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COVER FEATURE

Model Fair

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African spring sunshine

De Winton

An unusual locomotive
celebrates its half century

B1 Axle Boxes

We detail split
axleboxes for
a 5 inch LNER B1

DIVIDING

A neat indexing attachment for a Myford lathe

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The 3F "Jinty" Class

Some 425 of these locomotives were manufactured between 1924 and 1931. Mainly allocated to shunting and station pilot duties they also undertook occasional branch line work. The "Jinties" were frequently used for banking duties with up to three at a time seen assisting express passenger trains up the Lickey Incline on the Bristol-Birmingham line near Bromsgrove. They were frequently seen banking trains out of London Euston up to Camden - a particularly demanding task!

Designed by Sir Henry Fowler for the London, Midland and Scottish Railway they were based on earlier designs by S&W. Johnson.

Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

A majority of locomotives enjoyed long service with the final "Jinty" withdrawn in 1967, right at the end of the steam era. The locomotives were always painted in un-lined black livery. Before nationalisation in 1948 LMS initials were carried on the tank sides. In BR service either lion crest was carried according to period.

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- Reverser
- Approx Dimensions:
Length: 33"
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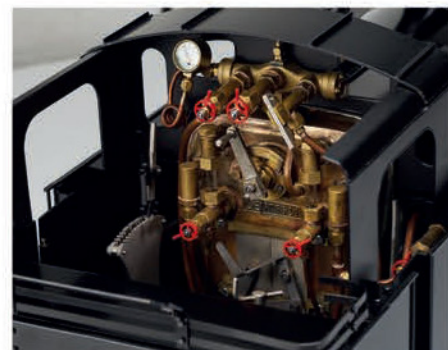
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ON THE COVER...

A three inch scale Allchin traction engine, based on Royal Chester, seen at a South African model fair (photo: Luker).

This issue was published on January 27, 2023. The next will be on sale on February 10, 2023.



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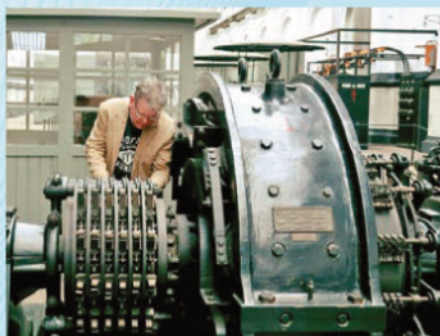
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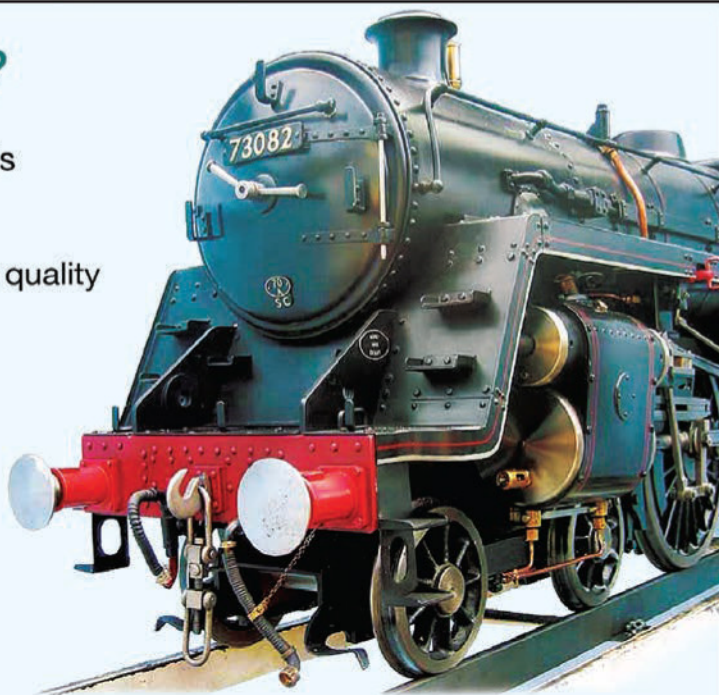
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IMLEC 2023

This year's International Model Locomotive Efficiency Competition, founded by my illustrious predecessor and namesake, Martin Evans (Mkl), will take place at the Bristol Society of Model and Experimental Engineers' track at Ashton Court from the 7th to 9th of July. The competition will form part of the Ashton Court railway's 50th anniversary celebrations. Invitations for entries will appear later but you need to get the date into your diaries now! However you plan to participate, either by entering a locomotive or observing proceedings, you may find the club's promotional video entertaining – it's at imlec.uk/2023/atrailer.html (or use the QR code). Having watched it, I can think of only one thing to say – 'loco driving doesn't get tougher than this!' (with apologies to BBC's MasterChef).



A Golden Age

As model engineers, we do indeed live in a golden age. As Steve Goodbody, in his excellent series *The Eating of Elephants* (see p.208) points out, we now have a broad range of options, and with options come choices. We can take the 'high road', making the best use of modern technology – CAD, CNC, 3D printing etc. – or we can take the 'low road' – minimal machinery and a greater reliance on hand tools. Either approach will get us to our destination - for some, that is the goal, but for others the enjoyment lies in the journey itself.

Oddity

Reader John Townsend writes to me as follows:

'Clearing out my late father-in-law's shed I came across an object which I have been quite unable to identify or guess the use of.

'It is a steel tray 9½ x 9½ x ¾ inches with a wire handle riveted to only one side and a small sliding door in the opposite side, opening to reveal an oval slot about 1¼ x ¾ inch. I imagine that the four lips above the top (or is it bottom?) wired edge fit into another component - but what?

'Perhaps the wisdom of *Model Engineer* readers will know of the previous use of this item. By the way, if anybody is missing one of these, I would be happy to send it on to them.'

Any ideas? It occurs to me that it may be an ashpan (but I may be wrong). Even so, if that is the case, what was it attached to?



On top of that we have the choice of whether we build from scratch, assemble a kit or buy 'ready to run'. Furthermore, our hobby, in real terms, is as affordable as it has ever been. Materials costs may seem high but, spread over the time taken to build a model, expenditure is actually comparatively modest. This even applies to kits and ready-made models, when you consider what you are getting for your money.

So yes, I believe this is a golden age. In the words of Harold Macmillan – 'Supremacy' himself – we've never had it so good.

The seminar, which is run jointly with the Northern Association and the Federation of Model Engineers, has limited places. As there have been no recent changes in the agreed boiler test regime, the purpose of this seminar is to train new boiler inspectors not for present inspectors to have a meet and natter day.

Further information may be found at the Association and Federation websites: www.name-1.org and fmes.org.uk/events

Boiler Testing Seminar

The next boiler inspector's seminar will be held in the north west on Saturday 22nd April 2023. The venue will be in Greater Manchester close to the M62 motorway. Places must be booked through the Association or Federation to which clubs are affiliated.

Stephen Jakeman

You have a set of Grasshopper beam engine material waiting for you at Noggin End Metals, all paid for and ready to go. Unfortunately, they do not have your address. If you could supply Hamish at Noggin End with this information, a big box of metal will wing its way to you! Hamish is at nemetals2022@gmail.com

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
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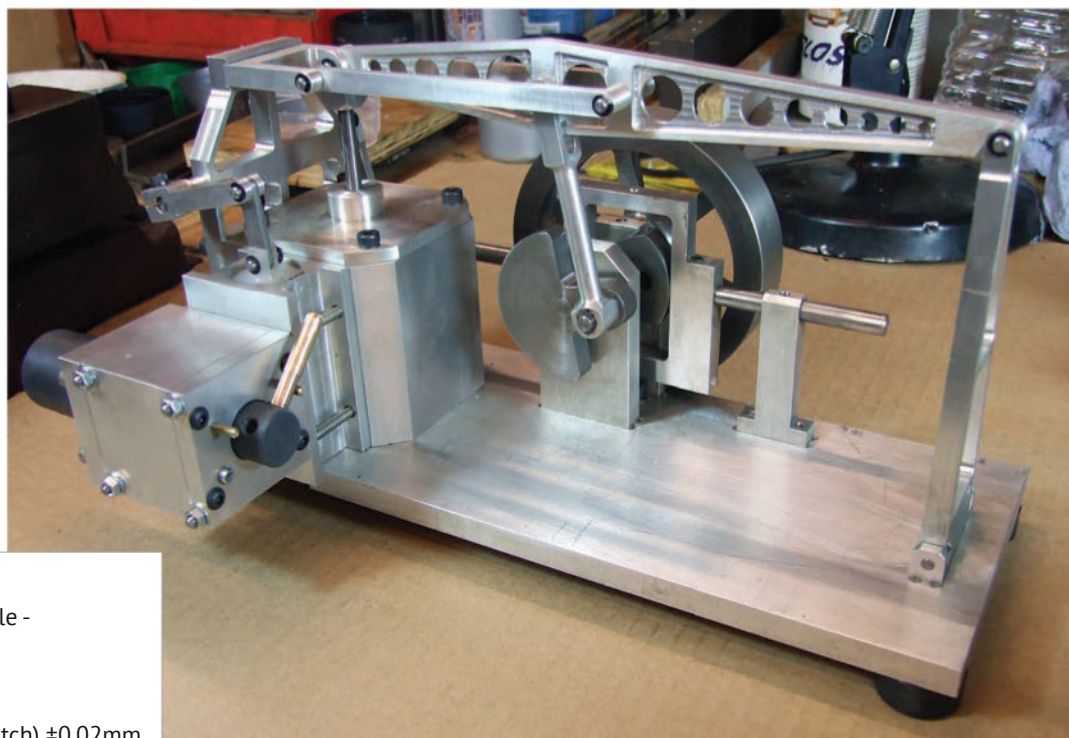
Martin Gearing

presents an ideal beginner's project with great potential for the more experienced builder.



Continued from p.146
M.E. 4708, 13 January 2023

All dimensions are in mm
Tolerance for all parts in the article -
unless otherwise stated:
Non-functional (i.e parts that do
not fit all match) $\pm 0.1\text{mm}$
Functional (i.e parts having to match) $\pm 0.02\text{mm}$



Grasshopper Beam Engine

PART 12

Item 23 – Beam (fig 35)

8mm 5038 Aluminium plate

Here is another item that can be made either a simple solid or a profiled version that greatly enhances the whole appearance of the engine mainly because it's so visible.

* Machine the edges of the blank square and to 246 x 30 and the thickness to 6.

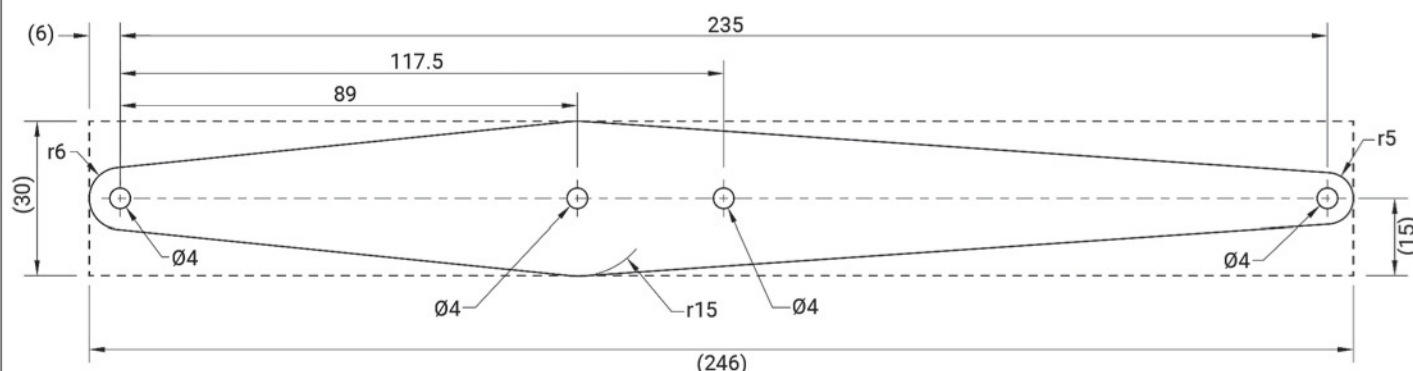
* Clamp in the vice on suitable parallels to bring the 246 x 30 face close to the top of the vice jaws.

* Zero the spindle to the centre of the width and 6mm in from the left-hand end. Clamp the Y axis. This provides the datum for the four $\varnothing 4$ reamed holes as indicated.

* At the four positions indicated centre drill and drill $\varnothing 3.8$ then ream $\varnothing 4$.

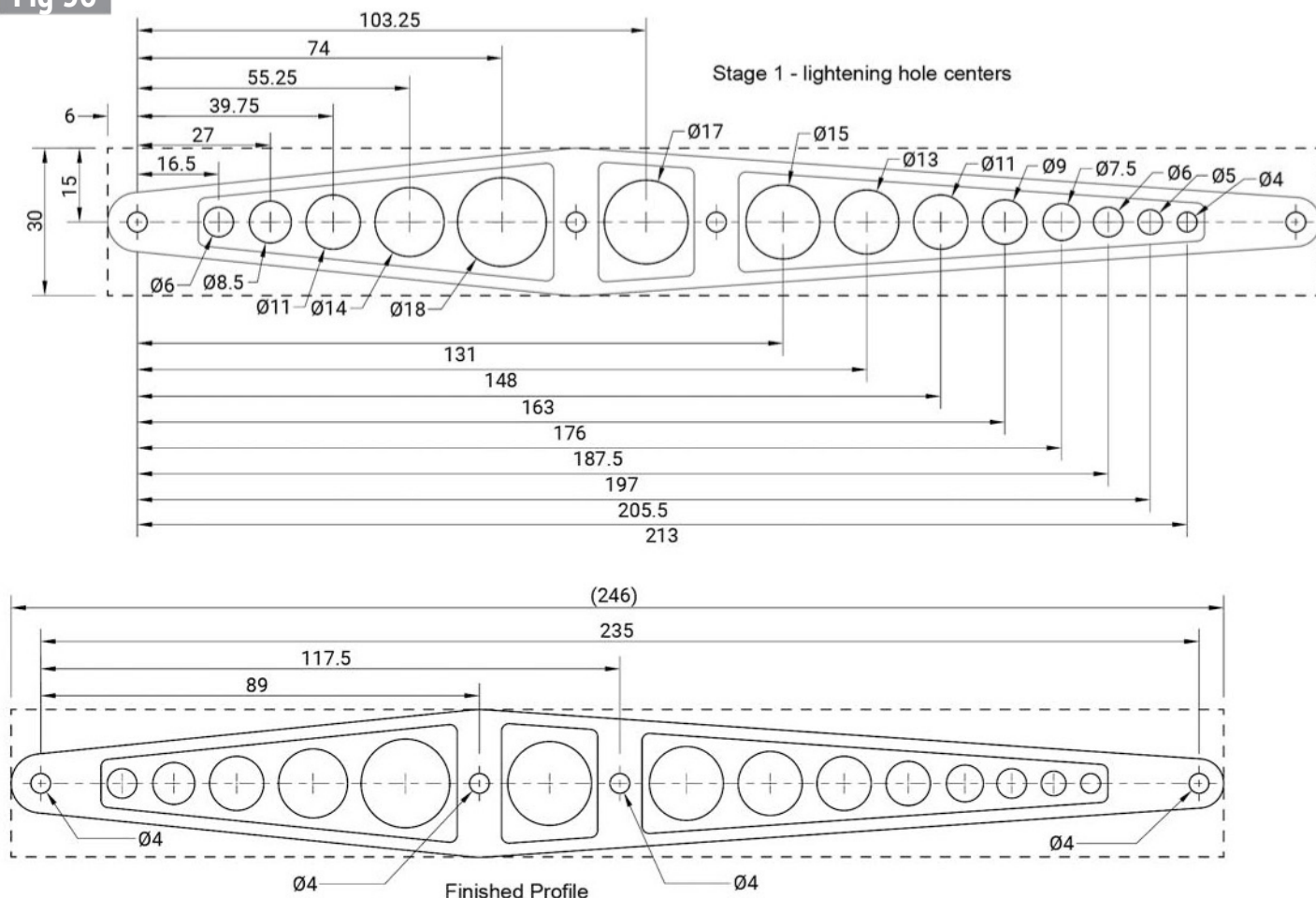
A method of producing the outer tapered and radiused profiles will be offered within the suggestions that follow. To aid the production of the 'Enhanced Alternative Profiled' version of the beam, its manufacture has been broken into stages, mainly to reduce possible confusion due to the mass of dimensions required, and to bring the task into the 'Bite Sized Chunks' category.

Fig 35



Item 23. Basic Beam
6mm thick

Fig 36



Item 23 (alt). Alternative "Enhanced" Beam

Stage 1 - Alternative Enhanced Beam (fig 36)

The following assumes the spindle has remained zeroed at the centre of the 30 width and 6mm in from the left-hand end (Ø4 reamed hole) with the Y axis clamped.

- * Centre drill at the 14 lightening hole locations indicated.
- * Drill as many of the holes as you have standard twist drills available.
- * For those larger than the drills available, pilot drill Ø13 each one in turn and then bore to size. Clamp the X axis when using the boring tool (photo 70).

Stage 2 (fig 37)

- * Using a Ø3 slot drill or centre cutting endmill, machine the six recesses 2mm deep, clamping the X axis at each



Drilling the lightening holes.

location indicated and moving between the plus and minus dimensions given on the Y axis.

- * To ease the work in a later stage machine away the material out to the dimension of the smallest width between each pair of recesses (photo 71).

- * Turn over the blank, taking care to maintain the



Initial machining of the recesses.

orientation of the left-hand end. Re-zero the spindle to the Ø4 reamed hole and repeat.

Stage 3 (fig 38)

To enable the setting up for the next stage you will need to produce five turned 'buttons' from any easy to machine material to hand. The amount of machining required can

be reduced by not making them solid, but in the form of 'washers' 5mm thick, each having the turned individual outside diameter required but all having a Ø4 reamed hole, and using two Ø4 x 12 'pins' of silver steel.

Three of the 'buttons' are to enable the marking out to guide a hacksaw in the removal of the bulk of the waste, which greatly

Fig 37

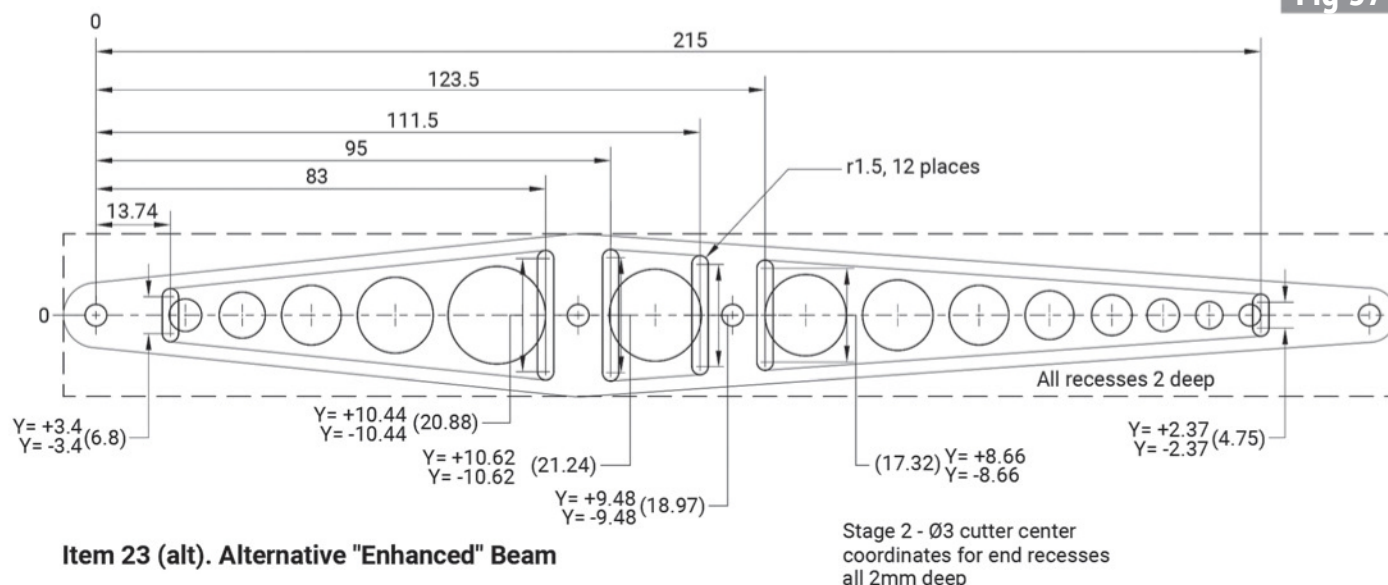
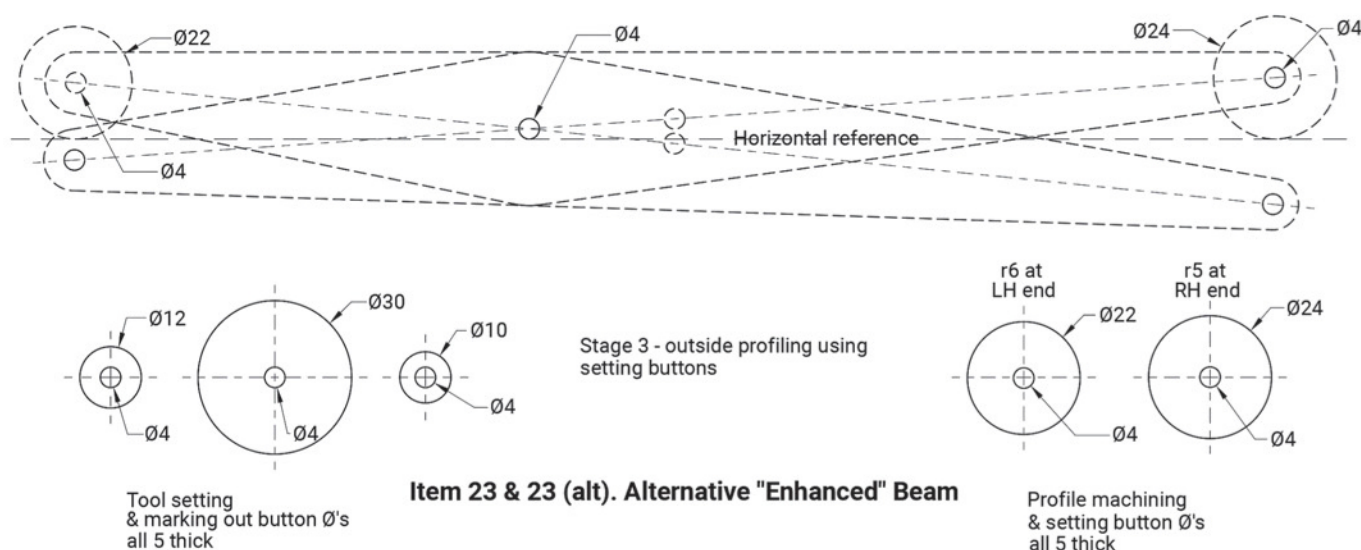


Fig 38



speeds up the profiling process. The second two 'buttons' are each used separately along with one pin for setting the blank accurately so that the four tapered surfaces may be machined.

* Turn the five 'buttons' to the sizes indicated, all having reamed Ø4 holes at their centre, and make two Ø4 x 12 silver steel 'pins'. Take particular care to remove all burrs from the ends, checking that they enter freely into both the reamed holes in the 'buttons' and beam blank.

* Use a permanent marker to generously cover the approximate line of the expected tapered profile.

* Take one Ø4 x 12 silver steel pin and pass through the Ø30 'button' continuing into the second reamed hole from the left on the beam (between the 'five' and 'single' lightening hole recesses).

* Assemble the Ø10 button in the same manner into the reamed hole at the far right-hand end (beyond the eight lightening holes recess) of the beam and, using a steel rule pressed firmly against



Marking out the outside profile.

these to the buttons, scribe a line either side of the centre line (photo 72).

* Remove the silver steel stub from the Ø10 button and use it to assemble the Ø12 button ➤

onto the left-hand (end of five lightening hole) and repeat, marking out either side of the centre line with a scribe at that end.

- * After removing the pins, remove the waste using a hacksaw or, if you have access to one, a bandsaw, cutting at least 1mm OUTSIDE of the scribed guide lines.
- * Remove the burrs raised by the sawing before fitting one Ø4 silver steel pin (on its own) into the second from the left reamed hole on the beam (between five and single lightening holes recesses).
- * Next, fit the second Ø4 silver steel pin through the Ø24 profile machining button and then through the right-hand reamed hole (beyond the end of the eight lightening holes recess).
- * Move to the mill.
- * Clamp the blank between two parallels that are just wider than the depth of the vice so that both the plain pin and Ø24 button are supported on the top surface of the parallels (**photo 73**).
- * Remove the Ø24 button and replace it with the Ø10 checking button. Install a cutter of choice at least twice the width of the blank in diameter and carefully raise the table until a feeler gauge is felt to drag between the cutter and checking button (**photo 74**). The picture shows the second face of the two at this end, being setup - seemingly illustrating the wrong end!
- * Remove the blank clear of the cutter and raise the table by the thickness of the feeler gauge. Zero the Z axis. Then



Setting up for profiling the beam.



Locating the depth of the cut for profiling.

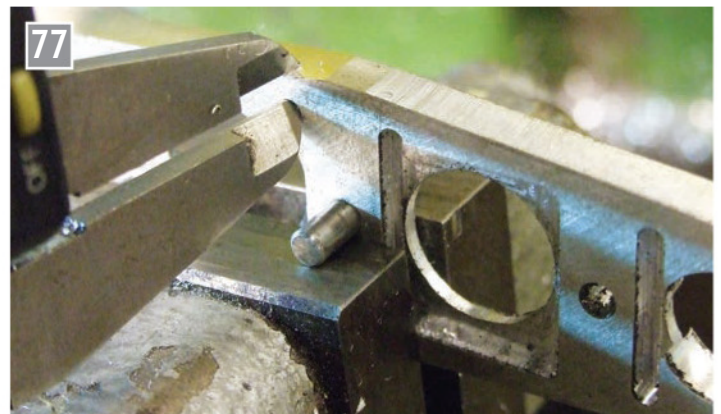


Cutting the outside profile.



Repeating the setting process for the next cut.

- lower the work 5mm. Remove the checking button and pin.
- * Carefully raise the work until the cutter contacts the blank, before taking small cuts to machine the length of the tapered surface until the Z axis reaches zero (**photo 75**).
- * Repeat this process on the opposite surface.
- * Fit the Ø4 silver steel pin through the Ø22 profile machining button and then through the left-hand reamed hole (beyond the end of the five lightening holes recess) and repeat the setting process but without the need for parallels if using the most common machine having 100/4 inch wide vice jaws (**photo 76**).
- * Remove all burrs created by machining.



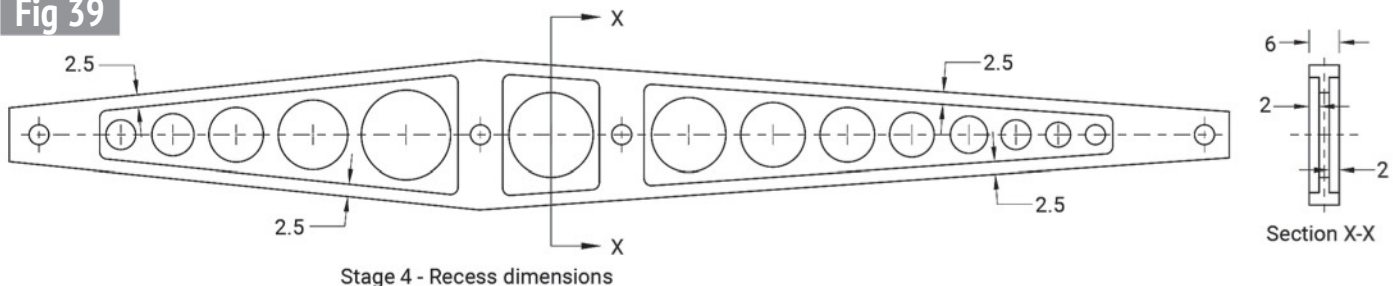
Checking the profiling.

- * Check the thickness between the surface produced and the inner recess at the end of the slot (**photo 77**).
- * Repeat at each of the remaining 11 slot ends and record the smallest reading if below 2.5.

Stage 4 (fig 39)

This is a repeat of the process used in stage 4 of Item 21 the link anchor mount, differing slightly because the smaller width blank can be clamped onto a parallel that is a little wider than the 30 width. This

Fig 39



Item 23 (alt). Alternative "Enhanced" Beam

rests on suitable parallels to bring it just above the vice jaws and against a parallel protruding at least 5mm above the fixed jaw.

Select one of the tapered edges, and push it against the protruding parallel before clamping the blank onto the face of the parallel with a toolmaker's clamp at each end.

* Using a Ø3 end mill, carefully raise the work until it just contacts the surface at the base of the recess. Taking small cuts feed the blank between the two end slots towards the fixed jaw, until the edge web measures 2.5mm, or the recorded figure if less (photo 78).



Finishing the recess.

* Repeat on the remaining five inner recess edges.

Stage 5 (fig 40)

* Finally machine the two ends to the radius indicated. Note – Use lock nuts on the pivot bolt (photo 79).



Rounding the ends of the beam.

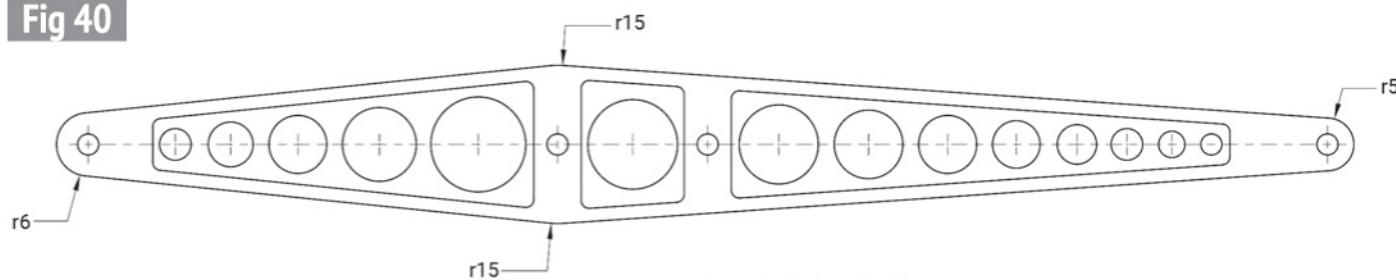
* Go over the completed beam removing all burrs, blending the external radii and removing machining marks with a fine flat file or abrasive paper.

NEXT TIME

We need to make a couple of control links.

● To be continued.

