

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 229 No. 4705 • 2 - 15 December 2022

MODEL ENGINEER

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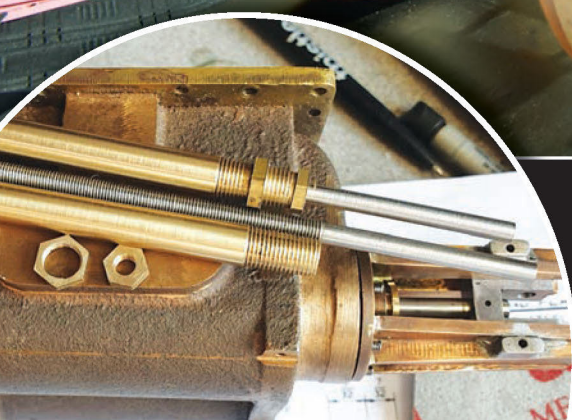
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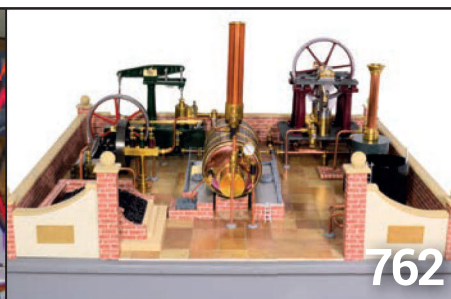
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ON THE COVER...

A wooden Fowler 'Superba' traction engine by George King, seen at the Midlands Model Engineering Exhibition (photo: John Arrowsmith).

This issue was published on December 2, 2022.
The next will be on sale on December 16, 2022.



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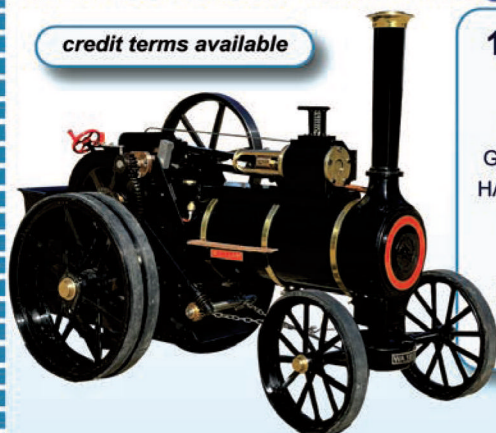
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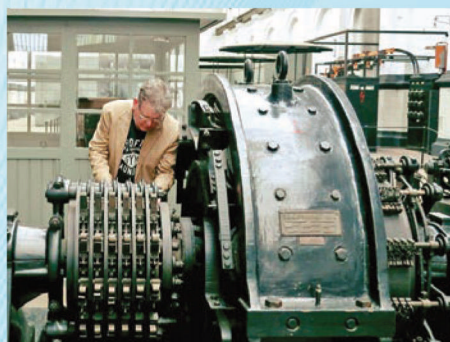
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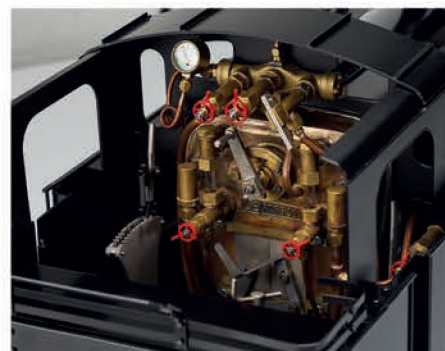
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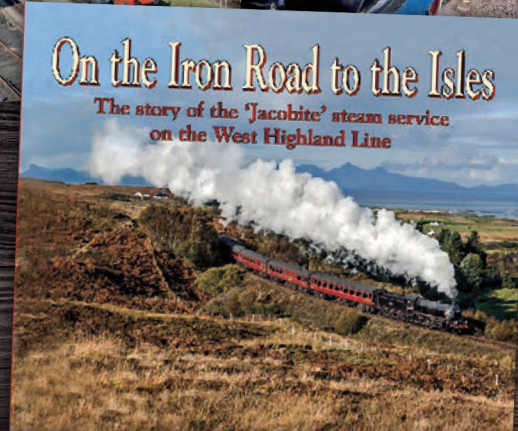
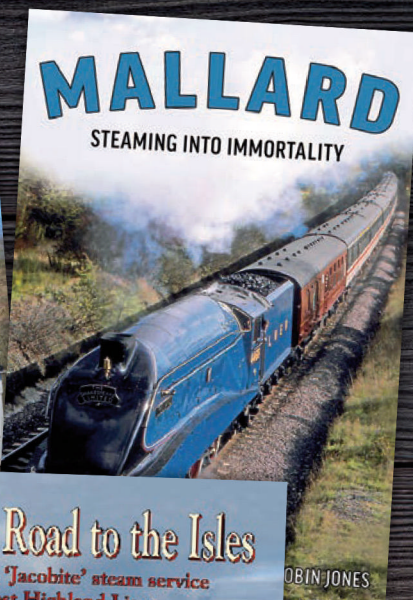
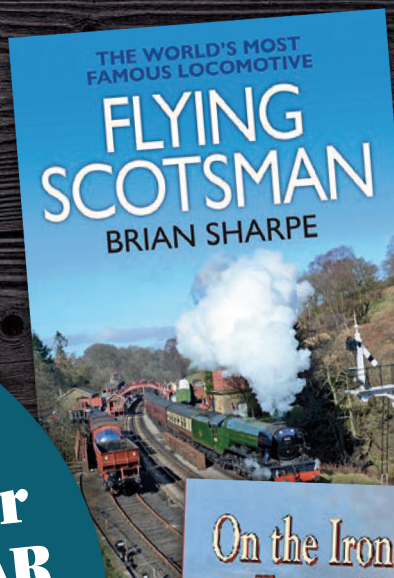
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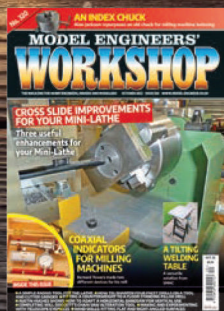
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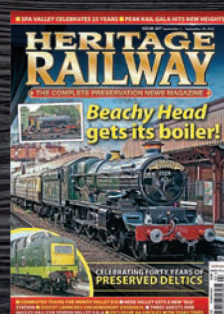
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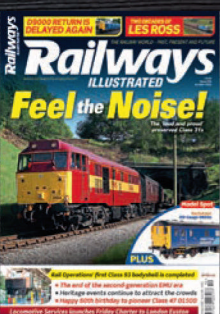
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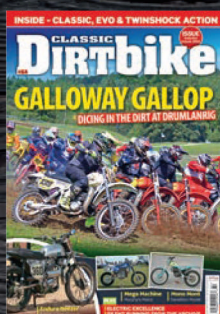
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Stirling Single

Whatever the question it seems that there is always someone out there with the answer! Sometimes it works the other way round too. Jeremy Buck has written to me as follows.

'I cannot help with drawings for the Stirling single mentioned in Des Adeley's letter (M.E.4700, September 23) but it has answered a question that intrigued me for many years. You may recall that I described my own Stirling single in a series of articles about three years ago. I mentioned that its antecedent was a non-working model of ancient but unknown lineage acquired by my father in about 1957. I now know, thanks to Mr Adeley, that it was to the design of W. Martin and Co. as evidenced by the hard stamping W. M. & Co on the cast gunmetal tender frames (see photograph). It may even have been the model built by the Rev T.B. Parley. I have ordered an 1899 volume of *Model Engineer* and, although I have no photographs of the locomotive and tender as acquired by my father, I should be able to tell if that is indeed the case.

'It was evident to me that there was no prospect of putting the locomotive into working order but I did use a number of its components including wheels, cylinders (much modified), bogie stretcher, tender frames, smokebox door in my own model. Although I still have a number of the smaller components that have not been recycled into later projects, eg, cast bogie frame, valve gear,

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connecting rods, buffer stocks, in my scrap box, the original frames, boiler, platwork and tender tank went for scrap many years ago. However, I could probably reconstruct the tender tank from memory.'

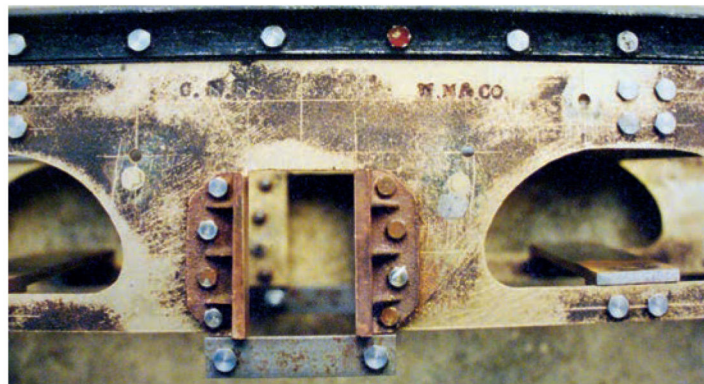
I think that's an offer worth taking up.

Tobin Bronze

I have received a query asking about Tobin Bronze, as recommended by Ron Collins for the first stages of the construction of his

Ballaarat copper boiler. I have to admit that I hadn't heard of it but supposed that was simply ignorance on my part. It seems that perhaps it is not such a well-known brazing alloy in this part of the world – no doubt it is familiar though in Australia. Consulting Wikipedia led me to the knowledge that Tobin Bronze was an Australian racehorse back in the 1960's. It seems just as odd to me to name a racehorse after a brazing alloy as *vice versa* so I am left none the wiser on that score (although I suspect the latter). Further investigation reveals that Tobin Bronze is an alloy of copper and zinc with 0.75% added tin – basically Admiralty brass.

I cannot claim to be an expert on brazing alloys so I wonder if anyone out there who knows about these things could recommend an alternative that is more likely to be available in the UK – or perhaps a UK stockist of this alloy.



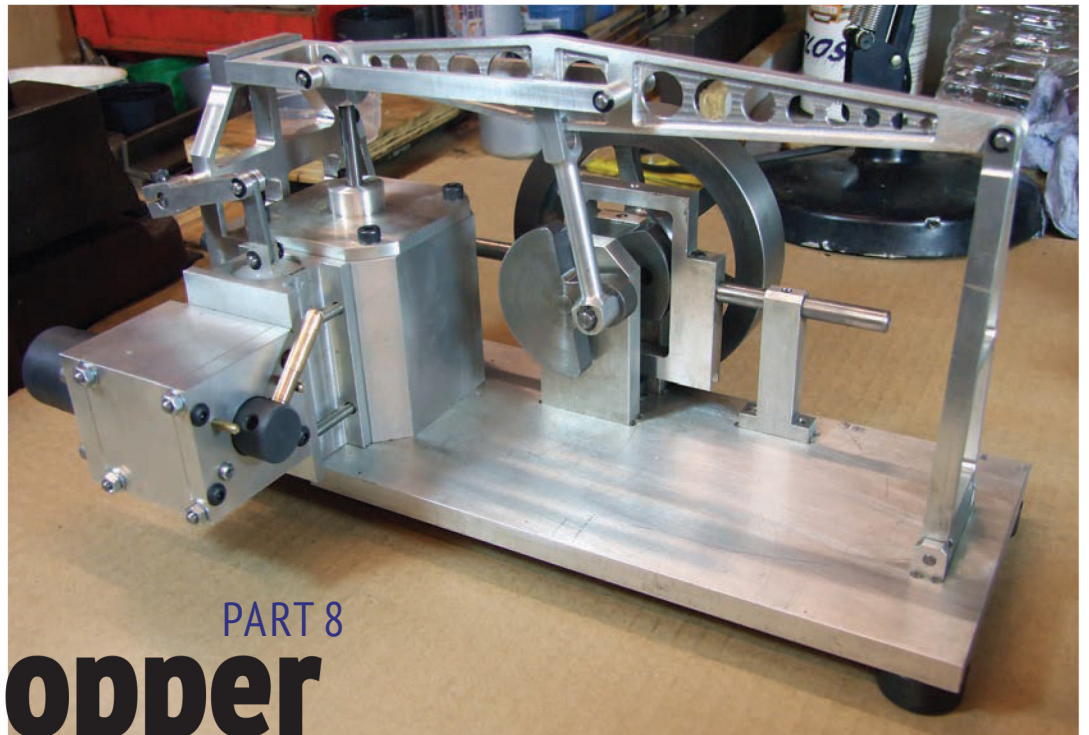
Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
MEeditor@mortons.co.uk

Martin Gearing

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



Continued from p.699
M.E. 4704, 18 November 2022



PART 8

Grasshopper Beam Engine

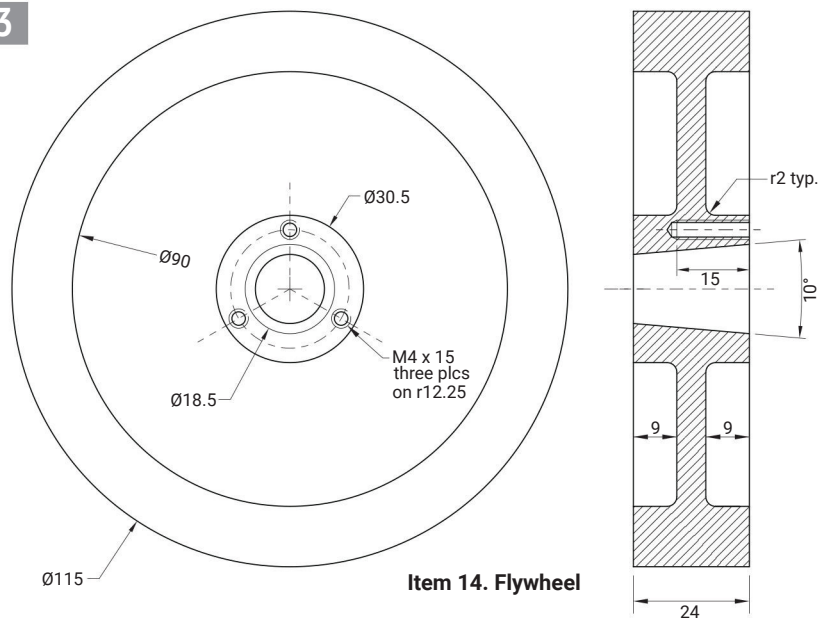
Item 14 – Flywheel (fig 23)

Ø120 x 1¼ inch cast iron

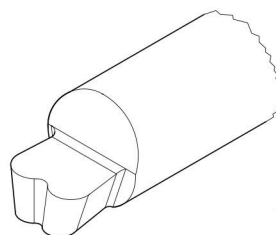
A visible flywheel on any engine is always a major focal point and I will always bear in mind a respected

engineer I worked with saying, 'The overall standard of workmanship to which an engine has been built can best judged by how true the flywheel runs'.

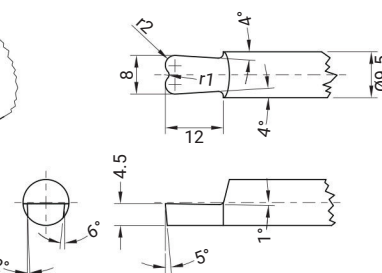
Fig 23



Item 14. Flywheel



Enlarged View Of Recess Tool



Dimensions Of Recess Tool

Flywheel.

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) ±0.1mm

Functional (i.e parts having to match) ±0.02mm

The flywheel and its mounting for this engine is described initially with a simple plain web between the hub and rim which is certainly fit for purpose, but the appearance of the engine is very much enhanced by an alternative version having six spokes, although demanding a little more time, along with an organised work plan.

At first sight, for the beginner, the production of the spoked version may appear daunting but by breaking down the various machining operations required to produce each spoke into ten simple and clearly defined 'bite sized chunks', a far more attractive/impressive flywheel will result.

The final decision whether to 'Go the Extra Mile' must lie with the constructor but it must be said that in addition to greatly enhancing the engine's appearance, much valuable experience will be gained, which will go a long way to enhancing the builder's confidence.

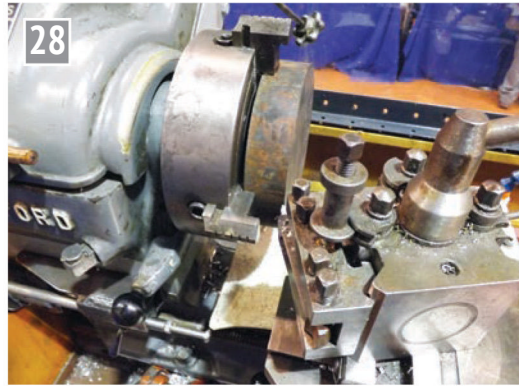
Preparing the blank

* Hold the sawn blank in a four-jaw independent chuck using the reversed jaws, set to run as true as the rough outer finish will allow, with the sawn face against the jaw pads (**photo 28**). Face off, and then turn $\varnothing 117$ to as near to the jaws as possible.

The face recess turning tool

* Select a piece of high-speed steel stock, ideally a piece of $\varnothing 3/8$ inch/10 round, as its profile will reduce the amount of waste that has to be removed to provide the necessary clearances, for what can best be described as a 'Radial' parting ('trepanning') tool.

* For recessing purposes this needs to be ground to about 8 wide, with the front face square to the length, and having between 1 degree and 2 degrees top rake on the top surface ground to just below the centre of the blank. This needs to taper in equally by about 4 degrees on both



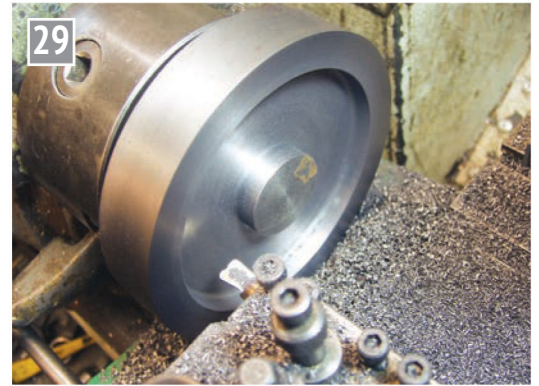
Facing off the flywheel blank.

sides for a length of 12 back from the front edge.

- * Clearances for the three cutting edges need to be ground as follows: front, 5 degrees, right-hand side (viewed from the front), 6 degrees, left-hand side (viewed from the front), 2 degrees. If you think of the tool as having to machine initially an 8 wide groove 9 deep, the larger diameter being 45 in the face of a piece of material with clearance for all three cutting edges, you will be on the right lines.
- * Because the width of such a cutting tool used on a light lathe will be prone to chatter, a single 1.5mm deep groove can be ground into the front cutting face with relevant clearances to reduce the loading.
- * Where the front meets the sides, radius the edges 2, continuing on around into the central groove - maintaining a radial clearance for the cutting edges. Refer to 'Enlarged View of Recess Tool' on fig 23.

Recess machining

- * Set the tool on centre height with no more than 12 protrusion, with the width of the front face set exactly true to the flywheel blank's faced surface.
- * Use a rule to adjust the outer edge of the left-hand cutting edge (viewed from the tailstock) to be 84 from the centre seen by the turning marks in the face. With the spindle running at around 90rpm move the tool until the end just touches the rotating face.



Machining the recess in the flywheel.

- * Clamp the saddle and zero the top slide dial.
- * Slowly advance the tool using the top slide 1 mm into the face - this will produce two semi-circular grooves - and then feed towards the centre using the cross slide, checking with a rule that you don't reduce the diameter being formed by the right-hand side of the tool (viewed from the tailstock) below $\varnothing 35$.
- * Adjust as required until you have two visible reference diameters either side of the 1mm depression measuring $\varnothing 85$ and $\varnothing 35$.
- * Return the tool to the outside and advance into the face a further 1mm, then feed slowly towards the centre ALWAYS keeping within the outer and inner reference diameters just formed.
- * Repeating a further six times and then one cut 0.5 deep, always keeping between the two reference diameters.
- * Withdraw the tool clear of the cut and machine the outside diameter to measure $\varnothing 90$, feeding in with the top slide to 8.5mm deep each cut. Set the cross slide dial to zero on the last cut.
- * Repeat with the inner 'boss' diameter bringing it to 30.5mm. Note the cross-slide dial reading.
- * Starting from the outside diameter with the cross-slide dial set to the previous zero position, feed the tool in to the full depth of 9mm, then slowly feed inwards, facing off the base of the recess until the previously noted cross-slide dial reading is reached at the 30.5mm position, then feed the tool back out of the cut

using the top slide. Chamfer all sharp edges.

- * Remove the blank and re-chuck in a self-centring chuck holding on the inside of the flywheel rim just machined, using the 'nibs' in the middle of the jaws. Make sure the machined face of the flywheel rim is in full contact with each of the jaws before tightening against the inside of the rim.
- * Repeat the recess machining process as described in the second face.
- * Skim outside diameter $\varnothing 115$. Chamfer all sharp edges (**photo 29**).
- * Centre drill and drill $\varnothing 13$ through. Set over the top slide to 5 degrees. Mount a boring tool with 35 protruding on centre. Taking light cuts, bore the tapered detail until the diameter measured on the outer face of the boss is $\varnothing 18.5$.
- * Chamfer all sharp edges. Leave the boring tool in place and the top slide set at 5 degrees (**photo 30**).



Boring the taper in the flywheel.

Item 15 – Flywheel Collet (fig 24)

Ø40 x 2 inch EN1A

An easy way to guarantee that the collet will fit perfectly with the tapered bore of the flywheel, and ensure true running, is to turn the taper using the same boring tool as used on the flywheel, but carry out the machining on the rear face with the spindle running in reverse.

* Hold in the four-jaw chuck with 35 protruding. Face off. Turn diameter 30.5 x 35. Turn diameter 18.75 x 26. Centre drill and drill Ø7.7 and ream Ø8.

* Turn the 10 degrees taper (included) until the tapered surface reaches approximately 24 along the length of the Ø18.75 section (photo 31).

* Check the fit by using the flywheel as a gauge, continuing until an assembled gap of 1.5 is achieved (check with a drill shank) between the face of the flywheel and the face of the collet flange section

(photo 32). Chamfer all sharp edges.

* Part off the collet 31 long.

* Using a stub of Ø8 silver steel with the ends free of burrs held in the tailstock chuck, support the collet as it's tightened in a self-centring chuck with the flange protruding from the jaws by 1.5 – 2mm (photo 33).

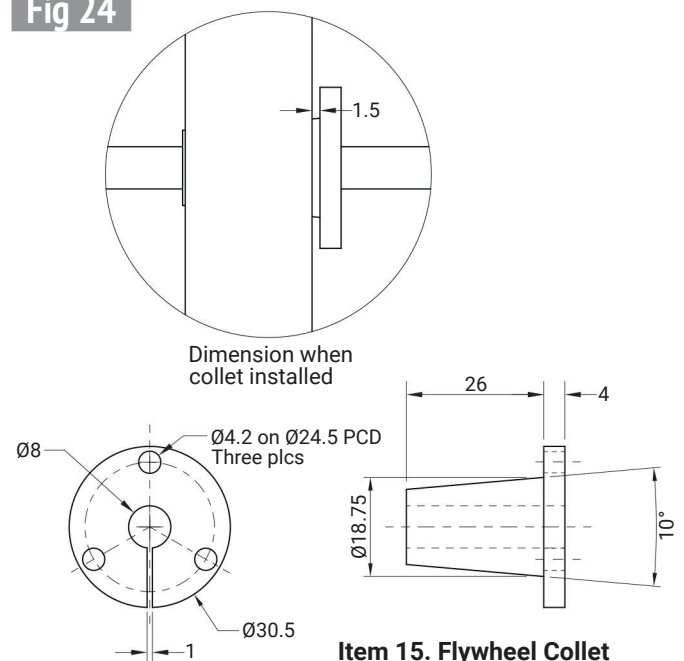
* Check that it's running visibly true. Skim the Collet flange until 4 thick. Chamfer the edges.

Fitting the collet into the flywheel

* Mount a rotary table on the mill and clamp to the bed after bringing the spindle true to the table's centre. Zero the X and Y axis dials. Place the flywheel onto the rotary table and set the bore of the taper to run true before clamping down (photo 34).

