years he gained a wide range of practical engineering skills.

Brian's days at sea ended when he

Brian had already decided that he wanted to build something a little bit different...

took a government decommissioning grant and he was keen to find something where his accumulated engineering skills could be put to some use without having to be bounced around the North Sea on a trawler. He was introduced to his local model engineering club where he met a group of people with a range of interests and an enthusiasm for miniature engineering.

Some of the models at the club were extremely impressive and Brian was tempted to try his hand at building one of his own. He bought a lathe and a small range of tools at an auction and also acquired several handbooks on how to use the various machines and achieve good results.

His first models were small-scale affairs largely built using Stuart castings, but he later progressed to a more ambitious project and spent two years building a 3-inch scale Marshall traction engine.

Once he had completed the Marshall Brian joined the rally scene and for the next ten years the scale Marshall was rallied each season. Then a few years ago Brian felt that it was high time that he built himself

ABOVE AND LEFT: The finished 6-inch scale Savage is an attractive traction engine.

All photos of finished engine by Alan Barnes



another engine and he aimed at something a little larger than the Marshall. A far greater range of castings and parts were now available with many of them being produced to a very high standard. Brian had already decided that he wanted to build something a little bit different so that meant the model would not be a Burrell although there were some excellent drawings and castings for these engines available from a number of sources.

Brian eventually decided on a 6-inch scale Savage 'Little Samson' traction engine and bought the drawings and a complete set of parts from Edward George in Cambridge. He also bought a copy of *Scale Model Traction Engine Design and Construction* which has since become his model engineering 'bible'.

An order for the boiler was placed with Tony Baldwin at AJB Boiler Fabrications in Derbyshire and with a ten-month delivery date Brian had plenty of time to work on other aspects of the build. To ease himself into the project he began with what he considered a relatively straightforward job, the chimney, which he rolled himself and which was completed with a nice brass top. Then his attention turned to the other end of the engine, building the ashpan with the damper and then the grate which he fabricated from some stainless steel which he had in stock. Although the steel was not exactly the right dimensions he hoped that by using the heavier metal the grate will last longer.

Challenge of stock

Using some of the stock materials which he had collected over the years had been one of Brian's intentions when he had made the decision to build another engine. This had advantages and some disadvantages. The thicker stainless steel for the grate made the ashpan more difficult to remove and replace. Brian applied the practical engineering skills which he has accumulated and designed and fitted a sliding trapdoor in the bottom of the ashpan. This allowed the pan to be cleaned out without having to take it out after every steaming and now it is only completely removed at the end of each rally season when the engine is given a thorough clean.

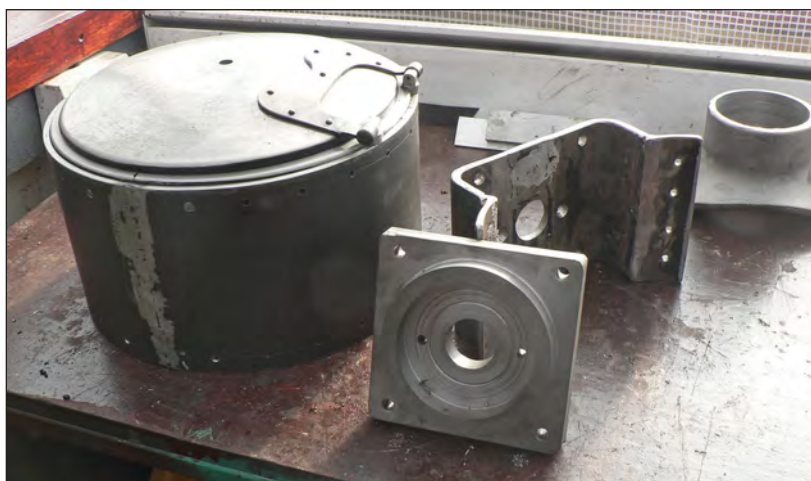
Although Brian has a well-equipped workshop he did encounter some problems when it came to cutting the gears. It was a job which he had never attempted before but he was determined to do as much of the work on the Savage as possible. He started by arming himself with more reference books; *Gears and Gear Cutting* by Ivan Law and *'Dividing'* by Harold Hall. He also bought the four



TOP: Stages in the build – castings for the wheels and cylinder, and hornplates gathered for the project.

RIGHT: The perch bracket, frame and front fork.

BELOW: A host of bronze castings were also required.