Fig 40



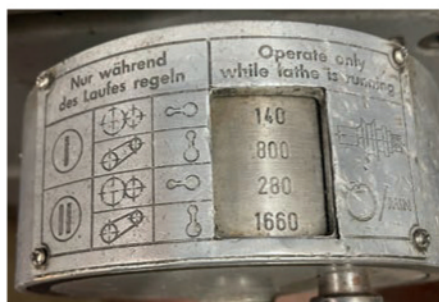
Item 23 (alt). Alternative "Enhanced" Beam

Stage 4 - Radius detail

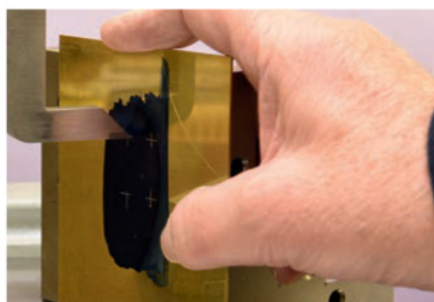
No.325

Look out for the March 2023 issue:

MODEL ENGINEERS' WORKSHOP



Chris Hobday recounts his adventures with speed indication for his lathe.



Artful Dodger **John Smith** offers some advice on marking out



Howard Lewis encourages beginners in hobby engineering with his 'Notes for Newbies'.

On Sale 17th February 2023

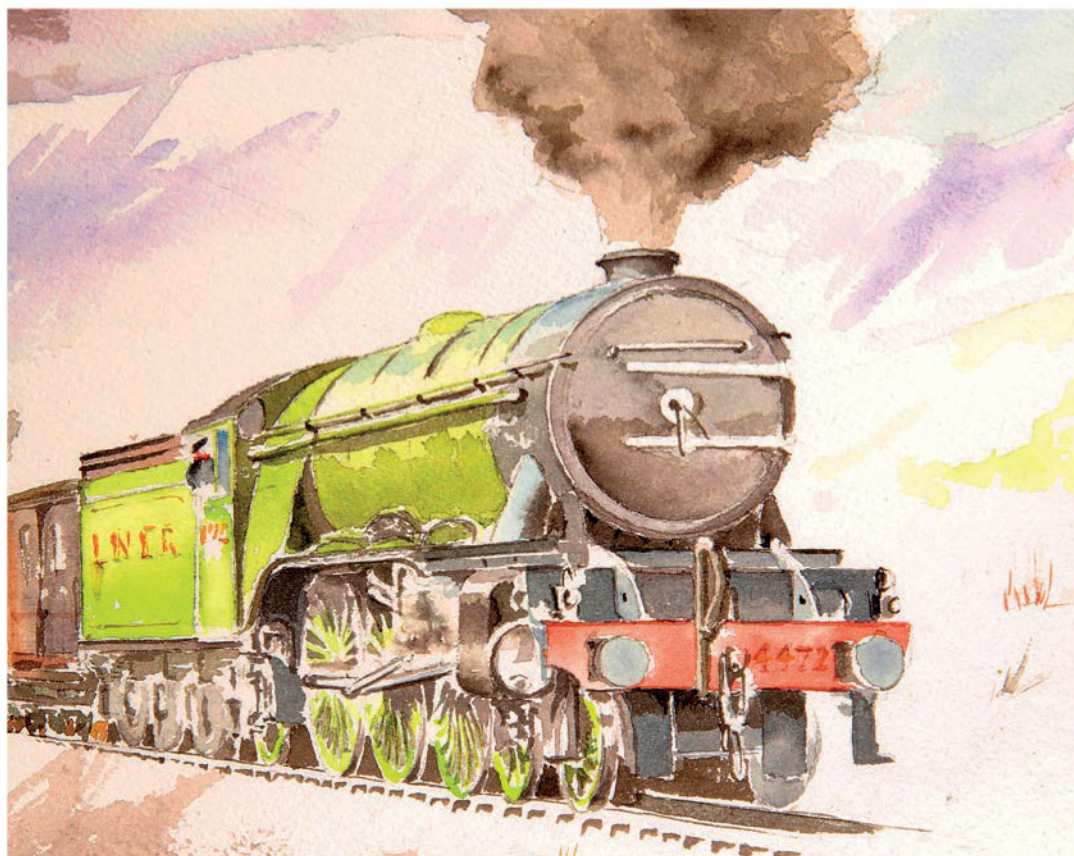
Peter Seymour-Howell

builds a fine, fully detailed model of Gresley's iconic locomotive to Don Young's drawings.



Continued from p.173
M.E. 4708, 13 January 2023

PART 51 – CROSSHEADS



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge

I decided to machine the crossheads from the solid except for the slipper which I want to have as a replaceable part. Eddie Gibbon's invaluable research directed me to making the 1934 LNER crosshead pattern and I'll also follow this design for the drop link and oiling setup.

My approach when tackling something like these crossheads, which is 'shall we say' a little out of the normal machining exercise, is to do all that I can first while still having large square flat faces, ie the blanks to work from. This means a lot of thought is given to the order of attack to such

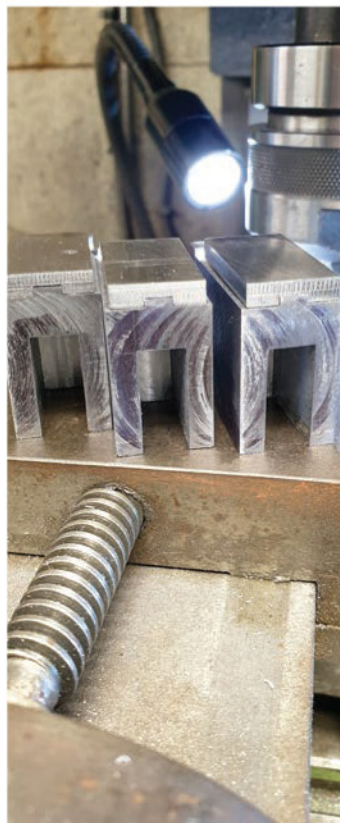
parts before actually cutting any metal.

Initial shaping

Don recommends the use of black steel and as it happens I had an offcut that was given to me which was big enough.

1. With the slipper pad marked out I machined away the top to give me a central ridge for the length of the slipper. The reason for the metal left at the front is so that I have a large stable footprint for the blank to sit on squarely for machining during other setups. Before machining the ridge I cut a slot into a piece of scrap steel and machined the top of the blank until the test piece required just a tap to be a snug fit.





LEFT: 2. The next job to do was removing the insides of the crosshead. After marking out the blanks and clocking in the vice I first cut the bottom face to the full. Once the slot had been cut from the bottom I then clocked the blank 90 degrees and flipped it around so that I could see what I was doing while machining from the back face. **RIGHT: 3.** I then made a start on finishing the slippers - lots more work to do here but you can see that I have machined the slot for the slipper to locate centrally onto the crosshead.

The first task was to machine the blanks to size. I then cut a groove across the block to register the slipper and then cut the central ridge for the length of the slipper. The insides of the crosshead were then machined out to get the basic shape.

Fitting the slippers

The next task is to machine the oilways into the slippers and fit the slippers. I'll follow that by drilling the holes for the gudgeon pin and piston rod.

After talking to fellow engineers, I decided to thread the bore and rod to make life a little easier for setting up the piston position. After another chat, this time with Reg Rossiter who came up with what I think is a great idea, led me to use a grub screw not only to set the rod position but also to tighten against. This and the tapered pin should ensure no movement in this important assembly.



LEFT: 6. The slippers were then turned over again, this time to machine more scallops, this time in a cross pattern between the oil holes and through the reservoir.

RIGHT: 7. With the slipper positions sorted it was now time to drill the various holes in the crosshead body. The first job was to drill the cross hole for the gudgeon pin. With the outside holes drilled I then turned over the crosshead, replotted the gudgeon pin hole and opened it up to size, finishing with a countersink drill to give me the 30 degree chamfer for the pin to sit in. The countersink has cut into the side a little as this face still needs machining to size.

8. With all three crossheads finished to this stage I then concentrated on the piston bore hole. The picture shows that the hole has been drilled/tapped and also features a short counterbore. This is for two reasons - firstly so that the thread on the rod is not seen once assembled and, secondly, to enable me to clock the crosshead in the four jaw chuck later.



LEFT: 9. The next job was to mill the top face to create the pedestal which the slipper sits on. RIGHT: 10. Reaching this stage I able to check for the first time that all was going to plan with the slide bars and piston rod relationship. I 'checked to fit' each crosshead as it was machined to see how things were looking. I am pleased to report that all three fit nicely.



LEFT: 11. I then machined down the side faces to their final dimension. For this job I upended each crosshead, set it on parallels giving me just enough clearance for the cutter. This picture shows the first side machined. Another thing to point out is now that the side has been machined to size the countersunk step which I mentioned before has now disappeared. RIGHT: 12. Now it's over to the lathe and onto the first setup in the four jaw chuck. Here we can see the second reason for machining the small recess into the opening of the rod bore. I don't need to worry about clocking each blank with a DTI, as all of the critical dimensions have already been set/ determined with the holes accurately drilled and then the blanks tested for fit on the slidebars - we are now just dressing the parts to achieve a prototypical shape.



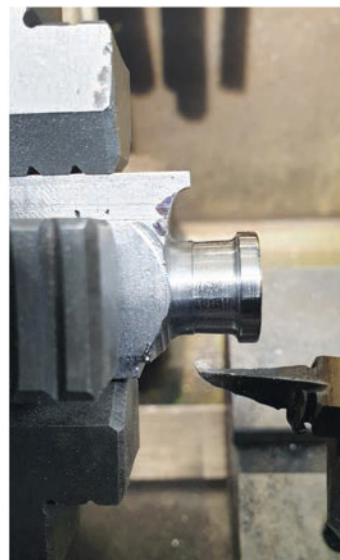
LEFT: 13. Once I was happy with the part running true I could begin to rough out the shape. To do this I used a profile tool, machining in as far as was safe before hitting the slipper pedestal and filing the end to give me a 30 thou radius. RIGHT: 14. The crosshead was then set up on the rotary table so I could begin machining the side face down to roughly meet the round section already machined. This is very much still in a roughing out stage and the picture shows that one side has now been roughed out.

Rod and gudgeon pin bosses

Now we start adding some 'shape' to the crossheads. At this stage we'll deal with the bosses for the gudgeon pin and the piston rod. This is also a good time to check the fit of the crosshead to the slide bars.

Profiling the front

I then began the most challenging part and profile - the front of the crosshead where the tapered round section meets the square section. There was a fair bit of hand shaping to complete this stage but I removed as



LEFT: 15. I first roughed out the taper and I then had to make a 'finishing' tool for machining the small step in the main taper. I shaped this to have a flat front edge and curved rear to give the desired shape. With the cross slide locked and the top slide still at the same taper setting, I could machine all three identically by having the full reach set for the top slide and the carriage marked for its return. RIGHT: 16. It was then back to the rotary table and some more profiling for the area where round meets square. I have fitted the button again as a guide. This button is larger than the round area that the drop arm mounting plate will sit on as I can see in period photographs that there is a 'lip' here.

much material as possible by machining first.

Final shaping

Now we see the crossheads finally take their shape at the front end. I won't say just how many hours this took to achieve - it was a lot. Last time it was mostly machining, this time it was all hand work, beginning with the Dremel, using diamond grinding tips and then needle files to smooth the surface. Next it was back to the Dremel, although this time using wet and dry sanding disks which give a lovely polished finish but are also abrasive enough to do the final small areas of profiling. I have kindly been sent a good few drawings/pictures of research material to help in this part for which I am most grateful.

●To be continued.



20. Here we have the model so far, not there yet but getting closer. The raised area where the gudgeon pin enters is still to be machined. I will machine this as a slight relief on the side letting the mounting plate bring it out closer to the prototype. Also the rear still has to be shaped - a lot of the rear area seen gets removed.

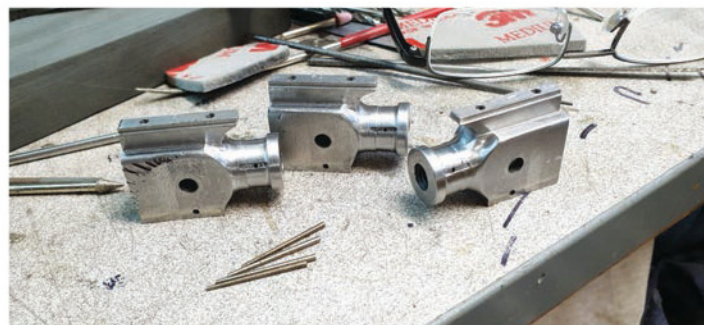
RIGHT: 21. Before I can move on to the rear profile I first needed to drill/machine the slot for the dummy cotter pin. Why a dummy? Well, it's easier to make and the piston rod itself is held by its thread and the locking grub screw at the rear.



17. This picture sees the completion of all machining for the front area, or should I say, this was as far as I was prepared to go with machining, much preferring to do the close-up stuff by hand.



19. Here I have made a start on the underside. I'll call this 'stage two' of the profiling. Once all are at the same stage I'll go over them for a final time, rounding off all of the sharp edges and polishing them to as good a finish as I can. I have set the far crosshead upright to give an idea of how much more metal is needed to be removed from the top.



22. Here we have the three crossheads having had their slots machined to a depth of 10 thou, just enough for the dummy cotter to rest in.

BELOW: 25. Once the holes were drilled and tapped I finished machining the front face of the mounting plate which is flush with the slot. Next up was to machine the outer edges of the locating tabs for the drop link and then I only needed to machine the circle to blend in with the bottom vertical section and a little filing of the tabs to complete the mounting plates.



LEFT: 23. The next job was to make the drop link mounting plates. I began with marking these out on some stainless-steel flat bar that was 120 thou thick. If you look closely you'll see that both mounting plates were drilled together. ABOVE: 24. I mounted the plates together in the machine vice but this time next to each other along the 'X' axis and machined a slot along their length. I dry fitted the parts to their respective crossheads ready to transfer the three new holes in each crosshead.



18. I then did a little more work on the inner curve of the slipper pedestal but I still have the upper curve where it meets the slipper itself to profile. I took this picture to show how I am approaching this grinding/filing/sanding stage. I'm using a variety of diamond cutters and some brass shim to protect the area nearby.



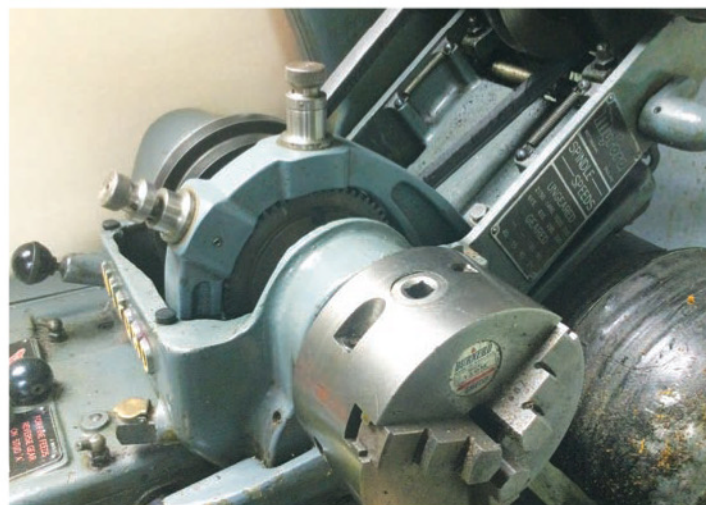
Direct Indexing Device

David Fulton makes a dividing accessory for a Myford lathe that looks the part.

Over the years there have been many articles on direct indexing gear for the lathe. Some use the bullwheel, others use a set of changewheels on the back of the lathe spindle. A device that I made decades ago for the Myford Super 7 fulfilled the criteria that it should not be complicated, nor require any visible alteration to the lathe. No doubt the same idea could be applied to lathes other than Myford.

Taking only one minute to set up, the device consists of a simple casting in the form of an arch that straddles the bullwheel. Two OBA bolts fix it firmly to the lathe. Even with the lathe cover open, one would have to look hard to find the bolt holes.

A refinement was the provision of two detents - one of them set at a half-tooth position relative to the other. This provides 120 divisions from the 60 tooth wheel. In total, 15 equal divisions are available, i.e., 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 24, 30, 40, 60, and 120 which will suit most requirements.

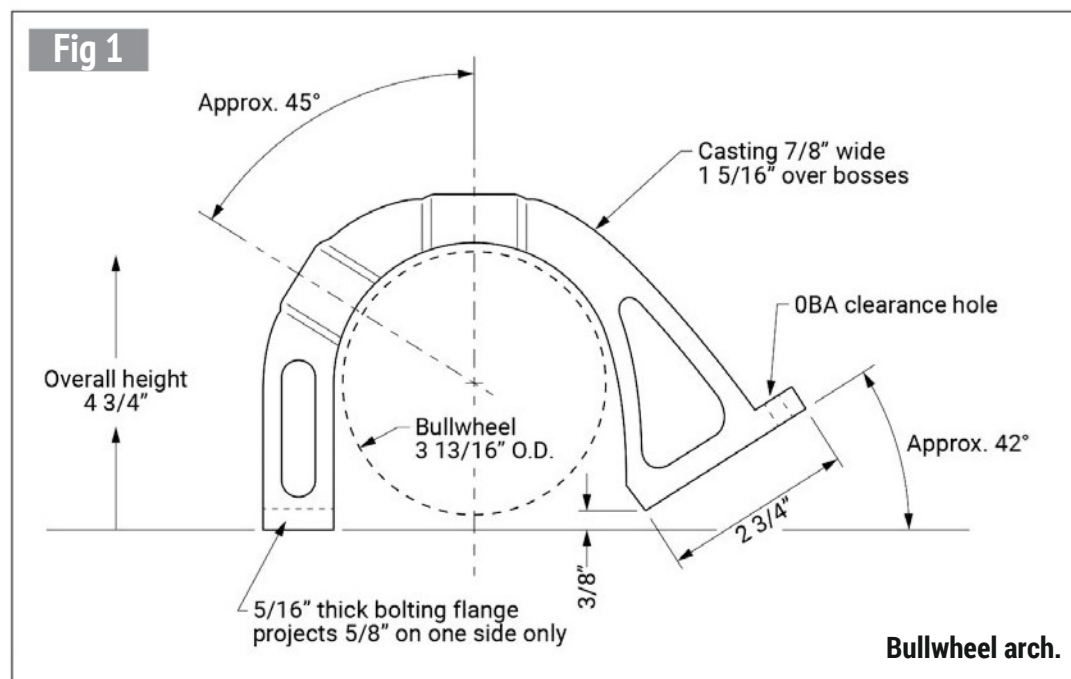


Thanks to its solidity and matching paintwork, the device could be mistaken for a standard Myford accessory.

For the casting, make a template out of stiff card to the approximate dimensions in **fig 1**. Cut away the card to the angles of the lathe casting, allowing a clearance of about $\frac{1}{16}$ inch between template and bullwheel. Using the template, make a wooden pattern, leaving $\frac{1}{8}$ inch extra on the feet to allow for machining and casting shrinkage. The cheeks either side of the detents are pinned and glued to the arch shape. A bolting flange is added,

projecting to the left of the near-side foot. Relieving the sides of the arch makes the casting lighter and gives a more professional appearance but is optional. My casting is iron, although light alloy would be fine.

Face the feet of the finished casting, ensuring that their angles match those of the lathe headstock casting at the bullwheel position. Drill clearance holes for the bolts and mark through onto the





The detents are held in the casting by grub screws - optionally one or two per detent.



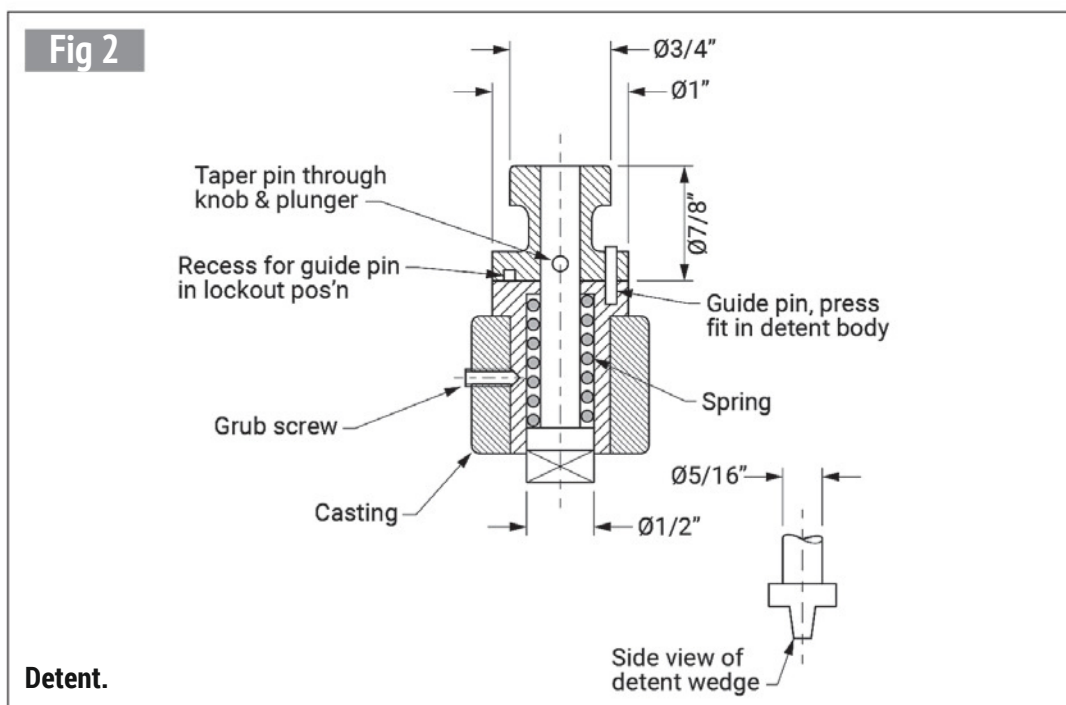
Showing the detent wedges, one in the engaged position, the other withdrawn and locked back.

lathe. This is of light alloy where it is to be drilled, so making two tapping holes with a power drill is easy.

The detents are straight-forward turning jobs (fig 2), the actual engaging tooth (or wedge) being hand cut on the end of the plunger. Keep the root of the tooth fractionally wider than the bullwheel tooth gap so that the detent has a wedging action when engaged. A $\frac{3}{32}$ inch guide pin is a press fit in the detent body to keep the tooth in line with the bullwheel teeth. The pin also serves to lock out the detent plunger when this is withdrawn and slightly rotated to drop into a shallow hole (fig 2).

One detent is located on the vertical centreline of the lathe and the other at about 45 degrees. The critical part is in locating the second detent exactly half a tooth offset from the other. One way to check its position is to lock the vertical detent *in situ*, then use a temporary $\frac{3}{32}$ inch sight-hole in the second detent position to establish exactly where a tooth crown of the bullwheel falls.

Careful alignment with the lathe bullwheel should get the detent angles right. However, if a tooth crown should not exactly bisect the 45 degree hole, cut the wedge on the plunger to compensate for the inaccuracy. Alternatively, the detent body can be bored eccentrically - so that when rotated it will bring the half-



tooth into line - before drilling for the guide pin.

Some previous designs have employed a simple threaded

spindle having a tapered end to engage the bullwheel teeth. While this is feasible, it is much slower to use.

Furthermore, the coned end is far less positive than a wedge shape and may damage the bullwheel over time.

ME

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Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.97
M.E. 4707, 30 December 2022

The Stationary Steam Engine

PART 42 – THE POST-PATENT WATT ENGINE

William Murdoch, the bell crank engine and the slide valve

A recurrent theme in the history of the steam engine is the overwhelming influence of James Watt's patents throughout the last years of the eighteenth century. Protection afforded by the master patent of 1769 for the separate condenser was prolonged to May 1800 under the parliamentary sanctioned extension of 1775. Five more patents were taken out by Watt between February 1780 and June 1785 but, thereafter, he ceased to be a patentee. This is not to say that the engine failed to develop further.

Four years after the last patent the first Watt rotative engine began work at the Albion Corn Mill initiating the greatest advance in the history of the stationary steam engine since Newcomen had applied his condensing cylinder to the mine pump. The rotative engine rapidly fulfilled Boulton's prediction that industry was thirsting for an effective rotative steam engine and after 1790 pumping engine output, counted in terms of numbers of engines built, rarely exceeded one third of the number of rotative engines although the latter were usually less powerful in unit terms.

Even before the Soho Foundry was opened the growth in engine demand was forcing organisational change upon Boulton and Watt. The heroic inventor figure of Watt labouring alone over the drawing board was no longer

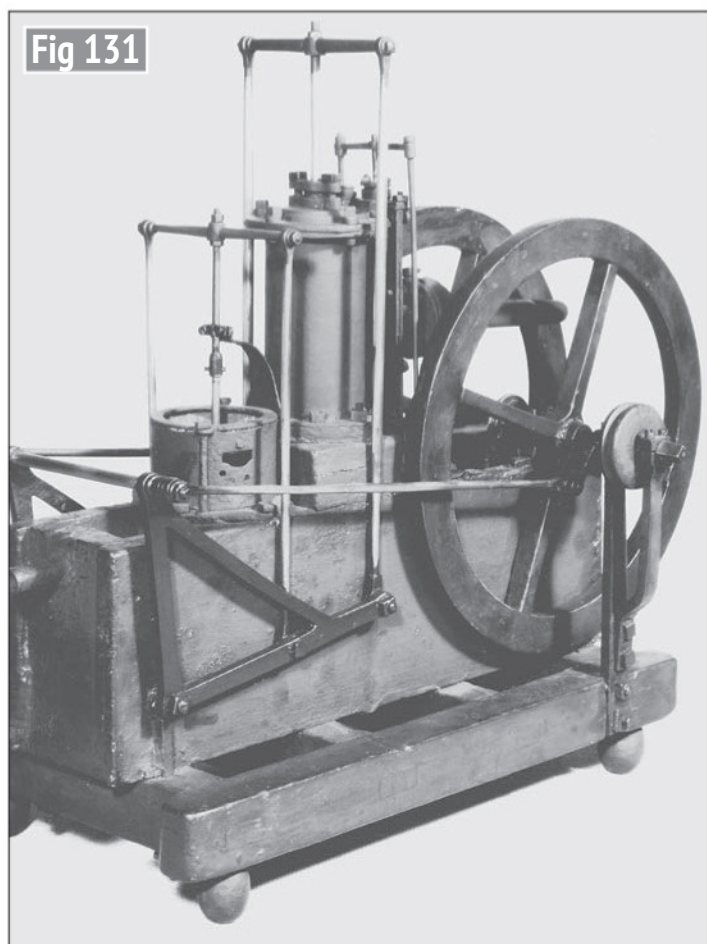
a viable way of sustaining production and he was increasingly supplemented and then supplanted by a business structure centred upon the drawing office under John Southern. Southern had been the elder Watt's amanuensis but after the 'Old Man's' progressive retirement in 1795, his role became that of head of the drawing office. Southern seems to have been less of an innovator than he was a development draftsman, an inclination that was reinforced by the pressure of demand which inevitably led to his main pre-occupation being the preparations of day-to-day designs for customers. For Southern, change was largely a matter of improved details associated with individual engines, thereafter absorbed into the characteristic machine.

Translating the output of the drawing office into successful working machines depended upon a growing team of specialised engineers, the group of craftsmen engaged in producing steam engine components at Soho and the field engineers contracted to erect the engines at the customer's premises, of whom John Rennie, Peter Ewart, James Lawson, Isaac Perrins and William Murdoch were the most prominent. Amongst these men several rose to eminence but it has been argued that William Murdoch's contribution to the success of Boulton and Watt engines from this time onwards has been

understated (ref 216).

Murdoch, who joined the firm in 1778, was quickly recognised as a man of exceptional ability. During the first part of his association with Boulton and Watt he held the line in Cornwall and until early 1799 he lived at his Redruth house more than he did at Soho. Throughout his life he consistently displayed a deep if maverick capacity for invention as testified by Southern who, in a letter to be quoted more fully below, refers to: *...the torrent of ingenuity which Murdoch's genius pours forth...*

Much of this impetuous energy was bestowed on projects that had little historical consequence (Murdoch's most lasting achievement, gas lighting, lay outside the field of steam engineering) but Griffiths maintains that credit for the sun-and-planet motion ought to rest more with Murdoch than it does with Watt. His evidence is equivocal and similar claims for Murdoch as a contributor to other aspects of the mechanical development of the Watt engine are also matters of conjecture. What is indisputable is that Murdoch's competence and growing field experience drew him into a close interactive relationship with the senior partners of the firm. James Watt Snr's allegiance and loyalty to Murdoch descended to his son who remained Murdoch's champion in the face of the



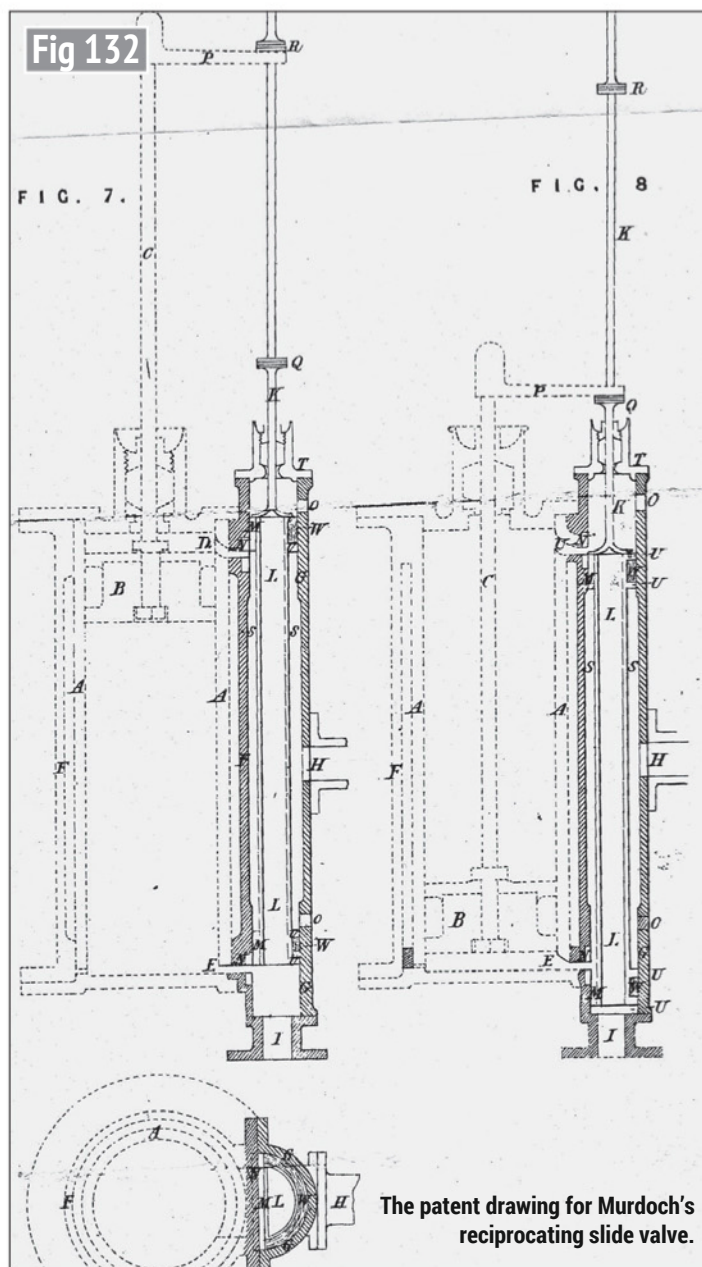
The model of the bell crank engine built by William Murdoch.
(Science Museum Picture Library)

somewhat more ambiguous attitude of Southern.