* Move 12.25 on the Z axis and clamp the table. Centre drill and drill 3.3 x 15 and tap M4 at 0 degrees, 120 degrees and 240 degrees (it's quicker to use each tool at the three angular positions before changing, than to carry out

Fig 24



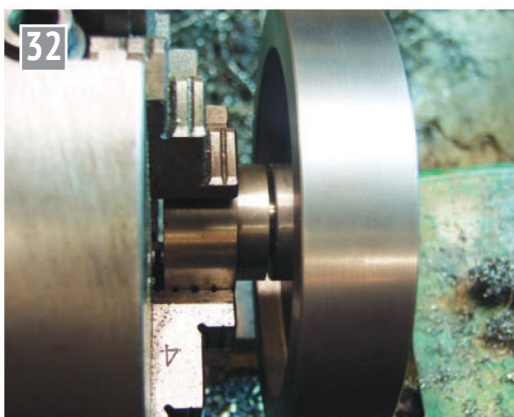
Item 15. Flywheel Collet
Chamfer all edges 0.5 x 45°

the three operations at each one three times). Clean away any swarf before placing the collet into the taper and securing it with a tap from a soft hammer. Using slow feed rates, centre drill and drill

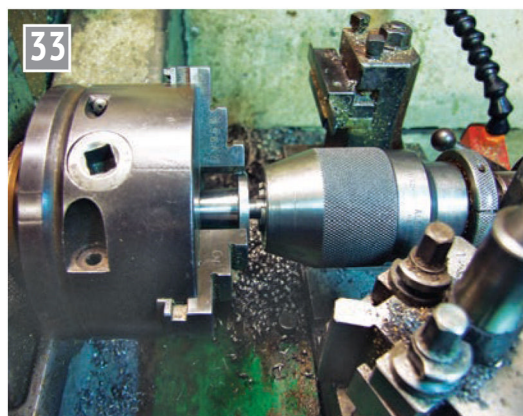
4.2 at one place only. Clean out any swarf in that thread location and fit a M4 x 15 bolt to firmly hold the collet whilst the two remaining holes are drilled in the collet flange in the next two angular positions (photo 35).



Turning the taper on the flywheel collet.



Checking the gap between the flywheel and the collet.



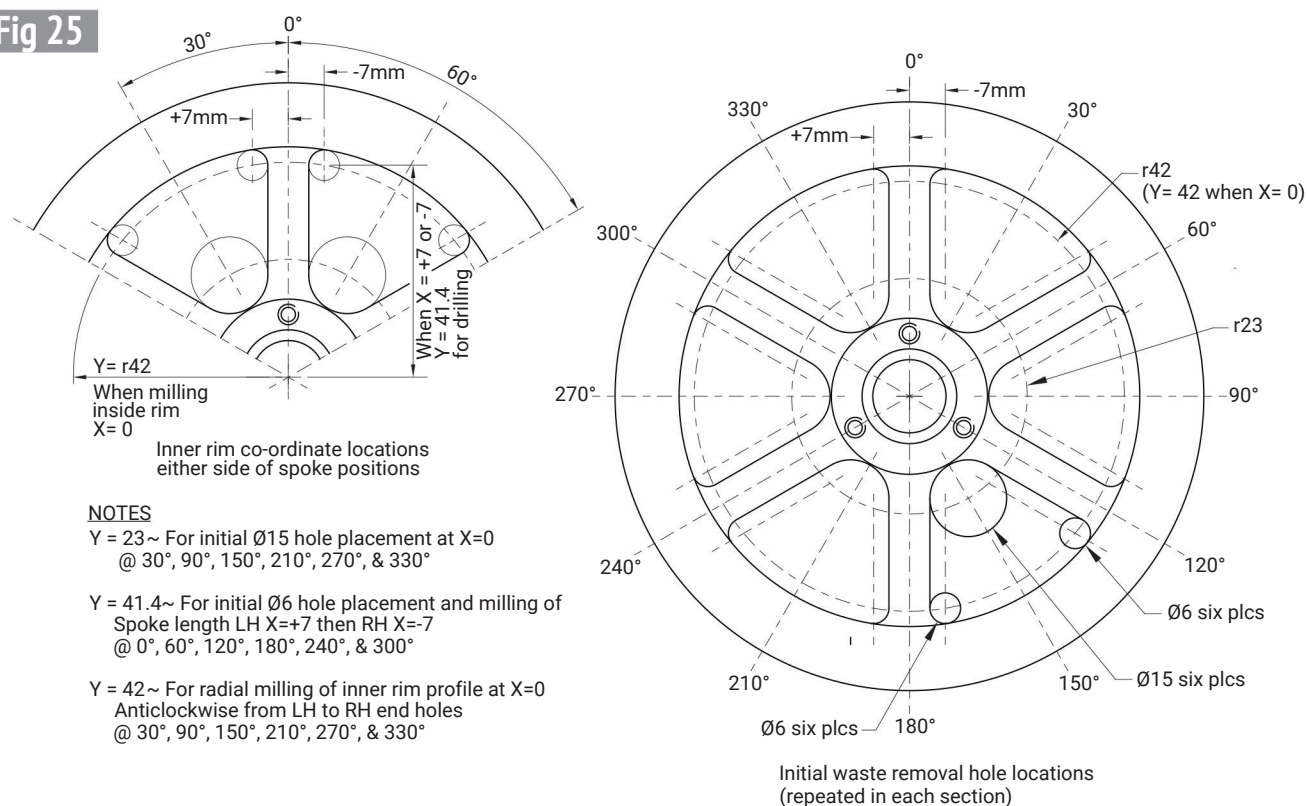
Truing the taper in the chuck.



Setting the flywheel taper to run true on the circular table.



Drilling the collet fixing holes.

Fig 25**Item 14 (Alt). Alternative Spoked Flywheel - Waste Removal**

Alternative Enhanced Spoked Flywheel (fig 25)

As mentioned previously the little extra time spent in removing sections of the plain web connecting the hub to the rim on the plain flywheel creating six spokes will very much enhance the whole overall appearance of the engine (**photo 36**).

In that sentence I have actually described simply the process of converting the plain disc flywheel into a six spoked version as just removing six sections of waste material!

For that to happen we need to make reference to two distinct sets of angular datums. These are 30 degrees, 90 degrees, 150 degrees, 210

degrees, 270 degrees and 330 degrees, used for the first and last operation, and 0 degrees, 60 degrees, 120 degrees, 180 degrees, 240 degrees, and 300 degrees used for all other operations.

The machining stages for the spoked flywheel are shown in **fig 26**.

For a beginner it is appreciated the prospect of the machining required to produce the six spokes may seem daunting but to apply the previously mentioned 'Bite Sized Chunks' principle means the work may be done in ten separate simple stages, each one repeated six times, that when completed will produce a successful result.

The biggest hurdle when

conventional machining is the removal of material not required, in this case the six sections of 6mm thick plain web material occupying the space between the spokes.

Generally drilling is the easiest way to remove metal quickly and with the use of cast iron doesn't come with the problem of dealing with long thrashing lengths of curling swarf!

The individual 10 stages are laid out in **fig 26** showing the following sequence:

Operations 1 – 3

Start off the waste removal process by drilling/boring suitably sized holes at the end of each profile direction change.

Operations 4 – 6

Next chain drilling between those holes, ideally using either a Ø5 or Ø5.5 stub drill.

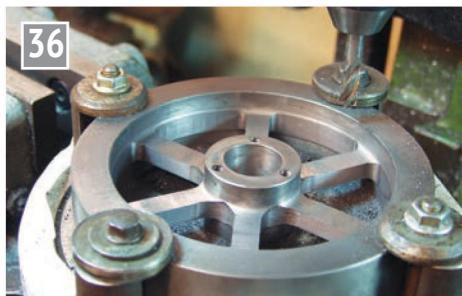
Operation 7

Removing the joining webs between the chain of holes ideally using a Ø5 end cutting end mill, which allows the waste sections to fall away before removal (**photo 37**).

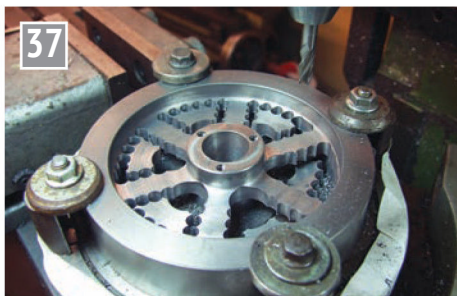
Operations 8 – 10

Finally milling the two spoke sides and radial inner rim surface to a reasonable finish using a Ø6 long series end mill (**photo 38**).

Remove and break all sharp edges with a fine file. Install the collet with three cap head screws and put to one side.



Machining out the web to create the spokes.

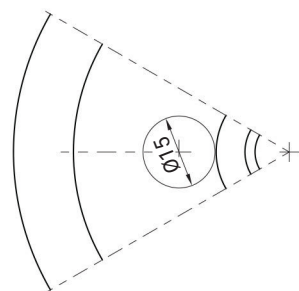


Removing the webs by chain drilling.

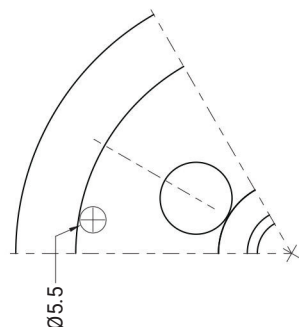


Cleaning up the spokes.

Fig 26

**Op. 1 - Drill/Bore Ø15**

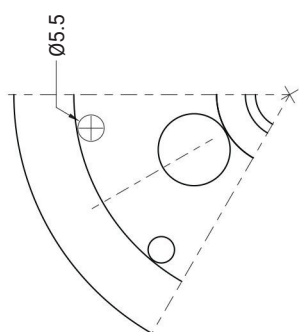
1. Center Blank
2. Zero Table
3. Move X0, Y23
4. Ctr Drill
@ 30°, 90°, 150°, 210°, 270° & 330°
5. Drill Ø13
6. Drill/Bore Ø15
@ 30°, 90°, 150°, 210°, 270° & 330°

**Op. 2 - Drill (RH) Ø5.5**

1. Move X7, Y41.4
@ 0°, 60°, 120°, 180°, 240° & 300°
2. Ctr Drill
3. Drill Ø5.5
@ 0°, 60°, 120°, 180°, 240° & 300°

Or if Using Stub Drill

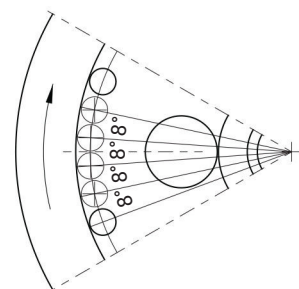
1. Move X7, Y41.4
@ 0°, 60°, 120°, 180°, 240° & 300°
2. Drill Ø5.5

**Op. 3 = Drill (LH) Ø5.5**

1. Move to X-7, Y41.4
@ 0°, 60°, 120°, 180°, 240° & 300°
2. Ctr Drill
3. Drill Ø5.5
@ 0°, 60°, 120°, 180°, 240° & 300°

Or if Using Stub Drill

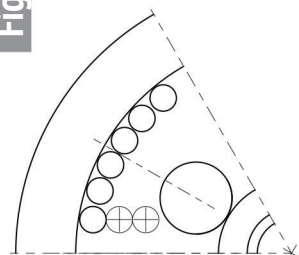
1. Move X-7, Y41.4
@ 0°, 60°, 120°, 180°, 240° & 300°
2. Drill Ø5.5

**Op. 4 - Chain drill Radius**

1. Move to X0, Y0
2. Rotate Table to Locate Ø5.5 drill in RH hole
3. Rotate 8°, Ctr Drill, Drill Ø5.5
4. Repeat 3 times at 8° intervals
5. Repeat in remaining 5 sections

Or if Using Stub Drill

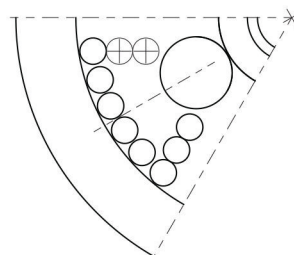
1. Rotate Table to Locate Ø5.5 drill in RH hole
2. Rotate 8°, Drill Ø5.5
3. Repeat at 8° intervals 3 times
3. Repeat 1 & 2 in remaining 5 sections

**Op. 5 - Chain Drill RH Spoke Side**

1. Move to X7, Y35.9.
@ 0°, 60°, 120°, 180°, 240° & 300°
Ctr drill, Drill Ø5.5
2. Move to X7, Y30.4
@ 0°, 60°, 120°, 180°, 240° & 300°
Ctr Drill, Drill Ø5.5

Or if Using Stub Drill

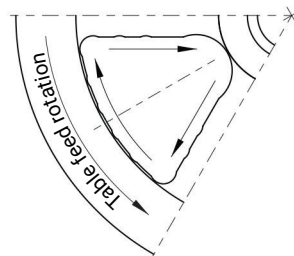
1. Move to X7, Y35.9.
@ 0°, 60°, 120°, 180°, 240° & 300°
Drill Ø5.5
2. Move to X7, Y30.4
@ 0°, 60°, 120°, 180°, 240° & 300°
Drill Ø5.5

**Op. 6 - Chain Drill LH Spoke Side**

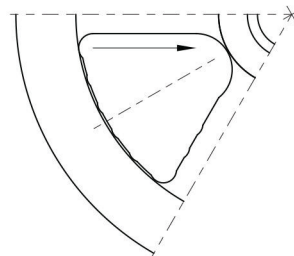
1. Move to X-7, Y35.9.
@ 0°, 60°, 120°, 180°, 240° & 300°
Ctr drill, Drill Ø5.5
2. Move to X-7, Y30.4
@ 0°, 60°, 120°, 180°, 240° & 300°
Ctr Drill, Drill Ø5.5

Or if Using Stub Drill

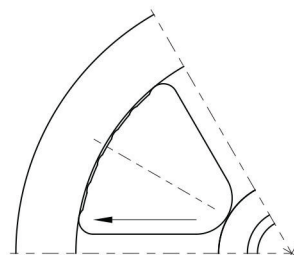
1. Move to X7, Y35.9.
@ 0°, 60°, 120°, 180°, 240° & 300°
Drill Ø5.5
2. Move to X7, Y30.4
@ 0°, 60°, 120°, 180°, 240° & 300°
Drill Ø5.5

**Op. 7 - Remove Waste**

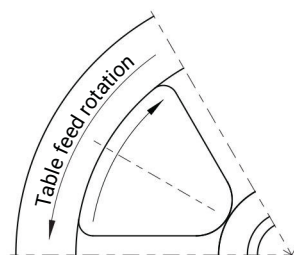
- Use Ø5 Slot Drill - remove "chain links"
1. Repeat positional locations and follow paths created by chain drilling
~Rim (Op 4 at X=0, at Y=42)
@ 0°, 60°, 120°, 180°, 240° & 300°
Radially from LH to RH end holes
 2. ~LH Spoke side (Op5 X=7)
@ 0°, 60°, 120°, 180°, 240° & 300°
 3. ~RH Spoke side (Op5 X=-7)
@ 0°, 60°, 120°, 180°, 240° & 300°

**Op. 8 - Finish Mill LH SpokeSide**

- Use Ø6 End mill
1. Move to X-7, Y 41.4
 2. Mill LH Side of Spoke (feed in)
@ 0°, 60°, 120°, 180°, 240° & 300°

**Op. 9 - Finish Mill RH SpokeSide**

- Use Ø6 End mill
1. Move to X7, Y23
 2. Mill RH Side of Spoke (feed out)
@ 0°, 60°, 120°, 180°, 240° & 300°

**Op. 10 - Finish Mill Inside of Rim**

- Use Ø6 End mill
1. From X7, Y 41.4
Feed anticlockwise from RH side of spoke to LH side of next spoke
@ 30°, 90°, 150°, 210°, 270° & 330°

Item 14 (Alt). Alternative Spoked Flywheel Machining Stages

Refer also to Drawing 25

● To be continued.

Merlin Biddlecombe Day

Nick Feast celebrates with the Southampton club the life of a longstanding member.



Merlin's unfinished five inch gauge Standard 5. He made several visits to the Watercress Line to ensure that all details were correct. (Photo courtesy of Station Road Steam.)

On Saturday 28 May 2022 Southampton and District Society of Model Engineers held a day to celebrate the life and achievements of long-standing member, Merlin Biddlecombe, who died in October last year. Merlin was also a member of Bournemouth and District club so members of both organisations, as well as members of Merlin's family, were present at the Riverside Park track in Southampton on a very pleasant late spring day.

Merlin served in the RAF and then worked for the Hants and Dorset Bus Company at their Bedford Place workshops in the centre of Southampton. He carried out precision engineering work, such as grinding crankshafts, and was active in his spare time repairing and building miniature steam locomotives. He built a Britannia pacific to LBSC's design in the early 1950s; this engine has survived although it is in need of restoration, having been stored in very damp conditions.

He moved on to AC Delco, who manufactured motor components on a large scale in Southampton Docks, where he met his future wife Marcia. He was a competent clarinet player and often performed with other



A Britannia built to the LBSC design by Merlin in the 1950s. Although in need of some restoration the fine quality of the engineering is still evident.



William Powell sits with Merlin's Mona, which had its first run since completion at the celebration day. Also present are Paul Dean of the Southampton Club and Merlin's wife Marcia.



Bill Perrett was also a well-known member of the Southampton club and here he and Merlin are being driven round the Southampton track by Fred Wilkins. The locomotive is Bill's Speedy, the winner of several IMLEC competitions.



Bill Perrett's Speedy again in 2012, with Merlin driving, in a recreation of a photograph from 50 years previously taken at the opening of the Southampton track. The local newspaper was able to trace all three lady passengers who were children in 1962. (Photo courtesy Daily Echo.)



Mike Sanderman is preparing his LMS Black 5 in the steaming bays. This locomotive is a much modified and improved commercial kit.



John Lloyd is preparing to light up his five-inch gauge unmodified Merchant Navy Pacific, Channel Packet.

musicians in the Southampton area. He took an active role in the Southampton Club and was one of the many members who worked to complete the current 3½ and 5 inch gauge raised track in 1962. Merlin's engineering skills were well known and he supplied many components such as sight feed lubricators to Don Young. He was also friends with Gordon Chiverton who was well known for producing top quality live steam injectors. Merlin then moved to Southampton University and worked in the engineering labs where he was able to use his engineering skills to the full. On retirement he moved to West Moors in Dorset and also joined Bournemouth and District Society of Model Engineers. He continued building his

largest locomotive - sadly one which was not to be completed - a five inch gauge BR standard 5 4-6-0. However, he did complete a Mona 0-6-2 tank locomotive to the LBSC design, although at the time of his death it had never been steamed. Several members of Bournemouth club ironed out a few teething troubles to get the locomotive tested and running and it performed well on the day.

Merlin also built a superb five inch gauge LNER B1 using works drawings and prototype information rather than the more usual Martin Evans design. Amongst many club projects, he built a new boiler for the Bournemouth club's Speedy and was involved in the maintenance and testing of the club's passenger carriages.

Merlin will be fondly remembered by all those who knew him as an enthusiastic and dedicated model engineer, always ready to offer advice, praise or constructive criticism depending on the situation.

The Southampton club provided an excellent buffet lunch, which was enjoyed by all, so many thanks to the chairman, John Roberts, and the members of the Southampton club who made the day possible.

ME



Family and visitors enjoy the hospitality of the host club.

A Model Atkinson Engine

Terry Dowling describes his model of a novel internal combustion engine.

Every engineer is familiar with the standard internal petrol engine using the Otto cycle that has powered our cars for the past century or more. But less well known is the Atkinson engine patented by the Hampstead engineer James Atkinson in 1887. It deserves to be better known as it is the Atkinson engine rather than the engine of Nicolaus Otto that is found in an adapted form in most hybrid cars to be found on the roads today.

I have always been fascinated by the Atkinson engine. For a start, it completes all four cycles — intake, compression, power and exhaust — in a single revolution of the crankshaft, unlike Otto's four-stroke engine. Moreover, there's no separate camshaft and there are no timing gears, thanks to its extremely clever design.

One might therefore wonder why Atkinson engines never achieved the success of the Otto engine in his lifetime. The answer lies in the fact that, while they are more economical than conventional engines, they are also less powerful. So, while they can provide enough power for steady cruising or low-speed driving, they can't provide that burst of power we need to accelerate sharply.

But this also explains why Atkinson engines have become popular, in one form or another, in hybrid cars, where



The finished model Atkinson engine.

economy is the holy grail and any sudden burst of power is readily available from the car's electric motor.

Building the model

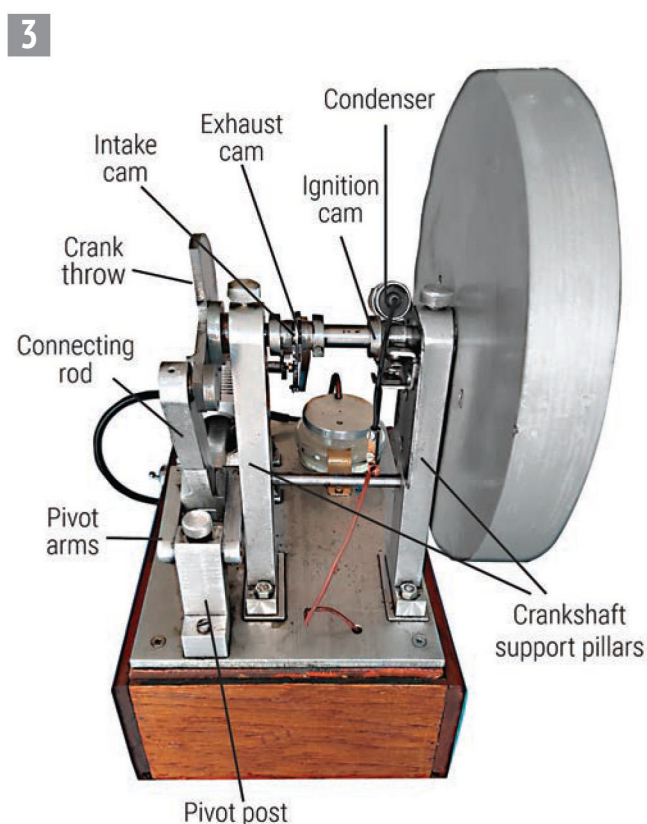
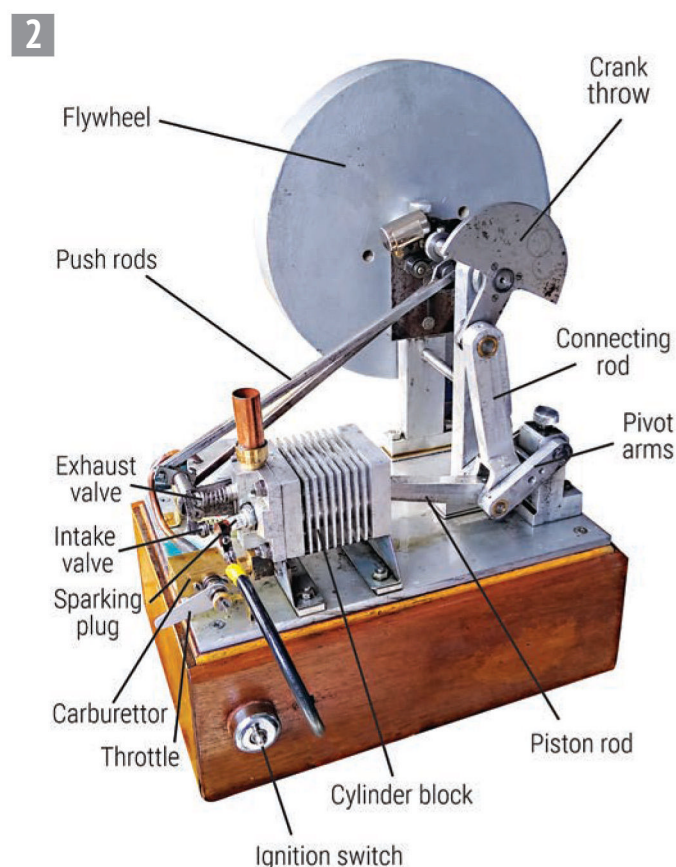
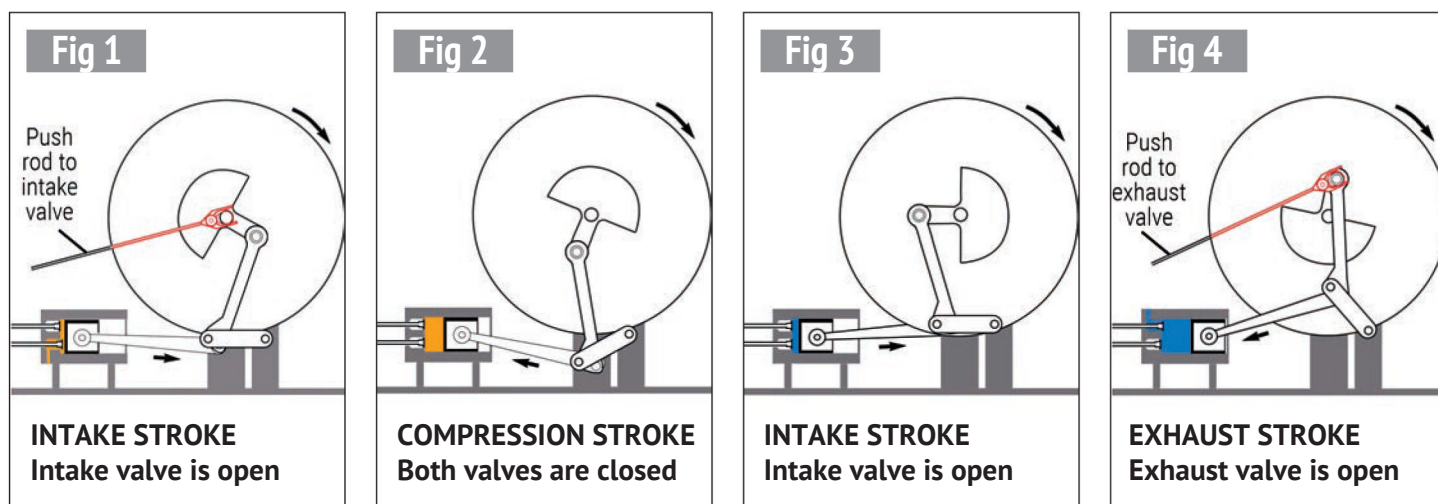
I had always wanted to build a model Atkinson engine, so I was delighted a few months ago to learn of an American booklet *Building the Atkinson Cycle Engine* by Vincent Gregory (ref 1) and it is my own version of this model that is the subject of this article. Detailed component dimensions are not given, as many model engineers may prefer to design their own parts, but the book mentioned earlier is still readily available for those wishing to make an accurate copy.