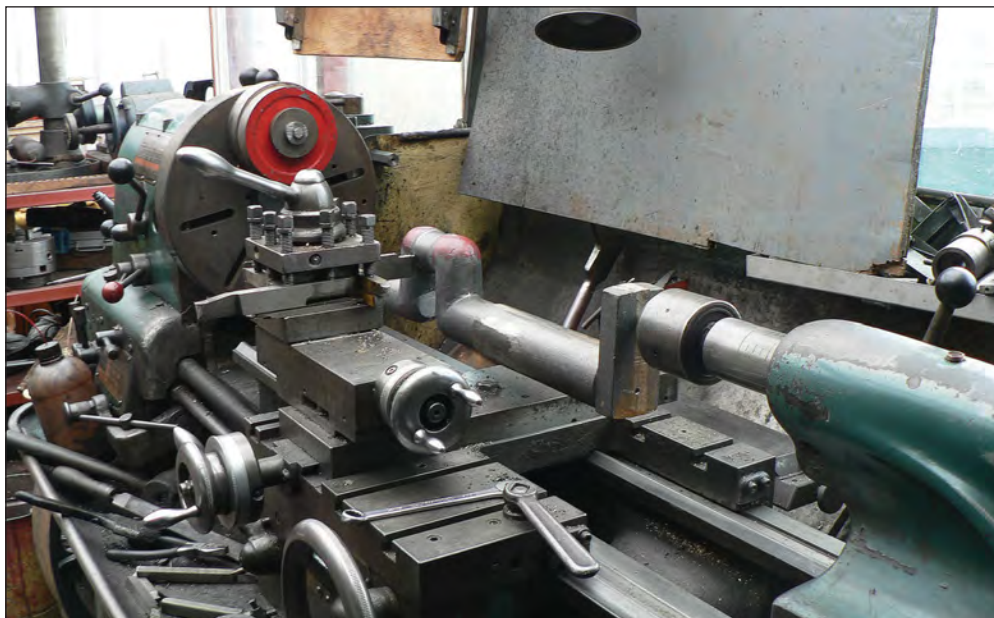


gear cutters which he would need for the job. His own milling machine was too small for the job but fortunately he was able to arrange to use the machines at a commercial workshop owned by one of his good friends.

No divided attention

While the experience of cutting the gears was a new one for Brian it ultimately proved successful and very satisfying as he told me. "My friend and I both learned something new





ABOVE: Lathe set up for machining the crankshaft.

LEFT: Milling the face of the cylinder saddle.

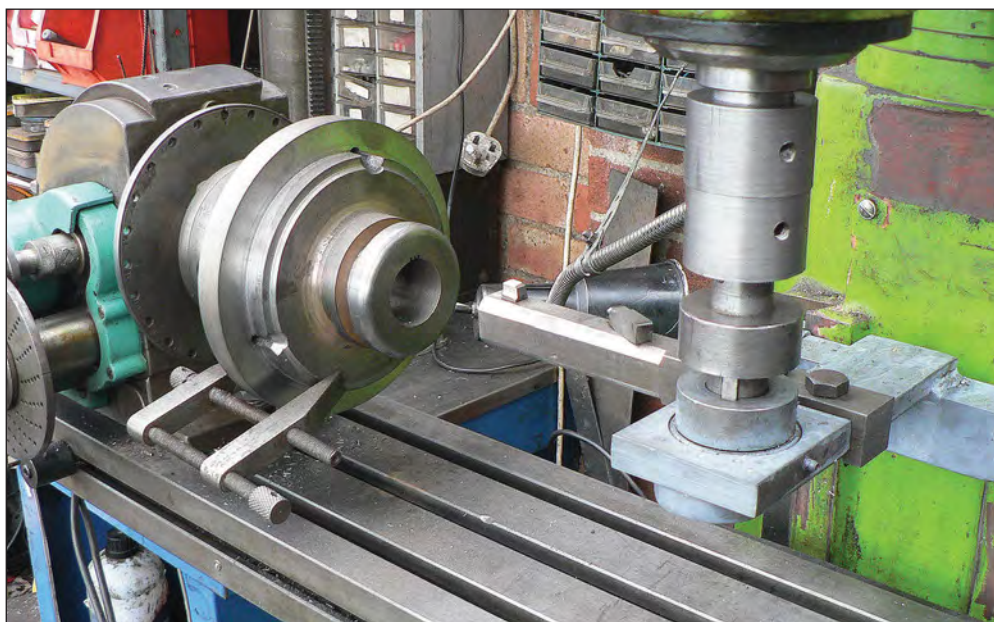
BELOW: Lathe now set to machine internal keyways.

FACING PAGE, ABOVE:

Detail views of the finished engine, paint and lining faithfully replicate full-size Savage practice.

FACING PAGE, RIGHT:

Brian on his Savage at the Bodiam steam rally in 2014, the two are regulars on the rally circuit.



during the work and perhaps one of the most important things was the realisation that you certainly do not need any distractions whilst using a dividing head!"

The ten-month wait for the boiler turned out to be only nine as the new steel vessel was delivered a month early and Brian was able to push on with the build. An advantage of the Savage engine was that the wheels were castings which saved a good deal of fabrication time. However he decided, again for practical reasons to make some non-prototypical changes to the engine.

Designed for two

Notably he fixed the perch bracket, bearing and front axle directly under the smokebox which brought the front wheels further forward. This allowed increased weight to be placed on the tender which meant that two people could ride on the back of the engine without any danger of the front wheels lifting off the ground.

The perch bracket was made from sections of heavy-duty box section which he cut and welded into shape to give a nice radius on each side. As Brian did not have broaches or a shaper he created his own set-up to cut the internal keyways and used homemade tooling. This method was rather slow but the end result proved to be very satisfactory.

Another design change was made to the hinge on the smokebox door as Brian felt the original was on the flimsy side, so he designed and fitted his own version.

The set-up for the machining of the crankshaft included a section of waste material on the end of the shaft which allowed for two centres and this material was removed when the big-end journal was finished. When drilling the saddle the head of the mill was set at the required angle which changed with each of the radial holes. "As anyone who has put together a scale model will know it is the preparation, fabrication and the machining of the parts which takes the time. However the time taken at this stage of the build is very well spent as care and attention to detail will result in a much more satisfactory model."