Murdoch's contribution to the success of the Soho engineering works after his return from Cornwall has already been described. Here, there can be no doubt that he averted what might have been a disastrous failure and it is probably as an innovative works manager that Murdoch's talents were best displayed even if there is often an ephemeral quality about his achievements. The worm drive had no lasting influence on the development of primary machine drives; the flat belt and pulley along with, initially, round rawhide bands working in 'V'-pullies, largely developed within the textile industry, provided the more enduring solution. His vacuum power distribution system by which some of the smaller Soho machines were driven was not copied elsewhere (ref 217).

As far as any influence that Murdoch might exert on the

mainstream of engine design goes, his contributions had increasingly to be filtered through Southern and, notably, the area in which his ideas found application were largely in the Soho Foundry workshops where his remit was more firmly established. Here the change that he instigated from Ewart's single centralised drive for the entire workshop to the provision of separate engines dedicated to individual machines brought forward the matter of smaller powered engines. This subject had been contentious since Rennie first attempted to induce Watt Snr. to consider producing machines of between two and four horsepower in the late seventeen-eighties. Watt had resisted, considering that they were more trouble than they were worth. His son was more convinced that a market existed and that the new foundry facilities would permit better control over costs.



Murdoch appears to have given substance to the form that the engine was to take (ref 218).

Murdoch's involvement with smaller engines extended back to his earliest days in Cornwall when he had built a winding engine for Wheal Maid in 1784, largely independently of Soho. His steam carriage model with its grasshopper beam and the model oscillating engine followed but none of these initiatives led to sustained development. The revival of his interest in smaller powers in the later seventeen-nineties owed no obvious debt to these earlier efforts other than that the precursor to full-sized version seems to have been

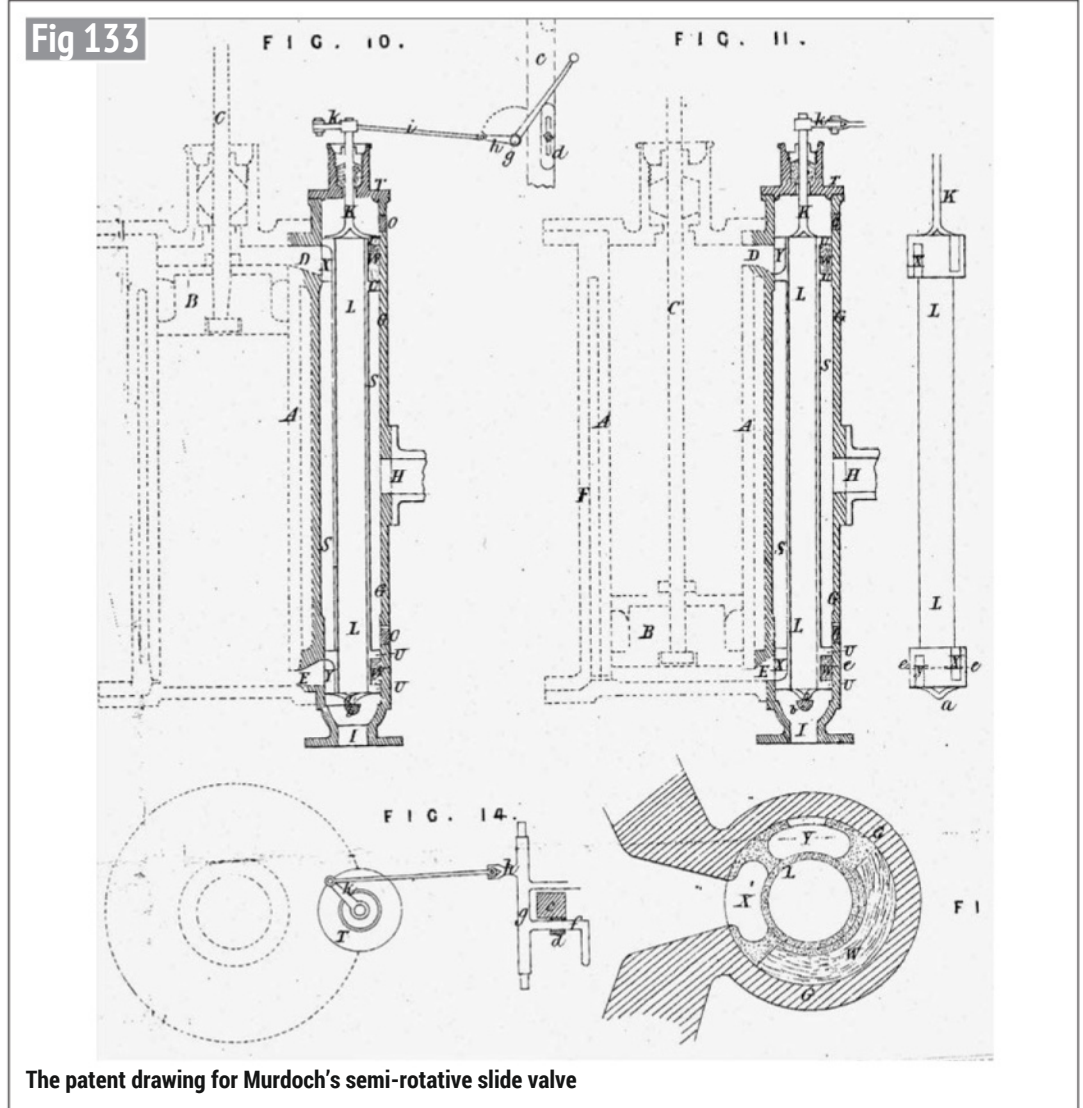
a model, believed to be that preserved today in the Science Museum's collection (fig 131).

The model retains the vertical cylinder of the traditional beam engine but the base is set upon a square block bridging across the open top of a rectangular timber cistern which forms the foundation of the machine. The piston rod is connected to a crosshead mounted above the cylinder. Parallel, round-section slide bars guide the crosshead. At the outer ends of the crosshead, two connecting rods pass down either side of the cylinder. At their lower ends each rod was connected to one arm of a bell crank. The fulcrum bearings of

the bell cranks are mounted on the side plates of the cistern. From the other arm of the bell cranks connecting rods passed horizontally to double web cranks overhung beyond the flywheels. The crankshaft spans the width of the cistern and the valve is driven by an eccentric fitted to the centre of the shaft. A small wooden 'V'-pulley on the crankshaft provides a power take-off. The air pump with condenser is partially immersed in the cistern at the opposite end of the cistern to the crankshaft with the drive taken off the lower arm of the bell crank.

Accounts of when and how the new bell crank engine was introduced in twelve-inch scale make a confused story. According to the Dickinson and Jenkins version the first beamless engine to be built was a two-horsepower machine to the order of Symons, the Reading brewer, placed before or in April 1799. The very low price quoted persuaded Watt Jnr. that it could only be built with profit as a beamless engine and the result was the first bell crank engine. Delivery did not take place until September 1799 but, un-mentioned by Dickinson and Jenkins, by this time one or possibly two bell crank engines were in service in the Soho Foundry works. These engines seem to have formed the prototype for Symon's engine and the design had been initiated some months before the Symons order was placed.

In early January 1799 Watt Jnr. wrote to Matthew Robison Boulton advocating the building of small engines. Boulton, in reply, says he had already discussed the issue with Murdoch. Boulton was aware of Southern's lack of enthusiasm but he prevailed upon him to devote some drawing office time to working up Murdoch's initial thoughts (ref 219). These concept drawings have not survived but it would seem that that the cast-iron tank bed was introduced at this time and that this was the form taken by the two engines which



The patent drawing for Murdoch's semi-rotative slide valve

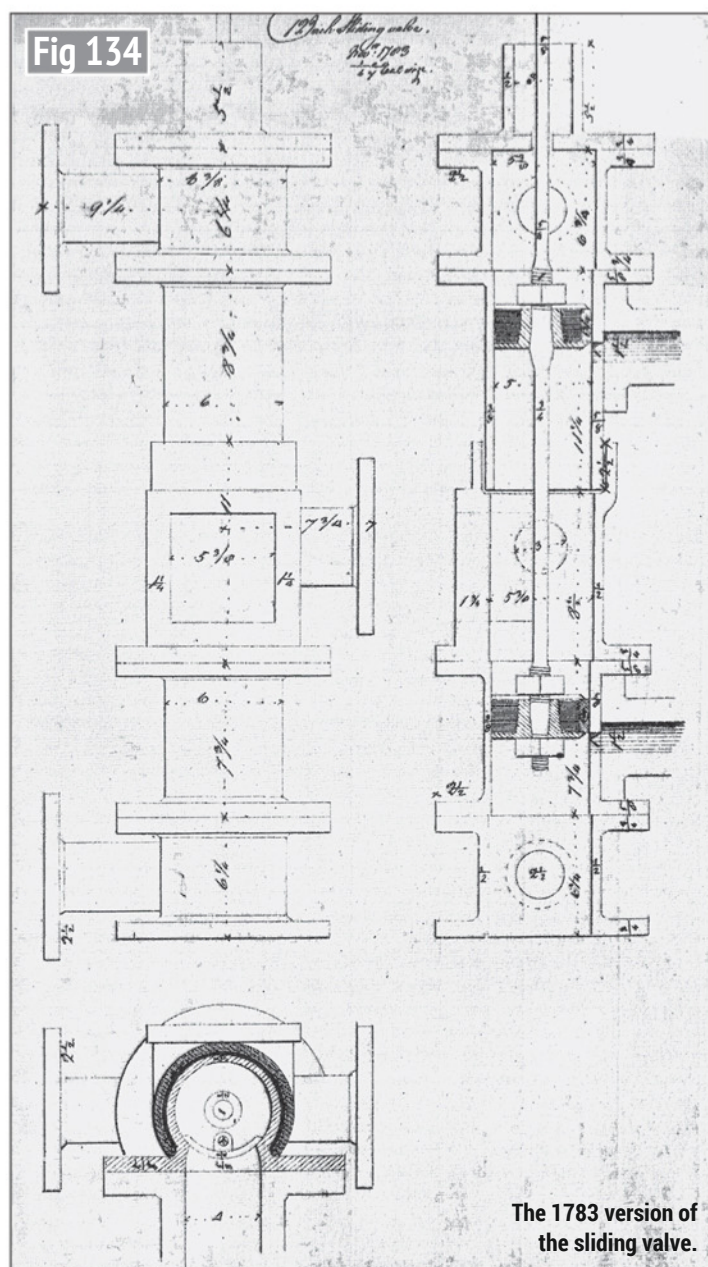
were eventually installed in the workshop to drive the boring mills. The use of bell crank engines was evidently a late change to the plans as the surviving workshop layout drawings are difficult to reconcile with anything other than two small beam engines.

The departure that the bell crank engine represented was not confined to the overall form of the engine but included the valves and valve gear. Poppet valves worked from the air pump rod that descended from the rocking beam had been universally used up to this time but the absence of the beam in the new engine meant an alternative had to be found and this in turn led Murdoch to substitute a rotating eccentric which drove a sliding valve. Both the eccentric and the sliding valve had a pre-history.

In September 1799 Murdoch was granted patent 2340, the patent that claimed the use of worm gears to drive boring mills and other machine tools. It covered three other topics, two of which died without issue (the rotary steam engine might be seen as the ancestor of the Roots/Gwynne/Beale pump but continuity is unproven) but the third, Murdoch's sliding valve, has frequently been claimed as the progenitor of what became the most common form of steam engine valve throughout the nineteenth-century. The reality though is more ambiguous.

Murdoch's sliding valve is presented in the patent specification in two forms. In the first (fig 132), a steam chest with a 'D' cross section is attached by flanges to the side of the steam cylinder, extending from the top to the

bottom of the cylinder's length. Steam ports at either end of the steam chest communicate between the interior of the chest and the cylinder bore. A live steam connection from the boiler enters the side wall of the steam chest and an exhaust outlet is attached to the base of the chest. Within the steam chest the working valve is also a hollow 'D' shape symmetrical with, but smaller in cross-section than, the steam chest. A raised collar at either end of the valve body forms a sliding fit within the chest and gland packings within the collars make the steam seal. At its top end, the interior cavity of the sliding valve is closed by a cover to which is attached the actuating spindle. This spindle passes out of the valve chest through a gland and continues for a length

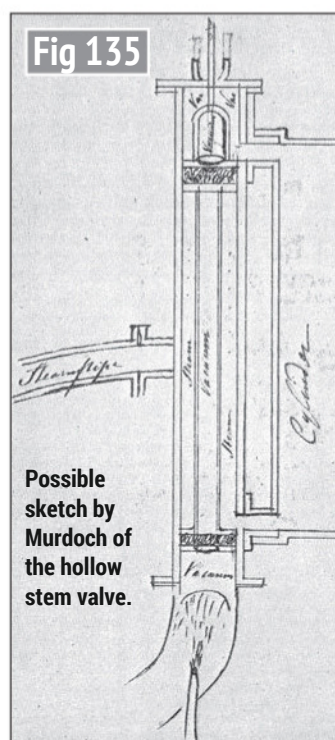


The 1783 version of the sliding valve.

somewhat greater than stroke of the main piston. Attached to the main piston rod is tappet arm which strikes stops mounted on the valve spindle, moving the spindle backwards and forwards sufficiently to allow the valve to cover and uncover the ports within the steam chest. As the ports at each end of the cylinder are successively uncovered the live steam within the steam chest, surrounding the exterior of the 'D' valve, is admitted into the main cylinder. At the end of the admission stroke the valve has moved to close the port but at the same time a second port in the wall of the valve, the exhaust port, leading into the internal space within the valve

body conducts the exhaust steam out of the cylinder and down through the interior of the valve which is open at its lower end. In descending, the lower collar of the valve closes the steam port at the bottom of the cylinder but the exhaust steam can pass freely to the exhaust connection at the base of the steam chest. The exhaust from the underside of the piston is only incidentally admitted to the valve body, the main path being directly to the exhaust manifold.

In its variant form (fig 133) the valve rotated through an arc. In this case the steam chest was fully circular in cross-section and cast integrally with the steam



Possible sketch by Murdoch of the hollow stem valve.

cylinder. The steam had to pass through ports within each annulus and the semi-rotative motion was derived from a link mechanism.

At least seventeen years before the patent was applied for both the reciprocating valve and exhausting the steam through the valve body had been investigated by the Soho drawing office. A 'D' shaped valve chest containing two separate, solid 'D' shaped piston type slide valves mounted on a single valve spindle had been proposed in January 1783 for a small experimental engine with a 12 inch cylinder and a trunk piston (fig 134). Live steam from the boiler entered the valve chest by a centre manifold and was confined between the two pistons. As the pistons reciprocated they opened and closed each port into the cylinder giving the live steam passage through the chamber between the pistons into the cylinder. Continuing to move, the piston eventually over-ran the port, opening the exhaust to the two ends of the steam chest whence it was led away by two separate exhaust pipes. The system will be familiar to locomotive builders as internal admission, external exhaust piston valves. By June 1783

this design had mutated to square piston valves and five months later the valves had become cylindrical running in a circular steam chest.

The drawings showing the progression of this valve design are in Southern's hand although an enigmatic sketch, un-dated but thought to be from 1783, shows a version of the reciprocating piston valve arrangement with a hollow valve stem between the pistons for the exhaust passage (fig 135). Significantly, the drawing shows condensing water injected into the eduction pipe below the exhaust manifold and not into a separate condensing vessel, the earliest form of condensing system, abandoned by the early seventeen-eighties. Dickinson and Jenkins comment that the sketch drawing: *...is not from the hand of Watt, possibly it may have been made by Murdock (sic) and the idea of these sliding valves may have been due to him. The fact that, as Boulton states, he applied a similar valve himself soon after lends colour to this suggestion. The model steam carriage lately in the Birmingham Art Gallery has a piston valve with a passage along its axis. This model is commonly said to have been made in 1784 or 1785 but Murdock himself gave the date as 1792...*

These early investigations of sliding valves did not result in any immediate application and the idea lay dormant until Murdoch took out his patent in 1799.

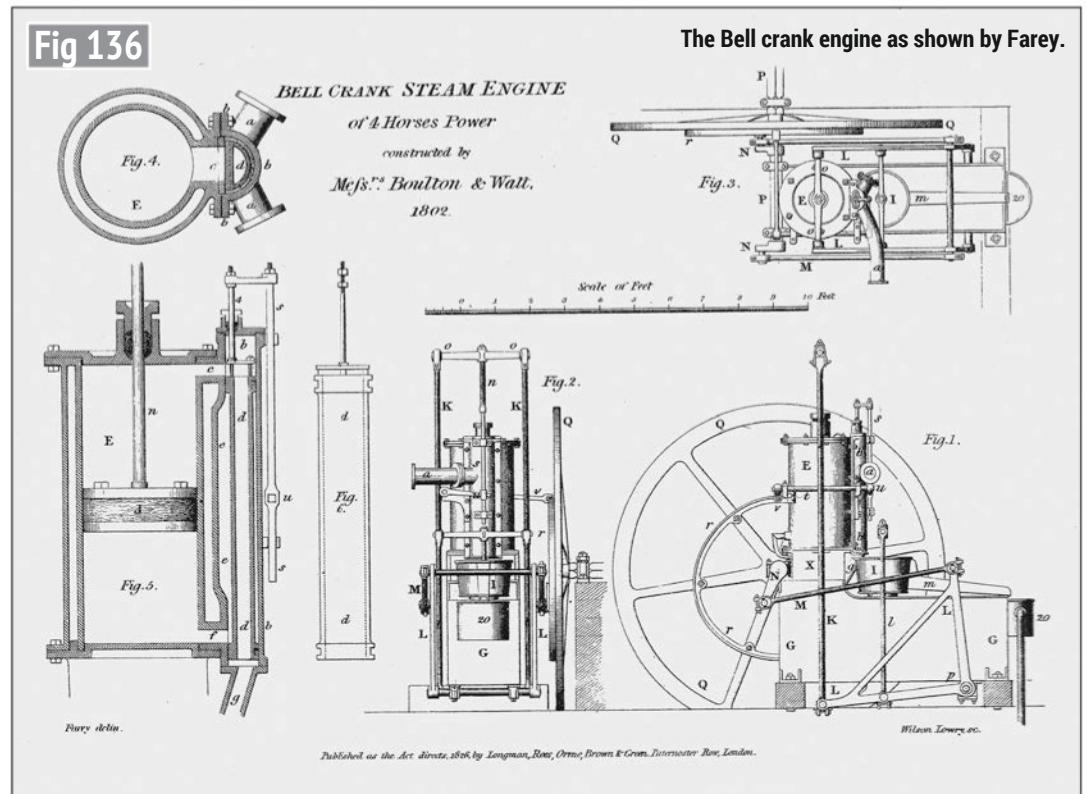
Southern seems to have attempted to distance himself from the revived proposal for the new valve, possibly as a result of his earlier experience. He expressed his misgivings about what he considered might be the over-hasty application to Symons' engine, sentiments that were shared by Watt Snr. On April 22nd 1799 Southern wrote to Watt Junr:

I cannot say I think the proposed construction of small engines with sliding valves is likely to be found of use. I am much afraid that the rubbing

planes will get shifted and should that happen the repairs will be so difficult and expensive that you will find the loudest complaints are made against you. I cannot but observe that I think you are attempting too many and too great changes in the construction of these engines at once.... Let me add that I think the construction of the sliding valve as now making it quite unexceptional and that there is nothing to be hoped from improvements in that way if they should be found to fail.

Watt Jnr. acknowledged that there might be justice in this argument and proposed that the arrangement should be first tried within the factory itself before it was released to the public. It may be reasonable to assume that the boring mill engines were the probationers for the new valves. The first of these machines, a three-horsepower unit that was to drive the smaller boring mill, was partially erected by mid-March. The cylinder was 11 3/4 inches bore and two foot stroke. The second engine, also of three horsepower, which drove the larger boring mill, was ready by October 1799. Neither machine had its own condenser but used the condensing plant for the remaining beam engine that drove the machine shop (ref 220).

The date when the Science Museum model of the bell crank engine was made is unknown but if, as has been suggested, it was Murdoch's first realisation of the bell crank engine concept (fig 136) particular interest attaches to the fact that in addition to the long slide valve it uses a disc or sheave eccentric enclosed within an eccentric strap to drive the valve. The eccentric is mounted on the crankshaft and the sheave is connected to an eccentric rod which operates a bell crank which in turn raises and lowers two vertical rods connected to a crosshead from the centre of which the valve spindle descends. Again, Dickinson and Jenkins make the claim that:



This signally important change was another of Murdoch's inventions (ref 221).

The authors make no mention of the bell crank engine model but they indicate that investigations into the possibilities of obtaining valve drive from the rotating shaft had been undertaken in 1798 when the drawing for the engine intended for Boulton's Mint shows two eccentrics operating the usual separate inlet and exhaust poppet valves by valve spindles passing through the covers of the nozzle boxes. This remained a paper design only and it was never fitted to the Mint engine. The preliminary designs for the Salford Twist Mill engine of 1799 used a cam rather than a disc eccentric although this engine was delivered with disc eccentric two years later.

It would appear that several of these early eccentric sheaves were made of wood and the first workshop engine had such an eccentric. The large beam engine that powered the rest of the machine tools also used an eccentric to drive the valves but this had an iron sheave. These engines along with the model almost certainly represent the

first practical use of the modern eccentric valve gear although Farey's illustration of the four horsepower Boulton and Watt bell crank engine dated 1802 shows a quite different type of eccentric. Farey's version consists of a circular cam ring of large diameter attached to the spokes of the flywheel. The cam ring has a raised rim that engages a forked rod which pivots on a fulcrum and by tappet action drives the valve spindle. The cam ring circle was distorted to give variable acceleration to the valve.

The bell crank engine was a radical departure from the

established pattern of Watt engine. Watt Snr. had seen small engines as reduced versions of the larger machines, retaining the wooden beam and frame, but Murdoch had moved decisively to a new format, at the same time producing Boulton and Watt's first all-iron steam engine.

●To be continued.

NEXT TIME

We take a look at the move from wooden to iron beams.

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216. *The Third Man. The Life and Times of William Murdoch, 1754-1839.* John Griffiths. Pub. Andre Deutsch, 1992.
217. *James Nasmyth, Engineer, an autobiography.* Ed. Samuel Smiles. Pub. John Murray, London 1912 ed., p. 162.
218. *James Watt and the Steam Engine.* Dickinson and Jenkins p. 170.
219. It is interesting to note that Farey in his *Treatise on the Steam Engine* written in 1827, on p. 677, attributed the development of the bell crank engine jointly to Murdoch and Southern.
220. B. & W. Archive Misc Portf Box 8. and Joshua Field, Tour. T.N.S. Vol VI, 1925-6.
221. *James Watt and the Steam Engine.* Dickinson and Jenkins. p. 189.

Wainwright's Swansong

The End of an Era

PART 8

Nick Feast builds a 3½ inch gauge version of one of the last of the elegant Edwardian locomotives.



Continued from p.159
M.E. 4708, 13 January 2023

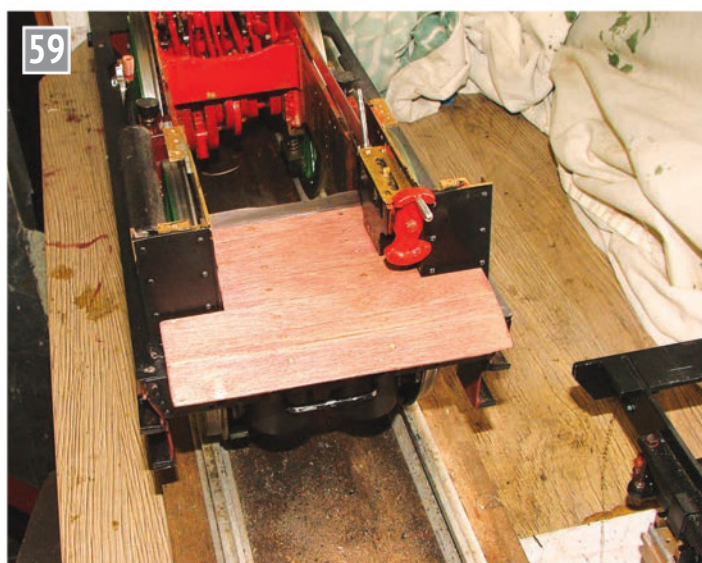


The locomotive was now coming together quite well, although without drawings there was a lot of test fitting to make sure that the plating lined up as it should. As well as the boiler cladding, the footplating was also thin nickel silver sheet. The cab floor was wooden planking and the works

drawings showed the boards ending at the back of the cab. This did not seem right, as it would have left a large gap between the end of the floorboards and the shoveling plate on the tender. There is a short hinged fall plate between the engine and tender at drag box level but this is much lower.

I was fortunate to meet Roger Ventin, an ex-BR footplate man, while he was volunteering in the locomotive works at Ropley. Roger worked as a cleaner at Tonbridge depot (73J) in the late 1950s, progressing to fireman over the next few years. He could relate first-hand experience of firing the L class as several of them were allocated to Tonbridge for secondary duties. He was able to confirm that the cab floorboards extended back and downwards towards the tender, as shown in **photo 59**. He also confirmed that it was a backbreaking arrangement and very hazardous in wet weather - not his favourite class of locomotive!

Photograph 60 shows the cab floorboards extending over the metal fall plate into the tender on the finished locomotive. Various sizes of miniature hinges were purchased for the cab doors, fall plate and tender locker lids. There are a number of specialist suppliers of these items for builders of doll's houses.



Strips of thin ply are fixed to a steel frame that can be removed to gain access to the cylinder oil tank beneath. The board nearest to the firehole is steel covered to prevent scorching from hot coals. The wood is stained light oak.

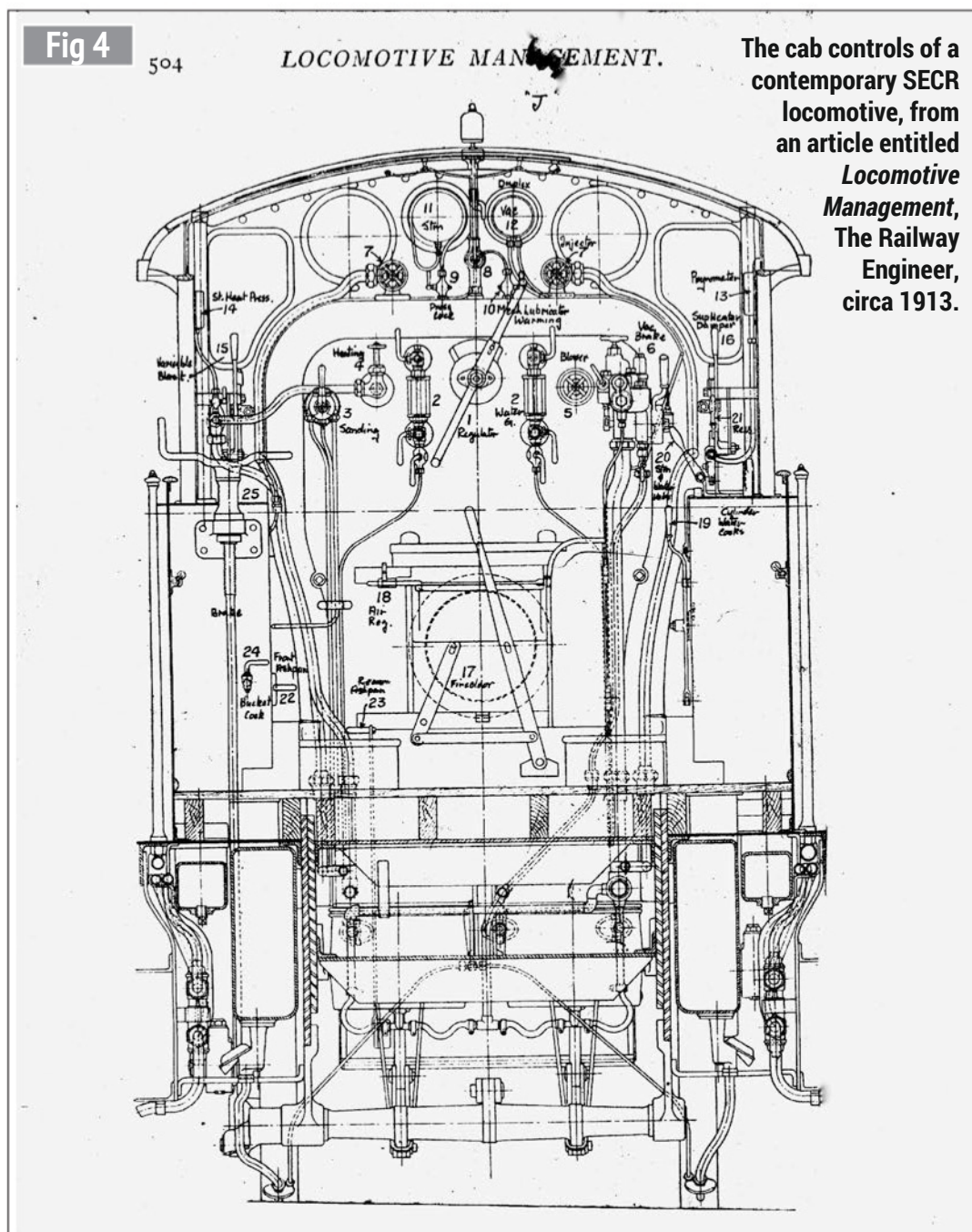
I was unable to find any cab drawings or photographs of an L class, but the contemporary J class 0-6-4 tank engines would have been similar (**fig 4**) and also the earlier C class 0-6-0 goods referred to later in the series. Note the left and right injector steam valves on top of the firebox, reverser control and drain cock lever on the right seating box, regulator with double ended lever and sliding firehole door.

Photograph 61 is the completed cab, with injector steam valves in the correct position, as are the dummy vacuum brake on the right side, the blower valve next to the regulator and the cylinder drain lever just in front of the reversing screw. Space was too tight for two sight gauges; to the left of the one fitted is the displacement cylinder lubricator. I have stopped calling them hydrostatic, as some readers believe that because the condensing coil is below rather than above the sight feeder it can't be called hydrostatic! I have fitted a small condensing coil under the floor but on the full-size engines there was a small finned heat exchanger on top of the firebox just behind the whistle. I have not been able to find any photographs or drawings of this item so it has not been included on the model.

The sight feeder was scratch built using a piece of 8mm outside diameter gauge glass. The feed to the cylinders passes through the boiler in one of the internal pipes mentioned earlier.

A Stones six feed mechanical lubricator mounted on top of the frames and driven from the left cylinder crosshead provided further lubrication.