I made two or three small changes to the published design in order to simplify its construction. The most significant is that my model is air-cooled rather than water-cooled. I have found that this

is perfectly adequate as mine is an unloaded engine being run purely as a 'demonstrator' for relatively short periods of time (photo 1).

How does it work?

So, what's the secret behind Atkinson's novel engine, originally designed more to overcome Otto's stringent patents than to improve its efficiency? Part of the explanation lies in the ingenious motion connecting the piston rod to the main shaft via a pair of pivot arms and a specially designed connecting rod. Intake and exhaust cams on the main shaft are subtly different in profile so that the intake valve briefly remains open at the start of the compression stroke. This essential characteristic of an Atkinson engine means that it takes in less fuel on the intake stroke but has a longer and faster power stroke (see **figs 1 to 4**).



Main component parts of the engine.

Another stroke of genius at Atkinson's part was the way in which his design also eliminated the need for a separate camshaft and timing gears. Located on the camshaft is the pair of cams which actuate the engine's intake and exhaust valves via long push rods.

Making a start

To give an idea of the scale of my model (photos 2 and 3), its base measures 11½ inches x 8½ inches and its overall height is around 15 inches.

The flywheel has a diameter of 8¾ inches.

The baseplate seemed an obvious starting off point for me. I opted to use a substantial sheet of ¾ inch aluminium, screwed on top of a sturdy box within which sits the engine's battery and ignition coil.

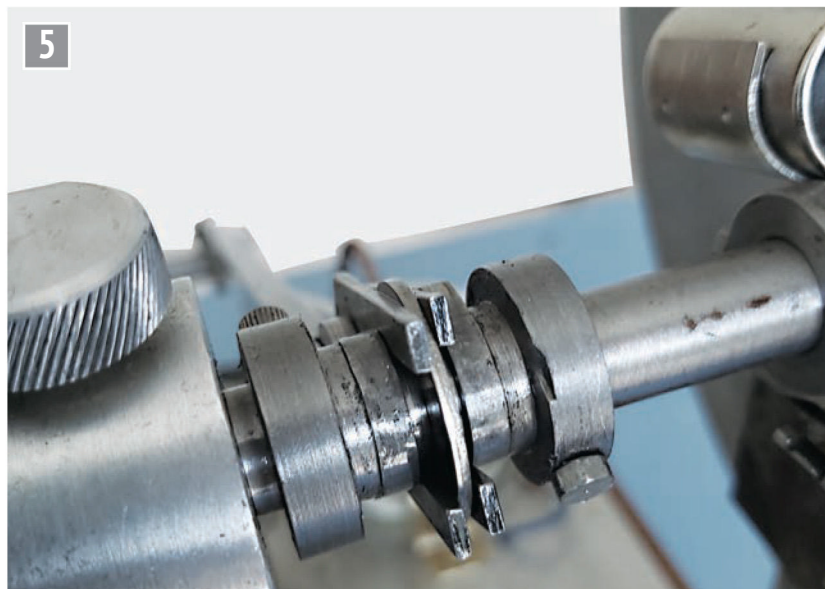
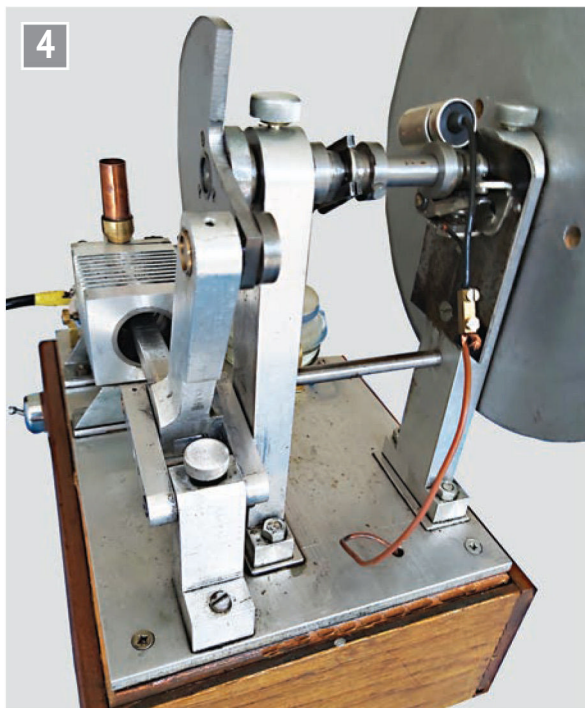
Most model engineers will want to make an early start on the cylinder block, as this forms the heart of the engine. I used a solid block of aluminium measuring around 60mm x 60mm x 85mm high. This

was then bored out so as to accept a ⅜ inch steel liner. The associated mild steel piston is 1⅜ inch in diameter and is 1¼ inch in length. I did not fit any piston rings, relying instead on very accurate turning.

An intake valve and an exhaust valve are fitted one above the other on the cylinder head, located within suitable valve guides. The valves themselves, and the valve head, are of mild steel. The springs shown are readily available from hardware suppliers.

Having completed the cylinder and piston, it is a good time to start work on the piston rod, a pair of pivot arms, a connecting rod, all of which are made from aluminium bar and milled or filed to shape (photo 4). The crank throw is of ⅜ inch mild steel which I happened to have to hand in the workshop and which I carefully filed to shape.

The main shaft itself, carrying the flywheel, cams and crank throw, is made from ⅞ inch bright mild steel bar and is located on two stout



Close-up of the motion, showing the piston rod, connecting rod and pivot arms.

Intake and exhaust cam, showing the 'Y' shaped forks which locate the ends of the push rods on the crankshaft.

aluminium support posts via bronze bushes.

The cams

Three small cams are located on the crankshaft and fixed in position via set screws (photo 5). The intake and exhaust cams, differing in profile, actuate long push rods via 'Y'-shaped forks fitted with cam rollers. The third cam operates points located on a small plate fixed to the rear main shaft support pillar.

Fuel

The fuel intake side of the model is conventional; air and petrol are mixed in the carburettor via a needle valve and spring-loaded intake valve. The brass carburettor is a simple barrel type as commonly used in model boats and aeroplanes. The needle valve uses a simple domestic darning needle,

silver soldered into a knurled threaded nut.

Electrics

For the electrics I chose to use a rechargeable sealed 12V lead acid battery, readily available from many sources. The coil is a standard motor or model component and the model uses a miniature sparking plug. Ignition takes place in the cylinder when the piston reaches top dead centre.

The simple electrical circuit is shown in fig 5.

Flywheel

The 8¼ inch diameter flywheel presented me with a slight problem as it was beyond the throw of my small lathe. I therefore decided to build it up from two pieces of heavy 8-ply wood with a central steel insert. I fitted this to the engine spindle using a tapered insert of the type older model

engineers will remember being a favourite technique used by the great Edgar T. Westbury in his petrol engines. The finished flywheel has a thickness of nearly 1½ inch (obviously this is not critical) and performs its task admirably.

Tank

Finally, any suitable small container can be used for the petrol tank. I used a small jar retrieved from the kitchen for which I turned an aluminium lid on the lathe. For fuel, I decided to use conventional two-stroke petrol which has its own oil already added; this enabled me to dispense with the oiler shown in the original model.

Running the engine

Running the engines is simplicity itself. Switch on the electrics and spin the flywheel against the compression of the engine and all being well it will burst into life. If it doesn't, the reason will almost certainly lie in the positioning of the two cams that operate the long push rods and the third cam controlling the ignition spark. Fortunately, the cams can easily be adjusted as they each have individual set screws. The positioning of the intake and exhaust cams can best be established by careful study of the Atkinson cycle drawings.

The intake valve should open at the point when fuel is first admitted to the cylinder. At this moment, the piston will be deepest into the cylinder. The exhaust valve should open at the end of the power stroke when the piston starts to move forward to eject the spent gases. Finally, the ignition cam should be set to break the contacts at the moment when the piston has reached the top of the compression stroke.

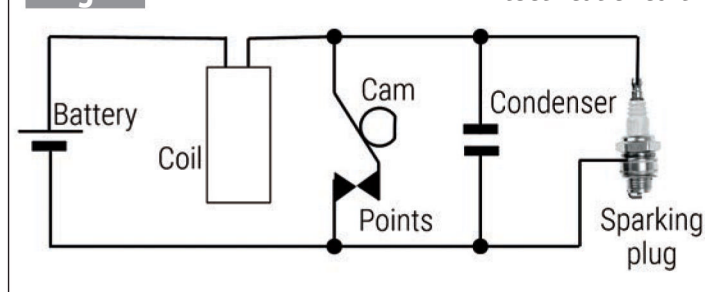
Conclusions

Building this model was a deeply rewarding exercise, not least because it is always satisfying to have a working engine at the conclusion of the one's endeavours. Moreover, its design never fails to intrigue visitors. Recently, a member of my own family commented that he had 'never before' encountered such an unusual engine. When I saw his hybrid car outside on my drive, I allowed myself a little smile.

ME

Fig 5

Electrical circuit



REFERENCES

1. *Building the Atkinson Cycle Engine* by Vincent Gregory is available from Camden Miniature Steam Services (www.camdenmin.co.uk).

An Engineer, his Book and the Owner

Sir Guilford Lindsey Molesworth PART 1

Roger Backhouse examines a Victorian volume well known to most engineers.



Surely one of those names that only a Victorian novelist could dream of, that of Sir Guilford Lindsey Molesworth is now little known. Yet in his time he was recognised as a distinguished engineer.

Born in Hampshire in 1828 he lived until 1925 and enjoyed a remarkable career. Trained at the College for Civil Engineering in Putney he worked for the London and North Western Railway, the London, Brighton and South Coast Railway and for Sir William Fairbairn. He was a President of the Institution of Civil Engineers (ICE) in 1904, advised the Government of India about railways and was consulting engineer for Ceylon Railways. Clearly a versatile



Sir Guilford Lindsey Molesworth as president of the Institution of Civil Engineers. He holds a copy of Molesworth's Pocket Book of Engineering Formulae in his left hand. Thanks to Carol Morgan, Archivist, Institution of Civil Engineers, for this photograph. Thanks to the ICE for permission to use the image.

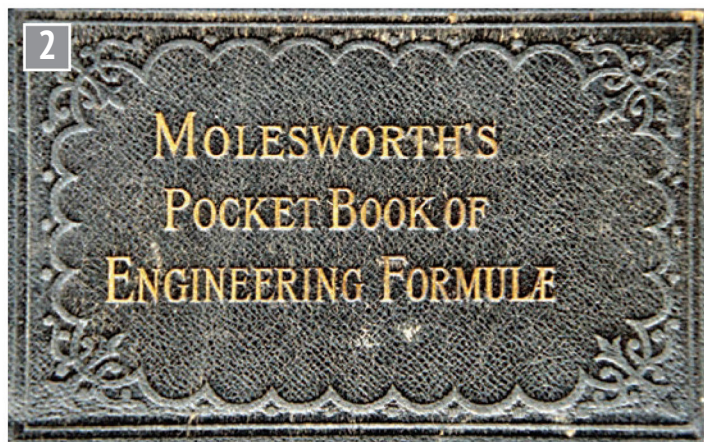
man, he also wrote books about economics, decimal currency, woodworking machinery and masonry dams.

As President of the ICE he had his portrait painted in the traditional 'debased boardroom' style (**photo 1**). The picture shows him holding a small book in his left hand, a book that helped many civil

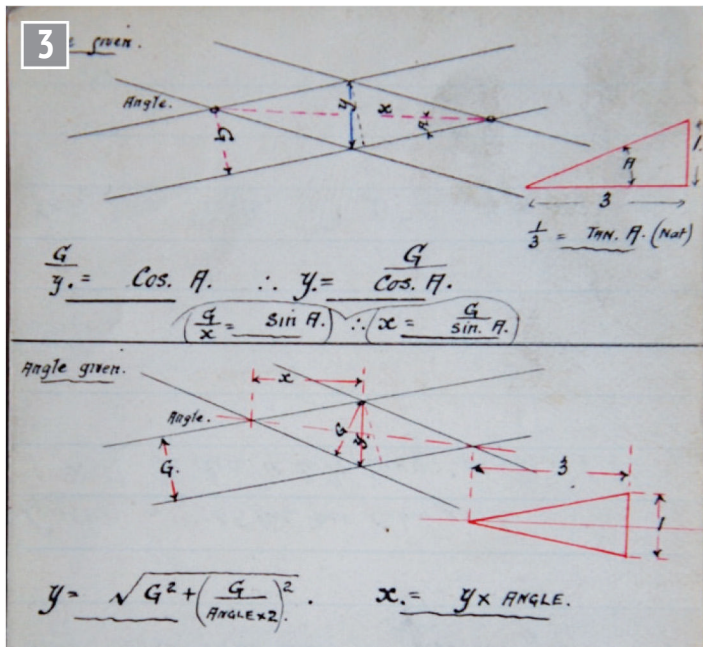
and mechanical engineers. Sadly, the ICE later sold the painting but have kindly supplied a reproduction.

A fellow SMEE member, Gareth Hughes, loaned me his copy of that book. He was given it by his sister, who knew Gareth's interest in engineering. *Molesworth's Pocket Book of Engineering Formulae* was first published in 1862 and was regularly updated to over 30 editions, later editions being produced in cooperation with his son Robert Bridges Molesworth who was an associate member of the ICE. Publishers were E. & F. N. Spon of 125, Strand, London.

It's a small book (**photo 2**). The 23rd edition, published in 1893, is not quite 'vest pocket' size but measures just 5 by 3¼ inches containing 783 pages of tiny print, perhaps just 6 points high, with adverts and some blank pages for notes on which the owner has made his



Cover of Molesworth's pocket book of engineering formulae. This is the 23rd edition published in 1893. It eventually reached over 30 editions.



Pages for notes include these neat drawings by a former owner. Probably drawn by A. J. Lander himself these may represent drawings of a tramway crossing layout.

own very neat drawings and calculations (photo 3). There is a comprehensive index.

The book is rubber stamped in several places with a former owner's name, A. J. Lander (photo 4). Thanks to detective work by the editor of the SMEE Journal, Mike Tilby, his life story has been uncovered.

Content and comparators

The content is a remarkable compilation. Neil Read, also a SMEE member and former technical editor of *Model Engineer*, says he cannot think of a book like it except perhaps *Machinery's Handbook* first published in the USA in 1914. Even that was not revised so regularly.

Another comparator could be Kempe's *Engineer's Year-Book* first published around 1895 but revised annually. That and *Machinery's Handbook* are both desktop volumes more concerned with mechanical engineering.

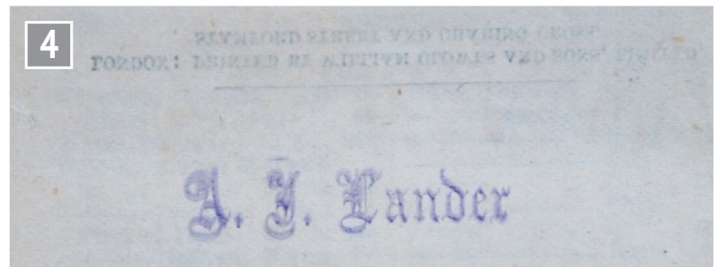
Neil says of Molesworth's pocket book, 'The amount of material covered in its pages is amazing. Armed with his Molesworth the young engineer could venture forth and irrigate India, build dockyard installations and install railways. It reflects a time when we, perhaps, had more confidence in ourselves

as a nation. It would perhaps be difficult to condense all modern technical knowledge into one small volume – particularly as it would be competing with the Internet'.

The content comprises almost any formulae that an engineer could find useful, reportedly put together from Sir Guilford's own experiences. Such a random compilation wasn't unknown to Victorians. That former mainstay of the public library, *Whitaker's Almanac* began as Joseph Whitaker's pocket book. Perhaps Sir Guilford started his book the same way.

Surveying

Molesworth starts with advice on how to carry out chain surveying of inaccessible points - for example across a river - using a 2 foot folding rule! The page is then filled with the Morse alphabet - Molesworth does not waste space and the eclectic mix is typical of the book. Readers are told how to calculate acreages and overcome obstacles when ranging and then measure heights with a sextant. If you are lost then he suggests how to determine latitude by taking the mean of the highest and lowest altitudes of any star revolving around the sun. (Really? – Ed.)



The name stamp of a former owner, now known to be Albert Jesse Lander.

ADVERTISEMENTS.

DRAWING AND SURVEYING INSTRUMENTS

OF THE VERY BEST QUALITY & FINISH.

W. H. HARLING,

Practical Manufacturer,
47 Finsbury Pavement, LONDON, E.C.
LATE OF 40 HATTON GARDEN. ESTABLISHED 1851.

CONTRACTOR TO H.M. GOVERNMENTS,
HOME AND COLONIAL.

ABNEY'S POCKET REFLECTING LEVEL, with graduated arc, for the measurement of vertical angles, in case £1 14 0

LOCKE'S POCKET REFLECTING LEVEL, in case 0 12 0

ILLUSTRATED CATALOGUE, post-free on application.

Advert for Harling's drawing and surveying instruments.

Should you have required surveying instruments W.H. Harling advertised their drawing and surveying instruments. Abney's pocket reflecting level would have set you back £1 14s but the firm assured buyers it will be of 'the very best quality and finish' (photo 5).

There is information about the average fall in temperature with height. Underground the average temperature below the surface increases by 1 degree Centigrade for every 31 metres down - but only when unaffected by volcanic disturbance.

Properties of materials

No engineering work is complete without information about strength and weight of materials including alloys of aluminium, bronze and white metal. It seems that British ironworks were not consistent in what they produced so strengths and breaking weights of their iron are compared. You can find the breaking weights for different types, whether that be iron from Dr. Price, the Butterley Company, Lord Ward's or Blaenavon, all iron works now long forgotten. Added to this are Admiralty

and Lloyds tests for steel and the budding engineer would have no excuse for not getting calculations right.

There is a table of weights per foot of bar or angle iron. Tables also show weights of different thicknesses of brass tube, the same for wrought iron and even hemp ropes plus two pages illustrating types of knot, that being contributed by H.N. Molesworth RN. You can also find information about seasoning timber and pile driving.

Civil engineering

Many pages are devoted to civil engineering related information. There are several tables for earthworks. How much material is required for a one-foot length of an earthwork 16 feet wide at base and 23 feet high? Molesworth has the answer in a table (photo 6). Should you wish to build a house a table shows how thick the walls should be for different heights of the building.

A section about tunnelling shows cross-section profiles

of various tunnels including the Hoosac, Hauenstein, Saltwood and Mont Cenis. If the tunnel heading is through calcareous schist progress might reach 274 yards a year but, if carried out by machine, 415 to 973 yards in the same time. Molesworth compares tunnelling systems and naturally finds the English system superior to the Belgian, if only for long tunnels.

Construction sites may require draining and need a pump that can cope with dirty water. The Pulsometer Engineering Company advertised their steam pump, suitable for raising muddy water. That used condensing steam to create a partial vacuum to lift water. They also offered pumping machinery 'for every possible service' and filtration machinery. After all, they ask quite reasonably, 'why pay heavy water bills?'. The Pulsometer Company had the answer with their steam pump (photo 7).

Major Allan Cunningham RE contributed pages on stresses in strengthening girders with

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EARTHWORK TABLE B.

Contents of 1 foot length in cubic feet (for lengths of 100 feet after two places of decimals).

Height in feet	Central portion. Width of Base in feet.					Contents of both Slopes.								Height in feet
	10 ft.	15 ft.	18 ft.	20 ft.	25 ft.	4 to 1.	4 to 1.	4 to 1.	1 to 1.	1 1/2 to 1.	2 to 1.	3 to 1.	4 to 1.	
1	10	18	18	20	25	39	33	25	5	75	1	1.5	2	3
2	20	32	36	40	56	60	66	1	2	3	4	6	8	12
3	30	48	54	60	84	90	99	2.25	4.5	6.75	9	13.5	18	27
4	40	64	72	80	112	120	132	4	8	12	16	24	32	48
5	50	80	90	100	140	150	165	6.25	12.5	18.75	25	37.5	50	75
6	60	96	108	120	168	180	198	9	18	27	36	54	72	108
7	70	112	126	140	196	210	231	12.25	24.5	36.75	49	73.5	98	147
8	80	128	144	160	224	240	264	16	32	48	64	96	128	192
9	90	144	162	180	252	270	297	20.25	40.5	60.75	81	121.5	162	243
10	100	160	180	200	280	300	330	25	50	75	100	150	200	300
11	110	176	198	220	308	330	363	30.25	60.5	90.75	121	181.5	242	363
12	120	192	216	240	336	360	396	36	72	108	144	216	288	432
13	130	208	234	260	364	390	429	42.25	84.5	126.75	169	253.5	338	507
14	140	224	252	280	392	420	462	49	98	147	196	294	392	584
15	150	240	270	300	420	450	495	56.25	112.5	168.75	225	337.5	450	675
16	160	256	288	320	448	480	528	64	128	192	256	384	512	768
17	170	272	306	340	476	510	561	72.25	144.5	216.75	289	433.5	578	867
Height in feet	Central portion. Width of Base in feet.					Both Slopes.								Height in feet
	10 ft.	15 ft.	18 ft.	20 ft.	25 ft.	4 to 1.	4 to 1.	4 to 1.	1 to 1.	1 1/2 to 1.	2 to 1.	3 to 1.	4 to 1.	