Brian freely admits that the painting of a model is not really one of his favourite tasks but he was determined to make as good a job of the finish as possible. The secret of a first-class finish is in the preparation of the surface of each part before there is any thought of getting out the brushes. Much time was spent cleaning, priming and rubbing down as any imperfections in the primer would be obvious on the final top

coats. All the parts were carefully brush painted using high quality brushes and working on warm dry days to give the paint the best chance of drying properly.

The lining was applied using low-tack narrow masking tape produced by model maker Tamiya. This needs a lot of patience to apply while some of the very fine lines were applied using an adjustable draughtsman's pen.

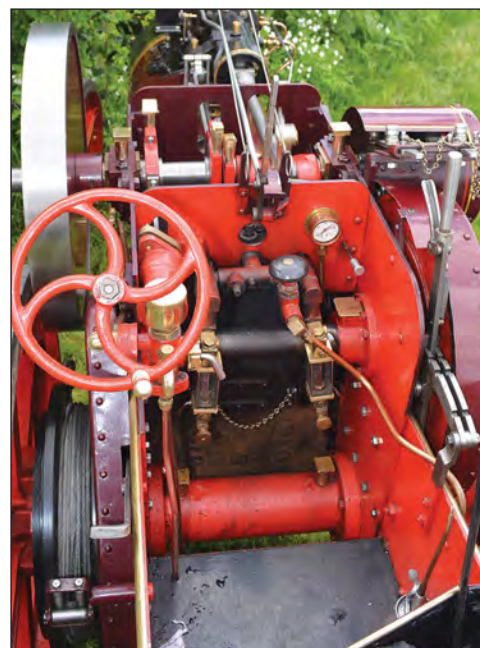
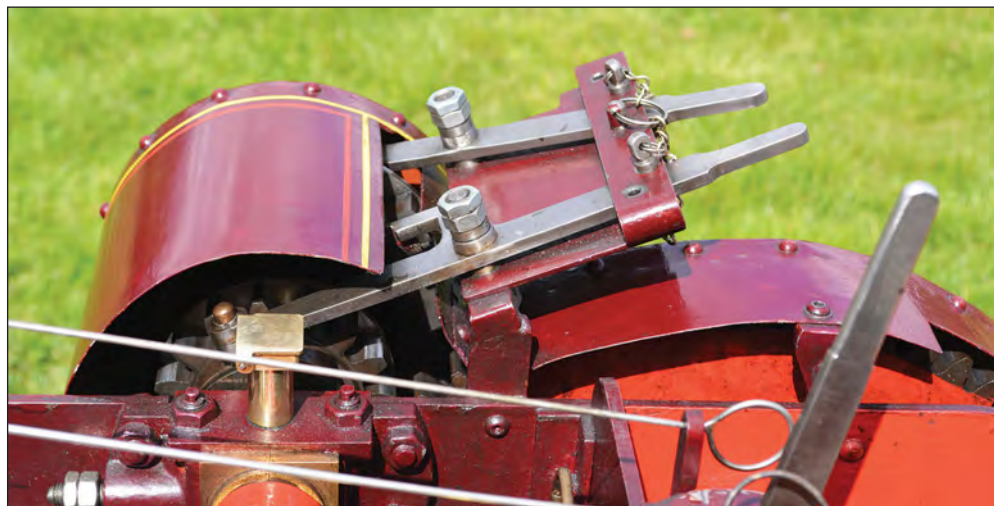
Deadline met

When Brian started the Savage build in August 2011 he aimed at completing the project in time for his 2013 steaming season which would begin in May. Despite one or two problems on the way he was able to keep pretty much on schedule and with the last of the painting, final assembly and detailing completed in early 2013 the completed engine made its debut at the Merton Farm rally near Canterbury, on time in the month of May.

During that first year of steaming the engine experienced a few minor teething troubles which Brian attended to as they arose but there was nothing major to worry about and the engine was taken to a number of events during the year. By the next season the engine had bedded-in well and Brian was very pleased with the way it steamed and handled. He has rallied the Savage regularly since then.

My thanks to Brian for providing the information and photographs on the building of his excellent Savage traction engine.

EIM



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Drawn out – and putting back in...

RIGHT:

Polly Model Engineering is well known for its impressive display of motive power at shows but perhaps not so much for the way the company puts back into the hobby by supporting young engineer initiatives such as that run by the Southern Federation - see the letter from Mike Chrisp. *Photo: Andrew Charman.*

Drawing skills - gone?

In your first editorial on assuming the Editor's chair, in the March issue, you alluded to being told that "no-one does drawings any more" and expressed incredulity that this could be the case. I would like to suggest that it might be true in the sense that no-one does *traditional* drawings any more.

I fear that the well-honed skills of the draftsman have gone the way of many a traditional skill, and disappeared like so much into computers. In my younger years I greatly enjoyed pottering for an hour or two on my drawing board with pencil in hand, but it seems today I must purchase, and even worse learn, a computer-aided drawing program, a modern technology I fear I have neither the skills or in all honesty the patience to learn.