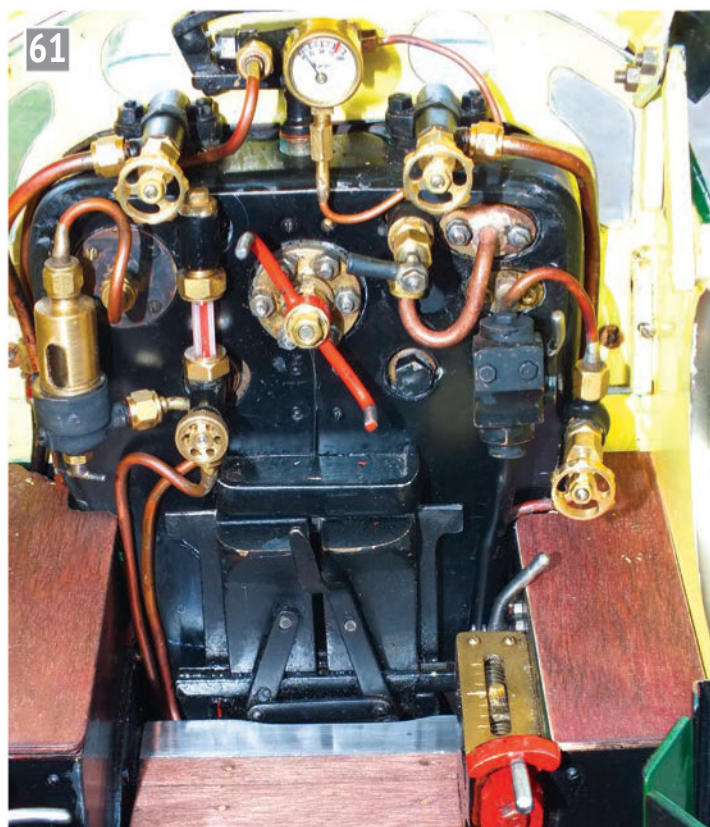
The boiler backhead is insulated and clad with thin sheet brass. I have used stainless studs and steel nuts to retain the regulator flange. I am not keen on screwing bolts or screws into a very expensive boiler; I prefer to replace a damaged stud rather than repair a stripped thread in a boiler flange. Please note that



there are NO washers fitted under any of the nuts. I have seen several models spoilt by the addition of washers under every nut and bolt head. Next time you are close up to a full-size locomotive, count the washers. You will not see any under the critical fasteners for frames, cylinders or running gear. Railways rarely use them, as it's just seen as another element that could fail. **Photograph 62** Shows the fireman's side of preserved Bulleid West Country class Pacific *Braunton*. I took a series of photographs of this locomotive a few years ago



The finished locomotive and tender together, with the floor in place and wooden seats on top of the box splashers and folding cab doors.



I have tried to produce a representation of the original cab layout that can actually be driven on the track. I have put the engine in mid gear but I fear I have the regulator fully open!

Please note that there are NO washers fitted under any of the nuts. I have seen several models spoilt by the addition of washers under every nut and bolt head. Next time you are close up to a full-size locomotive, count the washers.

including this one. I cannot see a single washer anywhere except for a few locking tab washers on the motion. Even the bolts securing relatively thin platework to the frames do not have them.

Photograph 63 is a platform level view into the cab, with the locomotive now fully lined and lettered. I will describe this in more detail later but this photo shows the distinctive cab roof and it is just possible to see the roof vent in this view. This was one of the few external differences between the Beyer Peacock and Borsig engines. The Borsig vents seemed to slide from side to side; the Manchester built engines had what looks like a hatch

that just lifted up. I used my method of four bar link hinges to allow the entire roof to be raised for driving, rather than removal of a sliding section. The hinges are unobtrusive enough and the roof remains in one piece. The inside surfaces of the cab are painted in an off-white or cream coloured finish, although the official specification states 'The inside of the cab shall be grained light oak'. In my grandparents' house just such a finish was applied to all the panelled softwood doors; I believe the process is known as 'scumbling'. The SECR 'D' class at the NRM in York has this finish to its cab. I opted not to apply this because of



Plenty of fasteners to be seen on this preserved locomotive but not a washer in sight.



The simplified lining of the later Wainwright livery can be seen here in this platform view. The class would only get this livery once, when new. At their first overhaul they would be 'Great War Grey' all over, and a small cast 'SECR' plate would replace the elegant cabside numbers, with the engine number painted on the tender in large white numerals.

the effect of scale; I don't think it would look right reduced 16 times! It is a bit like the very expensive 'dragged' designer wallpaper I was encouraged to buy for our living room a few years ago. This had fine

lines printed on of a slightly different colour to the base shade. From any more than a foot away it just looked like a plain colour!

●To be continued.

The Eating of Elephants

PART 6 – A LATHE, A WORKSHOP AND A FIVE-CYLINDERED ROB ROY

Steve Goodbody finds some things are best tackled in small helpings.



Continued from p.168
M.E. 4708, 13 January 2023

Having lost a stool fight, won a friend and met a mentor, the now thirteen-year-old author has also become the proud owner of an Edwardian round-bed lathe, several hundred-weight of accessories and an extraordinary book. He is, let's face it, a very fortunate young man.

The shoulders of giants

As we kick off the sixth part of this expanding series (which was originally the third part but that's a fact known only to you, our peerless editor, and myself so please keep it quiet), I must beg your indulgence yet again for another digression, but I think that this is an important one. Let me explain.

Today's model engineer has, for the first time ever, a wealth of exciting tools, manufacturing techniques and true-scale supplies that are available with the click of a mouse and a flex of the credit card. Laser cutting, 3D printing, CNC machining, digital readouts, lost-wax castings, excellent self-assembly kits, truly ready-to-run engines; the list of these high-quality resources increases yearly and the hobby has surely benefitted as a result. Putting aside the cost of these things and the jaw-dropping price of today's raw materials in general, I believe we live in a golden age for model engineers. Ours is not a hobby in decline.

However and hopefully without appearing Luddite-like in this assertion, I sometimes wonder whether we are in danger of losing something along the way. In short, by focusing on the immediate and the perfect, which is now attainable to all at a price, I suspect we are at the unintentional risk of ignoring,

or drowning-out, or perhaps even devaluing, the alternative path, which I would summarise as 'it may not be perfect, but it's the best I can do with what I have and it's good enough.'

And, with this thought in mind, I urge us to take a moment and review the many paths that are available, even those which have become overgrown and hidden with age, and to truly assess all the resources and options at our disposal. Before automatically investing in the new and newer, let's make a habit of considering the methods and resources of prior decades - they work just as well today as they did for the generations of model engineers that came before us.

Let us be on the look-out for the second-hand books and those used but well-loved tools and let us read those *Model Engineer* magazines from the 1960s and 1970s and, unless precision is needed, let's consider using hand-tools rather than machines. In short, our hobby has been around for well over a century and, to adapt the well-known quotation, we have the broad shoulders of Messrs. Lawrence, Westbury, Chaddock, Haining, Young, Wilson, Evans and many, many others, on which to stand. We don't always need to open our wallets and buy a new ladder.

To those considering our hobby for the first time and perhaps nervous of their abilities, I would add that there is a great deal of satisfaction to be gained from making something yourself, to the best you are able at the time and with the resources at your disposal. The result may not be as perfect as buying new or ready-made, especially at first and it does take longer, but the journey is well worth

it and you will learn new and useful skills along the way. If you look at the pictures accompanying these articles you will see mistakes and imperfections - I shudder today at the quality of some of my work on Rob Roy forty years ago - but that's what happens when you're learning on the job and working within your constraints. And you will get better with practice, as we all do, so don't apologise; be proud of your achievements.

Concluding this aside, in addition to reducing the expenditure, for me the alternative path is immensely satisfying. In the early days frugality was a necessity; a youngster simply hasn't much money to spend and must learn as they go. In later years it was a conscious decision - I wondered just how far I could go with the tools at hand and saw this as an interesting supplemental challenge. With a few notable exceptions where I truly felt I didn't have the ability (boilers, pressure gauges and Rob Roy's mechanical lubricator being the main ones), everything depicted in this series is home-made and followed that basic principle: it isn't perfect, but it was the best I could do at the time with what I had and I felt it was good enough. The reader can judge whether this is acceptable, I won't take offence either way.

Anyway, let's get back to the story.

A new home

With lathe at hand, some test-pieces tentatively turned and others cautiously milled and with the feeling that I was getting the hang of it, work on the locomotive restarted. Before too long the chassis sported horns and axleboxes, followed by wheels, axles,

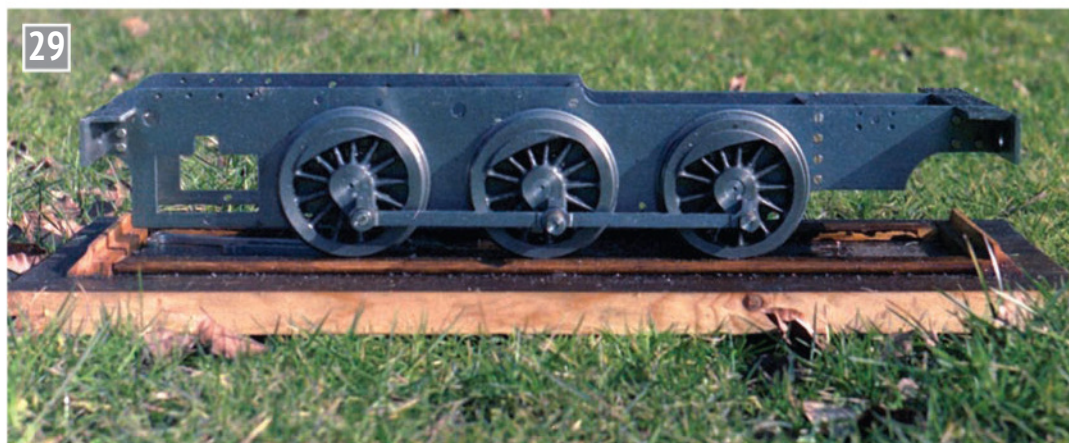
crankpins, coupling rods and even buffers. I especially enjoyed making and fitting the buffers!

Once up on its wheels and with the coupling rods in place, by the spring of 1982 the chassis was recognisably the basis of a steam locomotive, even to the layman (**photo 29**). With each new piece finished and added, I would frequently catch myself simply staring at the evolving chassis, much as I imagine art lovers do in front of their favourite paintings. I still do this when I build something new, but am no longer ashamed to admit it!

Seeing my continued enthusiasm and progress, my endless fight with condensation and rust and realising that the rear of a damp and poorly lit garage was not an ideal location for a metal workshop, dad announced that we should build a workshop shed. One side, he explained, would contain a woodworking vice and bench for him, the rest would be dedicated to my metalworking activities. I was, once again, ecstatic! The battle against rust, on tools and lathe and chassis and everything else that wasn't liberally re-coated with oil on a near-daily basis, was frustrating to say the least.

Measuring things out, we determined that a shed measuring 11 feet long and 7 feet wide would work well and it should have plenty of windows on the east, west and south faces to provide lots of natural light. Out came the obsolete printer paper once again, the same paper on which Bluebell had first taken shape, and together we drafted a new plan, this time for a workshop. To save money, dad intended to use the glass from a stack of gardening cloches which he had inherited from his father many years prior and which languished, unused, in a safe place during most of the year. There were more than enough panes for our shed, which, it would transpire, was a good thing.

Drawing up a plan, we dug



Wheels and coupling rods in place, the Rob Roy chassis begins to take shape.

and levelled the foundation, filled it with compacted rubble from a recently demolished wall and dad began to build the shed, calling for my assistance whenever a spare pair of hands was needed. I confess that I wasn't really interested in building the workshop, only in using it and selfishly kept my attention focused on *Rob Roy*. Dad didn't seem to mind, but I hope he accepts this as an acknowledgement and appreciation of his efforts and an apology for not doing my fair share at the time!

With the workshop finished and everything moved in, work began on the most complicated components to be dealt with so far - the cylinders. Having visited friend Nick's dad, Geoff and after parting with six month's pocket money, I was now the proud owner of a full set of *Rob Roy* cylinder castings. Mr. Evans's book was dutifully opened to Chapter Three, unambiguously titled *The Cylinders* and in the second paragraph I read that he recommended the use of a 'Keats Vee Angle Plate' for this job. Now what's that when it's at home? Consulting the index to Mr. Westbury's book, Chapter X (*Miscellaneous Lathe Operations*) depicted the device in question (**photo 30**).

'My goodness ...' I thought, or something like that, 'I've got one of those!'. Rummaging through the tools and equipment that had recently been relocated to the new workshop, I spied a hefty lump of iron that exactly matched Mr. Westbury's

drawing. Following Mr. Evans's instructions to the letter, I roughly dressed the casting with an old file to remove the worst of the sand and scale, bolted the angle-plate to a faceplate, screwed the faceplate onto the lathe, clamped a cylinder casting in the appropriate place and added a lump of steel to improve the balance. So far, so good and I was now beginning to realise the true value of the treasure trove which Bob had thoughtfully provided.

With everything secured and the lathe in back-gear, having

previously learned the trick from the wheel castings, a couple of deep cuts exposed the virgin metal beneath the rough exterior. Before long, the first cylinder casting was bored and faced to the finished length, as accurately as I could manage, and the second casting fastened in its place (**photo 31**). And that's when things started to go wrong.

Unlike the first one, the second casting refused to clean up. With every successive cut, the surface became more and more sprinkled with little dimples

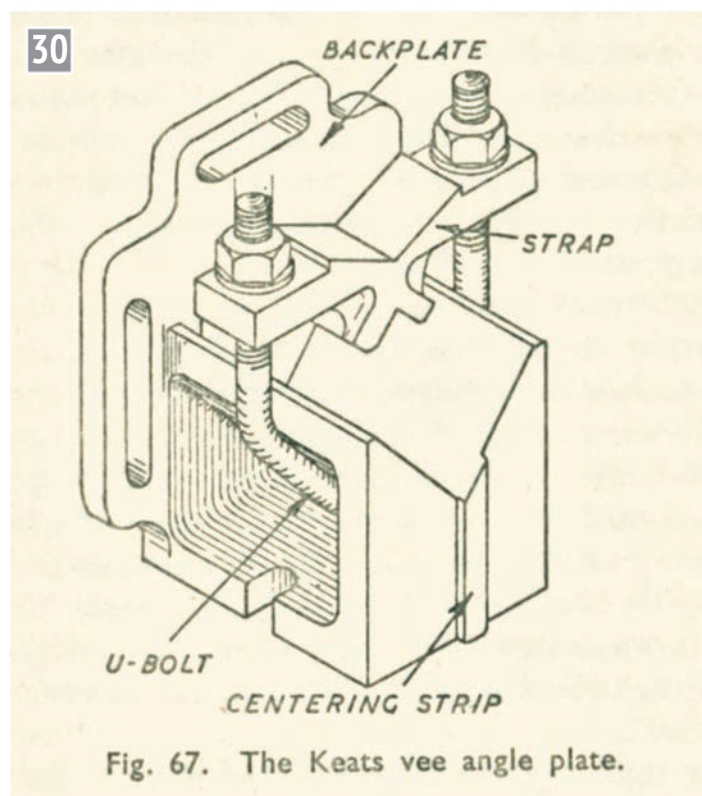


Fig. 67. The Keats vee angle plate.

A picture is worth a thousand words. (Extract from: The M.E. Lathe Manual by Edgar T. Westbury, 1951 edition, published by Percival Marshall & Co. Ltd. and reproduced with kind permission from TEE Publishing).

and black dots. Realising that I had to stop, or the cylinder would become too short, I switched to the boring tool. Once again I found that, no matter what I did, more dots appeared and spread within the cylinder's bore. What was I doing wrong?

I removed the casting from the lathe and examined the situation under the stronger light from a nearby window. On close inspection, I could see that the dimples and dots were in fact tiny holes, some apparently deep, rather like the inside of an Aero chocolate bar but much smaller. I had no idea what was going on but realised that this was probably the time to stop and seek advice. I phoned Bob who suggested that I bring him the exhibit for his examination.

A five cylindered Rob Roy

Jumping on my bike, I began the long slog up the hill from Jarvis Brook to Chapel Green. Arriving fully out of breath, Bob handed me a cup of tea and asked to see the problematic cylinder.

'Blowholes' he diagnosed, after a brief glance. "The sand was probably too damp for casting and created steam when the metal was poured. That's what created all these little bubbles - it's not your fault" he summarised. While this was good news, I confessed that I didn't know what to do next. Bob, as always, was ahead of me. "Show this to Geoff Swift and he'll sort you out" he advised.

Back on my bike, I made my way to the Swift's secluded house, the headquarters of Ashdown Models. Through the window I spotted Geoff in the annex of his large and orderly workshop, magnifier goggles on his head and tiny paintbrush in his hand, busy as usual. Nick wandered out, having heard my bike's tires on the gravel.

"Hello there! I'm going to build a Stuart Turner beam engine - want to see the castings?"

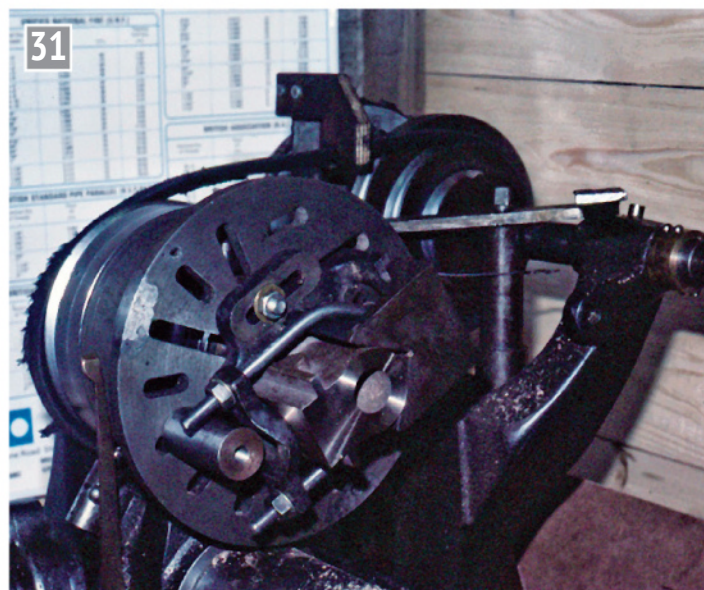
I admitted that I did and followed Nick into the workshop to inspect his newly arrived and neatly packaged materials. Before long, his dad came through to the workshop proper.

"Finished those cylinders already? My, you have been busy!" he chuckled.

I confessed that this wasn't the case and showed him the troublesome casting.

"Ah," he said, "that's no good. I'll phone the foundry and tell them there's a problem with that batch. Let's get you some more castings to try in the meantime". He disappeared into the storeroom, emerging a few minutes later with a cardboard box.

"There are three new castings in there - hopefully one of them will be okay. Bring back any that are bad and any that you don't need. Good luck and see you soon, I've got an engine to finish lining". He bade me farewell and returned to his painting. Giving my thanks in return and



A Rob Roy cylinder on a Keats Vee Angle Plate in 1982. Despite the grainy image, close inspection reveals the blowholes beginning to appear on the machined surface of the casting.

saying goodbye to them both, I pedalled my way back home, once again amazed at the generosity and kindness of the people in this hobby.

As it turned out, I needed every one of the five castings to achieve two blowhole-free cylinders. Some were obviously bad from the get-go; others kept their unpleasant secret until the very last cut on the very last operation at which point a rash of holes appeared like measles. However, after five attempts I had two finished cylinders and that was what was needed. As a further benefit, I had gained far more practice at cylinder-machining than would otherwise have been the case. And so, before too long, I was able to gaze happily at a chassis replete with its two cylinders (**photo 32**) - a fine sight to my eyes!

Progress and projectiles

As time passed, I gained more experience and confidence and the chassis continued to grow.

There were setbacks of course, some greater than others, and I learned many lessons the hard way. For example, as you, careful Reader, undoubtedly know very well, I discovered that gunmetal, brass and similar alloys have a nasty habit of snatching at drills without warning and,

therefore, it is very unwise to hold these materials by hand when drilling holes. This was made abundantly clear when, in the blink of an eye, while drilling the stud holes into a nearly finished and carefully machined gunmetal steam chest, it was wrenched out of my fingers and launched into the air with the graceful elegance of a brick, coming to rest at the base of an apple tree in the garden beyond with a soft thud. Now this sort of mistake does leave an impression and in this case the impression was a large and jagged hole in the window which had lain between the points of departure and landing. Fortunately, I escaped unscathed and no lasting harm was done because, as you will recall, we had spare panes of cloche glass and the window was soon replaced. Unfortunately, the drill bit had broken off in its hole and took many frustrating hours to remove, but that was another experience gained. Once again, more haste, less speed was the supplemental lesson of the day.

Over the course of the next few months the chassis was completed, the valves set and, by the late spring of 1983, all was ready for a test-run on compressed air. With the generous assistance of Geoff Swift and his air compressor, the chassis was raised onto



Of five cylinders started, two are eventually finished and proudly mounted on the chassis for the first time.

blocks, a pipe connected, a valve opened and the wheels began to turn of their own volition. Success - and first time too. I think Geoff was as surprised as I.

With this milestone achieved and a big smile on my face, I placed an order for the boiler thanks to another loan from mum and dad - paid off over the next twelve months from the proceeds of various chores and part-time jobs - and began the task of deconstructing, painting and reassembling the finished chassis (**photo 33**). Taking Geoff's advice I modified the drive to the mechanical lubricator, incorporating a slotted link to reduce the movement of the drive arm and curtail the alarming rate at which oil was otherwise pumped into the cylinders (**photo 34**).

Right on time and just as the chassis was finished, a shiny new boiler arrived. It was a lot heavier than I had expected and great care was taken to avoid scratching the new paintwork as it was lowered into place between the mainframes for the first time where, amazingly (to me, at least) it fitted perfectly!

Standing back, I admired this new sight for a very long time.

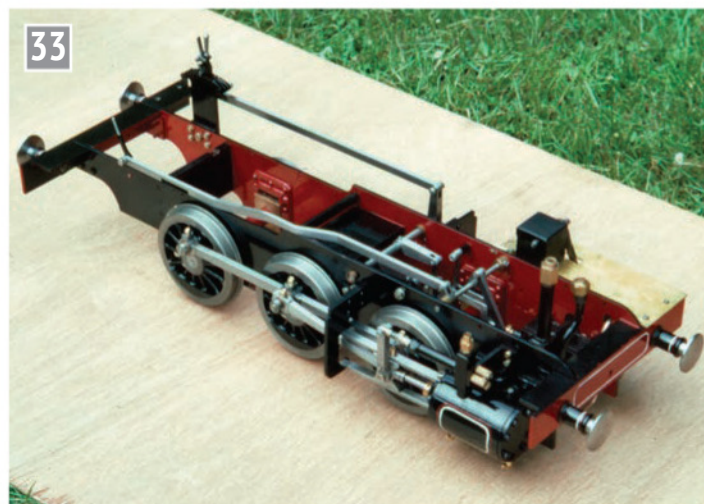
New horizons

It was now the summer of 1983 and, over the course of the previous twelve months, I had become used to the

chassis as an isolated entity. While a lot of work had surely gone into it in the meantime, its overall shape and size had remained constant for over a year; it took a keen eye to spot the progress and a knowledgeable one to appreciate the effort. But suddenly, with the addition of the boiler, the whole scene had changed; what sat on the workbench that day was no longer just a chassis but, very clearly, a steam locomotive.

I excitedly realised that I was on the home stretch. It occurred to me that there were now far fewer chapters in the Rob Roy book remaining than complete and the much-read chapter on driving the engine was drawing closer. With enthusiasm redoubled, work began on the cladding and platework, the valves and fittings and the many other bits and pieces that come towards the end of a locomotive project (**photo 35**).

As the summer holidays approached and with homework and exams over for the next few months, every available moment could be spent in the workshop. The weather was glorious and, just when it seemed that life couldn't get better, Bob phoned. "Would you like to help Cecil and me with the traction engine next weekend? We're giving rides at the school fête and could use an extra pair of hands" he explained. "... and



Early summer 1983 and a complete and painted chassis awaits its boiler.

besides" he continued, "from what I hear, it's time you learned how to drive a steam engine as yours will be finished soon".

Would I like to help with a real steam engine? And to shovel real coal onto a real fire? I could think of nothing I wanted more in the world! Hurriedly saying yes and jotting down the details of when and where and what to bring, I replaced the handset onto its cradle and literally - and I do mean literally - jumped for joy. And then the phone rang once again.

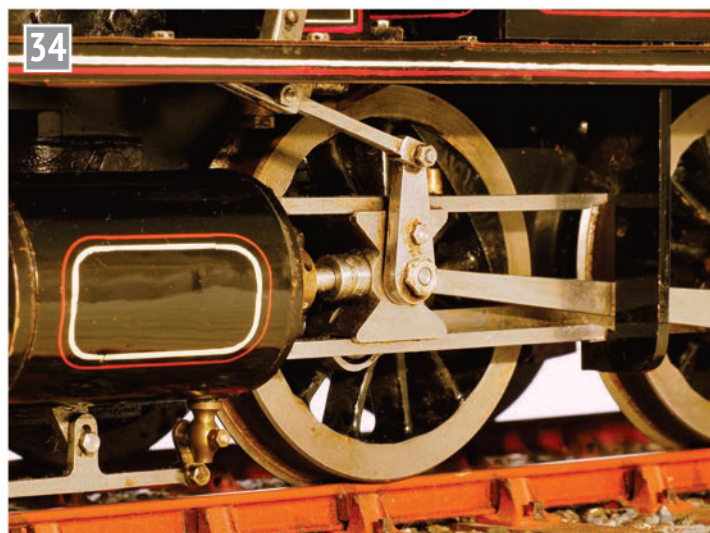
I tentatively lifted the receiver to my ear, half expecting to hear Bob telling me that he had reconsidered his request and didn't think it

such a good idea after all, but it was Nick's chirpy voice that came through.

"I'm going to the Uckfield Model Railway Club's meeting tonight - would you like to come? There's talk of building a ride-on railway somewhere in the area", he said.

Replying in the affirmative and with considerable relief and renewed excitement that my traction-engine-driving date was unaffected, I thought little more about Nick's invitation. I certainly had no idea that, of those two successive phone calls, the latter was to become at least as significant as the former in due time.

●To be continued.



The modified drive to the mechanical lubricator, reducing the oil delivery rate.



1983 and summer's end. With boiler in place and platework underway, the end draws near.

A De Winton in Model Form



De Winton maker's plate.

Peter Evans celebrates the first half century of an unusual locomotive.

The De Winton locomotive is not like any normal engine. The rule was, if it was not essential, then it was not present. It all had to be very strong and simple, just to enable it to run with the minimum of maintenance.

The originals were mainly built from the 1870's by a company in Caernarfon (**photo 1**) and were used predominately in the Welsh slate industry. With this in mind, I thought a model version would be fairly quick/easy to make and highly efficient to run. On the original, the chassis was massive for its size and it was all riveted together. The slate blade on the front and rear beams just missed the rails and would sweep the rail of debris that was all over the place in those days. The buffers were just blocks of wood and the original coupling was just a couple of links with a hook.

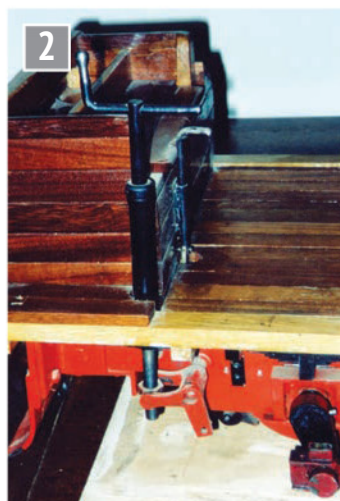
The wheels were solid and housed in large bronze bearings to give a great many years of life in that hostile

working environment. Some De Winton locomotives were made geared, others were not. Mostly only one axle was sprung and this was normally the rear one. Outside cranks where standard, as this allowed the gauge to be changed with comparative ease. Different quarries had different gauges in those days, so the standard De Winton could easily be modified to fit those requirements. On some engines the wheels were inside the frames; for a larger gauge, the wheels were just put outside the frames.

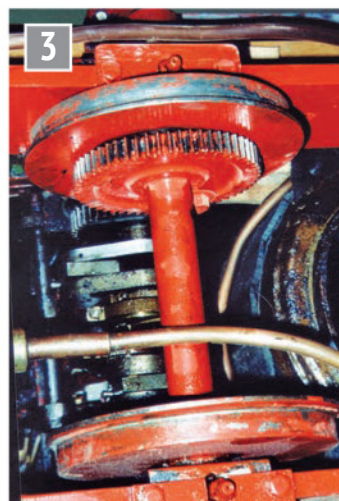
The boiler again was a simple vertical multi-tubular one, housing a round non-stayed firebox. The fire hole door again was often different, some being the conventional type, that is a hinged door. Others had a lower entry, with a floor trap door with a coal chute into the firebox. Water was held in a front steel tank, which was the normal construction at that period i.e. flanged plates and masses of rivets.

The cylinders were mounted vertically in front of the boiler on separate side plates. These in turn were fastened to the top of the boiler shell. The bottoms of these were attached to the chassis. The brakes were just an upright screw handle that applied large wooden blocks to the rear wheels. No compensation, just straight on (**photo 2**).

In the model, I have made some changes to make it easier working for me. This was the first locomotive I had built where I had done all my own drawings as well. My version was geared down, for power and low wheel slip when passenger hauling. I took the view that the locomotive was not going to be that heavy to start with, when built, so if we wanted to pull any sort of load, then it would slip all too easily if not geared down. I would certainly do the same again. I did wonder if it would be too slow when geared but I should not have worried - it is plenty fast enough to frighten me, even now. If I was going to make another one, I would make a simple dog type clutch in the drive, which I could use to disengage the drive gear train. This would allow you to push it about without the motion going. It would also allow you to run the engine and pump without moving, which could be an advantage if the fire was low. If I did find out later that it was not wanted, then you would just leave it in drive mode all the time. The chassis is $\frac{3}{8}$ inch thick BMS with cut outs for the axle boxes. The gears I used were copies of Myford change wheels (**photo 3**).



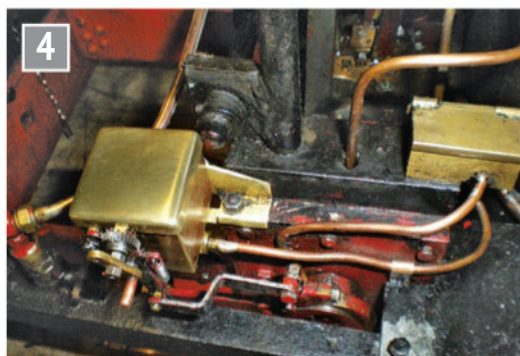
Brake column.



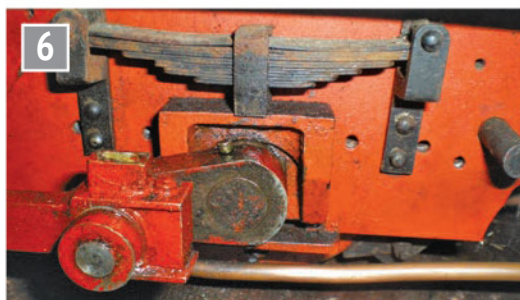
Crankshaft and gearing.