73

OF ENGINEERING FORMULAE.

One of many tables of useful information, a ready reckoner for the engineer in a hurry.

calculations and diagrams of bending moments. Though he doesn't give worked examples he provides plenty of formulae. For example, using Molesworth you could calculate the deflection in feet of a suspension bridge using the 'versed sine' method.

For plate and cast iron girders there's information about their strengths and qualities with figures to enable calculation of the strains on girders in truss bridges (photo 8).

Railway construction

A generous 267 pages deal with railways but perhaps Sir Guilford knew his market among railway engineers. They include the Regulations for Parliamentary Plans, requirements for railways crossing roads and Board of Trade regulations including 'a clock to be at every station and visible from the platform'. There is guidance for turnouts of unequal length in points and crossings, formulae for getting curves right and a diagram to help determine resistance due to railway curves. All potentially useful.

Cable railways were much used in Victorian Britain so there are drawings of cable tramways, their modes of construction and advice on the hauling power of a grooved drum. There is a table of well-known rack railways using the Abt rack system and for macabre interest a table of railway accidents in various countries. Sad to say Russia had the most accidents per million passengers although the UK topped the list for numbers of those killed or injured. However, if a life expired component caused an accident Molesworth has a table showing how long each might last. Crank axles could last six years and need five renewals in their life, whilst break blocks (note the spelling) would need replacing sixty times.

Engineers abroad weren't forgotten. Several tables refer to India giving standard railway

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PULSOMETER ENGINEERING CO. LD.
NINE ELMS IRON WORKS, London S.W.

THE PULSOMETER STEAM PUMP
IS ESPECIALLY SUITABLE, AMONGST OTHER PURPOSES, FOR RAISING MUDDY & GRITTY WATER, & FOR USE IN DIFFICULT OPERATIONS OF ALL KINDS.

A LARGE STOCK KEPT OF PULSOMETERS, DIRECT ACTING PUMPS, SINKING PUMPS, BOILERS, STEAM HOSE, ETC.

PUMPING MACHINERY FOR EVERY POSSIBLE SERVICE.

ALSO MANUFACTURERS OF FILTRATION MACHINERY FOR DEALING WITH THE LARGEST QUANTITIES OF DIRTY WATER For Manufacturing, Boiler Feeding, Water Works Requirements, &c.

WHY PAY HEAVY WATER BILLS
When you have a dirty supply available and can filter so cheaply?

Write for List No. 9A, post free, and if possible give particulars of work in view, when a full estimate will be forwarded of suitable pumps, boilers, pipes, &c., on sale or hire.

The Pulsometer steam pump used condensing steam to create a vacuum to pump water. Idea for use with dirty water.

8

MOLESWORTH'S POCKET-BOOK

BEAMS OF EQUAL STRENGTH throughout their length.
The section is supposed in all cases to be rectangular throughout. The beams shown in plan are of uniform depth throughout. Those shown in elevation are of uniform breadth throughout.
B = Breadth of beam. D = Depth of beam.

Fixed at one end, loaded at the other; curve parabola, vertex at loaded end; B D² proportional to distance from loaded end.

Fixed at one end, loaded at the other; triangle, apex at loaded end; B D² proportional to the distance from the loaded end.

Fixed at one end; load distributed; triangle, apex at unsupported end; B D² proportional to square of distance from unsupported end.

Fixed at one end; load distributed; curves two parabolas, vertex touching each other at unsupported end; B D² proportional to distance from unsupported end.

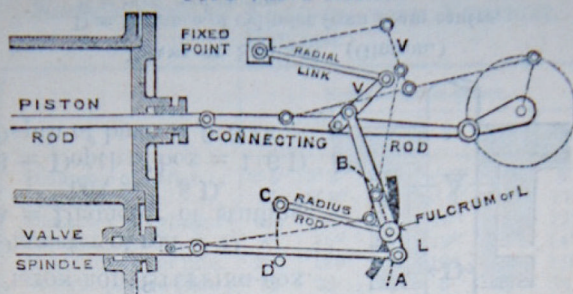
Supported at both ends; load at any one point; two parabolas, vertices at the points of support, bases at point loaded; B D² proportional to distance from the nearest point of support.

Supported at both ends; load distributed; curves two parabolas, vertices at the middle of the beam; bases centre line of beam; B D² proportional to product of distances from points of support.

Supported at both ends; load distributed; curve semi-ellipse; B D² proportional to the product of the distances from the points of support.

Drawings to illustrate the stress on beams. Highly useful for the civil or structural engineer.

JOY'S VALVE MOTION.



The essential features of the motion are a vibrating link V to which motion is given by a point in the connecting rod; and a lever L, one end of which is moved by a point in V, and the other end is connected with the slide-valve, whilst its fulcrum is forced by a radius-rod to travel through a curved path. The reversing is effected by moving the end of the radius-rod from C to D so as to alter the curved path of the fulcrum to the dotted line A B.

A movable slotted link may be substituted for the radius-rod.

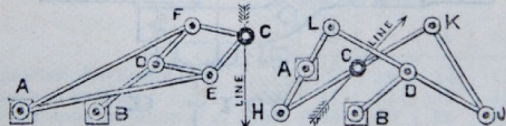
The dotted lines show another position of the motion.

PEAUCELLIER PARALLEL MOTION.

The distance apart of the fixed points A and B must always be the length of the spare link BD; C is the point that moves in a straight line; $DE = FC = DF = EC$; $AF = AE$; $HL = JK$; $KH = LJ$; $HA = \frac{1}{2}HL$; $JD = \frac{1}{2}JL$; $HC = \frac{1}{2}HK$.

PEAUCELLIER'S.

HART'S MODIFICATION.



Though Hart's modification has fewer links it has more joints than Peaucellier's.

Joy valve gear and Peaucellier's parallel motion are illustrated, but not Walschaert's valve gear.

dimensions for 5 feet 6 inches and metre gauge railways. Although not evident from the book Sir Guilford was not keen on narrow gauge railways and preferred to engineer a wider track wherever possible as he did for the Ceylon Government Railway from Colombo to the mountains at Kandy. Tables give Indian weights and measures, by no means then standard across the sub-continent. They also offer conversion rates of sterling to rupees and annas.

There is little on metric conversions but for that the reader is referred to Molesworth's metrical tables. 'which is uniform with and may be bound up with this book'.

Locomotive valve gears are not neglected. There is information about Joy's valve gear but puzzlingly not Stephenson's or Walschaert's in this edition. However, Molesworth offers Peaucellier's

parallel motion with Hart's modification (photo 9).

In sixteen pages about locomotives a table relates diameters of driving wheels to the piston stroke and speed of the piston. For example, at 60mph a three foot diameter driving wheel with a 26 inch stroke piston will traverse 2427 feet per minute. A locomotive with three foot wheels driven at that speed would be quite a sight!

Several pages of tables give key dimensions of various types of locomotive claimed to be drawn from 'actual practice'. There is similar information for marine engines.

Other power

Gas engines are mentioned as are 'petroleum or oil' engines but older forms of power are not forgotten with pages about waterwheels and 'floating mills'. Diagrams of water turbines show various

ALFRED WILLIAMS & CO.

Alfred Williams advertised their tube wells and windmills for pumping water.

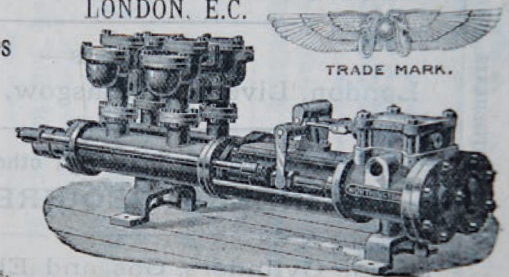
WORTHINGTON PUMPING ENGINE CO.,

153 QUEEN VICTORIA ST.,
LONDON, E.C.

WORTHINGTON

WORTHINGTON PUMPS
FOR ALL SERVICES.

Admiralty Pumps.
Fire Pumps.
Mine Pumps.
Ballast Pumps.
Pressure Pumps.
Boiler Feed Pumps.
Brewery Pumps.
Ammonia Pumps.
Independent Condensers.



NEW DESIGNS FOR ALL PATTERNS TO SUIT HIGH STEAM PRESSURES.
CATALOGUES AND ESTIMATES ON APPLICATION.

11

Not to be outdone Worthington Pumping Engines also advertised.

Armed with his Molesworth the young engineer could venture forth and irrigate India, build dockyard installations and install railways. It reflects a time when we, perhaps, had more confidence in ourselves as a nation.

types including the 'high fall' Girard turbine but not the Pelton Wheel.

Advice on windmills includes rules for the angle of sails and a design for a small Pantanemone windmill with two semi-circular sails at right angles and stayed to each other, said to be useful where it is difficult to arrange for change of position with varying winds. Alfred Williams advertised tube wells and windmills (photo 10). Molesworth then offers advice

on effective fans and 'the efflux of air from orifices'.

Several other manufacturers offer pumps including the Worthington Pumping Engine Co. (photo 11).

Roads and hydraulics

Roads are not forgotten. The 'specific' for asphalt is given as 'almost pure limestone impregnated with bitumen' so no great surprise there.

There is much detail on hydraulic calculations, clearly intended for the young man

➤

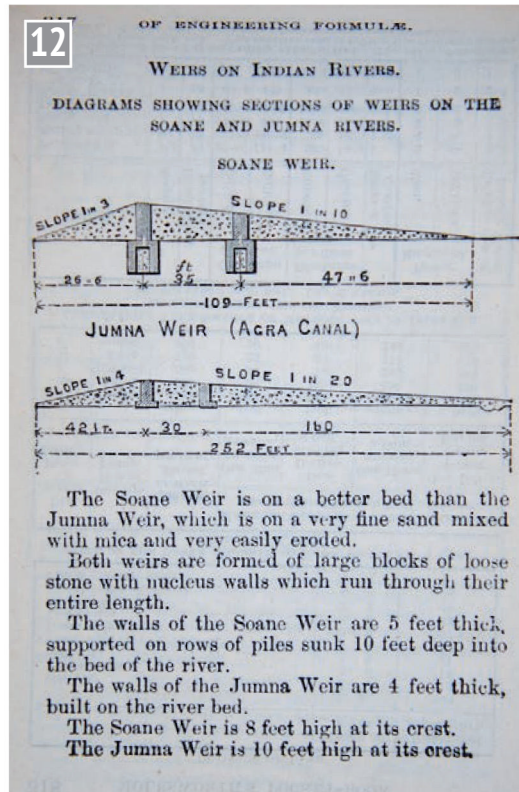
who might be expected to dam the Indus or irrigate Sudan (photo 12). Calculations and tables list the velocity of water under different pressure heads, discharge from orifices and proportions of nozzles, friction in pipes, capacity of different size pipes, rise of water caused by rivers with a clear overfall or a drowned weir and the flow of water in sewers. If that's not enough, pages advise on how to construct a reservoir and how big water mains should be, and for seashore works there is advice on how to construct a breakwater.

Physics

There's plenty of physics in Molesworth, starting with the statement of Boyle's Law. Apparently, it is also known as Marlotte's Law - something new to me. You can find out how to calculate gravity and Molesworth shows how to calculate the centre of gravity for various shapes. Following that is how to calculate a moment of inertia and a centre of gyration. There are calculations of what happens when bodies collide, wide ranging and potentially useful, presented in a concise manner.

Lighting isn't forgotten. Who now knows of Carcel lamps burning Colza (rape seed) oil? The book shows how much light should be created and also how much light a cubic foot of gas will provide. Should you wish to make gas there are specifications for retorts, details of the pressure needed and laying pipes together with information about gas flow in them. Gas for lighting needed purification so we read that for a wet purifier one bushel of lime mixed with forty-eight bushels of water will purify 10,000 cubic feet of gas. Dry purification needed one bushel of lime for 10,000 cubic feet of gas.

Electric light is scarcely mentioned but the book includes adverts for Hindley's high speed engines for electric lighting (photo 13). These high-speed engines preceded the introduction of steam turbines for electricity generation.



Hydraulic engineering forms a substantial part of the book. Maybe the engineer was expected to turn his hand to anything.

There is much detail on hydraulic calculations, clearly intended for the young man who might be expected to dam the Indus or irrigate Sudan.

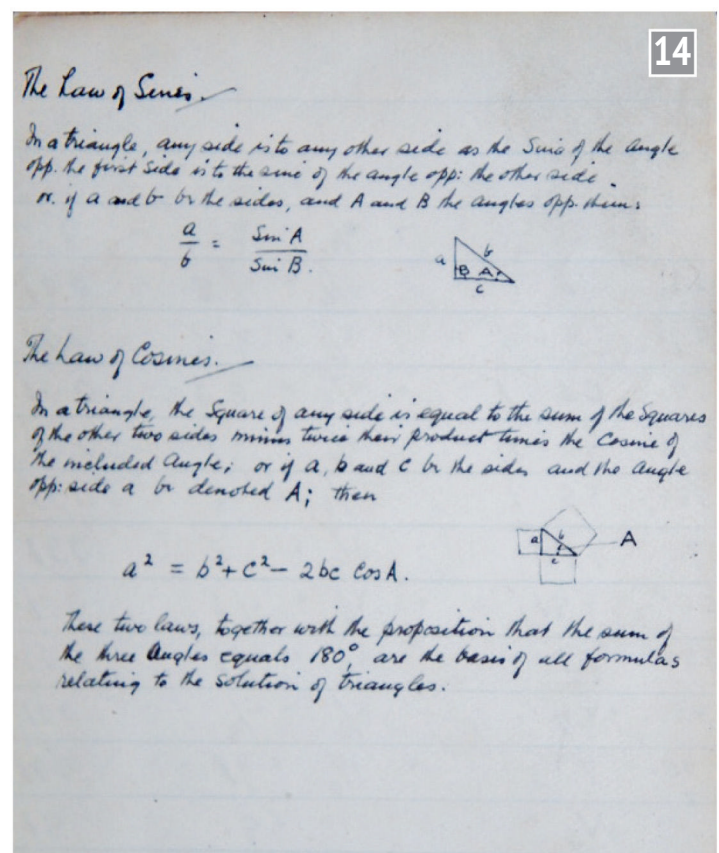
Mathematics

There is no shortage of mathematical information in Molesworth with hyperbolic log tables plus tables of squares, cubes, reciprocals and trigonometric functions including the 'values of the trigonometric ratio'. In case the reader has forgotten, there are instructions on how to use a slide rule.

To these A.J. Lander has added in his neat handwriting the law of sines and cosines (photo 14) adding to the demonstration of sines and cosines in oblique-angled spherical triangles in the book that must have been useful to someone, somewhere. Had



High speed steam engines like these preceded the use of steam turbines for electricity generation.



The law of sines and cosines as written out by A.J. Lander.

the owner wished to do so he could have learned how to construct an ellipse or a hyperbola from this book.

●To be continued.



HMS York, a Type 42 destroyer built by John Elliot and winner of Class 10.



The steam yacht Gondola built by John Hollis.

Midlands Model Engineering Exhibition Competitions PART 2

John Arrowsmith reports on the competition classes at the Midlands show.



Class 10: Marine Models – Scale (over 50% scratch built)

Another good entry here with some excellent models, with John Elliot receiving the First Prize and the Marine Challenge Cup for his splendid example of a Type 42 destroyer, *HMS York* (photo 24). In Second place was the steam yacht

Gondola in 1:18 scale built by John Hollis (photo 25). A Third Prize in this class went to Anthony Judd for his large model in 1/42th scale of a sailing ketch *Ashmead* (photo 26) and Steve Briancourt was Commended for his 1:100th scale model of USS battleship *Missouri* built with Meccano (photo 27).

Class 11: Marine Models – Kit (standard or modified)

There were no entries in this class.

Class 12: Horse Drawn Vehicles

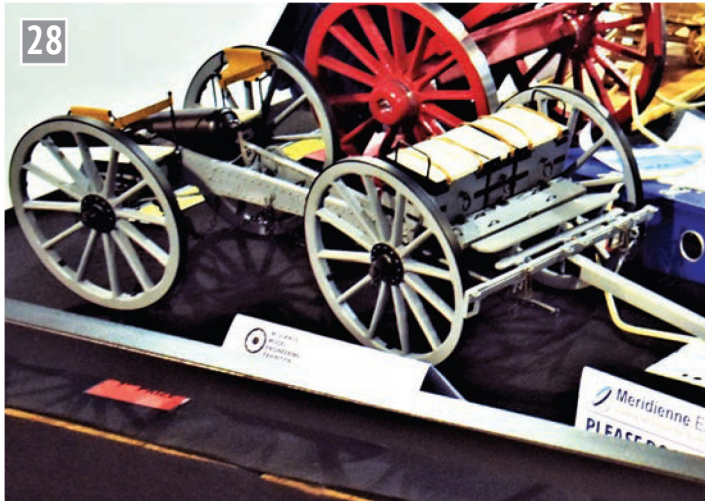
A small collection of entries here with Stuart Bell being awarded First Prize and the Lenham Pottery Trophy with



A fine sailing ketch by Anthony Judd in 1/42th scale.



Battleship USS Missouri built in Meccano by Steve Briancourt.



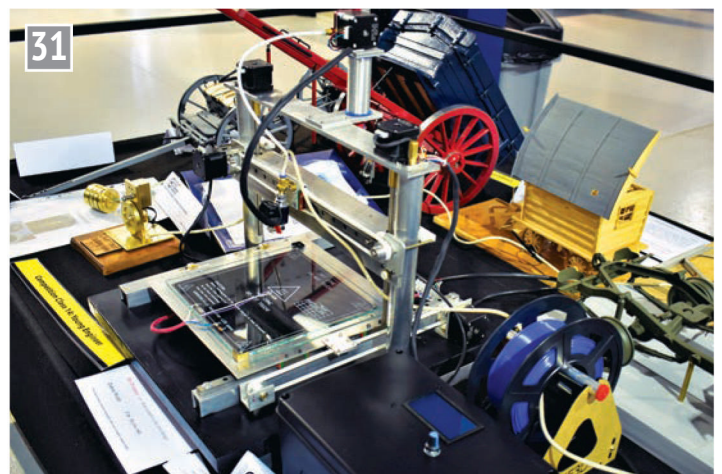
A 16 pounder rifled muzzle loading cannon and limber by Stuart Ball.



The $\frac{1}{6}$ th scale farm tip cart by Eric Keggans.



Terence Orton's Blackburn 'Iris III' three engine biplane flying boat.



16-year old Zahra Webb built this 3D printer from scratch.



Matthew Kennington's $7\frac{1}{4}$ inch gauge driving tender.

his 16 pounder rifled muzzle loading cannon and limber wagon, which was well made and finished (**photo 28**). A Third Prize was given to Dr Patrick Hendra for his gipsy caravan. Eric Keggans was Commended for his $\frac{1}{6}$ th scale farm tip cart (**photo 29**).

Class 13: Scale Aircraft Models

There was just the one entry in this class, with Terence Orton being Very Highly Commended for his Blackburn 'Iris III' three engine biplane flying boat, an unusual prototype but very well made (**photo 30**).

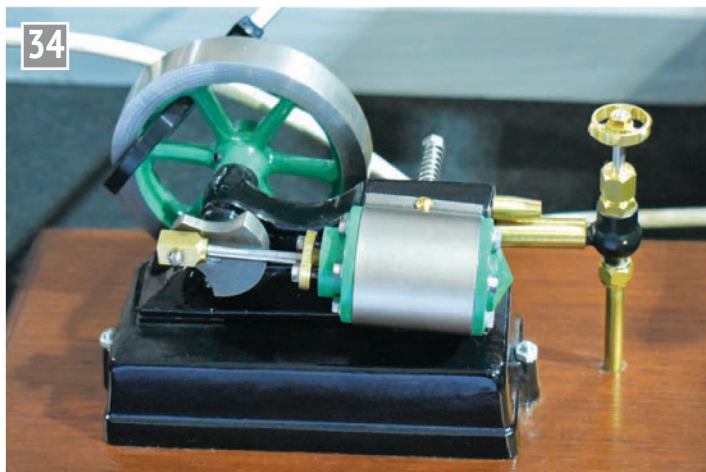


A interesting combination lock built by 17-year old James Knight.

Class 14: Young Engineers Award (under 20 years old)

There were some excellent presentations from some talented young people in this class with the First Prize and the Stuarts Model Shield being awarded to 16-year old Zahra Webb for her scratch built 3D printing machine (**photo 31**). This was no mean feat for a

16-year old. In Second Place was 17-year old Matthew Kennington with his $7\frac{1}{4}$ inch gauge driver's tender (**photo 32**), a well made and useful piece of work. The Third Prize was awarded to James Knight for an innovative combination lock (**photo 33**). Three awards were presented to two other young engineers,



Young Engineer Luke Mason built this Stuart Progress oscillating engine.

Luke Mason receiving Highly Commended certificates for his Stuart Progress oscillating engine (**photo 34**) and for his machinist's hammer while 12-year old Ollie Powell was commended for his simple oscillating engine.

Class 15: Miscellaneous

There was a good selection of different models in this class with seven awards being presented. In First place was one of the stars of the show in the shape of the 1:3.5 scale model of a BSA DBD34 Gold Star motorcycle (**photo 35**). Built by John Luscott it attracted a great deal of attention and fully deserved its First Prize. In Second place Brian Swann's little 1913 Mercer35J Raceabout in $\frac{1}{8}$ th scale was another fine model (**photo 36**). In Third place John Clarke's little model of a foghorn on the deck of an early lightship with accompanying carronade was a super model and the foghorn worked as



The superb BSA DBD34 Gold Star motorcycle by John Luscott.



The Brian Swann model of a 1913 Mercer 35J Raceabout.

well (**photo 37**). Two models in a variety of different woods were the work of George King. A Fowler 'Superba' ploughing engine and a $\frac{1}{8}$ th scale Fowler anti-balance plough (**photos 38 and 39**) were fascinating pieces of work and both were Very Highly Commended. Two Highly Commended certificates were presented to Eric Keggans for his $\frac{1}{8}$ th scale scratch built Ford GPW chassis and component

pressings (**photo 40**) and to Brian Swann for a 1912 Roll Royce Silver Ghost (**photo 41**).

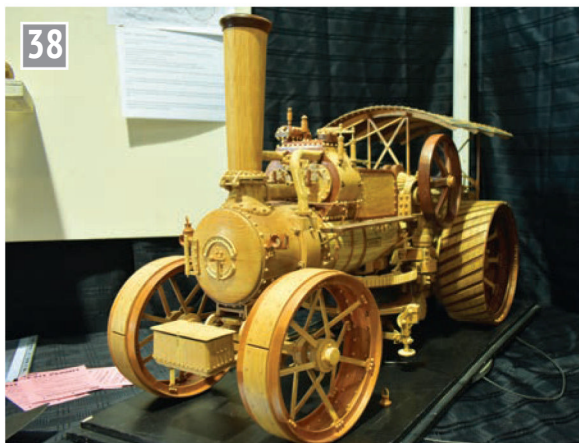
Class: 16 Hot Air Engines

There was just the one entry in this class from a young man who won Class 14 a couple or so years ago. This year Daniel Bell entered his self-designed and made Stirling engine which gained him a Highly Commended certificate (**photo 42**).



John Clarke's foghorn on the deck of an early lightship and accompanying carronade.