S Hollander

Andrew C replies: I have a lot of sympathy with Mr Hollander's views, particularly as in my formative years it was an unspoken family agreement, originating from I know not where, that I was going to pursue a career as a design draftsman, and my short list of educational qualifications includes A-level technical drawing. I'm sure if I had stuck to such a career path instead of having my head turned by the media I would today be CAD-literate having been forced to learn it to stay in a job!



Unlike Mr Hollander I would like to learn the mysteries of CAD, but time is as ever a factor – perhaps it is something we could look at in these pages. But meantime, is there a good proportion of our readership out there still doing things the traditional way?

Polly deserves thanks

Many thanks for publishing the excellent spread by John Arrowsmith concerning the Southern Federation AGM in the May issue.

John's reference to young model engineers was particularly welcome. It was very pleasing to have the opportunity to recognise the efforts and achievements of five members of the Hereford Young Engineers group

and to acknowledge the time, expertise and experience given freely by their mentors and the support and encouragement of their parents.

I would be grateful if at some future point you could emphasise the importance of the role played by Andy & Jayne Clarke of Polly Model Engineering Ltd, concerning the Southern Federation Trophy & Polly Model Engineering Ltd Prize. It is thanks to their original suggestion and generous support that we have been able to continue with the scheme and to meet and reward the efforts of many young model engineers.

*Mike Chrisp
Awards Officer, Southern Federation
of Model Engineering Societies*

Gordon Smith 1934 - 2018.

■ Gordon was a model engineer throughout his adult life, indeed he probably, like most of us; started with a Meccano set, construction kits and the like. During this time he built many fine models of which just one of these was the Bass 0-4-0 tank engine in 5-inch gauge to perfect scale.

Living in Burton on Trent, where the Bass Brewery was, he would spend a lot of time measuring the preserved engine there. This resulted in the request within our club "do you want some rivets?" because when he ordered the scale rivets for the engine, the minimum order was apparently 20,000.

Other models made by Gordon included a Bass steam lorry, a Rainhill loco, a 3½in Molly and a copy of the Trevithick loco as preserved at the Blist's Hill museum. And then there was of course his Tallyllyn loco. He was building a 'Sir Haydn' loco, also

from the Tallyllyn Railway, before he became too ill to finish it.

Gordon will most probably be best remembered for his range of 'Mild Pop Safety Valves'. One of his jobs was an engineer for the National Coal Board's research establishment at Bretby. He spent most of his time at the collieries working on hydraulic equipment, and the ideas for his range of valves evolved from a type of pressure relief valve he was working with. He used what he learnt in his range of valves to cure a lot of known problems within some of the existing designs and this range of valves is now sold under the Polly Model Engineering name. He also designed a very positive regulator, which was basically a safety valve with an opening system.

Gordon was the type of person to help anyone at any time. When I was putting the winter programme together last year for the Burton on



Trent MES, although he was very ill, he put together a talk about his valves and also found enough energy to attend the Midlands Exhibition last October.

Gordon had suffered with prostate cancer which had also spread into his bones – he was diagnosed in 2016. He leaves his wife Cynthia, son Nigel who now lives in Australia, daughter Angela, granddaughter Morgan and grandson Thomas, who will all miss him very much. As will the Burton MES for which Gordon was the oldest-serving member, head boiler tester for 43 years and our advisor.

*Keith Bloor
Chairman, Burton MES.*

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.

Up and running...

Many clubs have started running trains for the public, planning special open days and making the most of track improvements carried out over a nasty winter.

Compiled by **ANDREW CHARMAN**

As your editor compiles these words a very spring-like couple of days in the past week have been replaced by yet more threats of snow (!), but despite the unpredictable weather many clubs are into their running seasons and planning their summer open days.

One such is the **Melton Mowbray Model Engineers**, which will be holding its annual Open Weekend on 2nd-3rd June at the club's headquarters on the Whissendine Sports Club Ground, Melton Road, Whissendine, Rutland LE15 7EU.

The club tells us that all aspects of model engineering will be on display, particularly steam road vehicles of all scales as well as rail locomotives on the permanent track, supported by a display of model aircraft and an art and craft display.

A feature of the weekend will be daily road runs around lunchtime into the village, either to the working windmill or the local hostelry. We are told these are very popular with exhibitors, visitors and local villagers alike and are always well supported – the mostly uphill return journey makes the engines really work hard.

Sounds like there will be plenty to see at the event, which is free to enter while raising funds for LOROS – Hospice Care for Leicestershire and Rutland. Let's hope that afterwards the club remembers to send in some pictures for these pages, especially of the road runs.

BELOW: The editor could not find his photos of the **Old Locomotive Committee's** show display, so here's a picture of another 'Lion' – actually it's the LBSC design 'Titfield Thunderbolt', developed from the Lion, built by Bill Shakeshaft and displayed on the Chelmsford club stand at the London show in January 2017.

BELOW RIGHT: Rugby member Edward Parrott is producing a natty line in event posters....

FACING PAGE, BELOW: Typical of many clubs, winter track work underway at **Plymouth**. Photo: Ian Jefferson

The **Hereford MES** will be the host on 28th July for the 2018 version of 'Lionsmeet' – the annual gathering of the **Old Locomotive Committee** (OLCO). Your editor, who when not chasing locomotives of narrow gauge has a particular interest in the earliest engines, has often admired the displays the Committee puts on at the Midlands and London shows.