I fitted a standard LBSC type lubricator and this is driven off the water pump eccentric (**photo 4**). The water pump is fitted with a bypass valve, back to the front tank. As the water pump is right at the side of the water tank the pipe work is very short and it works perfectly, although it is quite a small bore. The lubricator is a single piston type and I have found it adequate. I have made hydrostatic lubricators in the past but it would look a little out of place here I thought. There is also a hand water pump concealed under the rear seat, with a pipe pickup from the front tank. This pipe also is the injector water feed as well but the hand pump is there just in case. I also fitted a (home made) normal type 5 inch gauge injector - this has been no trouble and is only used when stationary. Each of these systems can cope on its own, so there is never a problem to get water into the boiler. Having plenty of options is handy and they were all easy to fit.

The cylinders are made using a simple cast bronze block. I used METRO drawings from *Model Engineer*. This was being serialised at the time, along with the motion and crank. The crank is the built-up type, which is pinned and locited. The main difference to the METRO crank is the main shafts are left longer to get right across the frames. It is also machined down one end to take the water pump eccentric. The rest of the cylinders and motion were machined as METRO. I did have to fit a couple of $\frac{1}{8}$ inch spacers in between the cylinder ends and the mounting plates (to make it all about $\frac{1}{4}$ inch wider). A word here about the slide bars and valve guides. I found because they were all vertical that lubrication was a problem after use over a long period. This was overcome by a small reservoir with two very small pipes directed onto the valve guides fed by gravity and this has cured the problem. I can safely say the motion is



Lubricator.



Leaf springs, made from band saw blade.

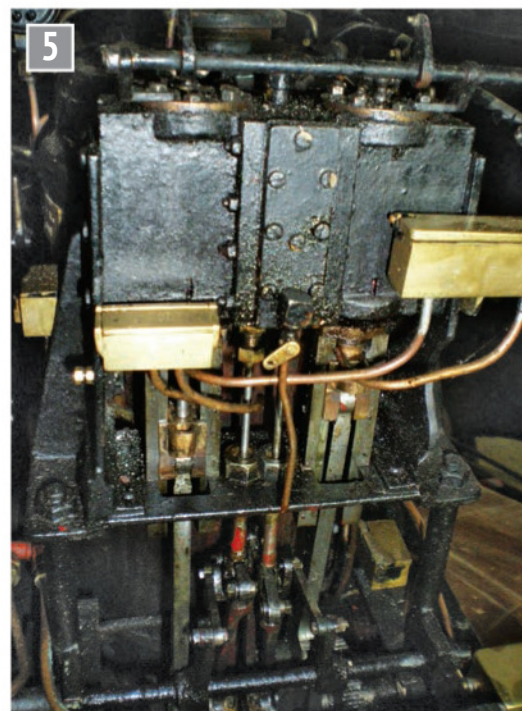
always now covered in an oil film. Maybe another LBSC type lubricator hidden underneath somewhere would have been a more positive method, if I ever had to make another. There is also another of my gravity type lubricators made to look like a toolbox and this feeds the two main crank bearings. These by the way were solid bronzes (**photo 5**).

The two axles are just $\frac{3}{4}$ inch BMS bar with the ends turned to fit whatever size you make your axle box bearings. Lubrication of these on mine is by grease nipples up through the axle box keep plates. My wheels were just turned EN8 blanks and were locited to the axles. Remember to either put a keyway in the axle to hold the gear onto the axle shaft or you could just bolt it to the inside of the wheel instead; I put in a peg as well. The axleboxes are just built up affairs using mild steel strip and then they slot into the chassis, held in position with keep plates using 4BA bolts into the $\frac{3}{8}$ inch thick chassis underneath. The bearings in these, on mine, are ball races but bushes would be just as good. If you are springing the rear axle, the chassis slots will have to be made a bit longer. I used proper leaf springs - these were made using steel band

saw blade (**photo 6**) but you could equally use a dummy with a coil spring inside. I did weld an extra bearer plate on top of these two rear axle boxes just to give the spring something better to purchase on.

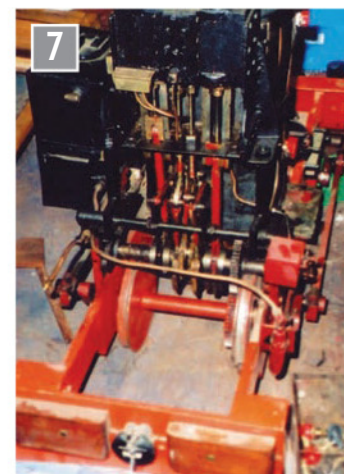
The buffer beams are 3 x 3 x $\frac{1}{4}$ inch angle. I had to cut the back of the front one (**photo 7**) just to allow the water tank to sit in place, which fits in between the chassis, then this allows the tank to come right forward to the edge of the front buffer beam. By doing this you get a bigger tank in and more water storage plus extra weight. If you do not want that extra room do not bother cutting out the beam. The back angle is left whole, to give the solid mounting required for the brake stand and the hand water pump fixing.

The boiler fits between the frames held by two shaped angles riveted and silver soldered to the outside of the boiler shell. The ash pan is just a copper or steel tube, with an outside diameter to fit the inside of the firebox nicely. A base is brazed or riveted in place, with a ring inside at the top to hold the grate. I drilled a hole straight through the chassis both sides and through the ash pan as



Oil boxes.

well (about half way up) and fitted a long stainless/steel rod right through. When you pull this rod out, away goes the ash pan, grate and fire all in one go. It may be better to make this ash pan in mild steel as my copper one is now getting pretty knocked about with the constant dropping. The first grate I made was just mild steel strip welded up as a grate. This did not last too long as it just burnt away in the middle. The next was stainless steel round bar $\frac{1}{4}$ inch diameter. A ring to fit the ash pan and the bars was welded in. This was used for years with no visible signs of wear at all. The ash pan front was opened up a bit at the



Front buffer beam.

bottom to admit more air. The faster you go, the more air gets in – well, that's the theory anyway. The bits cut out were only the sides and top and this was then bent down to make sure no ash dropped on the track. Some track stewards get all upset if that happens. As a much later addition I have now changed the grate from the original, normal fire bar type to a rosebud type which is just holes. This has been a great asset as it now uses less fuel to do the same job only better.

The smoke box is another ash pan type structure on the top. A good tight fit is required. I put a fire clay fillet using pyruma and then pressed it home. In the centre of this, which is slightly domed, there is the hole for the chimney of course. I made a large threaded BSP bush and fixed it there. I can now unscrew my chimney when I have finished running (**photo 8**), which then reduces the transport height a great deal and also allows me to get into the smoke box to change blower nozzles etc.

You will see that the regulator is external (**photo 9**), just screwed into a bush at the rear of the boiler (**photo 10**). Steam enters the regulator barrel and meets the regulator spindle and its 'O' ring. When this is opened steam is admitted into the outer body and then into the cylinders. This on some originals was by way of an external lagged pipe. I altered this so that, instead of the lagged pipe, I took the return pipe back into the smoke box, round a couple of turns like a super heater sort of idea, then back out of the front of the smoke box (**photo 11**). This was then direct into the cylinders via a flange. By doing this it must heat the steam a bit more and gets rid of the unsightly external pipe work. If I am asked, I can say it is superheated. Well, heated anyway.

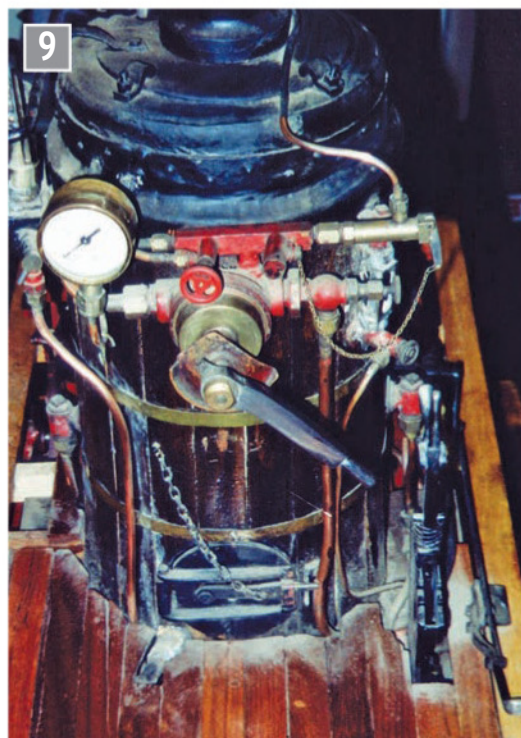
The safety valves and its mounting block are straightforward locomotive type. On the original it was usually the old Salter pattern. I therefore made the dummy top



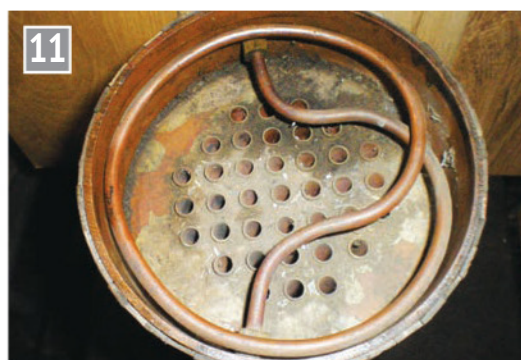
Chimney and blower.



The boiler.



Boiler and regulator.



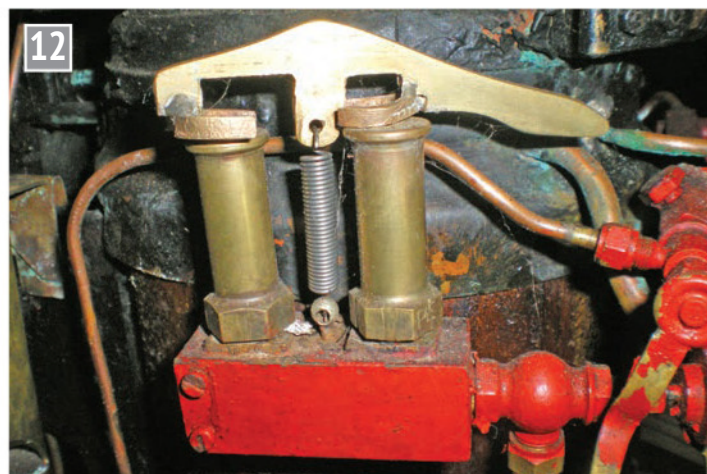
The superheater.

(**photo 12**), so it just looks the part. I think a proper working one of these would have been nice but I have never got around to that yet. This safety valve block also has a tap in it for the injector steam feed. There is plenty of room on this block for other live steam tap-off points, if they were ever needed (i.e. a possible ejector for train vacuum brakes etc).

Drain taps on the cylinders are on the top with a cross shaft and linkage to work them across the smoke box top. There are two things extra that I had to do on the METRO valve chest. On the front of the central valve chest I milled away as much of the front as possible of the valve chest and fitted a cover plate with a ring of bolts (studs). The problem

was setting the valves, as you could not see the valve face at all. The second change I introduced was on the front of this cover plate at the bottom end, where I also fitted

a small hand operated drain cock. I found that condensed water collected there, but only when the cylinders were cold. This, I felt might have caused problems. I just leave that tap



Safety valves.



Rear buffer beam.

open until it is all warmed up then shut it. When cool again, any water collected there can be drained off with ease. As there was a major problem setting the valves as you just could not see the ports. I used a dog's hair and kept moving it till the valve trapped it, and that worked just fine - very accurate too.

As I made all my own boiler fittings, I did get into slight trouble as I put a clack valve back in the wrong way round. I had made the inlet and outlet threads the same. I then must have put the valve in the wrong way round. Until the mistake was found, it caused me a lot of problems, like braking the train without warning. I now always make my fittings with different threads to stop this ever happening again.

The running boards and footplate on mine are all wood and so is the rear seat and coal bunker. All this will in fact lift off in sections. I just put some wooden cross bearers bolted to the chassis top and fixed everything to them.

The rear coupling on the buffer beam I made as a jaw and pin, albeit I admit it is well over scale (**photo 13**). I remember a well-known member at the club with a nice scale type coupling which broke and resulted in a runaway train. All very messy as the driver tried to hang onto the locomotive whilst straddling the track. I vowed that was never going to happen to me.

I did make the same coupling on the rear of my driving truck, where it coupled to the rest of the train. That one has a safety device as well, to stop unwanted small fingers uncoupling things when you are not looking.

Well that covers most of it. Many people have their own special ideas and there is room to put all sorts of things on this model. At the back and underneath, there is plenty of room to put all sorts of special gadgets all completely out of sight as well. I know it turns a few heads when it is seen for the first time on the track,



De Winton in steam.

usually accompanied by a few rum comments about a coffee or tea maker on wheels as well (**photo 14**). Often when they see the performance that it can deliver, they say very little from then on. Many have also now driven it and all seem to like this model. The maximum I have ever pulled for a test on level track is 27 adults. It is the gearing that enables this to happen.

The locomotive has now done a lot of miles since it was completed in 1973 (**photo 15**) and has had one semi-rebuild. That is - bushes/bearings changed, pistons repacked

and wheels skimmed. The cylinders had virtually no bore wear and the slide valves were okay. New wood brake blocks were fitted and a bit more paint applied. Also, the wooden footplate was changed to steel. That was about it - there was very little else that needed attention after all these years of running.

So, if you decide to build one of these locomotives, the best of luck and I hope you have as much fun as I have had building and running my own De Winton.

ME



De Winton's first outing half a century ago.

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Performance Testing an Electric Motor using a Dynamometer PART 3

Graham Astbury determines the output characteristics of a rewound electric motor by building a dynamometer.



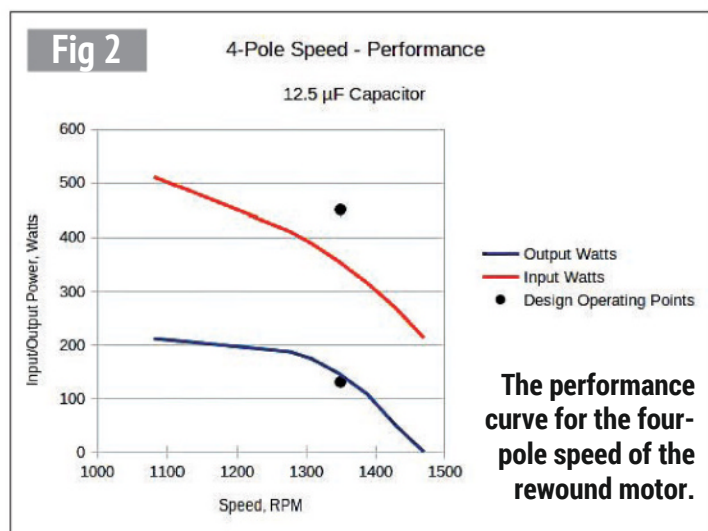
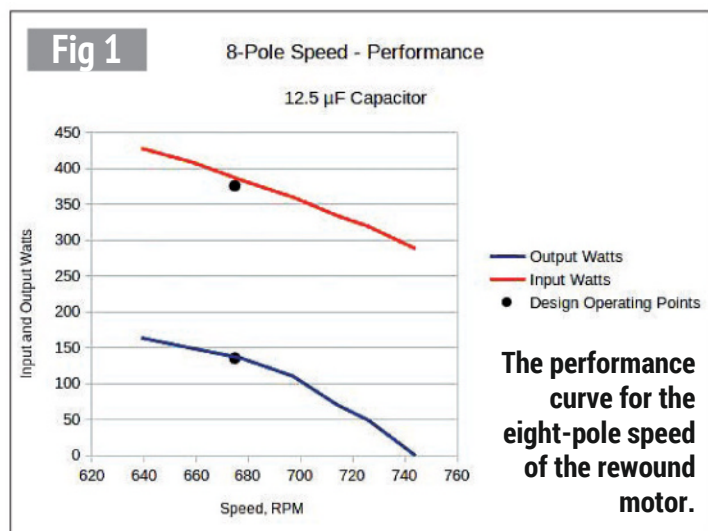
An actual test

I arranged the motor to have separate connections so that I could measure the total current taken; power factor and supply voltage using the power and energy monitor, and the main winding current, the auxiliary winding current and the capacitor voltage using separate multi-meters (photo 20). The *modus operandi* of the dynamometer was that the motor would swing in the cradle and the torque arm would press on to the kitchen scales. The power is calculated from the equation

Continued from p.162
M.E. 4708, 13 January 2023



Instruments - Top row (left) main winding amps; (right) auxiliary winding amps; Bottom row from left: tachometer; Power and Energy Monitor for measuring power factor/input watts/ input volt-amps/total amps; capacitor volts; and torque using kitchen scales.



$P = 2 \times \pi \times n \times W / 60$ where n is the speed in rpm and W is the torque in newton-metres. The 60 is to convert the revs per minute into revs per second.

The kitchen scales were zeroed with the weight of the torque arm pressing down, so that the scale then read zero torque. The torque arm pressing on the kitchen scales were adjusted to be 200mm long. I started the motor without the belt drive on, so as to be able to determine the no-load performance. I then set the belt to drive the dynamo, but with the field disconnected, so as to have just the mechanical load of driving the dynamo armature alone. The next step was to connect the field, as this adds more load to the dynamo and hence the motor. Finally, the dynamo had lamps gradually added to the load, until the motor was at the point of stalling so that the full characteristic curve is obtained. It was not necessary to attempt to achieve specific load increments - I just added the load in stages and measured all the parameters

at each stage. This allows a full curve to be obtained quite quickly from no load to overload. I finally stalled the motor (locked rotor) and read all the values.

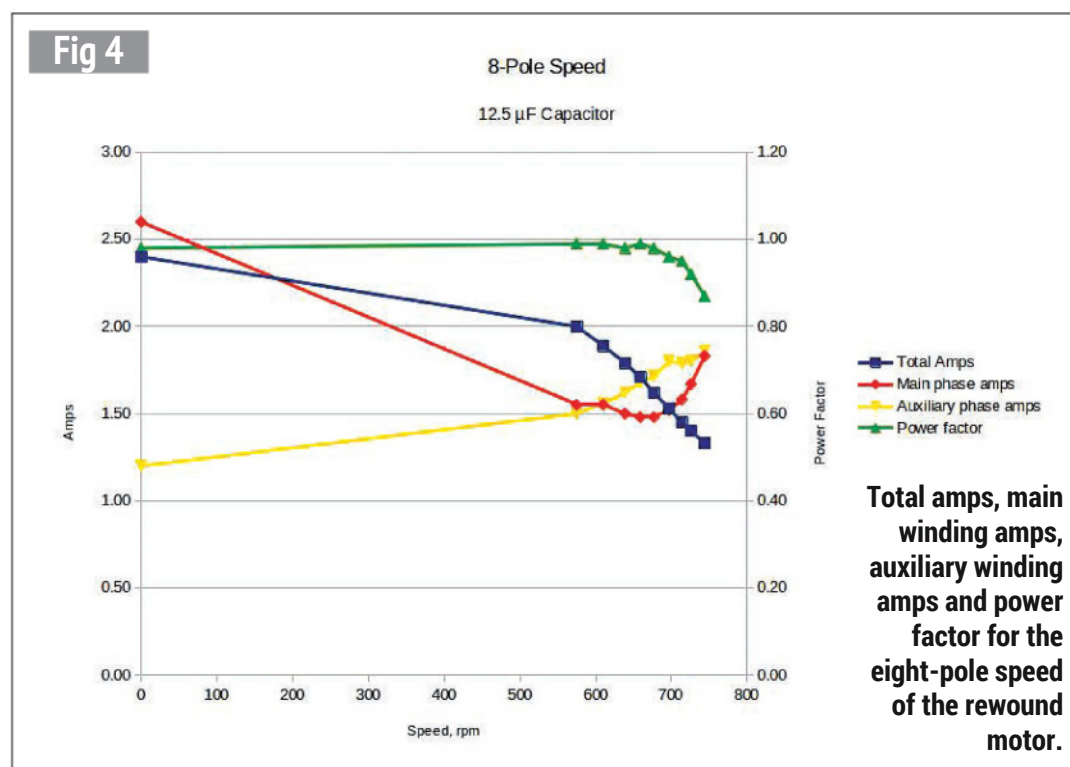
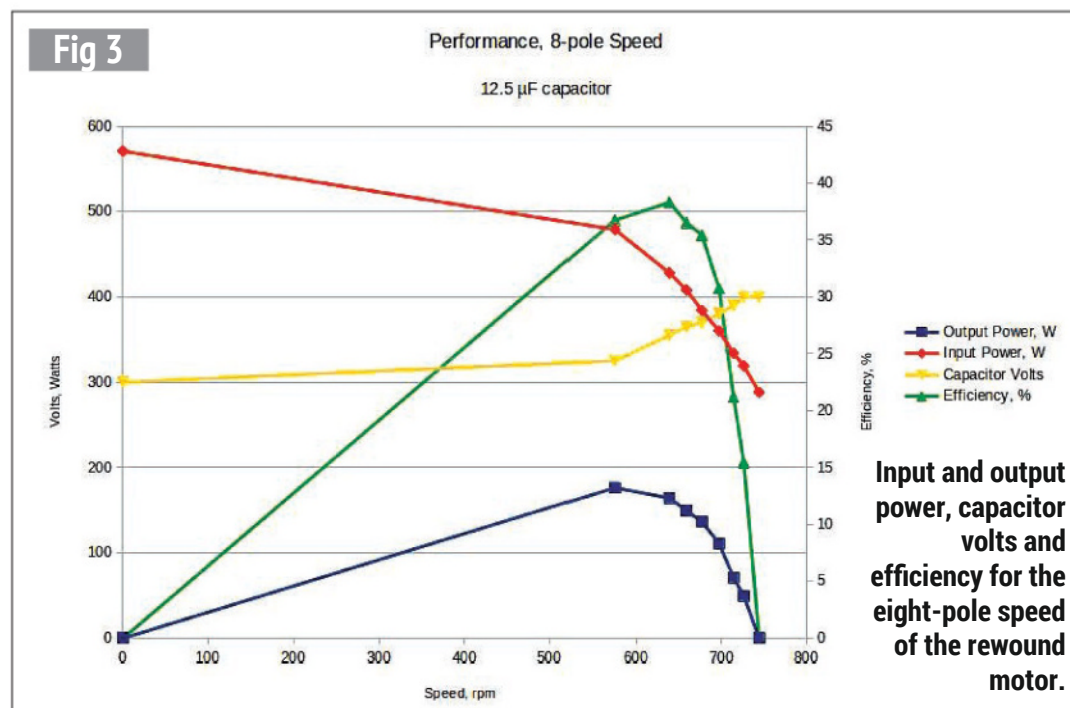
There was a slight problem in that on the low eight-pole speed of the motor, the standard dynamo pulley was too large for the motor pulley to drive the dynamo at the right speed, so I had to use a smaller pulley from an alternator on the dynamo shaft instead. Fortunately, both the dynamo and the alternator had 15mm diameter shafts so the pulleys were interchangeable (strange that a dynamo made in 1957 has a metric shaft!). On the high speed, the alternator pulley drove it a little too fast, so I had to change the dynamo pulley back to the standard size for the four-pole speed tests.

I set up a spreadsheet for the measured values and calculated the performance figures of power output and efficiency and then plotted a graph showing these values. The power is calculated from

the load on the scales and the speed by the equation $P = 2 \times \pi \times \text{rpm} \times \text{grams} \times 9.81 \times 0.2 / (60 \times 1000)$. The power P is calculated in watts from the speed in rpm and the load on the scales in grams. The 9.81 converts the kg to newtons; the factor 0.2 is the length of the torque arm in metres; the divisor of 60 is to covert rpm to revs/second and the 1000 factor is to convert the grams to kg. All the remaining parameters are read directly. The efficiency is calculated as the input watts divided by the output watts, and the apparent efficiency is the input volts x input amps divided by output watts.

The performance curves for the two speeds are shown plotted in **figs 1 and 2**. It is usual to use the speed as the base-line (X-axis) and the other measured values as the Y-axis. The motor was designed for a power output of 130 watts, and it can be seen from the graph that this corresponds to a slip of 10% or a speed of 675 rpm. I have another permanent capacitor motor which, from the nameplate, gave a value of 9% slip at full load, so a slip of 10% is good enough for me. As it is relatively quick to take all the readings for a performance curve, it is fairly easy to change the capacitor on the motor and see the effect on the output of the motor. This was discussed in part 1 (ref 1 – M.E.4707, December 30 2022).

The other values are plotted in **fig 3**, showing the power and efficiency in the eight-pole mode, and **fig 4** showing the eight-pole current and power factor. By separating the values into similar magnitudes, it is relatively easy to plot them on graphs and the customary X-axis is the motor speed. Similar results were obtained and graphs plotted for the four-pole speed. From fig 4 it can be seen that the two-phase currents are not constant, nor do they both increase as the load increases. This is because not only are the two windings connected together electrically but they are also linked magnetically, so changing the



load on the motor will change the current in one winding and this will affect the current in the other winding even though the capacitor is the same.

It can be seen that when stalled (zero rpm), the main phase amps are higher than the total amps which would seem to be impossible. However, it is not impossible because the main phase amps and the total amps are not in phase with each other so

the addition of the currents has to be done using vectors. Because the auxiliary phase is fed through a capacitor, which has constant impedance, the auxiliary phase current does not alter linearly, and it can be seen that the main and auxiliary phase currents are only equal at two points on the graph. These 'balance' points will be different if the value of the capacitor changes. Thus, there is really only one

point (corresponding to about 700 rpm) where the motor is truly a two-phase motor, and the choice of capacitor is somewhat dependent upon the chosen operating point. The design of capacitor motors is not a simple task and it does depend on the desired operating point. I chose the 12.5 μF capacitor as a compromise between the best value for both of the two speeds to avoid using

two capacitors which just introduces more complications when changing the speed. The design of capacitor motors is described well by Trickey (ref 5)

The results can, of course, be plotted using any axes you choose but it can produce interesting results if you do. As an example, I initially plotted my results using power output as the X-axis and, as the power output has a retrograde section, as in **fig 5**. It can be seen here that all the currents are too low a value to be meaningful on the graph, despite using a lower range for the right-hand secondary axis. This method of plotting is used by Langsdorf (ref 2 – M.E.4707, 30 December 2022) when deriving the performance curves from a circle diagram.

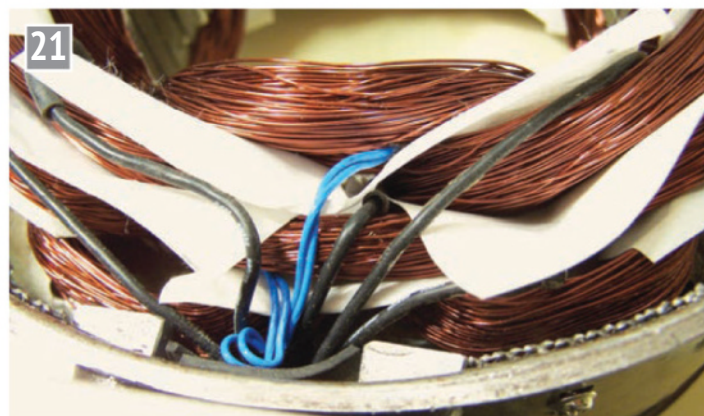
Temperature rise

Having obtained the performance characteristics, I decided that a thermal test should also be undertaken to ensure that the motor did not overheat when fully loaded for a considerable time - such as an afternoon in the workshop. Consulting the IEC Standard for testing of rotating electrical equipment (ref 6), there are three standard methods of determining the temperature rise, which are: the embedded thermocouple method; the

thermometer method; the resistance method. The embedded thermocouple method would have been ideal, as it can measure the temperature deep within the windings, but as typical easily obtained thermocouples are 1.5mm in diameter and the wire used in the rewind was only 0.5mm diameter, it would be difficult to fit it in (**photo 21**). Similarly, using a thermometer is difficult because of the size of the bulb which could not be inserted into the winding easily. That left the resistance method as the only practical method that I could use.

There are two ways of undertaking this method. The 'superposition method' gives the resistance measurement without interruption of the AC current whilst on load by superimposing on the load current a small DC current and measuring the resultant DC voltage drop. The other method relies on disconnecting the motor from the AC supply briefly during the test to measure the DC resistance of each winding and then reconnecting to the supply and continuing the test. I used this latter method as I was unsure of the practicalities and safety of the 'superposition method'.

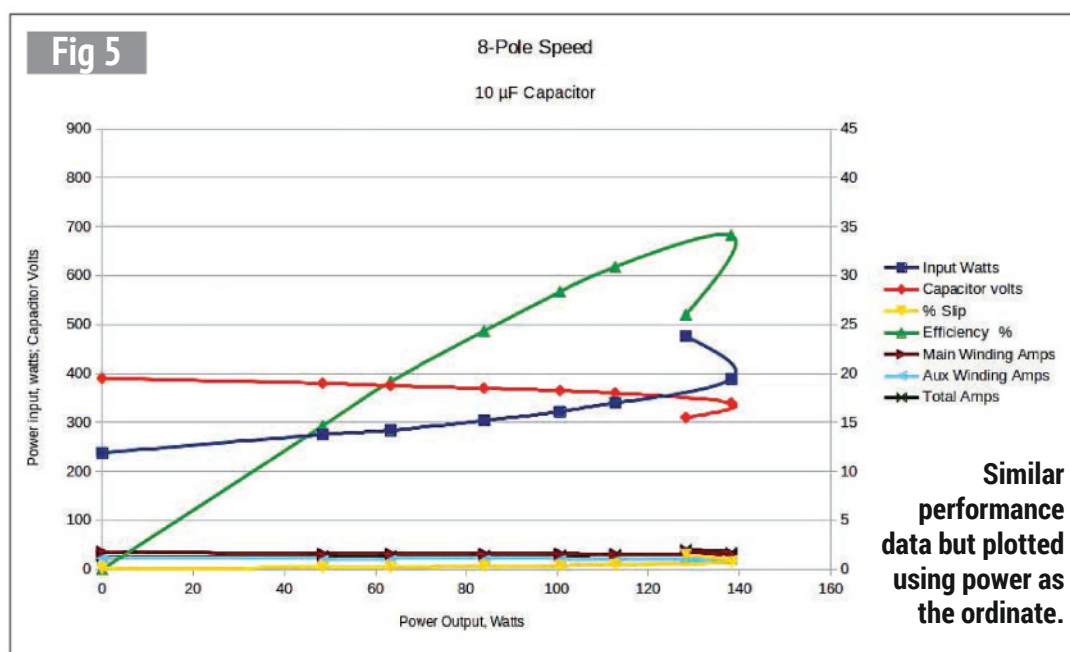
I searched the Internet for a value of the coefficient of increase of resistance of copper with temperature, but



Not much room in the windings for a thermometer!

that returned several slightly different values without any of them giving the source of their data. However, persistent searching led to the most common value as being 0.00394 per degree C. Further searching led to the original source being a US Bureau of Standards Report (ref 7). This allows an estimate of the *mean* temperature rise of the windings – not the maximum temperature that may be present somewhere within the windings. The resistance is measured cold and then periodically whilst the motor is run on load. The hot resistance can be converted to temperature rise using the equation: $\Delta T = (R / R_{ref} - 1) / 0.00394$ where R is the resistance measured hot and R_{ref} is the resistance when cold at the start of the test.