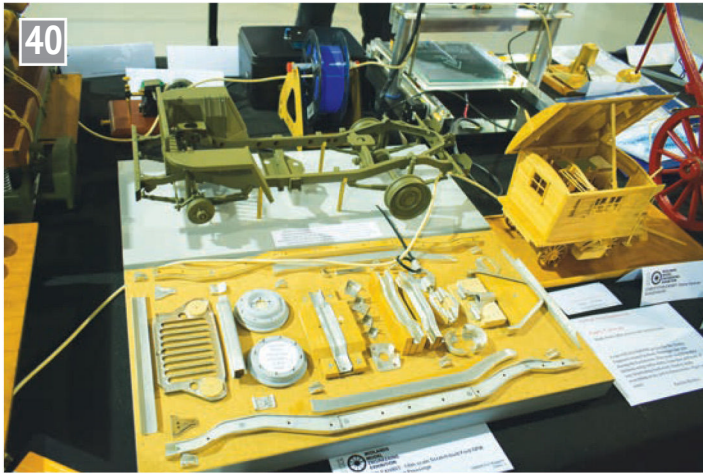
That just about sums up the excellent competition part of the Midlands show, but of course there were a couple of other presentations to be made. The first one was the presentation of the new



A wooden Fowler 'Superba' traction engine by George King.



The anti-balance plough in $\frac{1}{8}$ th scale by George King.

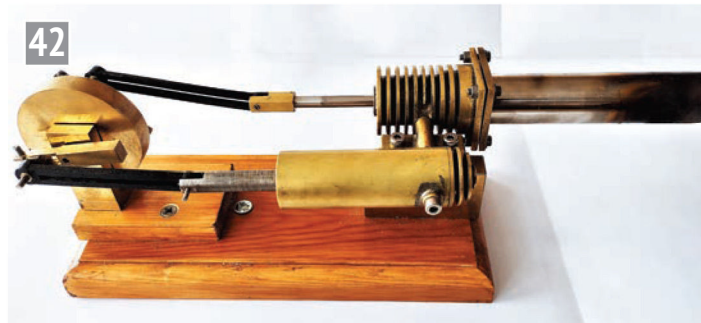


A 1/6th scale scratch built Ford GPW chassis and component pressings.



The 1912 Rolls Royce Silver Ghost by Brian Swann.

There were some excellent presentations from some talented young people with the First Prize and the Stuarts Model Shield being awarded to 16-year old Zahra Webb for her scratch built 3D printing machine. This was no mean feat for a 16-year old.



The self-designed and built hot air engine by Daniel Bell.



Winner of the Chris Deith Memorial Trophy, Mike Tull with Bob Moore.



10-year old Wilf Haynes with his 4 inch scale Burrell who won the Len Crane Trophy.



10-year old Will Haynes receives the Len Crane Trophy from Bob Moore.

Chris Deith Memorial Trophy presented for the best in show model as decided by the panel of judges. It was a unanimous verdict that the first winner of this new trophy should be Mike Tull for his 9 cylinder radial engine and he was duly presented with the trophy by Bob Moore, the chief judge (photo 43). Two other presentations were made to members of the Fosse Way Steamers who had entertained all the visitors outside with their traction engines.

The Len Crane Trophy for the best working engine, decided by the main judges, went to 10-year old Will Haynes for a 4 inch scale Burrell (photos 44 and

45). The prize for the best engine management, which is decided by the Steamers themselves over the period of the show, went to Anthony Batting with his 4 inch scale Foster (photo 46).

Finally, I would like to thank all the staff at the exhibition and all the club stands holders and traders who made the effort to attend, for their hard work and presentations. It all made for an excellent atmosphere through the whole weekend.



Anthony Batting with his 4 inch Foster agricultural engine.

1



The train.

Gerald Martyn shares his experiences of building 5 inch gauge wagons for the LSWR.



Building some PART 1 LSWR Wagons

Introduction

Regular readers may recall my previous article (M.E. Vol 224, 4637-4640, April-June 2020) about my adventures with bronze casting at home. Whilst not the main driver for my venture into castings, my illustrations then were mostly from a later project to build a batch of 5 inch gauge wagons. This current article will tell some of the wagon story and provide some outline design drawings to try and interest you in making your own.

Wagons are basic railway vehicles with lineage going back to the earliest horse-drawn wagon-way but which, by the late 19th century, were built to a baseline common requirement with many variations to suit the owning railway.

Why build wagons? Don't they look a bit silly with a gigantic driver between the locomotive and the train? One thing for sure; when I take them to the track cameras and phones seem to materialise in people's hands so they must be interesting/different/fun, or all of these. Like many of us I have an urge to be creative and simply enjoy making

things. If they work then that's even better. For someone who enjoys the building side of our hobby then wagons have the distinct advantage that they're not subject to the tyranny of a boiler certificate and constant re-testing. I already had a couple and I fancied some more to give a decent train length. Wagons are also fairly simple and quick to build and if timber-framed, as mine are, provide a bit of relaxation from the rigour of engineering tolerances and finish. Whoever saw a shiny and polished freight wagon? A few rough surfaces and dings and dents are entirely correct. Of course, all wagons were new once and were regularly serviced and repainted but, as workaday vehicles were, even then, not given the very best finish. As mentioned, this was my second go at them. Previously I've built one wagon and a brake van. Without the brake van at the back then, you can, of course, pull your wagon - at least on our type of railway - but the train looks incomplete! The present full set are shown in **photo 1**. The parts that were cast in my latest batch were fabricated in the

previous, so there are different ways of doing things and no insuperable problems.

The focus of this series will be on the wagons but the basics are similar for a brake van too; it's just a bigger wagon with a shed on top and extra brakes, really, so I'll give some details of that towards the end. My original intention was to provide a full 'how to' article with all the drawings, but my attempt at this ground to a halt. The build was complete so a lot was forgotten, but also, how many readers would really be interested in a wagon from the 19th century for a railway not many have locomotives for? This new attempt takes a more general view. Pre-nationalisation wagons were built to a standard requirement so they could run across the whole network, but there are many detail differences both between railway companies and even between batches for the same railway. So, many of the parts look pretty much the same and the overall sizes will be similar, but the starting point for any wagon model with leanings towards being a representation of the real

world should be a photograph or drawing of the one you want.

In my previous article I declared a modelling allegiance to the LSWR set in the late 19th century period. Apart from the fact that the LSWR was a pretty good railway and well worth a look, this is an escape from the uniformity of that other west-country railway outfit whose locomotives have nearly all been modelled and re-modelled in the past. Timber-frame wagons were normal at that time and were still being built well into the 20th century for an assortment of railways. Thousands of wagons were built to the same nominal dimensions and variants with steel or timber frames were visually similar and interchangeable in use. Many timber-framed ones would survive through grouping and into and beyond nationalisation. In the early days of railways, wagons had no brakes and parking was facilitated by chocking or putting a sprag-bar through the wheel spokes. When running long trains multiple brake vans interspersed through the train would be used. On the LSWR some early wagon brake systems were 'single-sided'



The wagon.

with the brake lever on one side of the wagon and the brake shoes on the opposite. This is a simplification that I've used in my designs. The prime design presented will be for a 5-plank 10-ton load wagon (photo 2), but many of the parts can be considered common across a whole range of vehicles.

The wagon in photo 2 has raised ends and a lengthwise drop-down support beam. Wagon covers or tarpaulins, commonly called sheets, were often used to keep the load clean and dry. The beam gave support to the sheet and the raised ends both support

and provide some shielding, making a sort of mobile tent. The design can be made with or without this support; just leave it off and don't add the raised ends if that's what is wanted.

I must also mention private owner wagons, many, many thousands of which were pulled around on the big railway, delivering loads for the wagon owner. These followed the same basic layout as the big railway companies and had to be made to the same outline standard, so can be created as a variant too. Every train should have at least one, with your own name on of

course, and who will dare say it's not correct? Such wagons may be the last bastion of freedom of expression in 5 inch gauge models as super-scale seems to be taking over everywhere these days. This article is based around a batch of three wagons, two 'scale' LSWR 5-plank opens and a private owner 5-plank for the builder. Photographs may be of any of these, for fun and to use the best illustration of the feature, but the drawings will be essentially LSWR.

●To be continued.

Club Diary

4 December 2022 - 18 January 2023

December

4 North Wilts MES

Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

10 York Model Engineers

Evening Talk – 7pm. See www.yorkmodelengineers.co.uk

11 Bradford MES

Santa Comes to Northcliff 2022. Northcliff Railway 11:00 – 15:00. Contact: Russ Coppin, 07815 048999

11 Guildford MES

SMSEG Open Meeting, Stoke Park, Guildford 14:00 – 17:00. See www.gmes.org.uk

11 North Wilts MES

Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

18 North Wilts MES

Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

21 Bristol SMEE

ZOOM Meeting – Look back at the year, 19 :30. Contact: secretary@bristolmodelengineers.co.uk

25 North Wilts MES

Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

27 Bradford MES

Mince Pie Steam-Up 2022, Northcliff Railway 12:30. Contact: Russ Coppin, 07815 048999

January 2023

4 Bristol SMEE

Talk : 'The Camerton Line', Begbrook Social Club 19 :30. BS16 1HY. Contact: secretary@bristolmodelengineers.co.uk

18 Bristol SMEE

Small, non-locomotive engines evening, Begbrook Social Club 19 :30. BS16 1HY. Contact: secretary@bristolmodelengineers.co.uk

Peter Seymour-Howell

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



Continued from p.677
M.E. 4704, 18 November 2022

PART 48 – VALVE SPINDLES, BOBBINS AND CROSSHEADS



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge



1. Here is one of the glands machined.

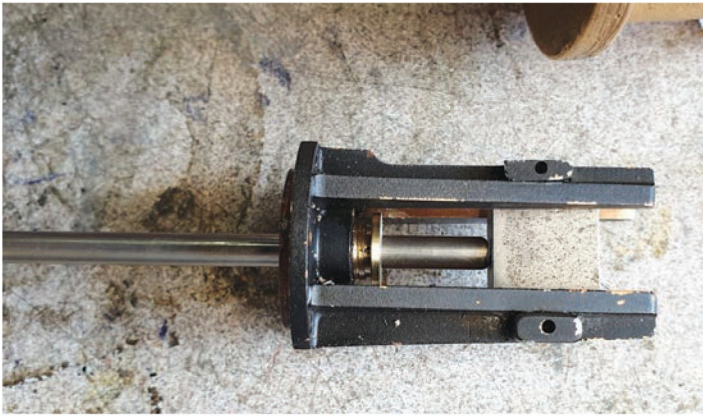
2. And here before parting off fully I have test fitted the valve guide to check that it screws in fully so that the gland can be accessed through the access slots and also that it isn't sitting too proud as the moving parts get fairly close here.

Valve glands

The glands begin life as $\frac{7}{16}$ inch diameter brass bar, reduced to $\frac{5}{16}$ inch for the thread to fit the guides, and a narrow flange

that needs to be castellated. I will be fitting 'O' rings and took the time to test fit each gland before parting off.





3. As each gland was made it was fitted to its valve guide and checked that it was running true. Here I have inserted a length of the $\frac{3}{16}$ stainless steel to ensure that the action is smooth.

Valve crossheads

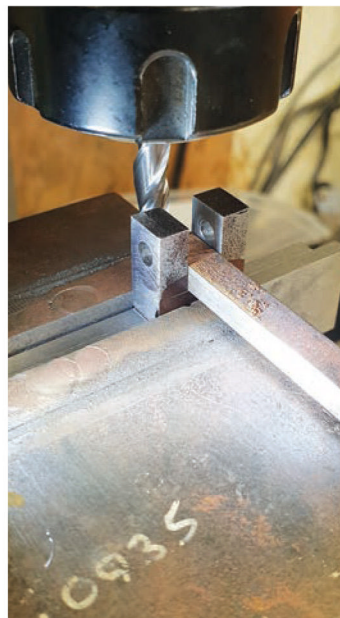
There are five crossheads to make. The outer cylinders have crossheads at both ends, one to connect to the combination lever and the other to connect to the valve connecting link. The middle cylinder, of course, is not connected to the valve gear as its motion is derived from the others through the conjugating gear.

The first job was to machine the blanks ready for the cross-heads. Once I was happy with them I lapped each to its allotted valve guide to ensure smooth operating. Having

machined the crosshead blanks it was then on to the more involved parts of the design. First, I clocked one of the crossheads upright in the machine vice; as the two types are the same width, they could all be quickly machined from this register. After first drilling/reaming the various sized holes on this axis I began with the three crossheads which connect to the valve connecting links on the 2:1 lever. These require a slot for the valve links to slide into, followed with a cross drilled hole to hold the link pin and



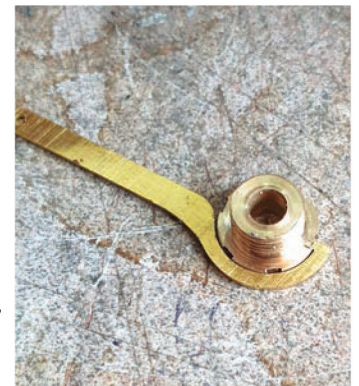
6. Having drilled a row of three holes, I machined an undersized slot using a 3mm cutter. This completed the roughing out stage and the slot is undersized on both axes. Alas I forgot to take a picture of the slot at finished size - it can be seen in later photo's though.



7. Before moving on from this register I tackled the $\frac{1}{4}$ inch slot for the combination lever to fit into. I used a 6 mm cutter down the centre and then widened the slot until a length of $\frac{1}{4}$ inch steel was a sliding fit. Note also that I have cross-drilled the holes to hold the combination pin.



4. Once happy with the gland fits, each in turn had its slots machined on the rotary table.



5. It then occurred to me that these gland nuts may be close to the castellated nut size that fits to the ejector elbow on the smokebox. Adam (Cro Fittings) had drawn up a 'C' spanner to fit these nuts for me and as luck has it this fits the glands too.



8. I then re-clocked to give me a register for the width of the cross-heads to enable drilling on the other axis. First hole seen here is the hole for the link pins, drilled in steps and reamed to finish. I then drilled all five crossheads for their taper pins.



9. To complete the three conjugating lever cross-heads I had one job left to do and that was to add to both top and bottom of the cross-heads. This was simple turning. I decided to use a retainer to bond the parts rather than applying heat and using solder.

also a tapered hole to connect to the spindle. I tackled these later, not wanting to lose my register for now.

Valve spindles

The spindles are really just plain turning jobs but being in stainless and of such a long narrow length I thought it best to show how I made them in a little more detail.

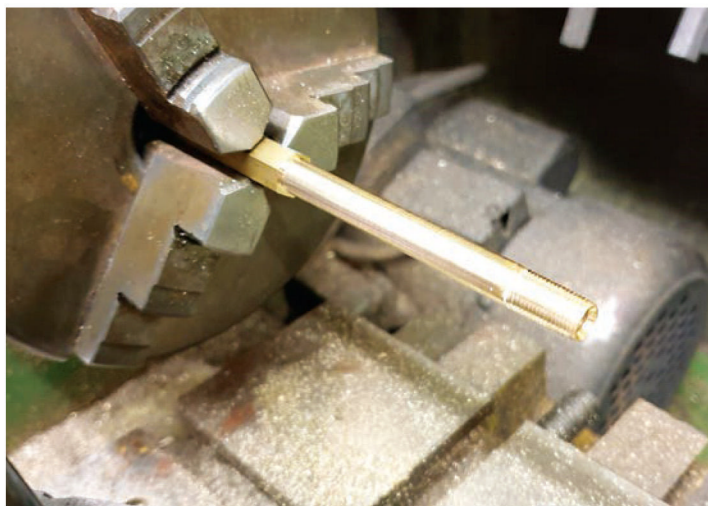
We start with some lengths of $\frac{3}{16}$ inch diameter stainless steel. The length shown on Don's drawing is overlength. At first I was going to make them to their proper length which can be worked out as Don gives the dimension

between the two crosshead inner edges. I know that the crossheads are accurately made and that the various centres are spot on but I was advised it was best to leave them overlength for now until the other parts of the motion are made. So for now, they are overlength at about $5\frac{3}{4}$ inches long. If all works out well, I'll need to remove $\frac{5}{64}$ inch from each end on final assembly.

The first job is to set the bar up between centres and turn the reduced end of the spindle. A long $\frac{3}{16}$ inch x 40 tpi thread is then cut on the spindle after the reduced length.



12. My lathe isn't really suitable for thread cutting so I needed to use the tailstock die holder which could not be done in one go as the die holder shaft wasn't hollow and nor was it long enough. I therefore cut the thread until the holder reached the end of the shaft, removed the holder shaft from the tailstock, refitted the live centre and placed it back in contact with the end of the spindle. I found that this worked well if brave enough to cut the thread under power. The picture shows the holder still on its support shaft before replacing with the live centre.

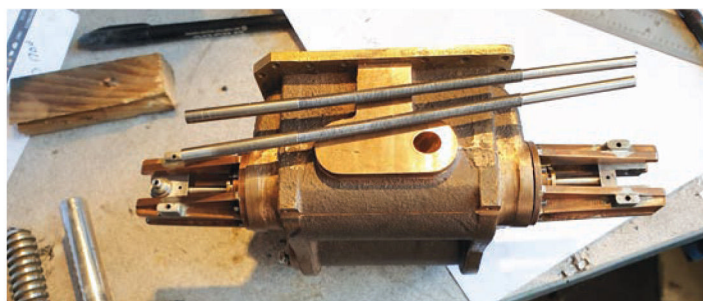


14. I now moved onto the valve bobbin following Jim Ewins's design - the clever bit is the long bolt that the bobbin slides over. I made mine from $\frac{3}{8}$ inch brass hexagon bar. First, I centre drilled what is the front end and drilled a 4.1 mm hole, and this was opened up to 5 mm to clear the $\frac{3}{16}$ inch spindle. The 5 mm section is only drilled approximately $2\frac{1}{2}$ inches into the hex bar. With the hole drilled, I then pulled the bar out far enough to machine and part off at just over 3 inch. I then needed to turn down most of the hex to $\frac{5}{16}$ inch and cut the thread on the end.



LEFT: 10. Here is the combination lever cross-head in position.

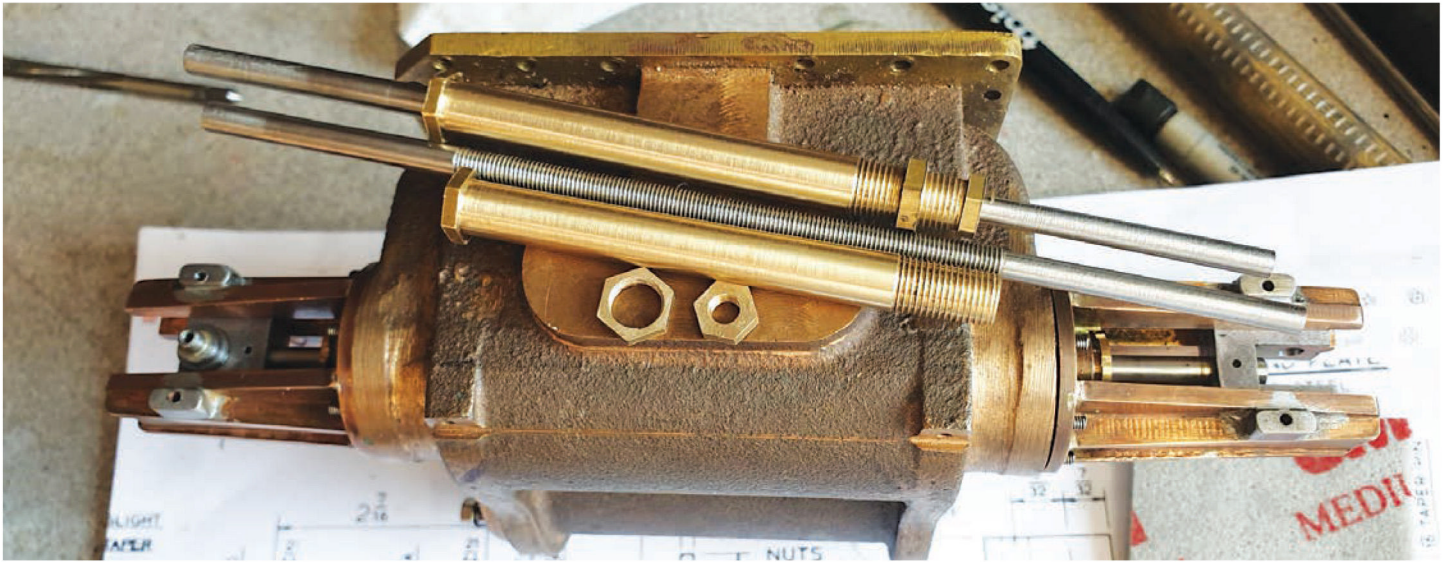
RIGHT: 11. At the other end is the valve connecting link cross-head. I have fitted its pin to show how the oil-way works. Simply add oil to the top of the pin and gravity will feed it out onto the link bronze bush below.



13. With the spindles finished for now, I checked one in a steam chest with covers fitted and crossheads slide on. The spindles will most certainly need shortening and it's so tempting to do so now but I'll follow the advice given and leave until the other parts are made. The picture shows two of the spindles sitting on top of a cylinder with the third spindle placed inside and engaged with the crossheads.



15. I then parted the bolt off and reversed it in the three-jaw chuck. With the bolt reversed I finished drilling the 4.1 mm hole to then be tapped $\frac{3}{16}$ inch x 40 tpi which is the other end of Jim's clever design in allowing the valve to be adjusted from one end.



16. Then there were two other parts to make, those being three of each size nuts, one size from $\frac{3}{16}$ inch hex, drilled and tapped $\frac{5}{16}$ inch x 32 tpi to fit the bolt, and the other from $\frac{5}{16}$ inch hex, drilled and tapped $\frac{3}{16}$ inch x 40 tpi to lock the bobbin bolt to the spindle. The picture shows all three made - one is in the steam chest, one complete and the other to show the parts involved.



LEFT: 17. First job to do to the bronze bar was to drill the centre and tap for the bobbin end. RIGHT: 18. I then turned down the end for the Fluorosint ring to fit on when machined. The length of the journal here is slightly longer than the slip gauge made.



19. And now the first use of the gauge. Here it was used both as a plug for the outside diameter of the journal and also as a gauge for the length of the journal. With the gauge slipped onto the journal I reduced the length until nearly hitting the gauge, stopped, moved the tool up to touch the gauge, removed the gauge and then cut the journal. The picture shows the gauge/plug sitting over the journal.

Valve bobbins

For those not familiar with these things and putting aside the various modern materials used these days, the normal practice when making valves, and which certainly is the case for Don Young's 'Doncaster' drawings, is to have a solid

bobbin (bronze or cast iron depending on the material chosen for the cylinders) which has the spindle through its centre and is held in position with two nuts either side of the bobbin. This of course means that to fine tune the valve, both covers need removing and

the four nuts loosened and retightened when the bobbin is in its correct position. This is a lot of work and the more complicated the model the more work that is involved. Jim Ewins's design allows the bobbin to be adjusted by removing just one cover and

20. Next, I pulled the bar out further, noted the critical dimensions, that is the gap between the two bushes and the length of the bobbin (outer port edges), and then machined the middle section using a profile tool. The picture shows the first stage of doing this ready to machine the other end. I have taken the profile tool up close to the first end - this is to help with the steam/exhaust flow when the ports open/close. I then pulled the bar out further still, noted the length required for the bobbin (port outer edge dimension) and made a start on the second journal, leaving it both overlength and over-sized on outside diameter, and then parted off.



21. I then needed to finish the other side, that is cut the thread and machine the journal to size. Before doing this, I turned up two threaded lengths of silver steel, threaded one end to match the bobbin and deeply centre drilled the other. For the stage seen in this picture one of these was threaded into the first journal so that I could grip the journal without risking damage to it. I still played safe though and took things very slowly.



22. Once I had tapped the second journal, I fitted the other stub and could now hold the bobbin securely between centres. Firstly, I reduced the outside diameter of the journal for the plug to fit, pushed the plug onto the journal and began machining to length. As with the first side I did the finish cut by touching the tool up against the gauge with the lathe off. After removing the gauge I advanced the tool another thou to give me the tight fit.

loosening nuts at one end. There are a variety of designs out there from fellow model engineers based on this but adapted/changed to suit their own needs/ideas. I have done likewise and mine is probably much closer to John Baguley's version. I know that others have done something similar too.