Lion's share

OLCO chairman John Brandrick tells us that all are welcome to the event – anyone who owns a model of 'Lion' (for the uninitiated, the famed 1837 Liverpool & Manchester Railway locomotive that today lives at the Museum of Liverpool Life, and which appeared in the film *The Titfield Thunderbolt*) and who would like to run their locomotive or bring along a Lion under construction, or for that matter a model of any prototype locomotive built prior to the Great Exhibition of 1851, will also be most welcome. An added attraction for those who can stay over for the weekend will be a visit to the Broomy Hill pumping engines, which are next door to the Hereford site at the Waterworks Museum and will be in steam on the Sunday.

OLCO's AGM was held on Saturday 14th April at the Museum of Liverpool Life, by courtesy of Sharon Brown, curator of Land Transport. The meeting was very well attended as it was preceded by a most interesting

talk by author and railway historian Anthony Dawson who has carried out extensive research on the early history of Lion.

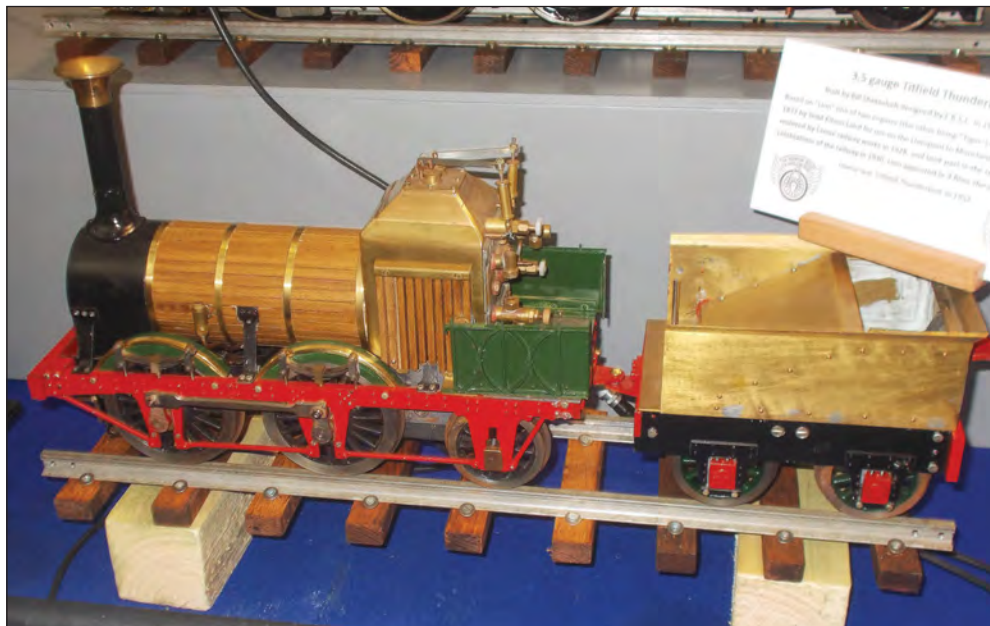
OLCO members were saddened to learn that founder member David Neish died recently. David's Lion, a veteran of many years was a recent winner of the Curly Bowl competition.

Another tempting event in the coming month is the 33rd rally of the **Model Steam Road Vehicle Society**, which is being held on 23rd-24th June at Tewkesbury Rugby Club in Gloucestershire. Between 10.30am and 5pm each day visitors are promised approximately 70 model engines, most of them in full steam showing off their paces in the arena.

Some of the owners will be offering 'driving lessons', giving visitors a chance to get behind the regulator, and for a donation to charity after having a go the participants will receive a Certificate of Competence.

The event will also feature a classic car display, a craft tent, model tent, plus many more attractions. Sounds well worth a visit...

A couple of months ago we highlighted the forthcoming Narrow Gauge event at the **Rugby MES** – as a reminder this will be on 28th-29th July at the Society's Olney Lane track



11th-10th
You are to
Fre

28th-29th July
10:00-17:00
You are welcomed to our special event, Free admission.

Running models of Narrow Gauge engines in 2 1/2", 3 1/2", 5" and 7 1/4" gauge, with an exhibition of other scales and part built locomotives.

If you wish to submit your engine to run, be part of the exhibition or if you have any questions, please email: NGEvent@outlook.com Exhibitor camping available upon request.
Facebook group: /NarrowGaugeMEE

Rugby Model Engineering Society
Olney Lane, Rugby, CV22 5SD
www.rugbymees.co.uk

and feature narrow gauge prototypes on 2½, 3½, 5 and 7¼in gauge along with an exhibition of other scales and part-built locomotives. Well now Edward Parrott from the club has sent in a further attractive poster alerting us to another themed event, this time focusing on British Railways prototypes and planned for 11th-12th August. More details can be had at BRailEvent@outlook.com, and if you are thinking of getting involved in the narrow gauge version the contact email is NGEvent@outlook.com

One final club event to alert you to – fans of internal combustion should head for the **Southport ME's** track in Victoria Park on 2nd June for the Diesel Day – plenty of action is promised between 10am and 4pm.