When measuring the temperature rise, it was necessary to disconnect the motor from the supply, measure the resistance of both the main and auxiliary windings and then reconnect the motor so that it restarts and the test continues. I was able to take both readings in less than 30 seconds, so I took the run time to be the actual time that the motor was running rather than the elapsed time. Although I ran the motor for 85 minutes on load, the temperature was still rising slowly and clearly had not come to steady state at the maximum temperature rise that I recorded. According to the IEC Standard (ref 6), thermal equilibrium has been achieved when the temperature change is less than 2 K per hour. I have used Kelvins (K) for determining the temperature *difference*, and degrees C for actual temperatures, in line with the standard practice of the International Electrotechnical Commission. The Kelvin is the same magnitude as a degree Celsius. The temperature rise for both windings on the eight-pole speed is plotted in **fig 6**, as they reached the higher temperature of the two speeds after 85 minutes on load. Typically, a motor will run with a frame surface temperature around 30 K below that of the windings (ref 8), so it is possible that the motor will be far too hot to touch, yet will still be below its maximum rated temperature for the windings. However, in this case, the mean temperature rise was less than 80 K from an ambient of 10 degrees C,



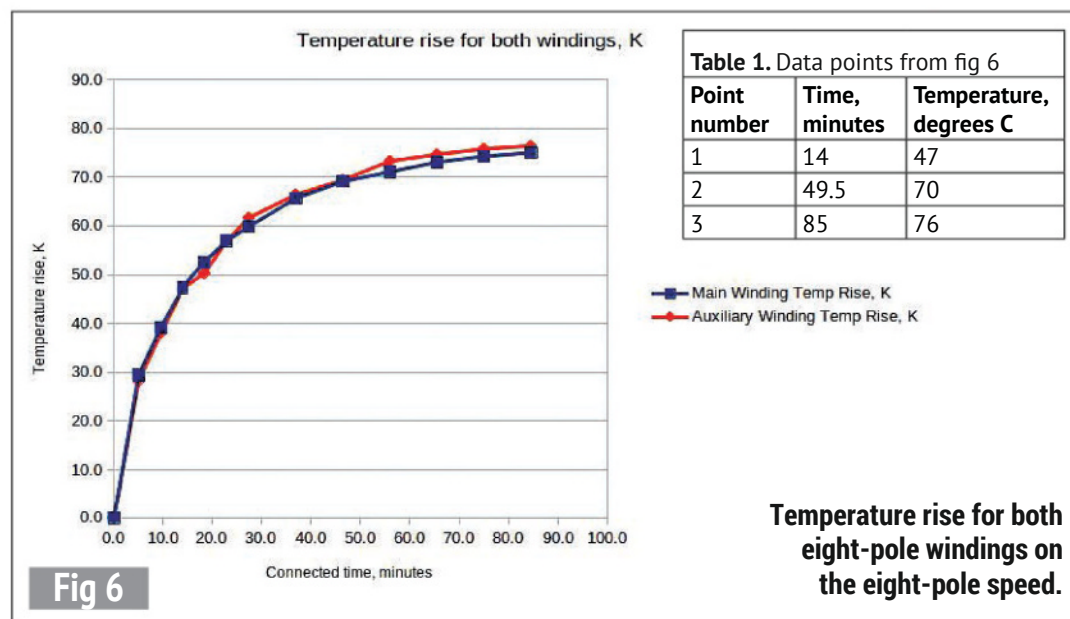
which is acceptable, being well within the limits of the insulation class which allow a maximum temperature rise of 105 K above an ambient of 40 degrees C.

Although the temperature did not reach equilibrium after 85 minutes, since the temperature was still changing by around 2 K over a time interval of around ten minutes rather than an hour, I terminated the test and then sought information as to how to determine the equilibrium temperature from the data which I collected. This is not a straightforward problem as the equation describing the rise in temperature with time is of the form:

$$\Theta = \Theta_0(1 - e^{-(t/T)})$$

where Θ is the temperature at time t , Θ_0 is the starting temperature; e is the base for Napierian or natural logarithms (about 2.71828) and T is the thermal time constant of the system. If this equation has made you think 'What on earth is he going on about?' then skip this bit as it isn't really that important. It is just there for completeness in case someone else decides to be foolish enough to want to rewind a motor and find the continuously rated temperature rise. In this equation, the problem is deciding what the thermal time constant T actually is. Any system such as this will reach about 63% of the final temperature after one time constant and will be at 99% after five time constants.

As an illustration, imagine a sausage roll from the local bakery that is still warm from the oven when you buy it. By the time you get it home, it is cold and needs re-heating in the oven, which only takes about 10 minutes (**photo 22**). This is because it has a small thermal time constant of a few minutes. In contrast, now imagine the Great Pyramid of Giza (also known as the Great Pyramid of Cheops) being heated during the day when the sun shines on it and then cooling down at night when the temperature in the



Temperature rise for both eight-pole windings on the eight-pole speed.

Egyptian desert drops rapidly, often below freezing point on clear winter nights (**photo 23**). Clearly the *surface* temperature will rise sharply during the day in the direct sunlight and it will cool down quickly at night, but the temperature right in the centre of the pyramid is a constant 20 degrees C all year round. This is because it has a very large thermal time constant of probably several years. Who would have thought that both a sausage roll and the Great Pyramid of Giza would be mentioned in *Model Engineer* at the same time (it's normally forbidden – Ed.)?

The problem in my case is that the thermal time constant for a motor is very difficult to calculate and, because it is a complicated construction of iron, copper and insulation, it doesn't behave as a single solid item with uniform properties. Setting out to solve this problem, Kemp (**ref 9**) refers to a method proposed by Prof. S.P. Thompson for

measuring the thermal time constant but, as I was unable to find the original work, I had to accept Kemp's assertion that *'...this method is very often found to be too inaccurate even for practical purposes...'*. The method is to measure the slope of the heating curve at the start of the test and then determine the point at which the slope is half its initial value. The equilibrium temperature rise is then twice the temperature rise at that point. Looking at the plot in fig 3, the initial rate of rise is somewhat difficult to determine but my best estimate is that the gradient halves at a temperature rise of only 33 K, implying that the maximum steady-state temperature rise would be 66 K, which clearly it is not, as it went up to 76 K before I terminated the test. The problem with Thompson's method is that the initial rate of rise for the copper wire is quite rapid as the thermal contact between the copper

of the windings and the iron of the stator laminations (which is cold at the start of the test) is separated by the slot insulation. At the start of the test, the winding itself heats up quite quickly but, since the slot insulation is not only an electrical insulator but also a thermal insulator, there is a delay between the winding getting hot and the heat transferring into the stator laminations. This corresponds to a small time constant for the winding alone but a large time constant for the rest of the motor. Thus, when the rate of temperature rise has reduced as the motor approaches equilibrium, the effect of the slot insulation is minimal and the rate of rise is more easily measured. This is what makes Thompson's method so inaccurate.

Further research turned up a paper by Zdenko Godec (**ref 10**), which suggests taking *three* temperatures at even time intervals instead of two.



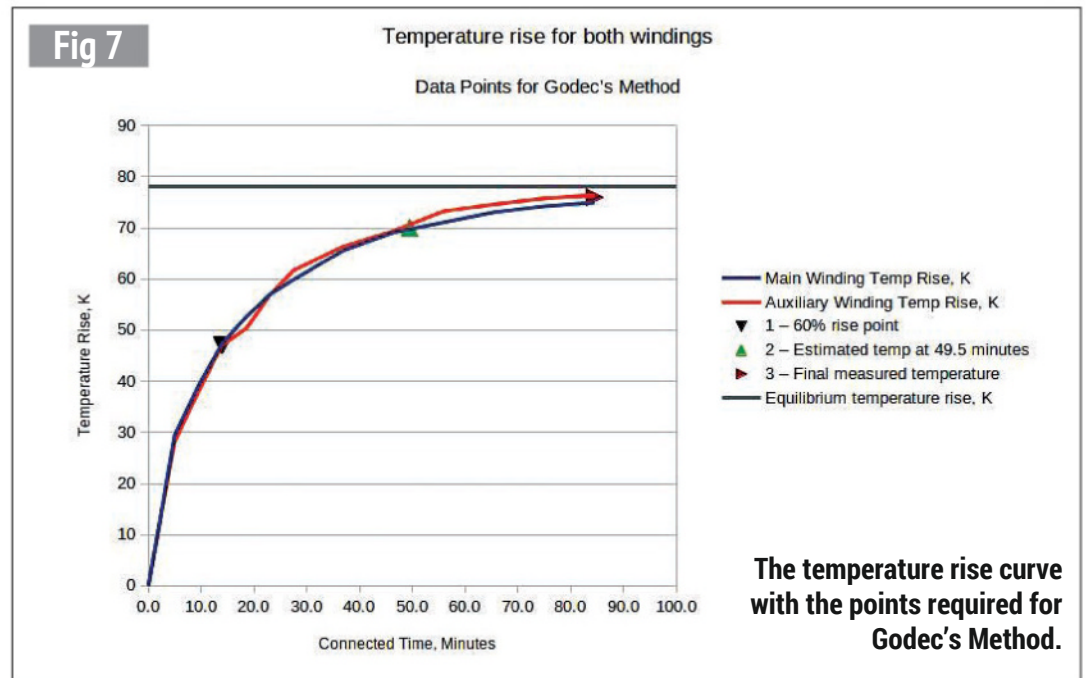
A hot sausage roll.



The Great Pyramid of Giza near Cairo. Photo: Nina Aldin Thune. Reproduced under the Creative Commons Licence: <https://creativecommons.org/licenses/by-sa/3.0/>.

Godec refers to the 'three points method' as a solution to a system responding to a step change and selects three specific points - the last point measured; a point at about 60% of the temperature rise of the last point; and one midway in time between the last point and the 60% point. Although he only used this on testing transformers, he does suggest that it is applicable to other electrical systems. Starting the test from a cold start and putting the motor under full load is effectively a step change from zero input to full input, so the method would be applicable to the motor test I was undertaking. As the last temperature that I took was 76 degrees C, the 60% temperature corresponds to $76 \times 0.6 = 45.6$, say 46 degrees C. Since these values are taken towards the end of the curve, the temperature changes are relatively slow so the timing is much more aligned to T , the time constant of the system, and a less inaccurate result is obtained. Taking the temperature as being θ and the time as t , then the subscripts 1, 2, and 3 are the points in increasing time. Taking the data from fig 6, the values are as given in table 1.

The time of 49.5 minutes is half of the time interval between the 60% temperature rise and the total time taken for the test, i.e. between 14 and 85 minutes and the temperature is estimated from the graph in fig 7 as the green point at 70 degrees C. I chose the auxiliary winding curve as this was the higher of the two by about 2 K so, as there was little difference between the two windings, they can be assumed to be the same. The equation for calculating the final steady-state temperature rise θ_s is given by Godec as: $\theta_s = (\theta_2^2 - \theta_1\theta_3)/(2\theta_2 - \theta_1 - \theta_3)$ and substituting in the values from the table gives: $\theta_s = (70^2 - 47 \times 76)/(2 \times 70 - 47 - 76) = 78.1$ K which is still within the prescribed limit of 105 K rise for the IEC Temperature



Class 155 and therefore the temperature rating of 155 degrees C (originally Class F) is satisfactory. A similar but slightly lower temperature rise was measured for the four-pole speed, which is unsurprising as the cooling fan is more effective at the higher speed and the current density in the windings is slightly lower. The original motor had Class 155 (Class F) windings - assumed from the slot liners and inter-phase insulation being polyester - so a satisfactory temperature rise was recorded. Superimposing this value on the previous graph, as in fig 7, shows that the calculated maximum equilibrium value looks quite realistic, so the method would appear to be satisfactory.

Variation of performance

Although the rewound motor did perform as designed, it did require some adjustment of the capacitor to be acceptable on both speeds. I determined the maximum power that could be obtained at a slip of 10% if the capacitor were varied for each speed. As each test only takes a few minutes, by loading the motor and then reading all the instruments, it is fairly straightforward to fit a specific capacitor, measure the performance and substitute

another value of capacitor. There will be a difference between the optimum capacitor required for each speed and similarly, there is a compromise if the same capacitor is to be used for each speed. The same dynamometer can, of course, be used for measuring the power of any other rotating equipment providing it can be fitted into the swinging frame and is suitably matched in speed and power to the dynamo.

Summary

- * A method of testing electric motors for their performance has been described.
- * The use of a swinging frame co-axial with the motor shaft

allows the motor torque to be measured easily.

- * The method is applicable to motors of an output up to about 500 watts ($\frac{1}{2}$ HP).
- * The method uses a 12 volt automotive dynamo to load the motor from zero to full load.
- * The dynamo is loaded using automotive headlamp bulbs.
- * As the torque is measured at the motor shaft, the 'V'-belt does not affect the output readings.
- * The use of a 'V'-belt to drive the dynamo allows low speed motors, below the rated input speed of the dynamo, to be tested up to full load.

ME

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Write to us

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Responses to published letters are forwarded as appropriate.

Lamson Tubes

Dear Martin,
Having read with interest the various references to the use of Lamson Tube systems,

I believe the following to be one of the more unusual and innovative applications.

When I was on an 'in-works' placement during my mechanical engineering sandwich course in the early 1960's, I was assigned to a project team commissioning the 6 x 190 ton capacity electric arc furnaces in the then new Templeborough melting shop

of the Steel, Peech and Tozer steelworks in Rotherham. One of the tasks was to evaluate the steel sampling and analysis system on the furnace operating floor. This involved taking a steel sample from the molten bath of steel in the furnace using a very long and heavy steel sampling spoon and then teeming it into a small metal mould. When partially solidified, the sample, weighing approximately 1.5 kg, was knocked out, cooled, and placed in a Lamson Tube carrier and despatched to the analytical laboratory. This was some half a mile away



Clangers

Dear Martin,
Reading about clangers in the latest issue of *Model Engineer* (M.E.4708, 13th January), I have one of my own and there, but for the Grace of God, a young teenage girl might have died.

As a qualified electrician, I was asked to have a look at a job to replace a consumer unit with a much more up-to-date one in a detached house. So, I poked around a bit to work out what was needed and whilst so doing the girl said to her father that the double socket beside her bed was not working. I go up and investigate (after having isolated the relevant circuit).

As I entered the room, I was hit by a very particular 'slightly fishy and slightly chemically' smell. This is something electrical and *hot**. With power off, I dismantle the socket the girl had complained of and lo, the live connection was loose and the cable slightly burnt because of arcing. I tidied the cable, re-assembled the socket and put the power on. Job done.

Satisfactory - the socket yes; overall absolutely not. The girl could have died in a fire. What was my clanger? I neglected to check the *other* two double sockets in the room, one of which, when I returned to replace the consumer unit, was a truly burnt mass of insulation and cable (see photo)! Effectively it was smouldering away behind the plate.

...There but for the Grace of God...

Regards, Mike Joseph

* Do not ignore this smell, something is very HOT, something is wrong. Investigate it, even in another's house and get electrical advice IMMEDIATELY.

and most of the route was in a tunnel running beneath the busy Sheffield to Rotherham main road! Following a rapid chemical analysis using an optical emission spectrometer, the results were conveyed to the furnace control room by Telex link. The First Hand furnaceman would then calculate the adjustments required to the alloying elements to achieve the desired steel analysis. Following these additions and further steel analyses to arrive at the required result, the liquid steel was teemed into the waiting pre-heated ladle and was subsequently cast into ingots for onward processing.
Best wishes, John Duffey
(North Yorkshire)

Stuck Chuck

Dear Martin,
To add a little to the ongoing saga of removing chucks, I had a similar experience with a stuck faceplate on a Myford Super 7 a couple of years ago.

Locking the spindle and attempting to unscrew it with my faceplate spanner (a length of 1/8 x 1 inch flat about 18 inches long with two M6 bolts to engage the slots in the faceplate) achieved nothing. Shock loading by Anthony Mount's suggested approach also achieved nothing. I phoned the dealer who sold me the machine six months previously and he warned me against any more forceful methods due to the potential for permanent damage to expensive bits of Myford and suggested machining the faceplate away. However, as a last ditch attempt, I tried locking the spindle and while applying a rapid series of light radial blows with a plastic hammer to the periphery of the faceplate I pulled gently on the faceplate spanner. It came loose in seconds with very little force applied to the spanner. I've never had anything stuck since. The vibration caused by the light rapid hammer blows does the trick. I hope this helps.

Best wishes, John Wing

A September Model Fair Like No Other

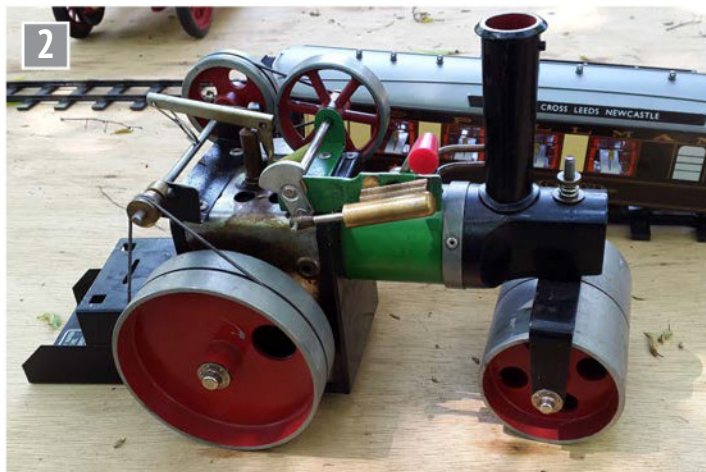
Luker has a pleasant day out in the South African spring.



Introduction

Here in the Southern part of Africa, we are seldom spoilt (unlike our model engineering brethren over the great lake) with model engineering fairs so you can just imagine my excitement to attend the spring September Fair hosted recently by the Centurion Society of Model Engineers (CSME).

I hopped onto my bike and in a blink of an eye I was in Centurion. At the gate I paid the very affordable R25 which entitled me to one live steam ride around the rather long (and scenic) 5 and 7¼ inch gauge track around the grounds. I had recently visited the CSME with my little *Ballaarat*, which made good use of the track so I decided to donate my ticket to the first youngster that walked past. The little guy seemed very nervous taking the ticket from a fully leathered, rough looking, bearded biker three times his size but when the reality hit home that he had an extra ride, his face lit up like a candle.



The roller type Mamod that has been modified by adding an additional reduction pulley to slow it down to more realistic scale speeds.



James' Mamod table featuring a few rail loops and space in the middle for the road type models.

At the club hall I met up with Leon Kamferr (the chairman of the CSME and recently featured as one of the master builders of SA) who was kind enough to introduce me to a number of the members manning the various stalls and organise a safe place to store my motorcycle gear (so I didn't scare any more youngsters). There was no shortage of displays and activities for the kids, both young and old.

James Leender's Mamod table

It's been my custom to head straight to James Leenders table for a good old chat and to see what he has brought to show the crowds. James sets up his table (photo 1) in the station just to the left of where the public queues to redeem their first train ride ticket. His table is normally filled with Mamod type models (rail and road type), all functioning and well used (as they should be!). Members of the public normally take a few seconds to realise that these models

are steam driven, just like their larger counterparts on the main rails. For most of the day James keeps them whizzing around the track and chatting to the general public about his hobby.

Other than the general maintenance and repairs required to keep these little steam rockets in good nick, James is also not scared to modify and make new parts to get a specific model to fit his set-up. A good example is the Mamod roller (photo 2) where the keen eye will notice a second reduction pulley to slow the roller down. This roller can be placed in the middle of the table and allowed to go in circles, without drifting like a race car, to the delight of everyone watching.

My personal favourite is his Mamod car (photo 3) which is fully functional but normally a static display due to the speed these models can reach - and, of course, due to lack of space on the table or ground to let her run like she should.



The Mamod car, usually as a static display in the middle of the table, but still fully functional.

32-45mm model engineers

Other than the larger live steamers, the 32-45mm model engineering club is one of the most resilient groups of gentlemen I've met. The track is raised and yet every time we get the seasonal floods the track is devastated. Nonetheless, they have a beautiful loop just behind the main station with a large bridge and tunnel for the locomotives to drive through. The main table had a large variety of static displays

(photo 4) for the public to look at with a number of locomotives traversing the loop to the joy and excitement of all the kiddies standing beside the line. Depending on the age of the little ones the locomotives pass them at eye level which, I'm told, adds to the whole experience. Most of these engines are electrical but that doesn't detract from the spectacle as they all make the characteristic (i.e. chugging and puffing) noises as they go past.



The centurion model trucker yard.



The centurion model trucker parking area with the petrol station in the background.



Some of the static displays on the table by the 32-45mm model engineers stand.

Most of these engines are electrical but that doesn't detract from the spectacle as they all make the characteristic noises as they go past.

Centurion model truckers

Within the CSME grounds is the Centurion Model Truckers yard. The yard consists of a construction site (photo 5), a petrol station and covered parking (photo 6) with the roads paved, lined and properly signed. Visitors can line up around the fenced area and watch the trucks and machinery work the construction site and move machinery and materials in an elegant automotive dance with the operators standing in the distance. If you're not careful you forget that this is, in fact, a miniature radio controlled yard.

I was fortunate enough to be let into the yard to take some

close-up photos of the trucks; the detail is impressive. If there weren't people standing in the background you could easily mistake the truck in photo 7 for a real one. Even the licence plate is correct for our province.

Finished and current live steam builds display

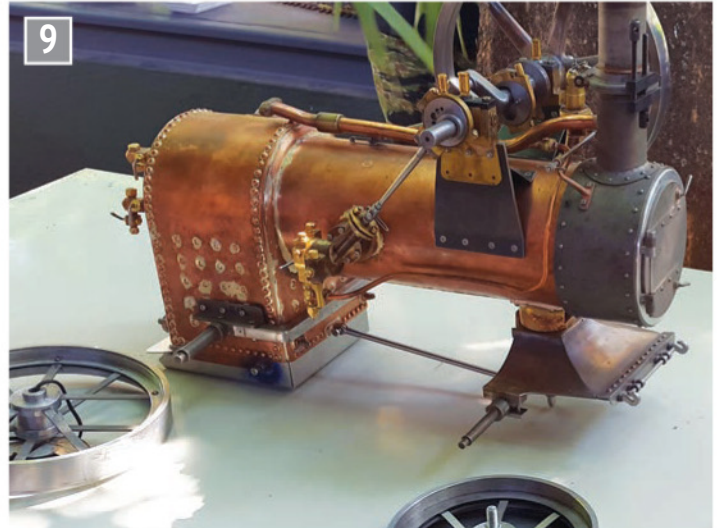
The live steam members were encouraged to bring their locomotives and current builds to display for the public. These - and there were a few - were all lined up on the unused track for the general public to appreciate, as well as a few smaller builds on the raised track, including a beautifully crafted 5 inch gauge Virginia



A close-up showing the detail of these trucks.



A beautiful Virginia was on display on the raised track.



A partially built (by member, Eddie Lloyd) portable steam engine on display.



Leon's recently finished SAR 5 Class Karoo is one of the regular passenger haulers at the CSME.



Charles behind his 7 1/4 inch gauge Lawley waiting for the passengers before setting off.



John Sharpe with his very large K1 Garret (a replica of the first one built for the Tasmanian Railways), another regular passenger hauler for the CSME.



Shawn and his faithful 3 inch scale Allchin based on the famous Royal Chester, giving rides to the public on the day.

(photo 8) that caught my eye. There were also a number of unfinished builds (photo 9) as well as stationary engine displays. The builders were close at hand to discuss their hobby with the general public.

The passenger haulers on steam

The stars of the show were no doubt the incredible live steam passenger haulers. There were a few running which made it very difficult to decide which ones to feature. In the end I chose the three largest and, because I can, my favourites. Leon's new Karoo (featured in the master builders series - photo 10), Charles' Lawley (a common but well-proportioned locomotive here in SA - photo 11) and John Sharpe's Garret (photo 12) pulled the crowds, all day, both figuratively and literally. All the locomotives that pulled passengers contributed to the club kitty and, judging by the number of people I saw on the day, they did well! I can see expansion to the club's infrastructure in the near future, which is good news!

Other attractions on the day

To finish off I would like to share some pictures I took of Shawn's traction engine (photo 13) and the classic cars on display (photo 14). Shawn's traction engine is a regular at these events, chugging around the grounds, pulling two loaded passenger carts. Shawn's classic 1956

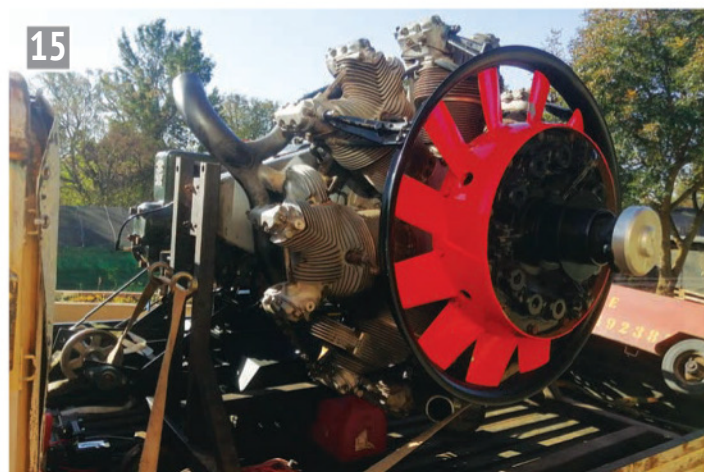


One of the classic cars on display.

DKW two-stroke pick-up had a mounted aeroplane engine - a 1930s seven cylinder Continental 11 Litre 250 HP; used in the Honey tank and Boeing-Stearman aircraft - which he started every now and again to the enjoyment of the crowds (photo 15).

What a day!

I could go on and on about all the various stands and different hobbyists I had the privilege of chatting to but, alas, space is limited so I had to be selective. No doubt the CSME has a winning formula. The grounds are well looked



Shawn's 1930s seven cylinder Continental 11 Litre 250 HP, used in the Honey tank and Boeing-Stearman aircraft. (Photo courtesy Shawn Spaan.)

after and within the CSME group, other smaller hobby clubs have found a home. Everything from the model boat club, O-gauge and up, to the CNC club are all part of the family. A wide range of stands can be found on the open days, bringing in the foot traffic and

their hard earned Madibas (local slang for money). The environment is very friendly and everyone I spoke to felt welcome on the day! I personally had a fantastic day out; thanks to everyone that made the day possible!

ME

Club Diary 29 January - 11 March 2023

January

29 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

February

1 Bradford MES

Talk - Geoff and Mary Twentymen, 'The Low Moor WW1 Explosion', Saltaire Methodist Church, 19:45. Contact: Russ Coppin, 07815 048999

2 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

2 Warrington and District MES

Natter night, St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

5 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

5 Small Model Steam Engine Group

Open meeting, 14:00-17:00. See www.gmes.org.uk

7 Taunton Model Engineers

Meeting, Stoke St. Mary village hall, 19:30-21:30. See www.tauntonme.org.uk

12 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

12 Sutton MEC

Track Day from noon - 16:00. Contact: Paul Harding, 0208 254 9749

15 Bristol SMEE

'Modelu' (small model figures), Begbrook Social Club 19:30. BS16 1HY. Contact: secretary@bristolmodelengineers.co.uk

16 Warrington and District MES

Talk - Geoff Stocker, 'Rebuilding the Welsh Highland Railway', St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

19 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

21 Taunton Model Engineers

Meeting, Stoke St. Mary village hall - 'More Engineering Tales' by David Hartland, 19:30-21:30. See www.tauntonme.org.uk

26 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

March

2 Sutton MEC

Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

2 Warrington and District MES

Natter night, St Mary Magdalene Church, Appleton Thorn, 20:00. See www.wdmes.org.uk/events

5 North Wilts MES

Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

7 Taunton Model Engineers

Meeting, Stoke St. Mary village hall with Dave Morris, 19:30-21:30. See www.tauntonme.org.uk

10/11 National Model Engineering Exhibition Harrogate show ground. More details to follow.

LNER B1 Locomotive

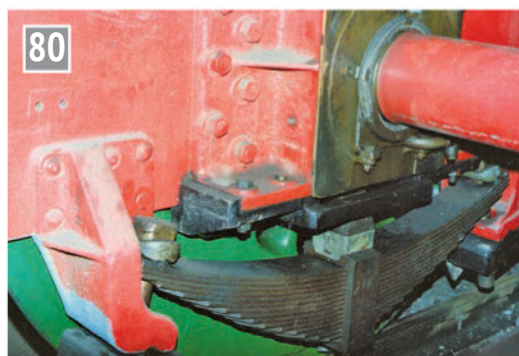
PART 13 – SPRING HANGERS AND HORN BLOCKS

Doug Hewson

presents an authentic 5 inch gauge version of Thompson's most successful locomotive.



Continued from p.712
M.E. 4704, 18 November 2022



Close view of the spring hangers (photo: John Thompson).



Linkage to the blowdown valve.

I will now go on the describing the spring hangers and horn blocks for the B1. I can no longer make any patterns for so this might be a question of muddling through. However, the basis of the hangers is exactly the same as the patterns which I made ages ago for a friend's Don Young LNER K1 and these are on sale from The Steam Workshop and I am hoping that Geoff Stait will also be able to oblige.

The trailing spring hangers are identical the those of the K1 but the leading spring

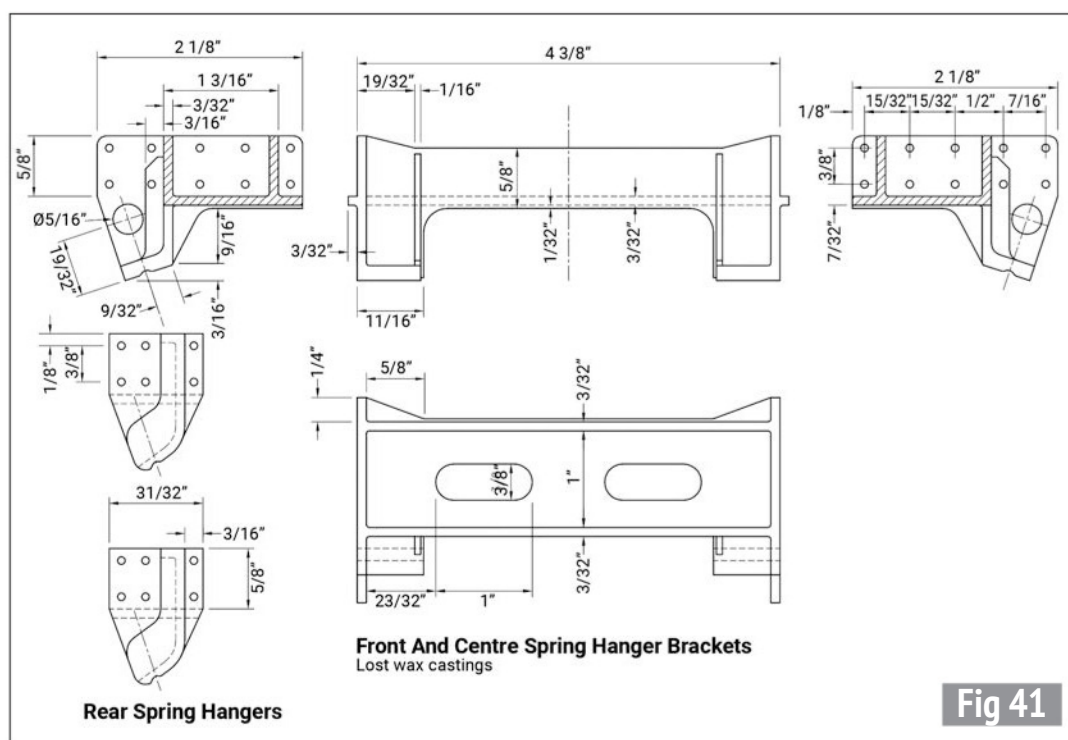
hangers need a modicum of work doing on them if you are wishing to make your B1 exactly to scale. I have shown the modifications on my drawings for the leading spring hanger brackets which are attached here (fig 41). This is just a question of using some 2.5mm brass plate to add between the trailing hangers and a 'U' shaped piece of 16swg plate to complete the job. The spring hangers are riveted on with 5/64 inch (2mm) snap head rivets. Well, some of them are although

the lower ones appear to have large countersinks on the inside of the frames and are filled with heads that have been flattened. These look as though they have been done like this so as to avoid the spring hanger bolts which have quite large heads on them.