My bobbin carriers are made from bronze and begin life as a 13 inch length of $\frac{3}{4}$ inch bar. I first turned down the

entire length of the bar to the liner inside diameter and this gave me a constant length to make all three bobbins and the six 'top hats' at their ends. I'll be using Fluorosint for the rings which is much harder than other plastics with little expansion, with a similar expansion rate to bronze.

Before I started I made a slip gauge to match the size of the rings.

●To be continued.



26. After all that work I had three bobbin carriers on their adjustable bolts and sitting on their spindles and here's a picture of one of them awaiting the Fluorosint rings.



27. The last task was to machine the six Fluorosint rings.



23. The last thing to do here was to further machine the middle section and take the cut up closer to the other journal and also check for concentricity. My reasoning here is that the bobbin's concentricity relies on the 'top hats' when fitted so the spindle should only touch the top hats, not the bobbin carrier itself. The top hats will be what floats on the centre bolt which sits on the spindle and will be made to allow the bobbin to float co-axially as their bores will be slightly larger than the bolt outside diameter.



LEFT: 24. Talking of top hats, here's the first having had the inner thread machined/tapped, the spigot has a small recess machined on the inside edge of the thread so it fully engages the bore. RIGHT: 25. And here's the other side reversed in the three-jaw chuck and gently held to machine the face.

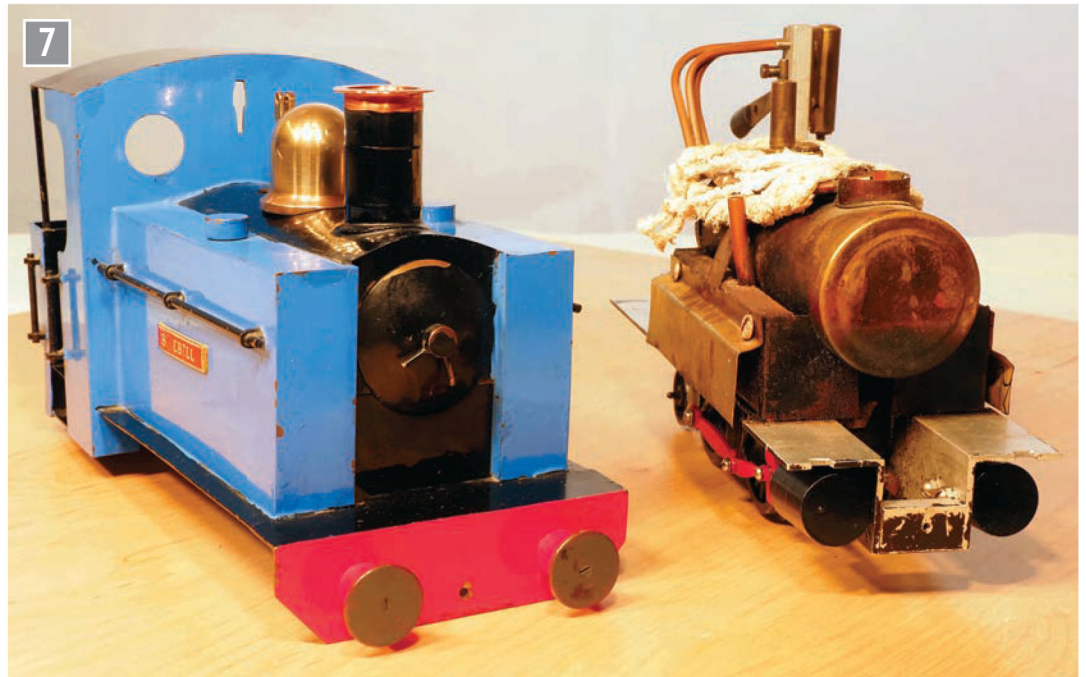


28. Here are the three valves all machined, just leaving the final cut of the Fluorosint rings. I have taken one apart to show the various components involved. The plan is to clock each assembled unit on the lathe and take the final cut, when all three will be cut at the same setting. Also in the picture is the simple tool that I made to measure the port outer edges. Before I permanently fitted the middle cylinder one of the things that I checked was that I could get this tool in to measure the ports.

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



Continued from p.684
M.E. 4704, 18 November 2022



Bluebell's body and chassis sit side-by-side for the first time in over 40 years.

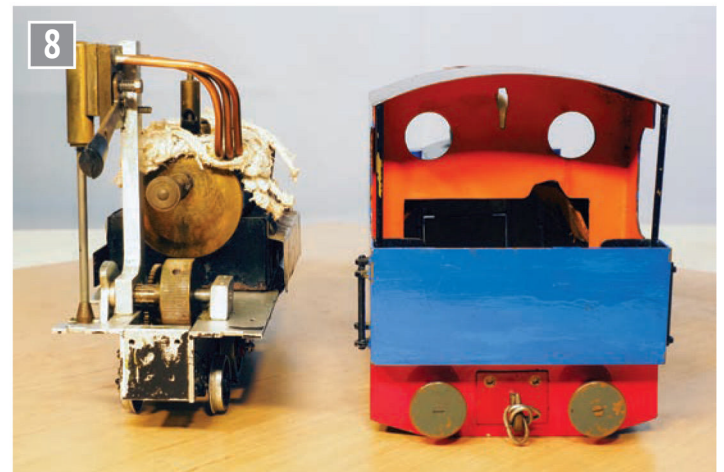
The Eating of Elephants

PART 2 - BLUEBELL

In Part 1 of this series, readers were introduced to *Bluebell*, a narrow-gauge steam locomotive destined to run on 0-gauge track, which dad and my ten-year-old self had begun to concoct from an elderly Mamod stationary engine purchased in a second-hand model shop in Tunbridge Wells; TBSITW, if you recall. We pick up the story in early 1979, her construction near complete, and the author excited for her first test run.

A warning to the faint-hearted

Over the years, I have come to realise there are as many different tastes as there are people and, like planetary sculptures made entirely from liquorice, it takes all sorts to make a world. For example,



Mamod components dictated Bluebell's narrow-gauge profile.

while I am not a fan of horror films, I know that there are many who like nothing better than being scared witless by the genre, and, while I respect their fortitude, you will not find your author in their company until the last credits have rolled and the lights have arisen on their popcorn-strewn torture chamber. No thank you, no sir.

In fact, although I find it hard to understand, it is even possible that you, fearless Reader, are of a horror-loving disposition, and, if so, then I can happily advise that your constitution and interests are well suited to this episode of *Elephants* and have no doubt that you will emerge unscarred if a little shaken by the experience.

For everyone else, I strongly recommend that you skip over this installment and turn your attention to Mr. Theasby's excellent column at the back, for it is always entertaining and, while some of his jokes may elicit an involuntary groan, he is a considerate chap and has never included anything that actually unsettles the stomach, at least not to my knowledge and recollection.

In short, if you choose to read on then you do so at your peril; personally, I wouldn't.

Bluebell, unskinned

Well, don't say I didn't warn you.

As you will see from the accompanying pictures, *Bluebell* was really two engines in one, and her outer skin could be removed to expose all her

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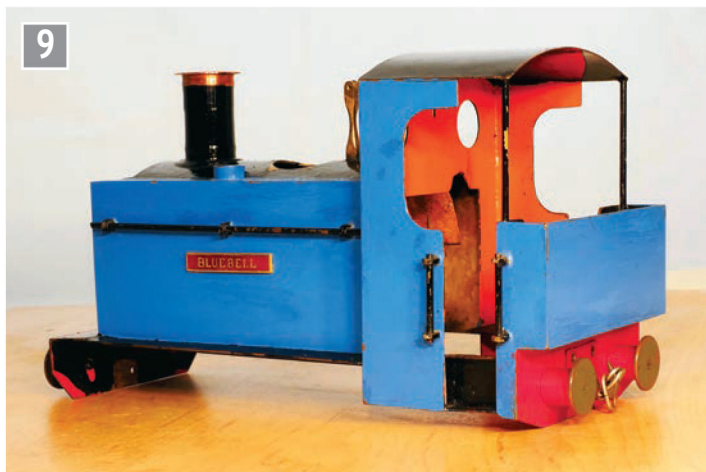
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We have everything for all of your needs. Just open <https://avxlive.icu>



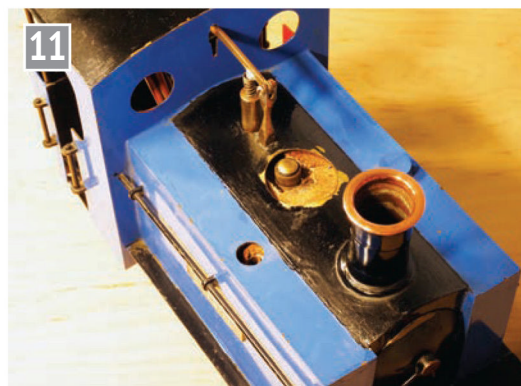
Bluebell's soft-soldered brass body comes off in one piece.

important bits-and-pieces to the full view of the shocked public (photos 7 and 8). Gruesome, isn't it?

On the inside, her chassis consisted of two aluminium-angle frames to support the boiler, the vertically mounted cylinder and the flywheel, gearing and chain, which together transferred the drive from the cylinder to the wheels.

On the outside, a one-piece soft-soldered brass body provided a more aesthetically pleasing facade, hiding most of the inner workings from view and creating the illusion of a normal locomotive (photo 9). Two copper piping unions, cut and soldered back-to-back, formed the chimney, and a dome-shaped brass offcut, kindly donated by John and Charlie in the workshop at dad's work who had heard about our project, was carefully filed to fit the body and became the dummy steam dome. Three 8BA screws, one in the front buffer beam and two in the rear, secure the chassis to the body, and it was the work of only three minutes to separate them for modification, maintenance or repair. That, we were to discover, was a good thing.

Once assembled, the cylinder sat handily in the cab and the forward/reverse/neutral lever stuck out the rear. The cab was roomy enough to flick the heavy brass flywheel and set Bluebell in motion, and also to remove and insert the extended boiler overflow pipe and thereby

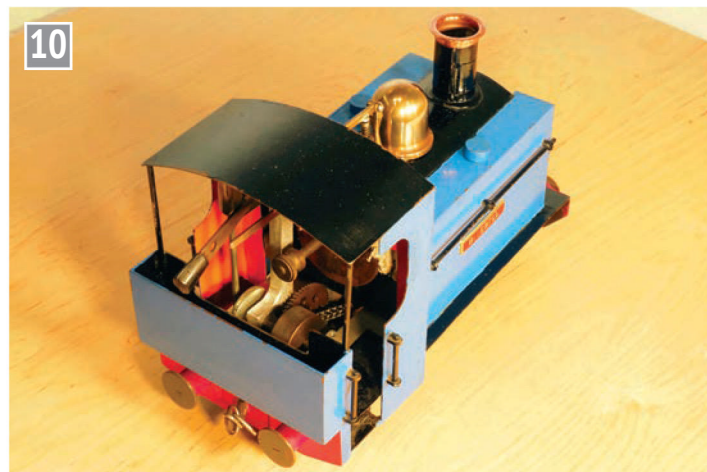


Bluebell's safety valve and fuel filler pipe are hidden from view but easily accessible.

ensure the pot-boiler was filled to the correct level at the start of each run (photo 10). Removing a dummy water-filler lid exposed the end of a short pipe beneath, which enabled the burner to be filled with methylated spirits carefully injected into the pipe from a syringe. Similarly, the boiler was filled with another syringe, water being squirted through the safety valve's bush which is located under the dummy steam dome (photo 11). Finally, by removing a screwed-on cover at the front, cunningly disguised to look like a smokebox door, the burner could be lit with a match poked through the resulting gap. In short, nothing about Bluebell was quite as it seemed (photo 12).

Bluebell fights back

And so, Bluebell was finished! Dad breathed a sigh of relief, I filled her with water and methylated spirits, lit the burner and we both sat and



Her open-back cab provides access to the flywheel.



Her dome, the water tank lid and the smokebox front provide access for water, fuel and a match respectively.

waited for the water to boil and the excitement to begin.

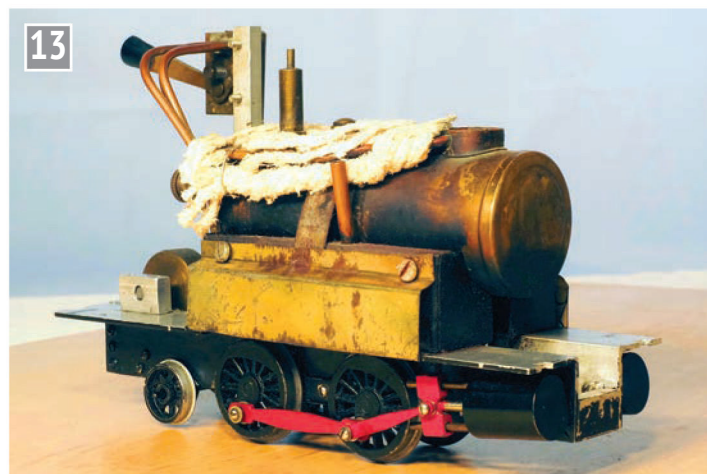
And the fire went out.

Mamod, we determined upon investigation, had wisely designed their little steam engine to allow air to reach the burner. We, we realised, had not. Never mind. Screwdriver out, locomotive disassembled, airholes drilled beside the burner, corresponding air slots cut in the frames, some thin brass sheet bent and installed

each side to direct the air, everything put back together, boiler and burned refilled and all set for round two (photo 13). This time the flame held, the water boiled, the safety valve sizzled, and she was ready to go once again.

And the fire went out.

Mamod, we determined upon investigation, had sensibly arranged the safety valve to allow excess steam to escape freely and harmlessly into the



On each side, thin brass sheets directed air to keep Bluebell's burner alight.

surrounding air. We, we realised, had arranged the safety valve to vent excess steam into a large brass dome, neatly capturing and condensing it, and redirecting it as a steady trickle down the outside of the boiler to fill the burner with water, douse the flames and prevent any hope of another attempt that weekend. Hmmpf.

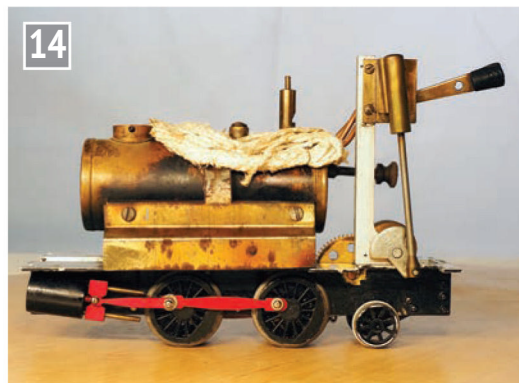
Even now, I can remember my ten-year-old self's disappointment and frustration. Why was this so difficult? Would it ever work? What should we do next?

Today, dispassionately, I realised how much these problems were teaching me, first-hand, about physics, engineering, design, resolve and the general Cussedness of Things. As a ten-year-old I didn't care – I just wanted it to work!

Fortunately, dad, being dad, had an idea and a plan. Together we disassembled the engine once again and, using some heat-resistant string and cork sheet purchased from a hardware store the following weekend, contrived an arrangement to soak up and redirect that troublesome condensate away from the flames (**photos 14 and 15**). Now, the condensed steam would, hopefully, not run straight down the boiler into the burner but would be redirected to the rear, at which point it would drip harmlessly onto the track below. Crude and simple, but would it work?

Success and beyond

Bluebell was reassembled once again and made ready for another attempt. Burner lit, water boiling, pressure raised, safety valve sizzling, condensed steam harmlessly bypassing the flames and dripping below – so far so good! With the engine on blocks, a finger-flick of the flywheel and round went the wheels as smoothly as could be. Move the lever into reverse, another flick of the flywheel in the opposite direction, and the same result – only backwards. This was fantastic! Wonderful! Magnificent!



Heat-resistant string helped keep her burner dry.

I can remember the elation clearly, which I suspect was reinforced by a strong sense of accomplishment and pride in having made something that worked, and that is the memory that dominates whenever I think back to those days over forty years ago, despite the setbacks along the way. I am sure that this was the moment at which model engineering became, for me, an inevitable lifelong hobby. Before *Bluebell* I had no idea that steam engines could be built by amateurs, and certainly not by the most amateurish of amateurs like dad and me. After *Bluebell*, while I knew it was not easy, I had discovered that it was not impossible to make something that ran on steam. I also knew that I wanted to do it again.

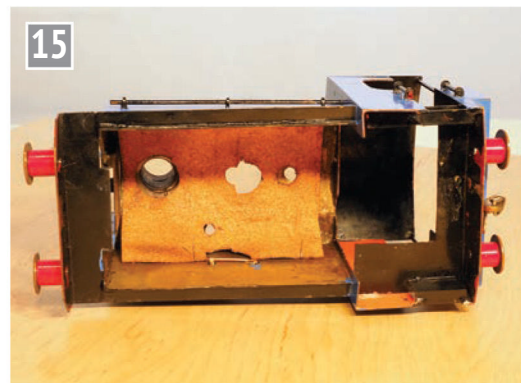
Perhaps most importantly however, I had witnessed how dad handled the setbacks. For him, each was simply a new problem to solve, and there seemed to be no doubt in his mind that a bit of methodical investigation, and some thought, and a bit of patience, would reach a successful conclusion. Without dad's example, ten-year-old me would have given up in frustration and anger. Fortunately, dad had shown me, tacitly, that there was a much more productive approach to be taken.

And so, I painted *Bluebell* the appropriate colour, by brush and not particularly well, and she received her lapel-badge nameplates in the spring of 1979 (**photo 16**). A few metres of 0-gauge track were pinned to a length of wood, and that

little Mamod-based locomotive spent the rest of the 1970s trundling back-and-forth under its own power, leaving behind a pungent wake of meths, dripping carefully deflected water onto the track below, and blistering my fingers whenever I was incautious or inattentive, which was often. And I loved every minute of it!

Postscript to Part 2

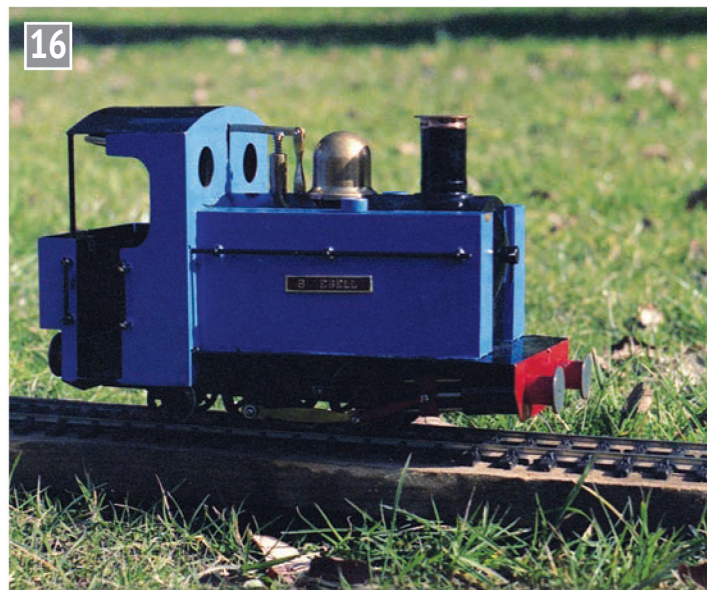
With *Bluebell* finished, I had no idea what the next project would be. I knew that I had a heck of a lot still to learn – I still do – and had a vague idea that one could only go so far with a Black and Decker hand-drill and a Ronson blowtorch. I also guessed that the next project would bring a whole new set of unexpected problems – it did – and that overcoming those problems would be part of the journey – it was. But that that was all for the future.



A cork sheet helps keep the heat and condensate at bay.

While she has not steamed for many years, over four decades in fact, *Bluebell* today sits proudly atop a glassware cabinet in our living room and wearing an 'I may be old but give me the chance and I'll still burn your fingers' expression, at least in my imagination. Her body and chassis can still be separated in three minutes flat which was a pleasant surprise; I had expected a fight in preparing Part 2 of this series. Once disassembled however, many of her construction details, which I confidently thought I had remembered accurately, turned out to be completely wrong. This caused me to re-write much of the supposedly finished text but, in retrospect, that should not be a surprise – *Bluebell* always knows how to burn my fingers and, over forty years after completion, always has the last laugh.

●To be continued.



Finished and ready to run! Bluebell in the spring of 1979.

Rewinding a Two Speed Motor

PART 11

Graham Astbury

learns a lot about single-phase induction motors and describes 'The long and winding road that leads to a 2-speed single-phase motor'.



Continued from p.705
M.E. 4704, 18 November 2022



The dynamometer with the motor in place.

Performance testing

I built a dynamometer to determine the power output of the motor on load (**photo 50**). The building of the dynamometer and obtaining the test results will be the subject of a further article,

with the editor's permission (granted! – Ed.). The motor worked well – two acceptably quiet speeds and sufficient power. There was some very slight humming of the motor when running at the eight-pole speed but this was



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

hardly noticeable and was not entirely unexpected from the information given by Appleman (ref 3 – M.E.4695, July 15) and Hildebrand (ref 12 – M.E. 4697 – August 12).