Call for entries

While you have your diaries out – first details are emerging of this year's edition of the premier Autumn show, the **Midlands Model Engineering Exhibition** at the Fosse near Leamington Spa. This year the event will run from Thursday 18th to Sunday 21st October, and organisers Meridienne Exhibitions are now seeking entries to the various competition classes. There are 16 classes in all, covering all aspects of the model engineering hobby and including specific classes for younger members. If you have built something you are proud of why not have a go? It would be good to have a bumper entry to enjoy when we head for the Fosse in October. Details are at www.midlandsmodelengineering.co.uk

Talking about younger engineers, the latest edition of the **Stockholes Farm Miniature Railway** newsletter praises the efforts of young member Alex Priestley, who has just gained his bronze Duke of Edinburgh's award. Such news comes, however, with a tinge of disappointment for us on **EIM**. As mentioned on the editorial page at the front of the magazine, this is the first issue for some time that doesn't carry a *Young Engineers* column, because we haven't received



any news to put on the page. We are sure there are plenty of younger members out there making a mark in the various clubs, please write and tell us about them, and in the process encourage more of them!

The Stockholes newsletter also mentions former young member Harry Billmore, who apparently started as a junior aged two (!) and is now the technical editor of **EIM**.

In his introduction to the latest issue of the **Bournemouth & District SME** newsletter club chairman Peter Burton states that so much is going on at present that it is difficult to know where to start!

Much of the effort surrounds the new container that has been installed at the club's track to enable a significant extension to the workshop.

ABOVE: Pride of the latest **Maritzburg** newsletter in South Africa is this loco newly built by Ray Tiechmann, that debuted at the most recent running day. Tell us more about it folks!

BELOW: That looks cold! An intrepid winter steam-up at Cinderbarrow – see text. Photo: John McKay

Work has been continuing in recent weeks with storage racks formerly located in the engine shed moved into the container, which will ultimately allow the creation of an attractive area in the shed for members to use.

Charitable move

The **Lancaster & Morecambe MES** was granted charitable status in January, something that we know other clubs have also been pursuing. Writing in the club newsletter *The Cinderbarrow Flyer*, chairman Geoff Martell acknowledges the "huge amount of work" needed to achieve this, work that was mainly carried out by member Tony Marshall. Geoff adds that the status will allow the Society to claim 25 per cent Gift Aid on its track takings and approach trusts for





financial help on capital projects.

Certainly summing up recent challenging conditions of the past couple of months are a couple of photos from 1st March when two intrepid club members decided to have a steam-up at Cinderbarrow, despite thick snow and freezing temperatures. Frozen steaming bays meant transferring boiler water from indoors while the vacuum brake system of the chosen locomotive was not at all keen to rise above 10psi. And a sure way to kill excess pressure was to add water to the boiler... Apparently a good run was had despite complaints from fingers and toes...

Members of **Plymouth Miniature Steam** were pleased to hear at the AGM that the club has secured a new lease on its site in Goodwin Park, lasting until 2043! Chairman Ian Jefferson reports that the work to secure the lease has helped to raise the profile of the club amongst local councillors and it is now seen as a significant asset to the local community. Some funding donations have been forthcoming as a result, which the club is very grateful for.

Over what was described as one of the wettest winters in years Plymouth

members have completely dug up and replaced much of the running line, and a particularly good turnout of members for a working party at the end of January saw more than 16 tons of concrete laid in just over three hours. The concrete was pumped to the site; "barrowing such an amount through 100 yards of mud just didn't bear thinking about," was the understandable comment...

First-day nerves

In the latest edition of *The Blower*, the newsletter of the **Grimsby & Cleethorpes ME**, Barry Green recounts an anything-but-dull opening day of the club's running season. No less than five locomotives were in steam for the event, but no amount of pre-planning and checks could have prepared for a bolt stripping its thread and rendering the main point leading from the steaming bay to the main line non-operational, just 15 minutes before the line was due to open...

A clamp and creative running round on the track layout ensued for the first hour or so before member Andy Hammond was able to set to and repair the offending point, just in time

for what proved a busy afternoon.

This was not the first drama to befall the club on that weekend. The previous day had been allocated as a boiler test day, the original date postponed due to inclement weather, and members arrived on the new day to find the water supply not working. This too was rapidly rectified.

Old but good

The boiler test day proved remarkable in that one of the vessels submitted was being tested for the first time, but was actually more than 25 years old...

It seems this particular boiler was built in around 1994 by Grimsby club founder Henry Hartley, but was never tested. The last boiler Henry ever completed, it was made at the request of a former member, Alan Clark, who at the time was building a Rainhill locomotive in 3½in gauge.

However soon after Alan gave up model engineering and his workshop, and the Rainhill project, was purchased by fellow member Dennis Hammond. The Rainhill has remained untouched since but Dennis has now decided to finish it and so presented the boiler for testing, which of course it passed with flying colours.