I think that **photo 80** shows the heads of the spring hangers very nicely. **Photograph 81** is one I took to show the linkage to the Everlasting blow down valve but I have had to use this as it also illustrates the trailing horn blocks and it is the best photograph I have of that. Also, in this photograph there is the trailing spring hangers and it shows the arched 'U' shaped piece which fits across the frames between the two hangers.

Photograph 82 is rather fuzzy but I hope that this will be printed as it not only shows the trailing horn blocks but also the frame stretcher just beneath the cab floor.

The horn blocks follow the usual pattern of 4-6-0s, where the two leading horns (fig 42) are the full horseshoe shape and the trailing horns (fig 43) are two separate cheeks so that the fire box can sit down in its proper position above them. My problem is that I just do not have any proper photographs of them as in my excitement at getting under



the B1 at Grosmont, I just forgot to take any (but here's a sketch instead – **fig 44**)! The horns are all bolted on, and they just scale down nicely to 8BA for our scale. I presume that they will be fitted bolts but I do not think that you need to go to those lengths for our purposes. However, you might need to use a No.44 drill and then finish with a No.43 to drill the holes for the rivets. The bolts should be countersunk on the outside of the frame plates otherwise you might have problems with getting the wheels in as the frame plates have been drawn to scale so everything there is a bit on the tight side.

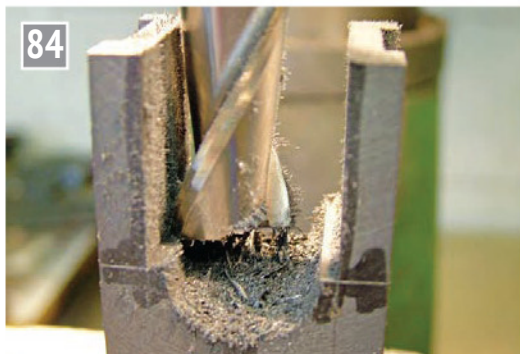
I think, for what it is worth, we may as well have a go at the main axle boxes. I have included the drawing for these (**fig 45**) and you should be able to obtain these from either of



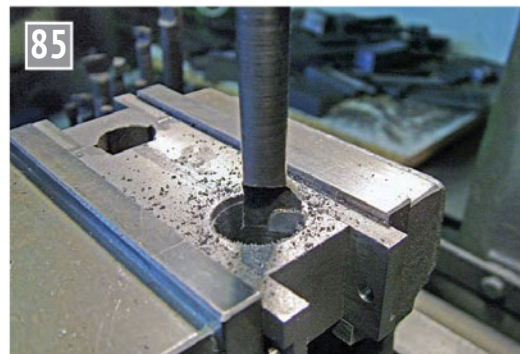
Trailing horn blocks (photo: John Thompson).



Machining the sides of the axleboxes.



Machining the inside of the axlebox.



Boring out the hole for the axle.

Fig 42

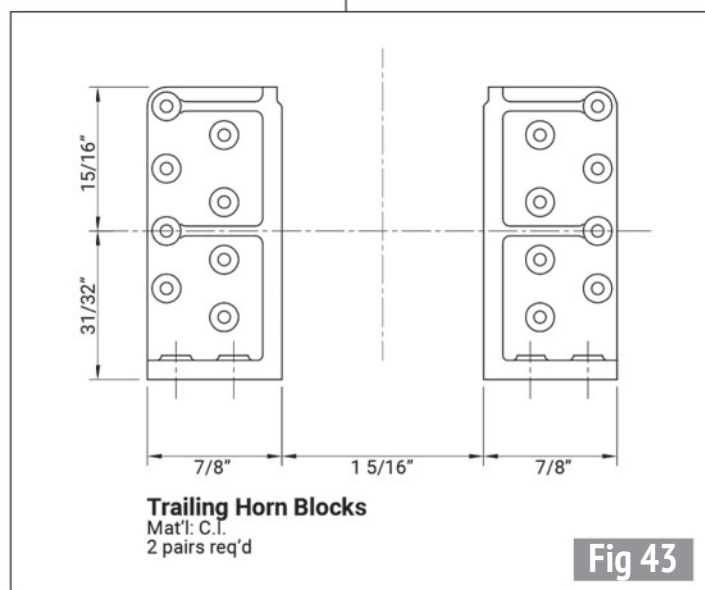
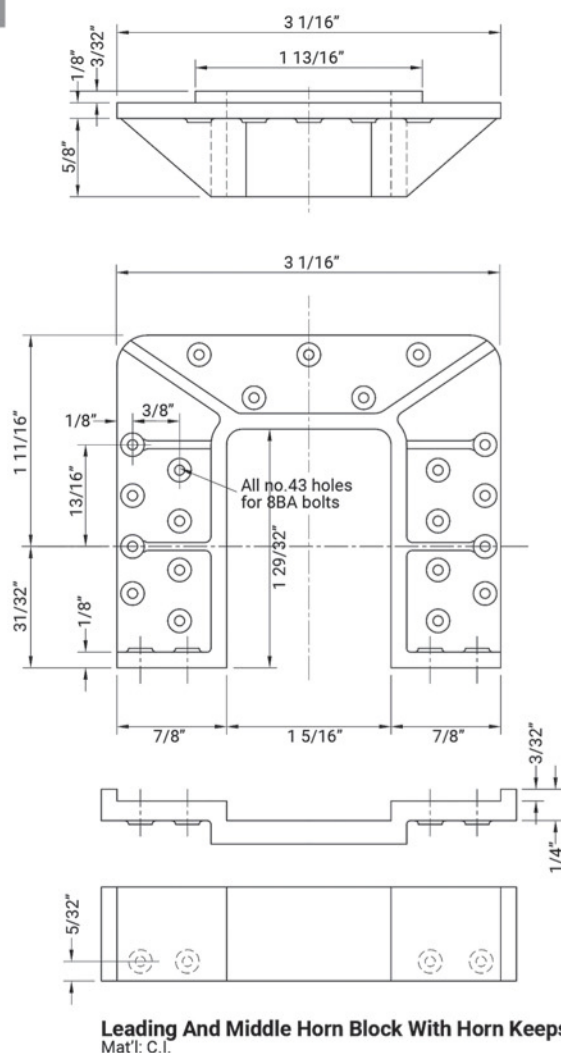


Fig 43

the two sources mentioned above. For a start, these are axle boxes like the ones made for 75069 and identical to the B1. They were made by Geoff Whittaker.

Photograph 83 shows the first stage with Geoff machining the sides having already squared up the casting.

Photograph 84 is the machining of the inside of the box to fit the keep.

Photograph 85 shows the boring of the boxes to nearly the right size.

Fig 44

Springing for trailing axle.

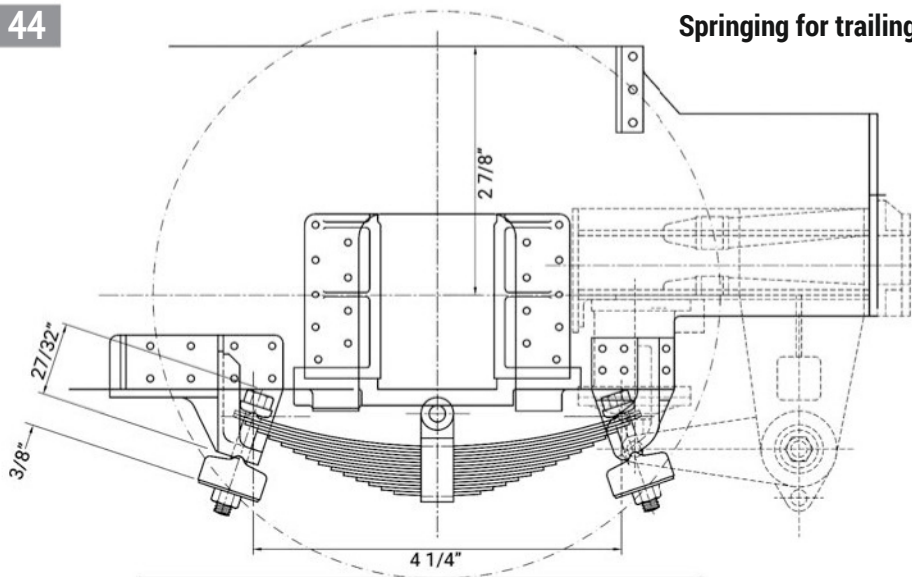
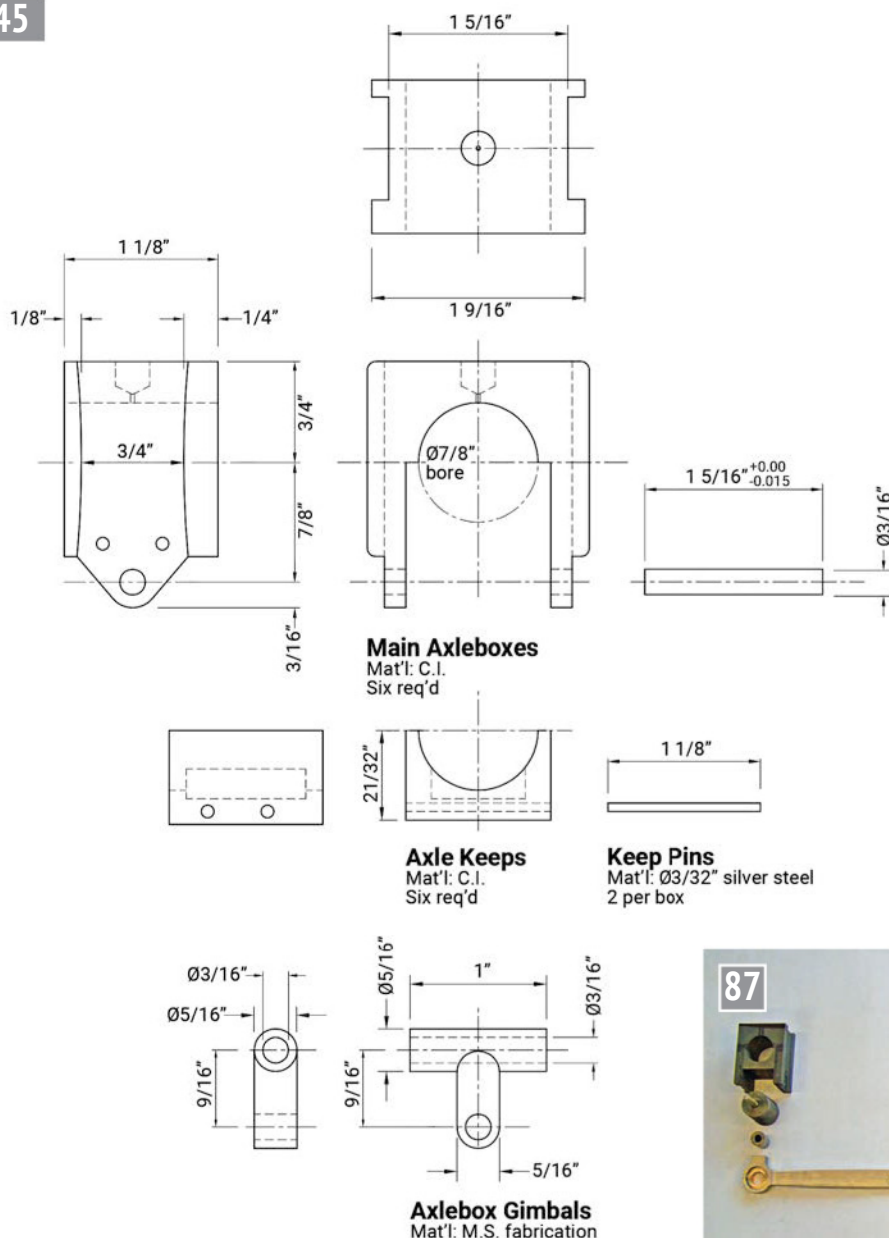
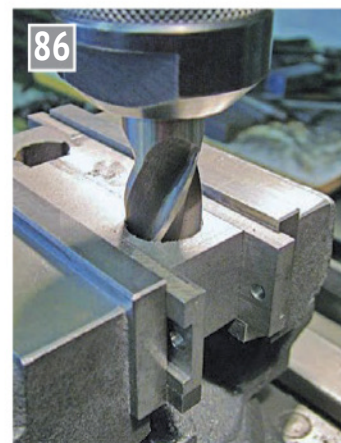


Fig 45



86



Reaming the axlebox to the exact size.

Photograph 86 shows the boxes being reamed to the exact size.

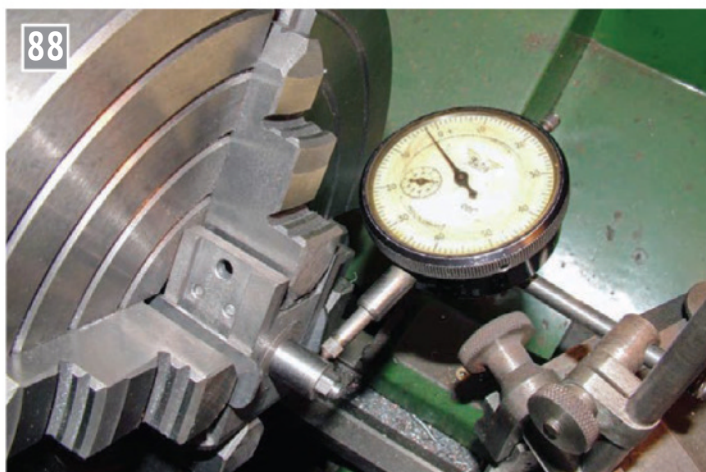
I had already had some CNC rods machined for 75069 and Geoff had a good system which used buttons for machining the leading and trailing axle boxes. The system was to make some short stub axles which had an outer spigot turned down to the relevant crank pin size. These were inserted into the axle boxes but the leading and trailing ones had floating buttons so they could be adjusted so that the coupling rods could be just slid onto the buttons quite easily and then they were clamped in place. If you are intending machining the coupling rods in the conventional manner from scratch, then as long as you bore each pair of axle boxes centrally the rods can be made to suit later. For this exercise the boxes were then set up in the four jaw and the buttons were centred using a dial gauge and then the buttons were removed and the boxes were bored out to the finished size.

Photograph 87 shows the rods, which had already had the bushes pressed in, and the buttons ready.

87



Axleboxes, buttons and rods.



Using the button to centre the axlebox.

Photograph 88 This shows the axle box in the four-jaw chuck with a dial indicator showing that the bush is just a touch out at the moment.

Photograph 89 shows the rods just slid on the axle boxes with no shake.

Photograph 90 shows the oil pipe connection which was used on my 2-6-4 tank locomotive, which had a flexible connection to an oil box. The oil boxes on the B1 are all inside the frames.

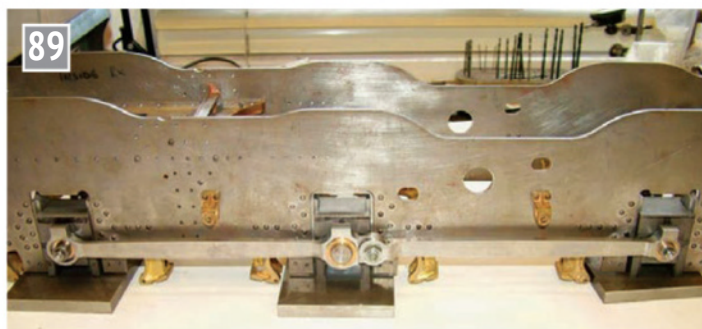
To finish the axle boxes off they require the various oil

holes drilling and the gimbals making to fit in the bottom jaws. On the 2-6-4 tank I also fitted a little lubricator connection to the keep with a passageway drilled through into the pocket.

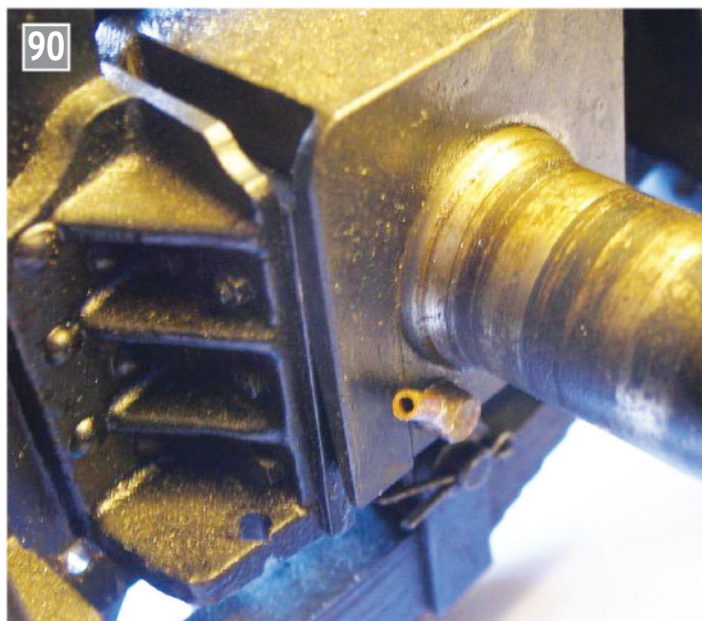
●To be continued.

NEXT TIME

We deal with the driving wheels.



Trial fit of the rods.



Oil pipe connection to the axlebox.

NEXT ISSUE

We Visit Bromsgrove

John Arrowsmith visits a thriving club near Birmingham.

Hit and Miss

Ian Couchman makes the cylinder head and carburettor for his 'Hit & Miss' internal combustion engine.

Flying Scotsman Drop Links

Peter Seymour-Howell completes his 5 inch gauge Scotsman's crossheads by adding the drop links and the gudgeon pin oiling system.

Driving School

Having made good progress on his first 'proper' locomotive, Steve Goodbody decides to take some driving lessons.

Stephenson's Valve Gear

Peter Gardner uses Dockstader's simulation to improve the events of Stephenson's valve gear on a 7¼ inch gauge 'Holmside' locomotive.



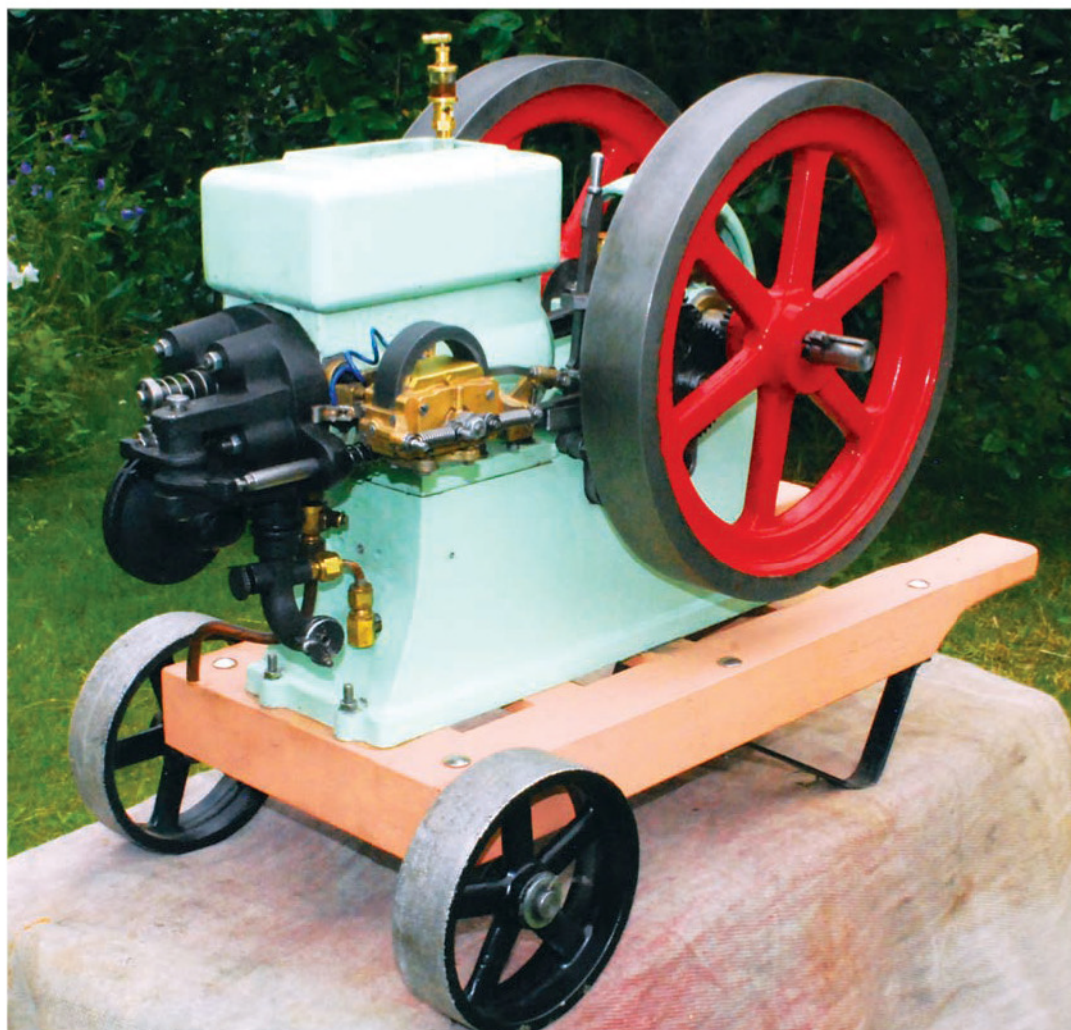
Content may be subject to change.

ON SALE 10 FEBRUARY 2023

Ian
Couchman
tries
something a little
different.

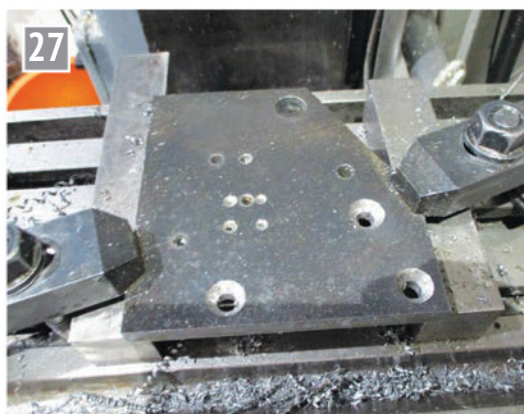


Continued from p.141
M.E. 4708, 13 January 2023

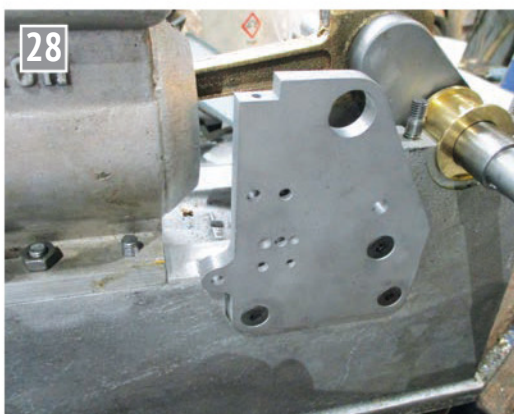


The completed 'hit and miss' engine.

'Hit and Miss' Internal Combustion Engine PART 4



Drilling the timing plate.



The timing plate in situ.

Timing plate, gears and bits

Now for the bits that make it work (we hope!). The timing plate (**photo 27**) holds most of the bits. It's important that all the holes are accurately positioned, to give the correct meshing of the gears. In **photo 28**, the plate is in position. The large hole at the top holds the governor, the smaller one below holds the cam gear and the timing gear fits on the crankshaft. The countersunk

fixings ensure that the plate is correctly located (assuming the holes are in the right place...). The drawings show 18 DP gears. I didn't have any 18 DP cutters but did have my 20 DP universal cutter, so the gears were changed from 21, 42 and 17 teeth at 18 DP to 23, 46 and 19 teeth at 20 DP. This meant changing the centres of the gears slightly.

The lug on the lower, left-hand side is the pivot for the speed control lever. I had to machine some clearance on the base as the lever fouled the base casting. I like to bead blast steel parts (other than machined surfaces) which gives a nice matt finish and hides smaller blemishes. You can see the result on the timing plate and the crankshaft web.

Next, the cam. The cam operates the exhaust valve (the inlet opens by suction) but also controls the ignition on the prototype. As drawn, the cam only operates the exhaust valve, with ignition controlled by a contact on the cam gear. For use with an igniter, there's a further operation to cock the Webster tri-polar oscillator (I believe the igniter and coil uses a similar method, but I've not found any details so far). So, let's run through the cycle.

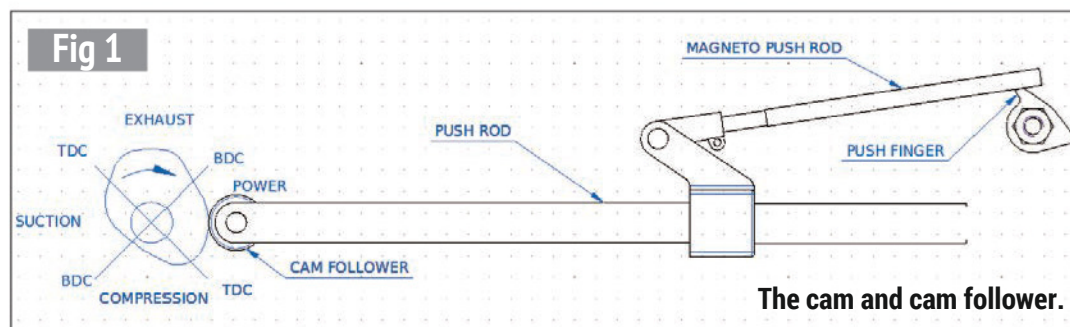
Figure 1 is looking at the cam and follower from the far side of the machine, with the cam rotating clockwise. As shown, the piston is about half way through the power stroke. As we get to Bottom Dead Centre, the cam starts to move the push rod and the exhaust valve begins to open. When the piston gets to Top Dead Centre, the exhaust valve is closed. This far, operation is the same as the supplier's version but now things start to change. About half way through the suction stroke, the push rod moves to the left (towards the centre) and continues as far as possible until we get to BDC. At this point, the magneto push rod drops down and picks up the push finger, as it's called, on the magneto shaft. As the cam continues to rotate, the push rod moves to the right, pushing the push finger and rotating the



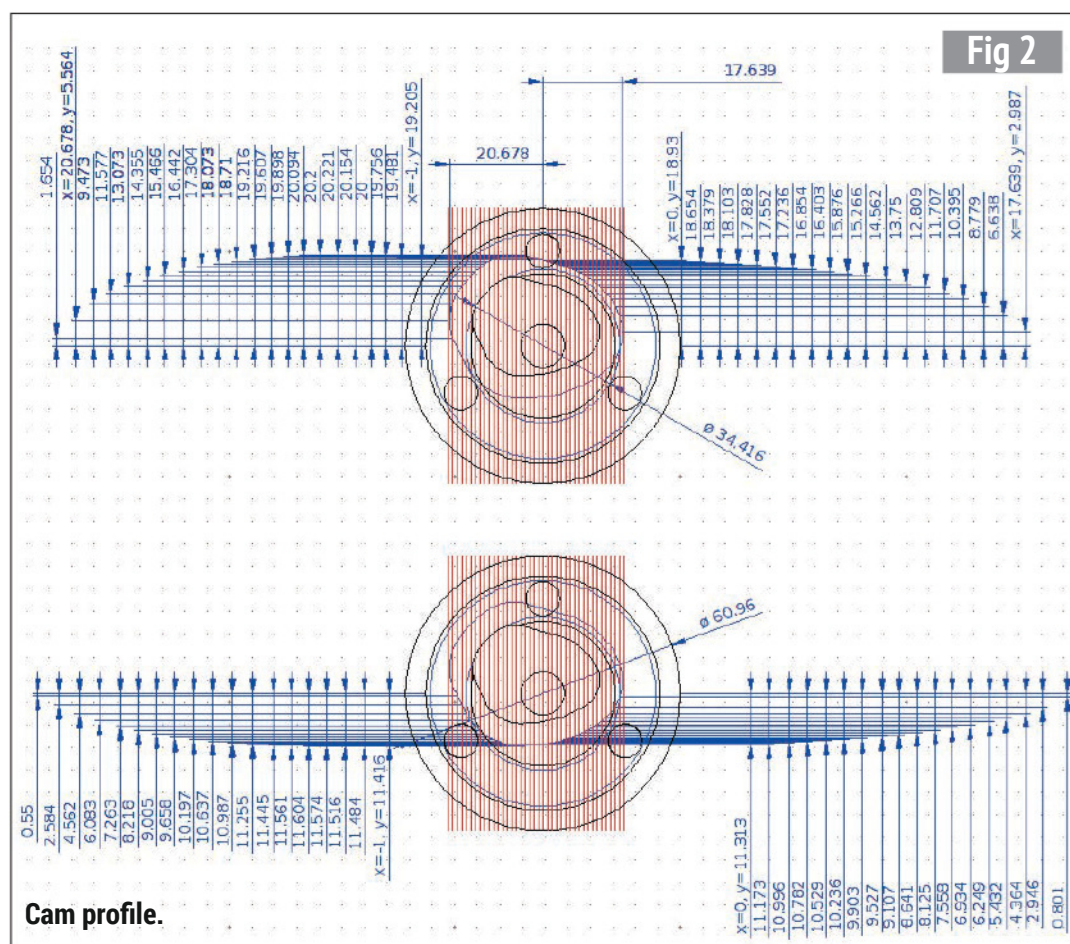
Producing the blank for the cam.



Roughing out the profile on the mill.



The cam and cam follower.



Cam profile.

magneto until it's fully cocked. At the appropriate point, the magneto push rod is lifted from the push finger, allowing the magneto to spring back to its rest point, generating a spark as it does so.