I measured the performance of the motor using a 12.5µf capacitor as this was the nearest value to the calculated 13.5µf. The performance figures are summarised in **table 6**. When testing the motor, I needed quite a lot of instruments (**photo 51**) to measure all the parameters to plot the characteristics. This is much better than using one meter and disconnecting and reconnecting to make the necessary measurements. If you do not have sufficient meters, then beg, borrow or even buy the necessary meters - they are really cheap these days - as it makes testing much simpler. I plotted the main results to show the characteristics of the motor and the performance at eight-pole and four-pole speeds are shown in **fig 21** and **fig 22** respectively. The blue line is the power output versus speed and the orange line is the

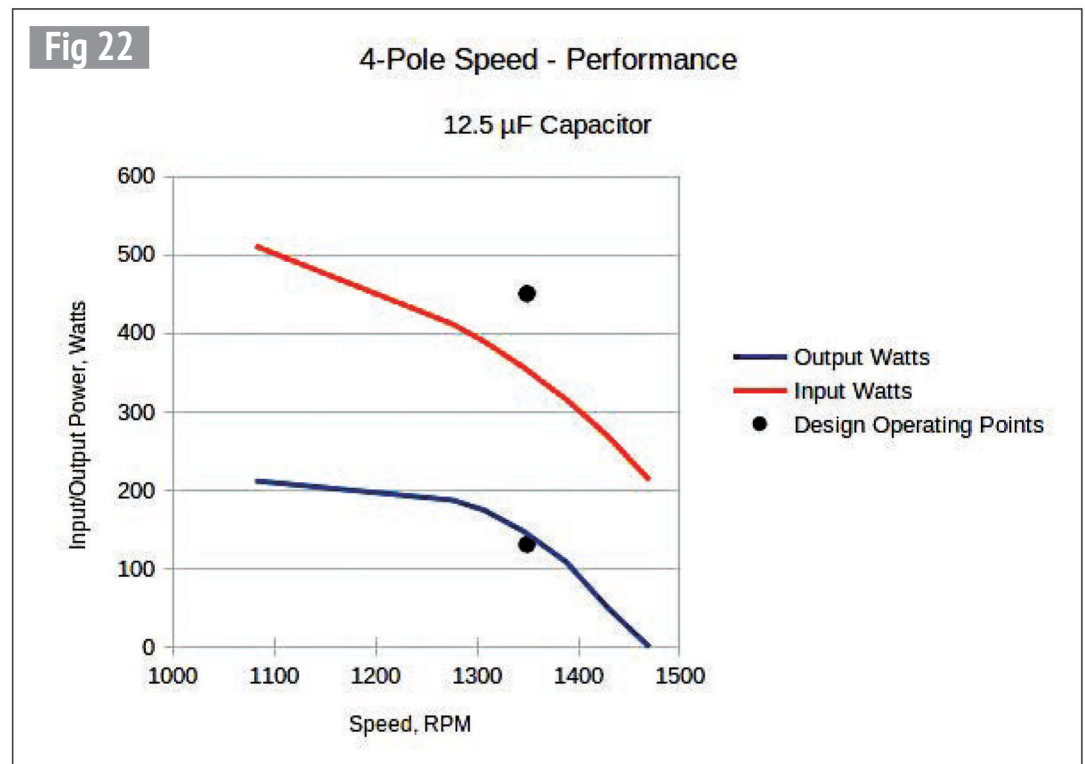
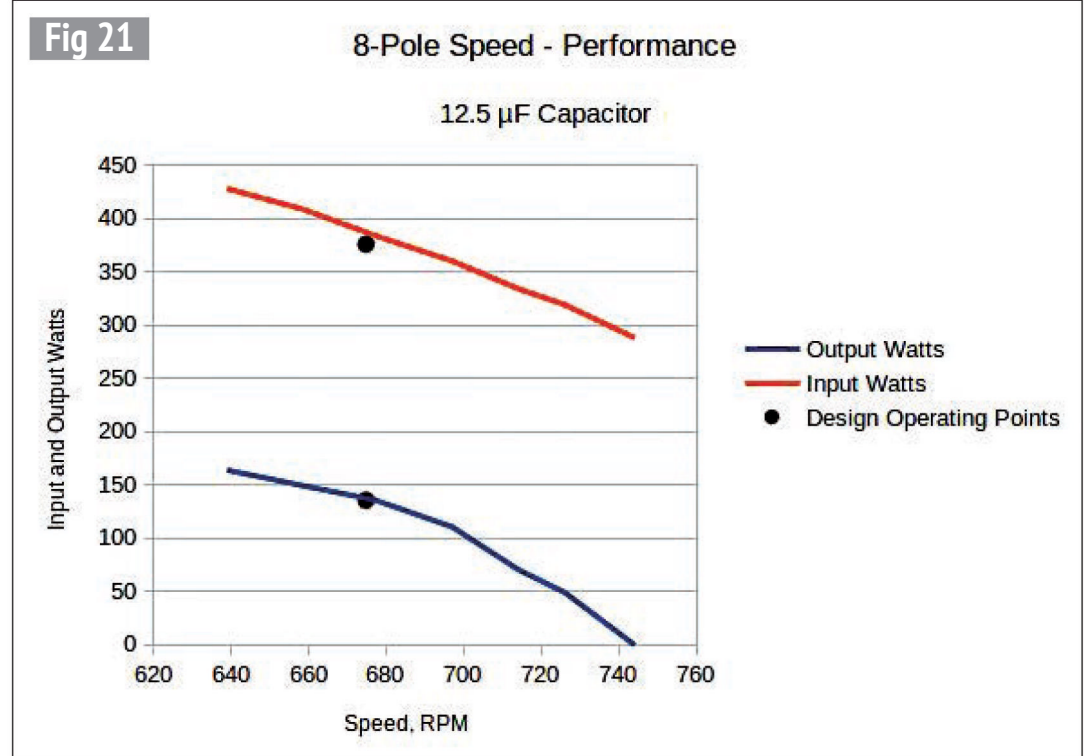
Table 6. Design vs Test Performance Figures

Parameter	Design value eight-pole speed	Test value eight-pole speed	Design value four-pole speed	Test value four-pole speed
Design input power, watts	375	385	450	355
Design output, watts	130	137	130	154
Design speed, rpm	675	680	1350	1351
Design slip, %	10	9.7	10	10
Line current, A	1.84	1.62	2.2	1.64
Main phase current, A	1.30	1.48	1.56	0.29
Auxiliary phase current, A	1.30	1.72	1.56	1.68
Main phase current density, A/mm ²	8.2	9.3	7.5	1.5
Auxiliary phase current density, A/mm ²	8.2	10.8	7.5	8.6
Capacitor value, µF	13.5	12.5	16	12.5
Capacitor volts	307	370	307	370
Power factor, Cos φ	0.85	0.98	0.85	0.91
Apparent efficiency, %	30	34	30	39
Actual efficiency, %	35	35	35	43
Main winding temp. rise - K	<105	78	<105	19
Auxiliary winding temp. rise - K	<105	78	<105	37

power input, with the two black dots being the design values. It can be seen that the power input on the four-pole speed is lower than I had estimated for the 130 watts output required, which is a result of a higher efficiency on the four-pole speed. This is probably due to the lower magnetic fringing as the pole pitch covers more teeth than with the eight-pole winding, according to Upadhyay (ref 16 – M.E.4698 – August 26).

I did test the motor on both speeds using different capacitors and settled on the 12.5 μ F one as the best compromise for the desired output on both speeds. Using different capacitors for each winding would have resulted in a greater output for the four-pole winding, but I decided that using one capacitor was simpler for arranging the switching between the speeds. I also did a long-term full load test to determine the temperature rise of the windings. The final temperature rise was around 78 K, so the maximum temperature of the windings ended up at around 95 degrees C which is well within the maximum permitted under the requirements of the appropriate IEC Standard (ref 24) and well below the switching temperature of the PTC thermistors.

From the above figures, all are in reasonable agreement with the predicted or calculated values except for the four-pole power input and the phase currents. The much lower power input for the four-pole speed is accounted for by the increase in efficiency. For the individual winding currents, the maximum current density of 10.8 A/mm² still lies within the range of 9.3 to 12.4 A/mm² suggested by Karnavas and Chasiotis (ref 15 – M.E.4698) for an open frame fan ventilated motor. Note the large discrepancy between the main and auxiliary winding currents for the four-pole speed. This is due to the choice of capacitor to be the same as that for the



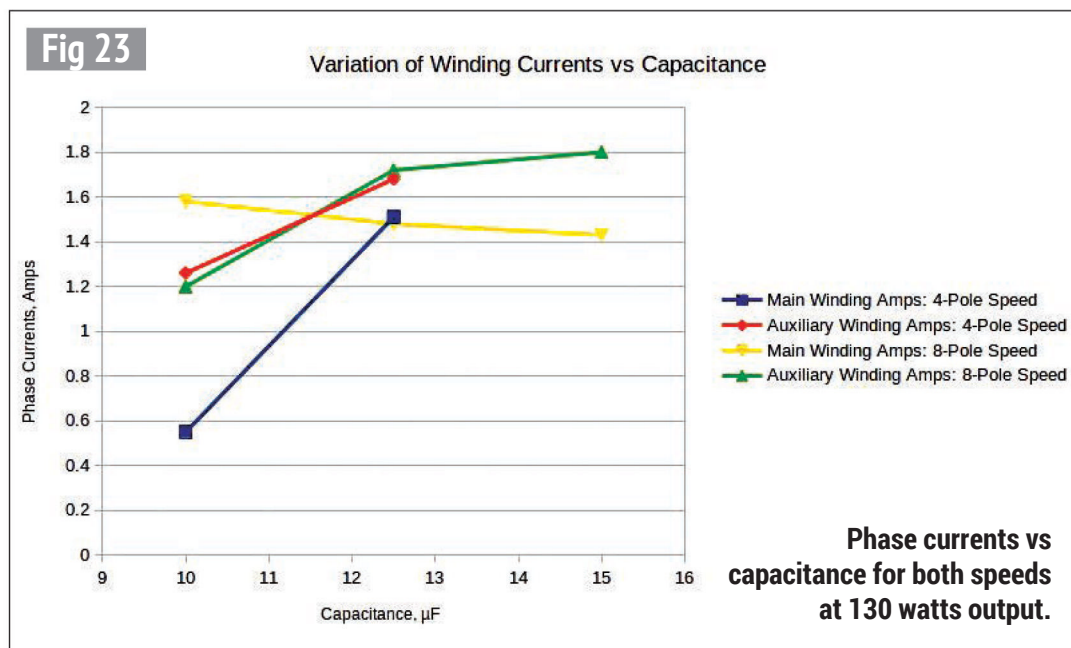
eight-pole speed. I could have chosen different capacitors for each speed but that meant that there would have been insufficient room inside the terminal box to fit both and I wanted to avoid fitting external capacitors.

The two phases, whilst separate electrically, are actually linked magnetically as each phase winding overlaps

the other phase winding twice on each pole. Hence the phase currents are interdependent and it is not possible to exactly balance the phase currents at all loads. Since at the design power, the main and auxiliary phase currents were not identical and the selected capacitor was not quite the same as the calculated value, I decided to check the phase

currents against a change in capacitor value at the design power output of 130 watts. In general, increasing the capacitor will result in an increase in input power, an increase in the maximum output power but an increase in the auxiliary phase current. At the design full load of 130 watts output on both windings, the phase currents for various

values of capacitance were as in **fig 23**, showing that the selected capacitor of $12.5\mu\text{F}$ is probably the optimum value for both the speeds. The optimum balance point for the eight-pole speed would be about $11.5\mu\text{F}$, and for the four-pole speed, extrapolating the lines would suggest a value of around $13\mu\text{F}$, but any more would increase the possible power output considerably. However, with the $12.5\mu\text{F}$ capacitor for the four-pole speed at the design output of 130 watts, the main phase current was significantly lower than the auxiliary phase, suggesting that the capacitance was a little too high. Simply increasing the load would increase the current in the main winding and decrease it in the auxiliary phase. I did try using a $15\mu\text{F}$ capacitor and the peak output did go up to 250 watts, with the speed dropping to 1098 rpm giving an increased slip of 27%. I considered the final design



using a $12.5\mu\text{F}$ capacitor to be quite acceptable in that at the design slip of 10%, the output was just a little over the design value on both speeds.

●To be continued.

REFERENCES

24. International Electrotechnical Commission Standard IEC 60034-2-1:2007 Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles).

NEXT ISSUE

Planetarium

Henk-Jan de Ruiter tells the story of the oldest working planetarium in the world.

Rochdale

John Arrowsmith drops in on a long-established model engineering society near Manchester.

Hit and Miss Engine

Ian Couchman describes the construction of a 'hit and miss' internal combustion engine.

Pipe Insulation

Mike Tilby looks at the science of pipe insulation and discovers that it can sometimes be counter-constructive.

Content may be subject to change.



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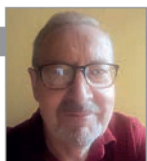
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Ian Beilby
invests his
spare time
into the cultivation of his
own steam plant.



Continued from p.687
M.E. 4704, 18 November 2022

Growing a Steam Plant

PART 5

One of the problems with running the pipework beneath the baseboard was that the diameter of the holes in the baseboard had to be made sufficiently large enough to allow the union nuts to pass through the baseboard. The resulting larger holes would have been unsightly so I machined and painted some washers that could be run on the pipework, along with the union nuts before soldering the nipples in place. **Photographs 51 and 52** show examples of how the washers cover the larger holes drilled in the baseboard. Likewise, the larger holes provided in order to drain the water from the condenser and boiler blow-down valve were obscured by removable covers (**photos 53 and 54**).

A gas cylinder is also required in order to fuel the gas boiler and a similar arrangement was needed in order to allow the gas tank to be easily accessible for replacement and adjustment



Covering a large hole in the baseboard with a washer.

and yet be kept out of sight! The solution can be seen in **photos 55 and 56**. The flexible gas connector runs underneath the baseboard and connects with the burner feed pipe.

I was acutely aware that man-made board reacts unpredictably when wet and even though it had been well primed and sealed, I decided to cover the surface of the



baseboard with 1 1/4 inch water resistant vinyl tiles that I cut from a large off-cut sheet of vinyl that I had to hand. Some of the cut tiles can be seen in **photo 57**. After fixing the tiles in place they were sealed with sealant; hopefully they will stand up to any small spillages of water but only time will tell!

The finished steam plant can be seen in **photo 58**.



Drain for the condenser.



Drain for the sight glass.



Cunning disguise for the gas canister.

Having never operated a gas fired boiler before I was a little apprehensive, however the instructions provided with the boiler were comprehensive and took the user through all the important stages including filling the boiler, lighting the gas supply, adjusting the safety valve, observation of the water level in the water gauge and the use of the blowdown valve.

Finally, the boiler was filled nearly to the top. A space must always be left above the water in order to allow steam to be raised. The boiler filling plug was replaced and a check made to ensure all the connections were tight. The distribution oilers were filled with steam oil and all the moving parts of the engines lightly oiled. All the valves were then closed except the valve to the exhaust chimney. With all these tasks performed a first attempt at lighting the boiler and steaming the plant was made.

The gas burner was lit via the chimney. From there on it was just a question of waiting until the boiler started to reach working pressure and the safety valve started to blow off. The boiler is tested to 100 psi and the safety valve was checked to see that it was blowing off at the recommended working pressure of 50psi.

Initially each engine was tried on its own, in turn. At first all seemed to be working well, however it wasn't long before one or two relatively minor

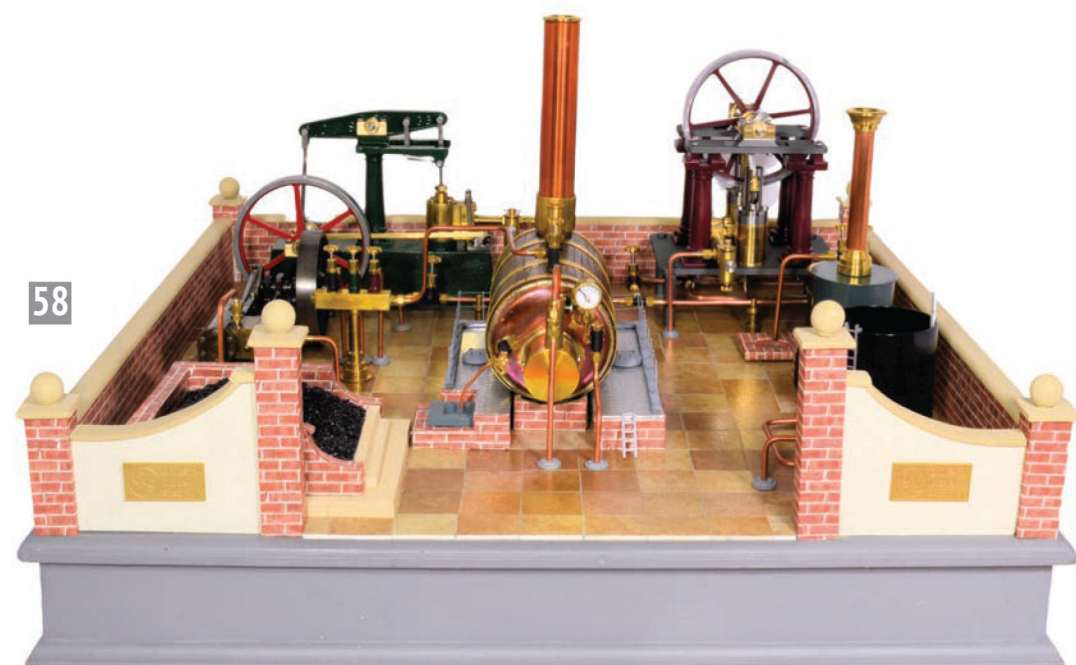
problems arose and one quite major issue.

The boiler was losing pressure quite quickly and it was evident that steam was being lost somewhere. There was an audible hiss when the beam engine feed valve was opened and it became apparent that the union nuts on the elbows of the feed pipe required tightening. It was also evident that more adjustment/ graphite yarn was needed around the piston rod and the packing nut of the engine. PTFE tape can also be used.

As the pipework was running underneath the baseboard the leak was not visibly evident and, of course, this is one of the disadvantages of running the pipework out of sight!



Tiles cut from vinyl sheet.



The finished steam plant.

I mentioned earlier that I had tested the engines on air pressure which is quite forgiving, but I was quickly learning that steam pressure is another matter altogether!

Having fixed the steam leak and attended to the beam engine piston rod, everything seemed to be running well, then something more serious happened.

The 'bitsa' engine ground to a sudden halt and there was clearly something seriously wrong. One of the pistons would not travel the full length of the cylinder; something was preventing the piston rod from making a full stroke. Clearly the engine had to be disconnected and removed from the baseboard for inspection. It transpired that I had not tightened the nut securing the piston to the piston rod sufficiently and it eventually worked loose, falling to the bottom of the cylinder and preventing the piston from completing its full stroke. Fortunately, the engines are designed to be easily assembled and dismantled therefore it was no trouble to dismantle the cylinder and piston in order to replace the nut, only this time a little more tightly and using some Loctite!

Should any type of failure occur, it is most important to stop the engine immediately and systematically look for the cause of the fault. Never be tempted to try and force the engine to work as this will only lead to further damage that may be extremely difficult to repair. When building a fairly comprehensive plant such as this you must expect things will go wrong. The engines are not run-in and each time the plant is run you will spot something that needs adjustment and rectification. I decided that each time I ran the plant I would concentrate on one particular engine at a time in order to get the best running performance possible.

For the beginner, looking for, and correcting faults can be a good way for you to learn a

lot more about the engines, eventually you become adept at spotting when things are not working correctly and need adjustment.

You learn how to fault find, dismantle, assemble and make adjustments as necessary.

It quickly becomes apparent that running a steam plant, even with one engine is no simple task. Adjusting the gas pressure and heat of the boiler, maintaining good boiler pressure, checking the water level, oil levels, topping up the boiler and emptying the condenser are all quite demanding tasks, however, practice makes perfect and it wasn't long before I could manage to keep my eye on the all-important details and operate the engines at the same time. Perhaps one of the most important tasks is keeping a close eye on the water level, never letting the water level fall below half in the water gauge. In this context the external water tank and water pump are most important components allowing you to maintain a good water level in the boiler and extending the running time of the boiler and engines.

Naturally, adding cold water to the boiler reduces the pressure and it is necessary to allow the boiler temperature to recover. I eventually found it less disruptive to add small amounts of water frequently rather than waiting for a low water level and then having to let the boiler recover. After a while I found I could run the two single cylinder engines at a realistic speed and maintain a boiler pressure of between 40-50 psi which I was more than happy with, although the engines would tick over unloaded on a lot less pressure. A close eye should be kept on the pressure gauge. Should the boiler suddenly lose pressure it can be a sign something is wrong and requires investigation. Opinions vary but I prefer to run the engines quite slowly, enabling you to watch the action of the pistons, connecting rods and

flywheels. The parallel motion on the beam engine was a very clever invention and is most interesting to watch. Quite simple but effective.

It is a tremendous thrill to control and see the engines running, the steam rising from the exhaust chimney, the engines coming to life and operating in very much the same way as their larger predecessors would have done over a hundred years ago.

I am pleased to say the condenser works very well in keeping the plant free from excessive exhaust water and also provides evidence that the lubricators are working properly. If the lubricators are adjusted correctly the waste water should be seen to be quite 'oily'.

Improvements have been suggested to me by other enthusiasts and their comments are appreciated... 'Some of the pipework might benefit from being lagged'; 'shorter pipe runs would be beneficial'; 'considering the number of engines, a larger boiler may have been more suitable'; 'further lagging to the boiler'. These are all well-meant and are all possible improvements for consideration.

Without a doubt designing and assembling this steam plant has been a most rewarding and fulfilling exercise, not just from a practical point of view, but from an educational point of view as well.

Interest and a desire to fulfil an ambition in one subject invariably leads to curiosity and awareness in another and so our knowledge and understanding increases at every stage. Designing and assembling a model steam plant and comprehending how it works requires an awareness and understanding not only of engineering, mechanics, practical assembly and materials but also physics and history.

In conclusion, I hope that by assembling this model steam plant, and writing this series of articles, I have shown what

can be done not only by myself, but also by others with an interest and appetite for engineering.

When designing my steam plant, it was always my intention to create a suitable backdrop or diorama for the engines rather than simply display a number of engines and a boiler fastened on a board. I wanted to place them in a visual setting which would enhance their appeal, not only to the model steam enthusiast but also the casual onlooker with no interest or experience in model engineering at all.

The engines and boiler that I assembled were made by Chiltern Model Steam and I found them very well designed and finished. The kits come with comprehensive instructions and diagrams and all the necessary nuts and bolts to complete a fully working model.

Similar kits by other makers are available and I would recommend readers take a look at the kits offered by Chiltern Model Steam and other manufacturers in order to see the numerous different styles and type of engine available. For those like me, with only the most basic knowledge of engineering and equipment, ready machined kits can provide a wonderful introduction to model engineering, immersing you in a highly interesting, creative pastime and satisfying project. Hopefully, after reading this series of articles, other readers similar to myself will be encouraged to do likewise and enter the fascinating world of the model engineer. Who knows where it may lead from here on?

Apart from research, enthusiasm and time, good practical advice and help when needed is invaluable, and in that respect I must acknowledge the help given to me most willingly and freely by both my friends, Crispin Cousins and Simon Rowley, the proprietor of Chiltern Model Steam.

ME

Wainwright's Swansong

The End of an Era

PART 4

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



Continued from p.695
M.E. 4704, 18 November 2022

Building a small locomotive with two inside cylinders and two sets of inside Stephenson's valve gear presents a few problems regarding adequate sizing of the components. Add to that, in this engine there are four slide bars per cylinder and rocking levers in the valve drive train. It all gets a bit 'busy'. Another complication was the need to provide a screw reverser in place of the steam reverser of the prototypes. The railway companies of southern England all looked after their drivers with this labour saving device, the LSWR, the LBSC and the SECR all having their own versions. Railways further north and west were generally not so sympathetic!

Ray Stephens, who designed this model, was a former locomotive draughtsman himself so was able to fully investigate the valve gear and come up with a working design. As far as I can see there was no computer assistance, all the valve gear design being scaled from the original and checked by drawings and calculation. The original design was altered slightly by Maunsell, or in reality one of his draughtsmen who had come with him when



he joined the SECR from Ireland in 1913. Lead was reduced to 7/8 inch, so this translates to 55 thou on the model.

The angles of advance on the eccentrics caused the designer of the model some confusion as the forward and reverse eccentrics used unequal angles, being 97.5 degrees forwards and 101.5 backwards. Further checking revealed that the centreline of the motion was placed around 2 degrees above the centreline of the cylinders, so by factoring this into the eccentric positions the result is 99.5 degrees for both directions.

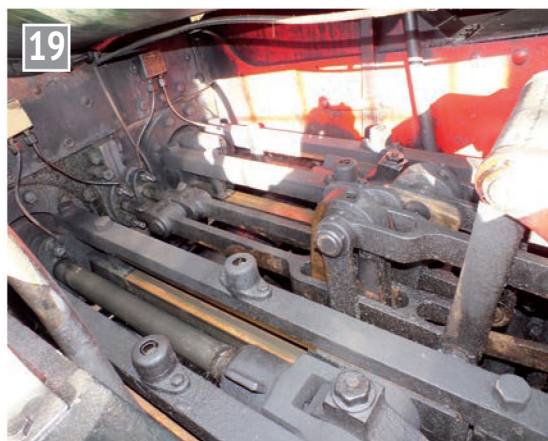
A letter by the designer was published in this magazine on 9 May 1997 detailing the above and it concluded with the following paragraph that seems appropriate:

'Lastly a tip from Henry Greenly on angles of advance. I have recently set and secured with Loctite a 3½ inch gauge wheelset for Stephenson's motion driving piston valves through rocking levers. For this I drew out accurately to scale the working centres and suspension points and ran off photocopies to plot the paths of the motion for a range of four to eight positions of movement and varying

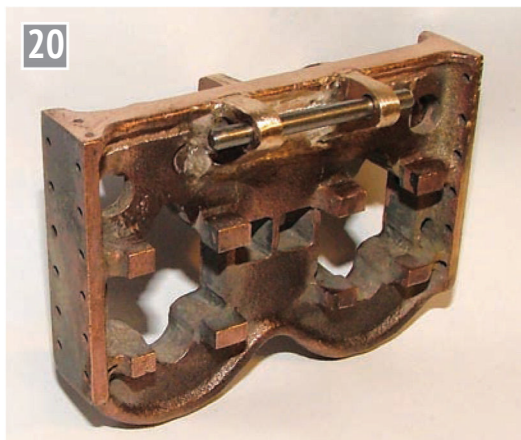
angles of advance, the ports being drawn at 0.100 inch wide and moveable valve heads giving 0.055 inch lap. The results varied greatly and were mainly unworkable with lopsided travels and port openings. However, Greenly maintained in his book *Model Steam Locomotives* that for locomotives up to 3½ inch gauge no angle of advance be provided for Stephenson's motion with 'open rods', the influence of the out of gear eccentric and rod being so marked that better results could be obtained by ignoring lap and lead angles (although lap would be provided on the valve). At most, the advance should be restricted to 1/32 inch. Upon drawing a valve motion layout using this figure, I obtained the best result. In my judgment they could not be bettered, so I made my settings in accordance with Greenly's way.'