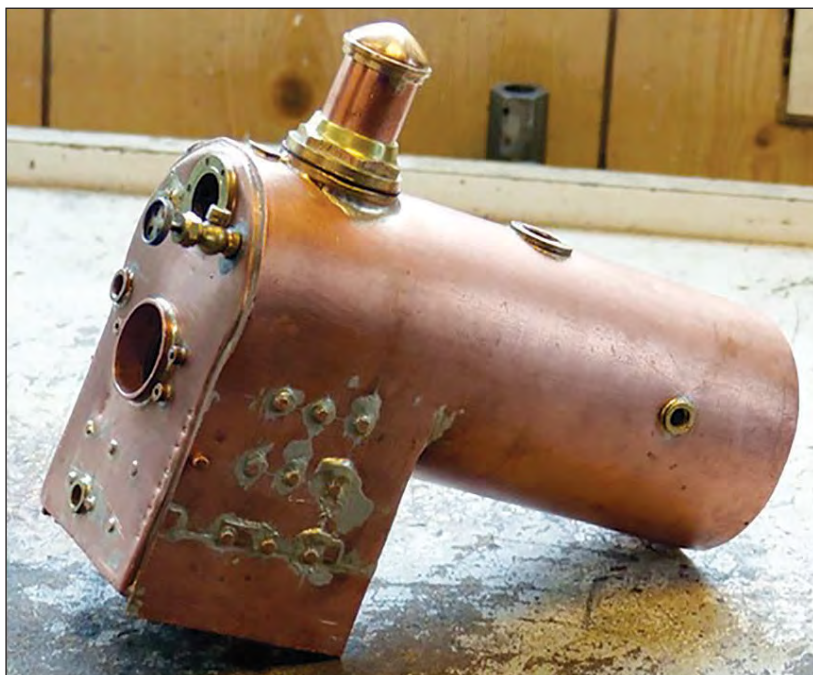
An interesting story – hopefully Dennis will send us a picture or two of the Rainhill when it is complete.

Which leads me to remind all clubs out there – these are your pages, so if you have new or tales that might be of interest to other model engineers, send them in – especially if they have pictures with them!

■ Club news and pictures for these pages is always welcome. Send by email to andrew.charman@warnersgroup.co.uk or by post to 12 Maes Gwyn, Llanfair Caereinion, Powys SY21 0BD

ABOVE: This intrepid team relaid the raised track at the **Bradford ME's** Northcliff site. It was ready on time for an Easter reopening but annoyingly bad weather caused the first public running day to be cancelled.
Photo: Rebekah Ashworth

BELOW: The 25-year-old boiler that surprised the testers at the **Grimsby & Cleethorpes ME** (see text).



Empire builders...

Railway Empire – how the British gave Railways to the World

by Anthony Burton

Railway Empire is an apt title for this book, telling the story of just how much influence on the railways of the world came from the UK – it is probably not exaggerating to say that Britain effectively built much of the global railway network, British technology in railway engineering spreading around the globe.

However those considering a purchase should be aware that this is not a 'railway book' in the traditional sense, in that it places the growth of UK-built railways around the globe in the context of their surroundings, analysing the political, economic and social effects of such development. You will not find details of classes and types in this publication.

The book also focuses on the early development of railways, through the first 50 years of the 19th century, when British railway technology very much led the way. In doing so it misses out on a later time of growth, the first half of the 20th century when companies such as Hunslet and Fowler were supplying particularly narrow gauge equipment to global customers.

The book is an interesting and in places thought-provoking read on aspects of railway history not previously widely discussed from an overall point of view. **AC**

ISBN 978-1-47384-369-1 Published by Pen & Sword Books.

Email: enquiries@pen-and-sword.co.uk

Web: www.pen-and-sword.co.uk Price £25.00

The Pretenders

by Lawson Little

This interesting, inexpensive softback covers an unusual subject, documenting the various and mostly miniature steam-outline internal-combustion locomotives that have operated on lines throughout the UK over the years. We know several **EIM** readers have an interest in such types – one or two have even been observed working on them...

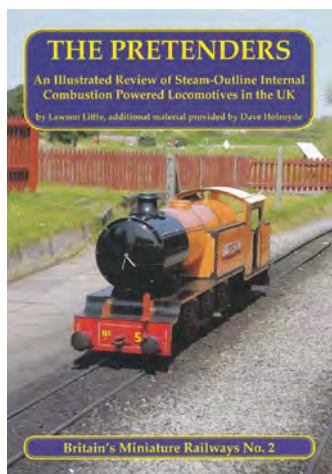
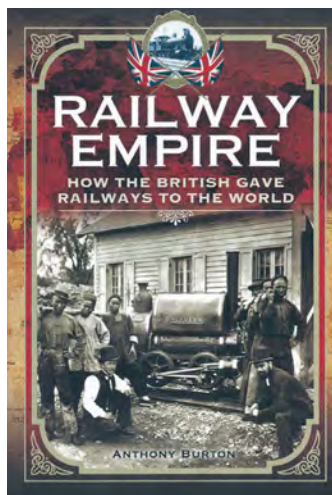
Initially three well-known locomotives, 'Blacolvesley', 'Auld Reekie' and 'C.P. Huntingdon', get a chapter each, and successive chapters then describe the products of such builders as Severn Lamb, Alan Keef, Hudswell Clarke and Baguley, while also detailing more unusual engines such as the Barlow diesel-electrics.

The text is detailed but highly readable, and accompanied by a good selection of photographs, most in colour and used to a large size. A list of further less well-known examples of such locos, including where they were built for and where survivors reside today, completes this useful publication.

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JUNE DIARY

EVERY SATURDAY

(Weather permitting)

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

South Lakeland MES Public running, Lightburn Park, 1.30-4.30pm.