Now we understand how it should work (don't we?), how about making the cam. **Photograph 29** shows the blank emerging from a piece of cast iron. The first thing I did was print the outline and stick it in

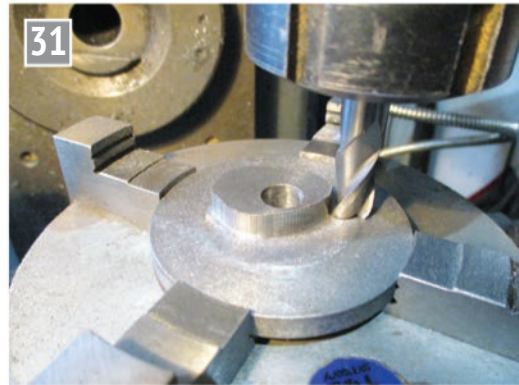
place on the cam. I then centre punched marks just outside the profile. Then the bulk of the waste was removed on the mill by eye (**photo 30**). Next, I drew up a list of co-ordinates for points around the profile

If need be, run the gears together with a little lapping paste and you will have some lovely gears!

(figure 2, the vertical lines are 1 mm apart) then milled a series of points to produce the result seen in **photo 31**. A quick run over with a smooth file gave me a pretty good cam (**photo 32**).

The blanks for the other two gears were produced (all from cast iron, **photo 33**, mounted on arbours ready for cutting). I mentioned earlier my universal gear cutter. This will cut any number of teeth from about 12 to a rack (oh yes it will!), giving a good approximation to the involute form. Let me explain. The cutter looks, at first glance, like a hob, but the vital difference is that there is no spiral. Think of it as a number of normal cutters stacked together. The teeth are rack form i.e. straight sides at the appropriate pressure angle, 20 degrees in this case. Let's see it in action. **Photograph 34** shows a partially cut gear. The primary tooth (or should I say space) about to be cut is the 4th cutter tooth from the left and this cuts as normal, with straight sides. Look at the tooth to the left, however, and you can see that a second cut has taken place, cut by the 3rd cutter tooth from the left and an embryonic involute tooth is starting to emerge. On larger gears, more teeth would be touched either side.

After cutting all teeth, we can refine the tooth form as follows: rotate the gear by, say $\frac{1}{8}$ th of 1 tooth. Move the cutter sideways by $\frac{1}{8}$ th of the circular pitch and re-cut all teeth. Now rotate the gear back to the original position, then another $\frac{1}{8}$ th of a tooth and move the cutter back by $2 \times \frac{1}{8}$ th of the circular pitch, then re-cut the teeth again. In **photo 35**, I blued the teeth before making this second cut and you can see where the tooth form has been refined, with shavings taken from the top and bottom



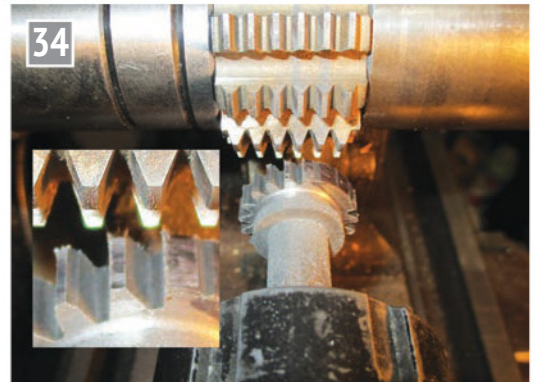
Milling out precisely the points of the profile.



The profiled cam.



The cam and blanks for the gears.



A partially cut gear.



Refining the tooth form.



First step in making the cutter.



Drilling the positions of the cutter teeth.



Beginning to form the teeth.

of the teeth. You can continue to refine the form this way if you want, but I find that these three cuts give a pretty good form, much better than that produced by some cutters I've

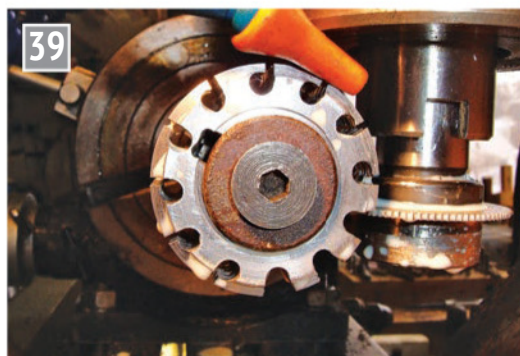
bought in the past! If need be, run the gears together with a little lapping paste and you will have some lovely gears!

"How did he make that cutter" I hear you cry. Well,

let me tell you. I started with a piece of silver steel which was bored to one inch, faced on each end and a keyway broached (**photo 36**). Next, 12 holes were drilled end

to end (**photo 37**). Using a cutter ground to the pressure angle, with the width of the end ground to the correct width, the basic teeth were formed (**photo 38**). The teeth were separated on the mill (**photo 39**). Many years ago, I made a Eureka tooth relieving device as described in Ivan Law's excellent book *Gears and Gear Cutting* (**photo 40**, with a couple of 0.5 mod gear cutters made with the thing). **Photograph 41** shows the process of tooth relieving in progress. You can see the cut formed against the blue background. It's mesmerising to watch! You can see the relief in **photo 42** and in **photo 43** you can see a close-up of a tooth formed with this cutter, in the manner described.

Back to the story! **Photograph 44** shows the complete gear train. I mentioned that I intended to use electronic ignition. The kit I bought had the main unit, with a Hall effect sensor and a tiny round magnet. I printed a holder for the magnet on the



Separating the teeth.



Eureka in action.



Eureka teeth relieving device.

3D printer, which is a press fit in one of the timing gear holes (**photo 45**). I also printed a holder for the Hall effect sensor (**photo 46**), which clips

around the cam gear shaft and is fixed by two screws, which allow some timing adjustment.

● To be continued.

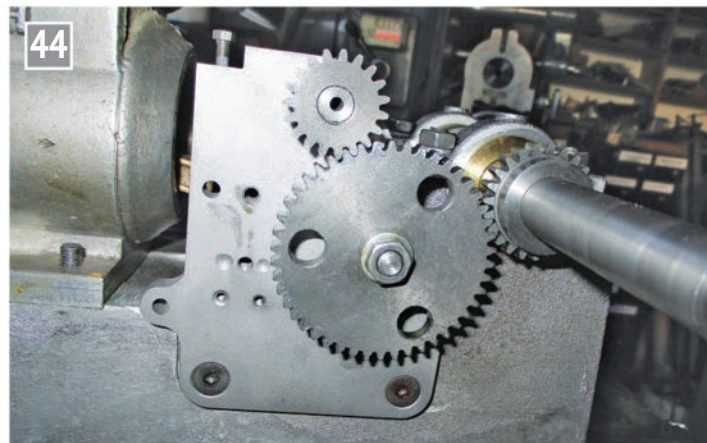
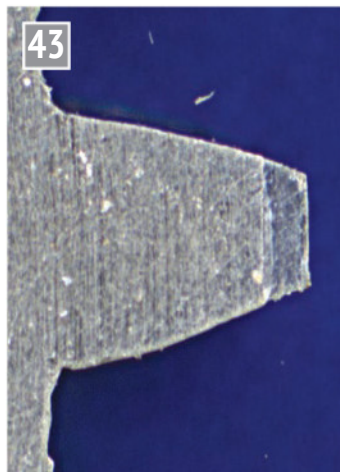
NEXT TIME

We move onto the cylinder head and its associated parts.

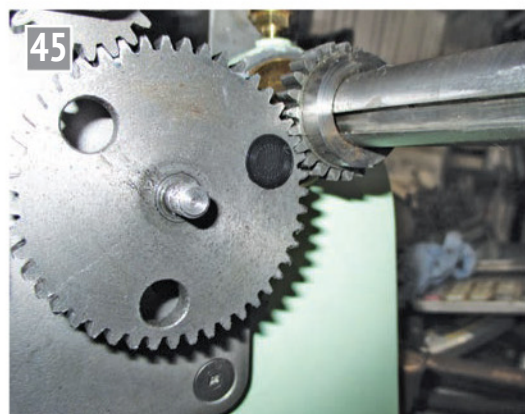


Reliefs are formed.

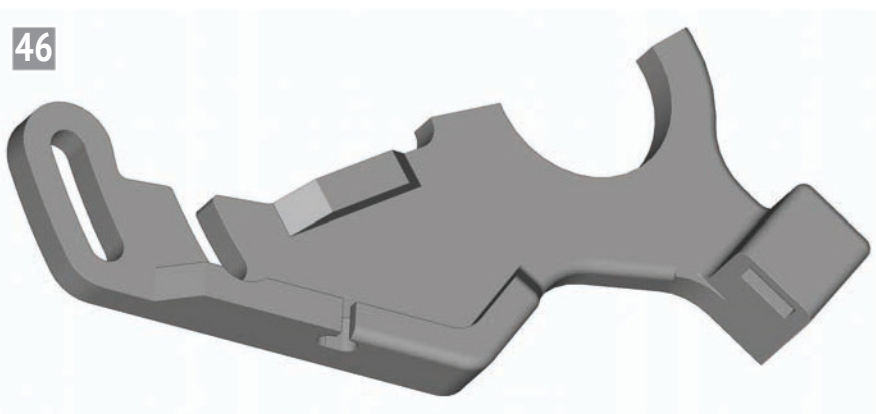
Close-up of the tooth profile.



The complete gear train.



3D printed magnet holder.



Hall effect sensor holder design.

Geoff Theasby reports on the latest news from the Clubs.



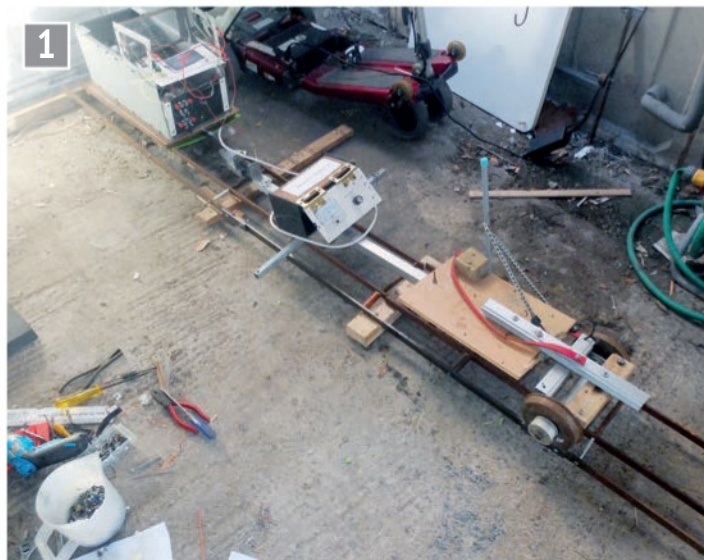
Not much work has been done on my locomotive, *Deborah*, due to the weather being perishingly cold and not, therefore, suited to working in the garage. The next job is to shorten the driving trailer and install the seat at the balance point (photo 1).

Roger Backhouse's review of Sir Lindsey Molesworth's useful pocket tome reminded me of his distant relative, Plantagenet Molesworth, who achieved distinction in his own field and, of course, who can forget the irrepressible Nigel, scourge of St. Custard's prep school? I distinctly remember his utter joy and fascination with the discovery, in 1980, that cruise missiles were to be deployed at his namesake, RAF Molesworth. Protest by CND led to the installation of a seven mile long steel boundary fence. *Chiz!*

Hawkeye the red-nosed car spotter saw nothing much in the way of interesting vehicles but a recent trip to Halifax (from Hull, Hell and Halifax, good Lord deliver us ...) yielded the Mini Cooper convertible on the M1. Not really exotic but unusual in the everyday traffic.

In this issue, a VAMBAC, a motorcycle, a rant, an archive, three sheets, more spooky pix, an Open Day, Fell running and record numbers.

Halesworth & District Model Engineering Society winter *Newsletter*, goes trams! Ollie writes that members of the Society visited the Lowestoft Transport Museum specifically to ride on Marton Vambac Blackpool Tram No. 11, which was built in 1939 and restored at Crich in 2009. The Vambac unit is interesting in its operation and is housed in the central tower of the tram. The trams so equipped were said to be unreliable and if it failed in service, the brakes became inoperable. Bad move! I recall a Salvage Squad TV programme on the restoration of such a vehicle. Another exhibit was a 1916 Thorneycroft wagon, hand cranked to start, its idling speed is so slow you



Deborah with driving trailer.

can count the firing strokes. Chairman, Phil Hall visited the Cotswold Motoring Museum, opened in 1978, and Bressingham Steam Museum whilst others went to Lowmex, yet again said to be very good, improving with every event. Secretary Brian Sinfield noted the number of exhibitors using small trolleys or trucks to convey their weighty exhibits fro and to. We got one when Deborah's younger daughter went to university. We could have hired it out for a mint to all the other parents moving their own youngsters in at the same time. Ultimately, there were 300 tables in use at this event, plus the layouts, exhibitors' own stands and models big enough to stay on the floor. John Luscott's BSA Gold Star BDB34 in miniature was scaled to fit the smallest chain he could find. Professor Baz showed his home-made Enigma machine. The possibility has been mooted of evening classes in model engineering for tyros. Profiles this time are for Andy Belcher (... It's a hobby, I don't HAVE to do anything I don't want!) and Peter Joyce, in his Special Hat. It is a one-off, awarded to him on completion of a difficult project. Richard Stone writes on 'Steamworks' at Southwold, whilst John Mitson tells us about his *Susie*, which he is getting to know and to drive well. (*If you knew Susie ...*)

W. www.hdmes.co.uk

Stamford Model Engineering Society had a talk by Keith Hansell on the history of Stamford around the Free Masons' Hall. Editor, Joe Dobson found it so enthralling that he forgot to take notes and this report is made from Keith's notes, to whom thanks are due. Keith Holderness' latest model is a beam engine, using free plans from the Internet. Over the years, Stamford has made traction engines, cars and bicycles, the *Pick* being an example; produced until 1925, it made it as far as the Antipodes, being known in Australia, and there are records of six survivors in NZ.

Bradford Model Engineering Society's President, Jim Jennings was accosted while out shopping and berated for wearing a mask. A conventional debate not being possible, due to the other's tirade about natural immunity, he and his wife had to withdraw without further comment. John Barraclough has died. He met his wife in the Merchant Navy, serving together for several years and narrowly missed being aboard *M.V. Derbyshire*, as they were on holiday when the ship was reported missing, becoming a *cause célèbre* in the shipping world. Also deceased, Graham Done was a prolific model maker whose workshop remained a museum of tools, part-finished models and an array

of treasured materials which 'might come in useful'. What a man! The autumn auction, presided over by Godfrey, disposed of several items of questionable relevance to our hobby. A food mixer found no takers and a new coffee maker was cunningly added to a subsequent lot in order to proceed in good order. Of particular interest to the nascent Henley Solon Owners' Club was a huge soldering iron (or 'club'... - Geoff), the use of which gladdened the heart of the electric company as the lights dimmed and which eventually sold for £7. Godfrey made quite a few purchases, but was outclassed by Harrun Degia who slowly seemed to be entombed by his acquisitions to the extent that reporter and editor, Graham Astbury wondered how he got them all home... An invitation to Ribble Valley Live Steamers to visit BMES was taken up with enthusiasm. About a dozen turned up with nine locomotives, leaving Ken Shipley feeling a little overwhelmed when they all arrived together at 10 am, but order was soon restored and a great day was had by all. Dominic Scholes adds some tips on using Superglue; dressmakers' needles feature prominently.

W. www.bradfordmes.uk

The Cam, Special Edition, from **Cambridge & District Model Engineering Society** felt sufficiently confident to produce a 'spooktacular' edition to celebrate the success of the Society's Hallowe'en running. (Other themes are available.) The sounds of ghoulies and ghosties and things that go bump in the night (like living next to a busy goods yard in the steam days ... the ringing cadence of buffers as a goods train is brought to a halt, the wheezing and coughing of little shunters as they drink the first tea of the day... its all a lot of warlocks really...). Mick Flack's Shallowford Corporation Tramways vehicle is pictured (photo 2). As the participants partied into the

night, unsuspecting visitors were led into the woods by the power of fire and steam to meet their fate. And as we say goodbye to the hardy souls who made it back home through the misty, cold October night, observed by the creatures of the forest, moles (worth) bats, googlies, triffids and other sane people of Earth and their familiars, the lingering fragrance of oil and coal smoke remains, until next year.

W. www.cdmes.uk

Reading Society of Model Engineers' *The Prospectus*, December, tells us that Ronald Pickett has revamped the club website and will include an archive of all previous *Prospecti*. John Spokers' Nord locomotive tender is proving a handful. The design has rounded corners and includes four where three sheets meet. There are no known drawings and only one photograph to work from. Fortunately, John found an extruder of aluminium sections, one of which was very close to scale. In a few cases gluing the sections together with epoxy adhesive was undertaken. However, obtaining the exact substance was fraught with difficulty, being sold either in quantities more suited to gluing the wings on an Airbus, or at extortionate prices (you know who you are ... Geoff). David and Lily Scott visited the Bluebell Railway after first consulting the Weather Radar god.

W. www.rsme.org

The Centre Punch, December, from **Andover & District Model Engineering Society**, opens with editor, Jonathan Godfrey welcoming new contributors to this, the second issue of the calendar year. Colin Hughes visited the Midlands MEX as part of a raiding party from Andover and added his felicitations to the many others who attended this still growing event. Cream Tea Sunday has become a fixture in the calendar and this year raised £130 for club funds. The event was begun in 2016 to facilitate the meeting of families and friends of members and also

has grown over the years. A spooky selection of seductive, suspect Daguerrotypes by Graeme Bristow were taken at the Hallowe'en run and Rex Hanman visited the outer limits of YouTube finding Joe Pieczynski, 'Blondihacks' and Mr. Crispin. Quinn, of *Blondihacks* is a software engineer during the day, has a cat called Sprocket and is a great pinball machine mechanic into the bargain. Rex picked up some workshop hints, including the fact that your brother's toothbrush is very handy for cleaning internal threads - of a chuck, for instance. Colin Gross describes how he built a locomotive that he didn't really want, in some detail ... Donald Cowling built a 7¼ inch gauge A3 Pacific and, discussing with a friend what to do when it was finished, the friend said, "You never finish a model steam locomotive". 'What to do' was rather imposed on him as the supplier went bust after 14 of the 18 kits were produced. Luckily, he found a supplier locally who had an engineering business and was also building an A3, who would supply the remaining items. Joining ADMES, he found

another A3 builder who invited Donald to his club, North Wilts, with a view to analysing why it wasn't steaming too well. Colin Gross has tried an idea to cure weeping clack valves, use an O-ring to achieve a seal. It accommodates uneven ball seats and is easy to change, although it lasts only 50/60 hours in service.

W. www.admes.uk

On Track, from **Richmond Hill Live Steamers**, December, mentions something a little different; two 'speeders' are for sale. Ex-CPR, they are type A-4 and are currently non-runners. Readers who wish to know more about engineering company Alan Keef, can see a video of their recent Open Day on YouTube. Fascinating stuff, which may lead to other websites, down which the rolling English road-user can be guided, (predestinately, as it were - Geoff) offering more of interest, should you have the time...

W. www.richmond-hill-live-steamers.tripod.com

Ryedale Society of Model Engineers' November Newsletter takes us on a Night Run during which Mike Aherne's Fell locomotive and Travelling Post Office train was notable for the coaches



Cam tram, Shallowford Tramways, Cambridge 'Spookathon'.
(Photo courtesy of Helen Hayes.)

being internally illuminated to great effect. Come Christmas, this train may well be the only UK train in operation over the 'festive' season.

W. www.rsme.org.uk

The Whistle, November/December from **British Columbia Society of Model Engineers**, arrives later than may have been expected, due to editor, Paul Ohannesian moving family and chattels from downtown Vancouver to a house in Port Moody, of which more anon. Secretary, Joe Holman is to lead a review team to assess the books in the club library as space is likely to become a problem shortly and some items of lesser importance may have to go to shelves new, or that great shredder in the sky. Ken Walker says the railway carried 63,038 passengers in 2022, an average of 1502, over 60 days of operating. This closely approached their record of 1510 set in 2019. Five other days in 2022 also came close to this figure. The best day welcomed 1541. Chuck Laws has installed a water separator on the air line, only 25 years after being advised that one was needed. This should prevent the system becoming full of what looked like peanut butter. Alan Ponting, workshop director, has died. He created a good and safe work area, which was in danger of becoming neglected, making it nicer to use and more efficient. A new locomotive, a GP-7 switcher and attendant 'Slug' has been



GP-7 and 'Slug' at BCSME. (Photo courtesy of Frank Fleury.)

obtained. The combination is so powerful, it can pull a loaded train almost as long as the platforms on the railway (photo 3). As the Burnaby Central Railway runs several large steam locomotives, train crew instruction courses are to be held, ready for the coming spring, as the number of qualified train crews is slowly diminishing. Port Moody's origins lie in the Cariboo gold rush of 1862 as its harbour remained open even when the Fraser River froze over. Port Moody station now includes a useful railway museum but with no rolling stock.

W. www.bcsme.org

Just before I sent off my copy to the editors, I received the '75th Anniversary' issue of the Gauge 1 Newsletter & Journal for December. That is, the 75th Anniversary of the Gauge 1 MRA, not the N&J. To crown it all, the Bicester show was the most successful ever. Stuart Hithersay writes



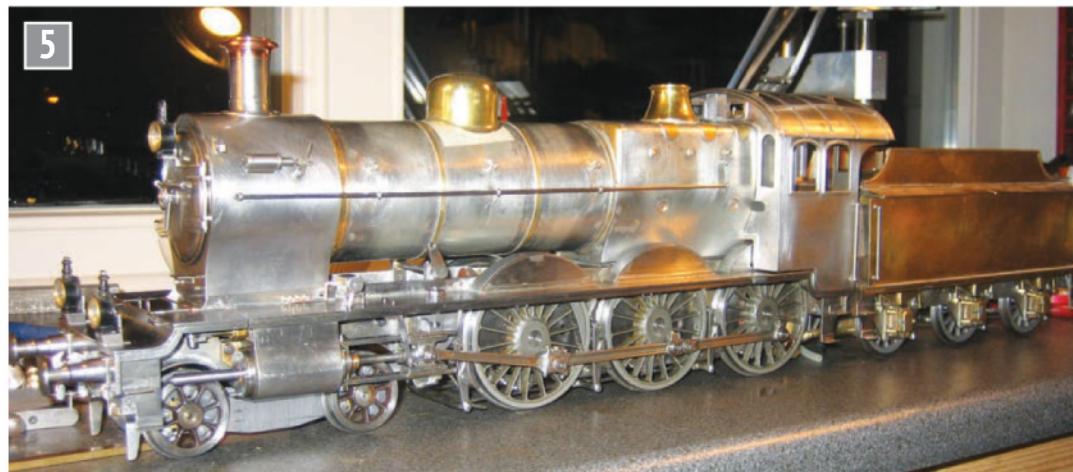
Peter Chrisp's BR Class 31 coming round the mountain. (Photo courtesy of Nick Barlow.)

a two page article on how it was conceived and organised. I imagine that in future years, people will say, "Ah! Bicester!" in the same reverent tones as Churchill's famous line about the RAF. Composer, Ben Cocks may have hit the right note with his new song but the old one, *Never in a month of Sundays* will be more familiar to readers. A representative

selection of fine pictures completes this issue's offering; more to come next time. Here are Peter Chrisp's Class 31 coming round the mountain at his Suffolk gathering with a train of Curlew coaches (photo 4) and Dutch State Railways SS700 ready for the paint shop (photo 5). See YouTube KXgaf7vX6ps for its new livery.

This issue's Club News has been a doddle to write, not that I don't enjoy writing the columns which take more effort. Therefore, I say 'Thank You' to the many and various Club News editors and their contributors, who make my job so much easier.

And finally, I bought a record of wasp noises but I actually preferred the bee side.



Jaap Oudes' SS700. (Photo courtesy of Jaap Oudes.)

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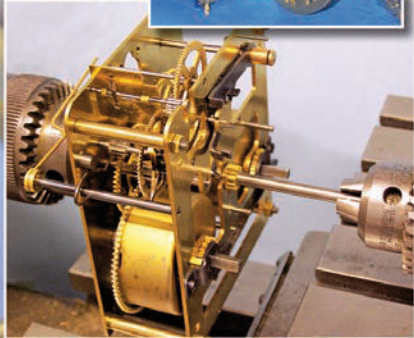
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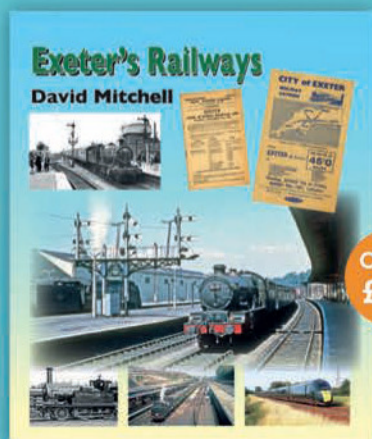


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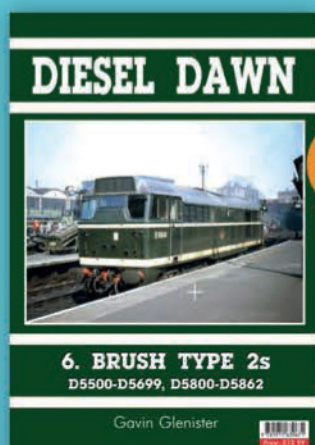
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All equipment considered: Myford, Warco, Chester, classic British brands etc
Polly steam locomotives also purchased, especially those needing a bit of 'TLC'



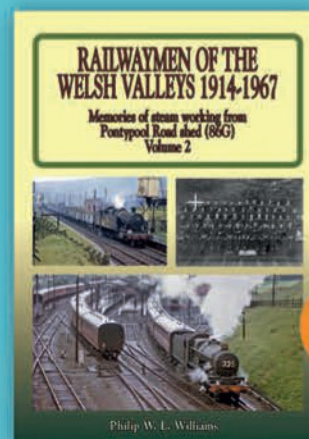
Exeter's Railways by David Mitchell

A lavishly illustrated
comprehensive survey of
Exeter's railway history.



Diesel Dawn 6 by Gavin Glenister

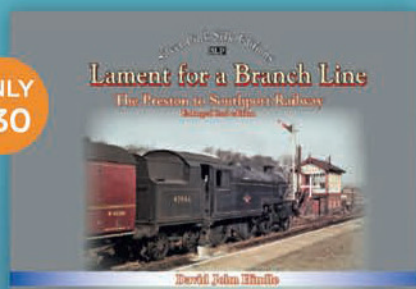
No.6 in the Diesel Dawn series,
describing the 263 locomotives
built by the firm Brush Ltd of
Loughborough from 1957.



Railwaymen of the Welsh Valleys Vol.2

by Philip W.L. Williams

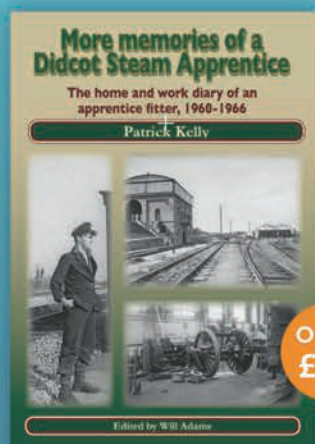
The second volume chronicling
the lives and times of railwaymen
working in and around Pontypool
Road loco shed.



Lament for a Branch Line

2nd Edition by David Hindle

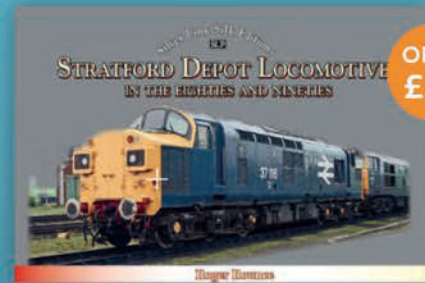
The second edition of
the evolution and complete
history of the Preston to
Southport branch.



More Memories of a Didcot Steam Apprentice

by Patrick Kelly Pat

Kelly's day-to-day life at Didcot
shed on BR's Western Region in the
dying days of steam, as a young
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Pacific poss. 5" locomotive 4-6-2 Boiler kit, casting set and frames see website for more pictures £1800



Elliott 12" rotary table 4 1/4" height £500



Harrison Graduate wood lathe £1450



DP / MOD gear cutters £20 each please enquire



Sweeney and Blocksidge flypress 5 1/4" throat £300



Centec 2B milling machine + quill head and power feed table, nice! £2250



Neat cut and soluble cutting oils £10 each



Milling cutters, drill bits, chasers, DOC cutters etc



70KVA Perkins engine diesel Generator, silent run £3750



Books and manuals in our eBay shop from £6.00



Harrison M300 lathe £3950



Blacksmith tools and tooling in our eBay shop!



Colchester Bantam 2000 lathe (long bed) metric leadscrew, Dickson post £4950



Stanier precision vice 55mm jaw New / New Zealand £195



Startrite Robland K210 £2450



X-Y 12" x 6" table £525



Myford Super 7 B lathe, power cross feed, gearbox £4950



Harrison / Colchester change wheels



Multico M1 240V Mortiser + Chisels Original £750



Harrison M250 lathe 5" x 20" 240 VOLTS FROM NEW £5450



Startrite 24 V 10 + welder bandsaw, nice £1750



Oxford 180 amp arc welder + leads + wheels £180



Meddings L1 MK.V drilling machine £2250



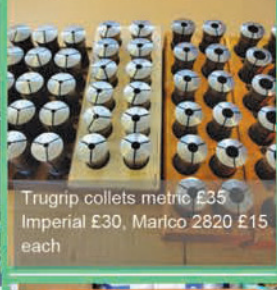
Emco 5" 6" centre height lathe Toolpost grinder £600



Colchester Triumph 2000 (part exchange) £3500



Myford ER25 solid collet chuck made by Myford (Notts) New £70 More in our eBay shop!



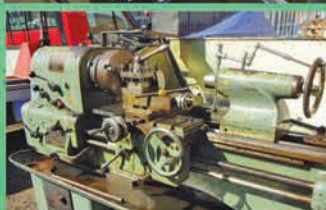
Trugrip collets metric £35 Imperial £30, Marico 2820 £15 each



Chester Cub 630 6" x 30" centres chucks, steadies hardly used £2950



Clarke 917 vacuum former £495



Colchester Triumph 7 1/2" x 30" gap bed centre lathe, 2" spindle bore, 3 jaw chuck, 4 way tool post from university (nice condition) £2750



RJH Bison 10" pedestal grinder complete with light £450



Facom tool cabinet, key £375



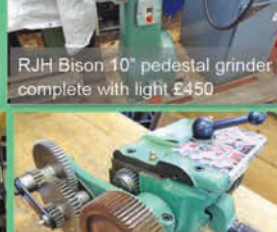
Tripus 240v switch £90



Crown Windley Brothers 6ft x 4ft cast iron surface table £1425



Webbed angle plate 300mm x 300mm x 30mm thick £250



Myford gearbox unused £1000

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