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

Fylde SME Public running at Thornton Cleveleys from 1pm.

Grimsby & Cleethorpes MES public rides, 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 at Kinver 2pm – 4pm.

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

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, North Yorks (not 10th)

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 running, 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.

1 Portsmouth MES Members work, venue TBC, 6.30pm

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

2 Lancaster Morecambe ME Summer Babecue, Cinderbarrow Rly, from 2pm

2 Polly Owners Group Rally and AGM, Erewash Valley MES, www.pollyownersgroup.org.uk

2 SMEE Monorails of early 20th century talk, Marshall House, London SE24, 2.30pm. Pre-book only at chairman@sm-ee.co.uk

2 Southport ME Diesel Day, 10am-4pm. Contact Gwen Baguley gwenandderick@yahoo.co.uk

2 Tiverton MES Summer Open Day, Worthy Moor from 11am.

2-3 Melton Mowbray ME open weekend, Whissendine, Rutland LE15 7EU. Contact Ann Bates on 07763 866287. www.mmmes.co.uk

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

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

3 Plymouth Miniature Steam public running, Pendeen Crescent. PL6 6RE

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

3 Welling DME public running, next to Falconwood rail station, 2-5pm.

4 Lancaster Morecambe ME members evening running, Cinderbarrow Railway, from 5pm

6 Bradford MES Loco Competition, Northcliff track, 7.30pm.

6 Chingford DMEC Fish & Chips night, Ridgeway Park, 7pm

8 Tiverton MES meeting, Old Heathcoat School Comm Cntr, 7.30pm

9 Frimley Lodge MR Charity Day 11am–4pm, Sturt Rd GU16 6HT.

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

9-10 Bristol SME Sweet Pea Model Rally, Ashton Court, BS8 3PX

9-10 Cardiff MES Welsh Rally, Heath Park. www.cardiffmes.com

9-10 Ryedale SME driver training, Village Hall, Pottergate, north Yorks

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

10 Chichester ME Public Running, Blackberry Lane, PO19 7FS. 1-5pm

10 Leeds SME public running, Eggborough, 10am-4.30pm

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

13 Chingford DMEC ground-level driving, signal box training, Ridgeway Park, 7pm

14 Worthing SME Fish & Chip evening, Field Place, The Boulevard, BN13 1NP, 7.30pm

16 Bradford MES Open Day, Northcliff Woods, Shipley

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

16 Little LEC at Worthing SME, Field Place, The Boulevard, BN13 1NP

17 Bristol SME Steam Special Day, Ashton Court, BS8 3PX

17 Grimsby & Cleethorpes MES monthly meeting, Waltham Windmill., 7.30pm

17 Plymouth Miniature Steam public running, Pendeen Crescent. PL6 6RE

17 Tiverton MES Club barbecue, Worthy Moor from 11am.

17 Welling DME public running, next to Falconwood rail station, 2-5pm.

18 Lancaster Morecambe ME, Car airbags by Martin Sams, Cinderbarrow Railway, from 10am

18 Pietermaritzburg MES (New Zealand), Meeting, Pietermaritzburg 3201

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

20 Chingford DMEC 'Stretching a Point', Ridgeway Park, 7pm

20 Leeds SME Mid-Summer Steam-up, Eggborough, noon-late

23 Gravesend MMES Open Day, Thong Lane, from 10am

23 SMEE Model running including gauge 1, Marshall House, London SE24, 2.30pm. Pre-book only at chairman@sm-ee.co.uk

23 Littlehampton Min Rly 70th Anniversary, Worthing SME track present, Mewsbrook Park, BN16 2LX

23 Model Steam Road Vehicle Society Steam Rally, Tewkesbury Rugby Club

24 Bristol SME public running, Ashton Court, BS8 3PX

24 Cardiff MES Open Day, Heath Park, 1pm-5pm

24 Pimlico Light Railway Public Running, Helmdon, Northants, 3-5pm

24 West Cumbria GME Gala & Open Day, Curwen Hall Park, Workington, from 1pm

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

27 27 Chingford DMEC Library Books & DVDs, Ridgeway Park, 7pm

28 Worthing SME 'Life of a Bargee', Field Pce, The Boulevard, BN13 1NP, 7.30pm

29 GL5 Association Rally, Lincoln (also 1st July)

Your club's events not listed? Send details into the address on page 3...

Details for inclusion in this diary must be received at the editorial office (see page 3) at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of every event being held. Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions



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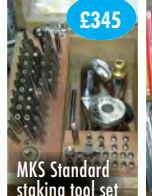
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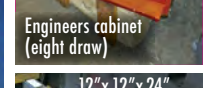


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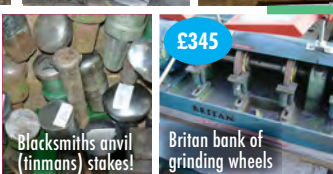


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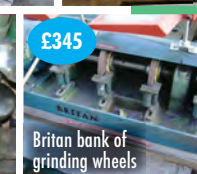
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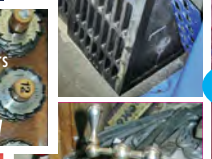
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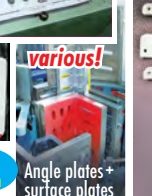


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