The proof of the pudding came towards the end of the build, over 20 years later, when the completed chassis was tested on air and went away like the proverbial wind, forward and reverse!

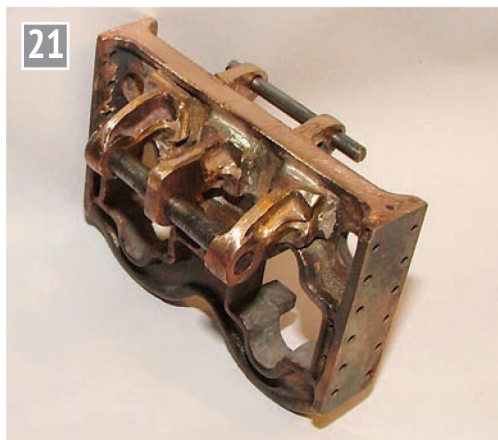
Before detailing the valve gear **photo 19** shows the layout of the valve operating mechanism of an earlier SECR



19
I believe the SECR 01 class 0-6-0 was being worked on outside on this visit to the Bluebell Railway, allowing a good view of the piston and valve rods. Oilers are neatly built in to the top slide bars.



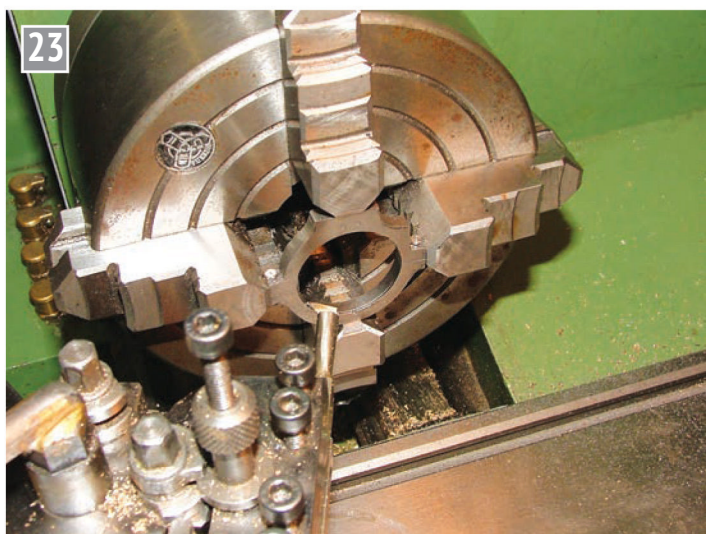
20
The back of the motion plate will need to be drilled for the slide bar fixing bolts. The intermediate valve rods go through the square holes and are suspended by links attached to the spindle seen at the top.



21
Seen from the front, the rocker arm castings have been silver soldered in place. The spindle shown was for location during assembly and will be replaced with a stainless one later.



22
One of the rocking lever brackets needed reclamation by silver soldering - the only bad casting on the locomotive fortunately, as there was no opportunity to recast.

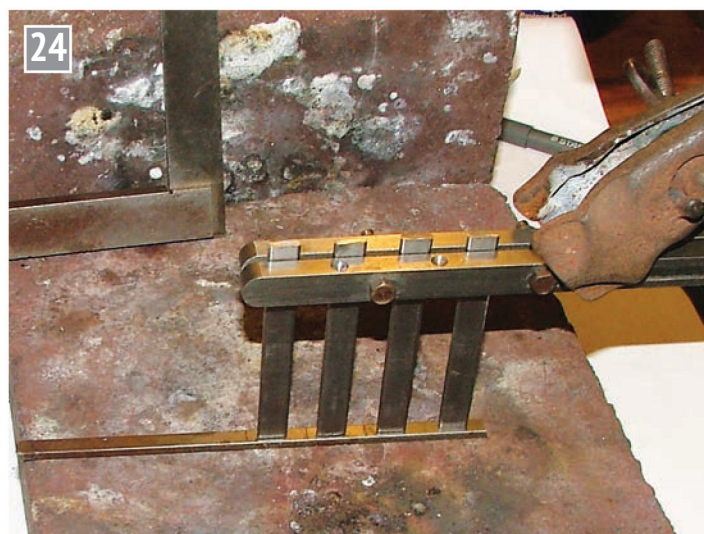


23
The two halves of the eccentric strap are bolted together and carefully machined to a good working fit on the eccentric sheave.

locomotive, the O1 class of 1898. Although this locomotive has slide valves between the cylinders and not piston valves above as on the L class, it features four-part slide bars and valve operating levers suspended from a bracket on the motion plate.

Dealing with the motion

plate took some time. The main casting also acts as a frame stretcher for the mid part of the frames. The main frames taper from the back to the front, being $3\frac{5}{32}$ inches wide at the firebox end, tapering in two stages to $2\frac{13}{16}$ inches wide at the front buffer beam. At the motion



24
Two steel bars are used to clamp the metal strips in position for brazing the eccentric rods onto the foot material.

plate the frames are tapering in at 1 in 72! The supporting brackets for the lever arms and suspension arms had to be attached to the motion plate; fortunately, the castings had been included in the many boxes of small parts supplied with the locomotive.

Photograph 20 shows the motion plate from the rear. The lugs supporting the back ends of the slide bars are not yet finished or drilled. The brackets for the valve lever suspension arms have been silver soldered in place and bored for the spindle. **Photograph 21** shows the front view; the three brackets for the rocking lever spindles have also been silver soldered in place and a spindle fitted. One of the brackets was quite a poor casting and had

some porosity which caused the drill to wander off centre when making the bores for the spindle. Clearly another casting was not an option so the hole was filled with silver solder and redrilled (**photo 22**).

I had to make most of the valve gear parts even though the necessary castings were in the 'kit'. The cast iron eccentric straps needed splitting and remachining; a straightforward turning job (**photo 23**). The radius rods were fabricated from $\frac{3}{32}$ inch mild steel strip; **photo 24** shows the set-up for brazing the feet onto all four at once. The feet were separated and drilled, bolted to the strap and a block added so that the forked end could be produced by milling (**photo 25**). The top and bottom rods are handed and pinned to each



25
A block is brazed to the forward end of the eccentric rod; a hole has been drilled as a guide for milling the slot to form the jaws.

end of the expansion links. The links are raised and lowered by rods connected to the top of each expansion link and the reversing shaft that runs across the bottom of the frames. This was another fabrication as shown in **photo 26**.

The rocking levers and all the remaining valve gear components were straightforward fabricating jobs. Stainless steel pins were used to make all the connections. Lack of space meant using slight countersinks on some of the joints and peening the ends of the shaft into the recess to make a flush joint.

Photograph 27 shows the fully assembled valve gear, looking from the cylinder

end. The rocking shafts in the foreground are connected to the end of the valve rods at the top and at the bottom end are operated by intermediate valve rods from the expansion link via holes in the motion bracket.

The top of the reverser lifting arm just inside of the frame on the left of the picture is attached to a bell crank operated by a slim reach rod back to the non-prototypical screw reverser in the cab. There was just enough room to feed this under the boiler cladding. **Photograph 28** is the view from the other side of the motion plate a bit later in the build. The reverser cross shaft bearing can be seen at the bottom of the left-hand frame plate, with the shaft and

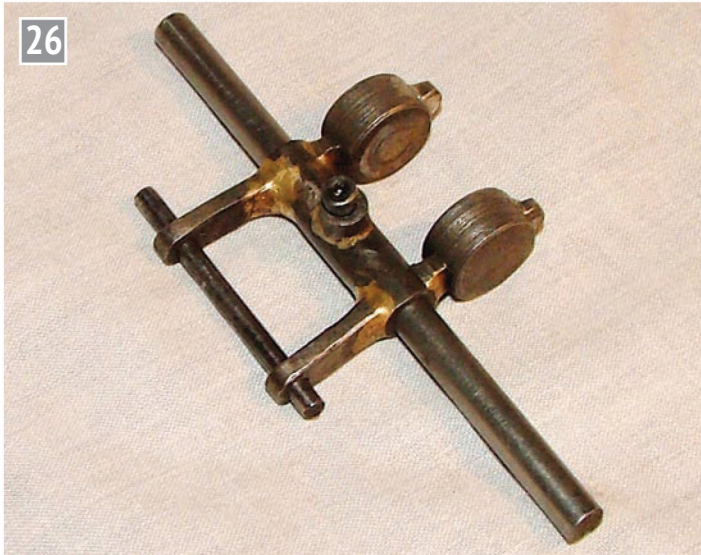
spacers for the suspension links for the intermediate valve rods also prominent. It should be remembered that when riding over uneven track the driving axle will not always be perfectly aligned with the axis of the valve gear. As well as radiusing the ends of the axle box slots it is also necessary to allow for some twisting in the cylinder and valve gear drive. There should be no linear play in rods and bushes, but some rotational play needs to be built in to allow the gear to operate without binding up. A good test for a locomotive in this gauge is to lay a 2mm twist drill in the bench across one track of the locomotive and push the locomotive across it. Each wheel should 'flow' over the

obstacle without lurching.

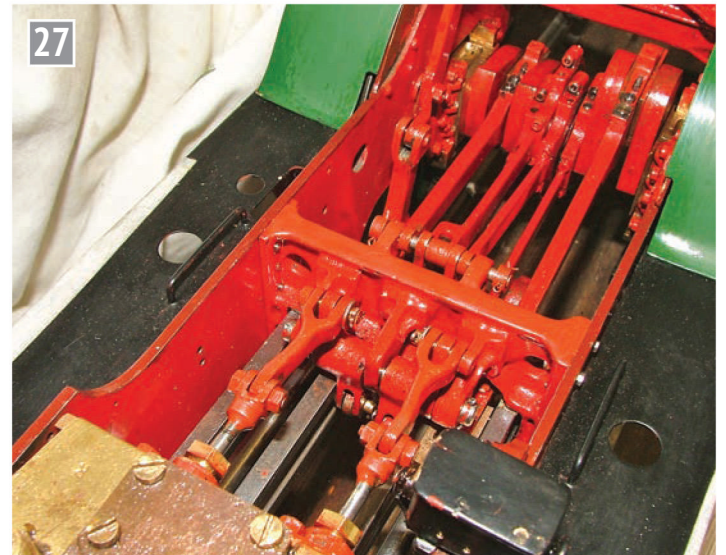
Suspension that is too stiff will not provide good traction and may result in derailment on uneven track.

Photograph 29 shows the almost completed locomotive from underneath. The reverser cross shaft is hidden behind the brake beam and the four lifting links can be seen on the lifting bar with pinned sleeves fitted at each end. The bottom four slide bars are secured by socket head cap screws. Ahead of the bogie axle, the cylinder drain pipes cross over on their way to the rotary valve that can just be seen ahead of the bogie.

● To be continued.



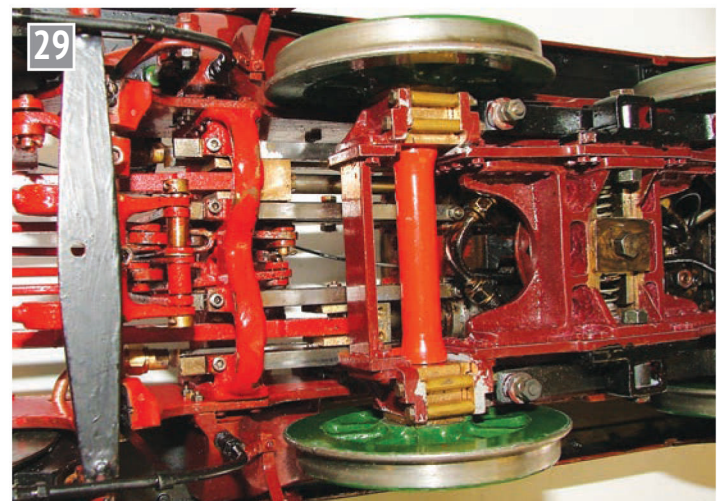
The reverser cross shaft has been made from round bar and the lifting arm and balance weights have been fabricated, with a clamping screw for exact positioning.



All the motion work has been completed and painted; the rocking levers and their pivots can be seen on the front of the motion plate.



In this view the eccentric rods can be seen. Note also the wedges securing the big end bearings. The feed pipes to the front boiler clacks are threaded through the frames and motion plate as on the full size.



Apart from the brake linkage everything is now in place. The reverser lifting arm is at the top of and just behind the brake beam - non-authentic but necessary.

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

Continued from p.621
M.E. 4703, 4 November 2022

The Stationary Steam Engine

PART 40 – MATTHEW MURRAY AND THE ROUND FOUNDRY (cont.)

The rotunda

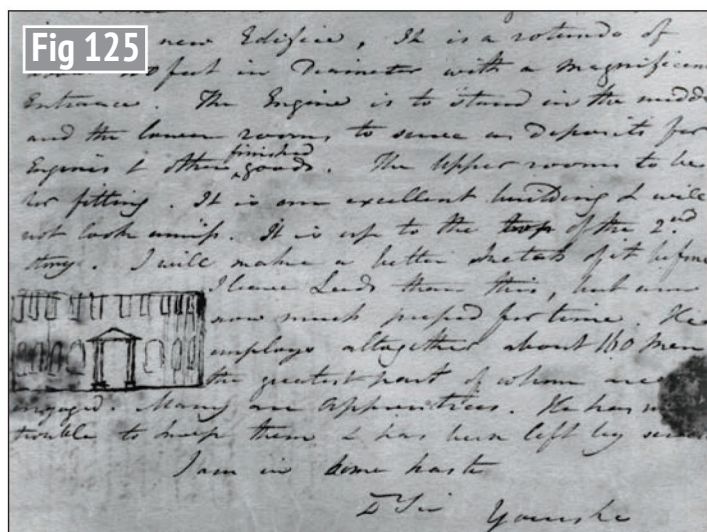
In the space of four years Fenton, Murray and Wood had built over the full extent of the ground known as the Leckkeys. They were increasingly successful suppliers of textile and other machinery and they were also making dramatic inroads into the business of steam engine building with its allied trade, boiler making. It was of course perfectly possible to be eminent in engineering without making money. The late eighteenth and nineteenth-centuries are littered with the biographies of talented engineers who died in poverty but the alliance of Matthew Murray, David Wood, James Fenton and, after January 1804, William Lister (ref 207), who was essentially a financial sleeping partner, kept the firm solvent despite periodic liquidity crises. There is no evidence to support

James Watt Jnr's insistence that Marshall was Murray's sustained financial backer and the legal documents for the next land purchases indicate that Fenton, Murray and Wood were entirely reliant upon their own resources.

On January 28th 1801 the *Leeds Intelligencer* carried an advertisement offering for sale land which adjoined immediately to the south of Murray's site, the Shoulder of Mutton Close. This advertisement may have concealed more than it revealed for the vendor was Marshall's close friend, Peter Garforth, who owned all of the land surrounding the Murray estate on the east, south and west sides and application was to be made to Marshall and Benyon or William Fenton's office in Leeds. Fenton, Murray and Wood purchased the Shoulder of Mutton Close in March 1801. It was roughly L-shaped, abutting the south boundary of the Leckkeys and extended to Marshall Street. The total area was 8,197 $\frac{3}{4}$ square yards. In 1802 further purchases took place embracing a rectangle of land in Marshall Street and two plots within the enclave formed by Shoulder of Mutton Close and the Leckkeys. On the last day of 1801, Marshall sold to Fenton, Murray and Wood the part of the Leckkeys remaining in his possession after parting with the northern portion to the builders Longley and Cave. The land was conveyed as two plots, the first containing 1,242 square

yards to the north of Shoulder of Mutton Close and on the east side, Kirby's malthouse. Longley and Cave's land formed the northern boundary. The second transaction involved 1,842 square yards. Including the earlier purchases, Fenton, Murray and Wood's total landholding now amounted to 18,202 $\frac{3}{4}$ square yards. The site boundaries were to remain unchanged for the rest of the nineteenth century.

The conveyance states that at the time of sealing Murray and Wood were already occupying the Shoulder of Mutton Close but it is not clear whether this meant that any buildings or sheds had been erected. On the 12th June 1802 Watt wrote to Boulton (fig 125): *...It is said that Murray & Co. have purchased from Marshall the land upon which their Works are built, and it is not known that he advances anything to the new Rotundo, for such it appeared to me to be, but I shall get a nearer aspect of it tomorrow. ...It is generally believed that Murray & Co. are making a great deal of Money & that the new works are constructing from their profits, as also a superb house which Murray is building for himself. Fenton is, as we formerly heard, a man of some property & was Marshalls partner, who provided him with a share in this business to get him out of his own. Mr Gott speaks well of him & thinks he would be ashamed of his partners proceedings although he may not have the power to control him. Wood is the steady man of business who directs the*



James Watt Jnr's letter to Matthew Boulton Jnr with sketch of the Rotunda built up to second floor level.

works: Fenton keeps the Cash & Books & Murray solicits orders superintends the erection of Engines &c. He passes[?] him for a great scoundrel but a very able mechanic & Gott says he has got great credit from his last patents, no one doubting that the Inventions are exclusively his own...

This letter contains several misrepresentations but it does include the first known reference to the Rotunda, a building that was to give rise to the name by which Murray's works became widely known thereafter, *The Round Foundry*. The same letter included Watt's sketch showing the two foundries and, although placed slightly too far to the west, the plan also shows the Rotunda, standing on the Shoulder of Mutton Close.

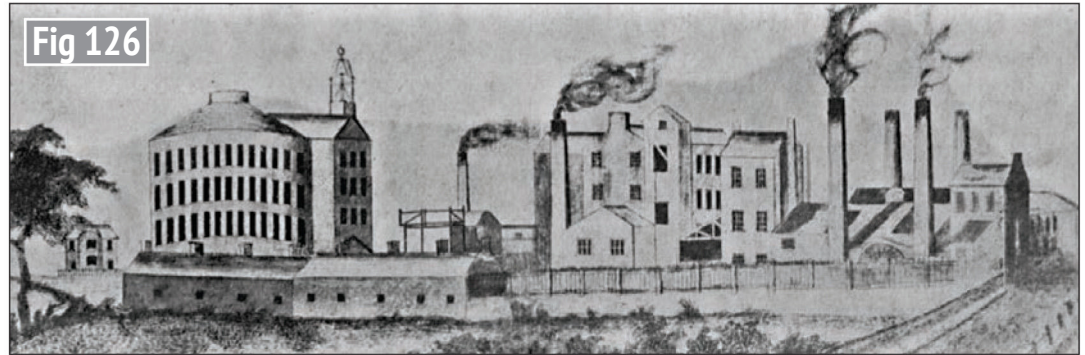
Two days later Watt expanded upon his previous letter:

...Fame has not outrun the magnitude of Murrays new Edifice. It is a rotundo of about 100 feet in Diameter with a magnificent Entrance. The Engine is to stand in the middle and the lower rooms to serve as Deposits for Engines & other finished goods. The Upper rooms to be for fitting. It is an excellent building & will not look amiss. It is up to the top of the 2nd story. I will make a better sketch of it before I leave Leeds than this, but am now much pressed for time.

Simon Goodrich provides the next description of the Rotunda following his visit on August 4 1804: *Panopticon building 84 ft. Diam. divided into 8-3 floors-room in the centre about 18 ft. Diam.—3 windows in a room—inner walls 14 inches—outer walls 2 feet thick.*

Goodrich's use of the word Panopticon is interesting as it was to be later synonymous with Samuel Bentham's brother, Jeremy, in connection with prison design.

The Rotunda appears to have been first insured at the end of the Michaelmas Quarter, September 29th 1804, by the Sun Life Company when it was subject to a mortgage raised with Beckett's Bank:



North East view of Messrs. Fenton Murray & Wood's Iron Works at Leeds 1806.
From Matthew Murray, Pioneer Engineer. E. Kilburn Scott. Original untraced.

On a circular building, lettered 'Q' in the office plan, used as a workshop and heated by steam, 2000

On utensils of trade therein, 300
On two cottages nearby £100 each, 200

On a stable & carthouse adjacent nearby, 100

On utensils & stock therein, 60
All brick built & slated. Warranted that there is no steam engine in, adjoining or connecting with either of the above buildings.

In view of its enormous significance it is curious that only one illustration is known to exist of Fenton Murray and Wood's works. This was watercolour sketch drawn in 1806 and despite the primitive style all of the buildings described up to this point are represented (**fig 126**). In a slightly different form, by 1811, it had become the company letterhead although the epithet Round Foundry had evidently not emerged as the cartouche simply reads *...Iron and Brass Foundry Leeds (ref 208)*. The drawing prominently shows the Rotunda and, at the left-hand edge, Murray's house. (An intriguing detail is the framed construction beyond the smithy sheds which may be the hydraulically powered lifting gantry used for loading boilers onto road wagons for transport.)

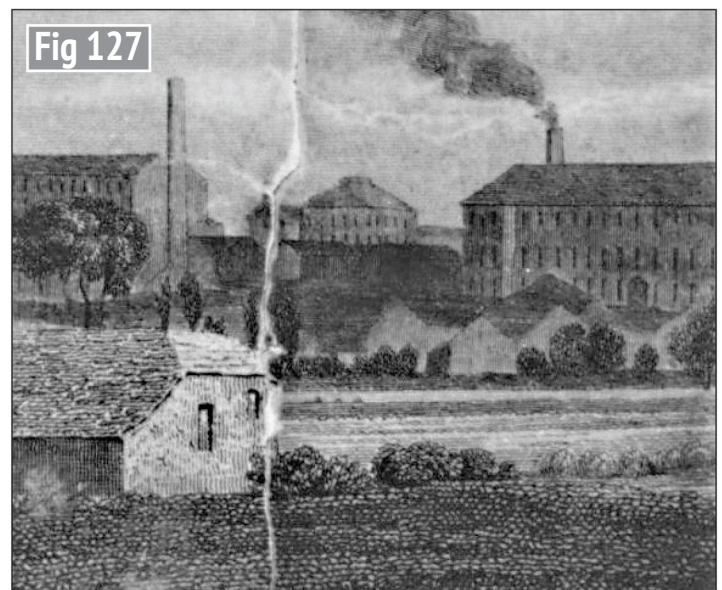
Apart from this 1806 image the only other known representations are two panoramic views of Leeds that include glimpses of Murray's site in passing. The earlier is an engraving, *...South West Prospect of Leeds...* dated 1824 (**fig 127**) and the other is from twenty years later,

Burra's 1844 *View of Leeds from Armley*. Neither shows anything of the works other than a virtually identical distant and incomplete view of the Rotunda. They differ only in that the earlier view depicts the two upper stories of the building whereas the later painting shows three stories.

Written descriptions are also sparse but a serendipitous account of the Rotunda is to be found in a manual on surveying published in 1850 (**ref 209**): *A circumference of a circular building at the iron foundry of Messrs. Fenton, Murray & Wood in Leeds is 241 feet and its height from the bottom of the eaves 49' 6" how many rods are contained in the wall deducting for a door whose breadth is 12 feet and height 14 feet; for 96 windows each of which measures 6' 7" by 4 feet and for 14 windows whose heights are 9' 6" and breadths 5' 4".*
Ans. 135 rods 19 feet.

In his preface the author, Anthony Nesbit, says for this example he is indebted to Mr. Benjamin Jackson Snr., an able and experienced architect in Leeds and to Mr. Joseph Brooke, teacher of the mathematics at Wortley near Leeds.

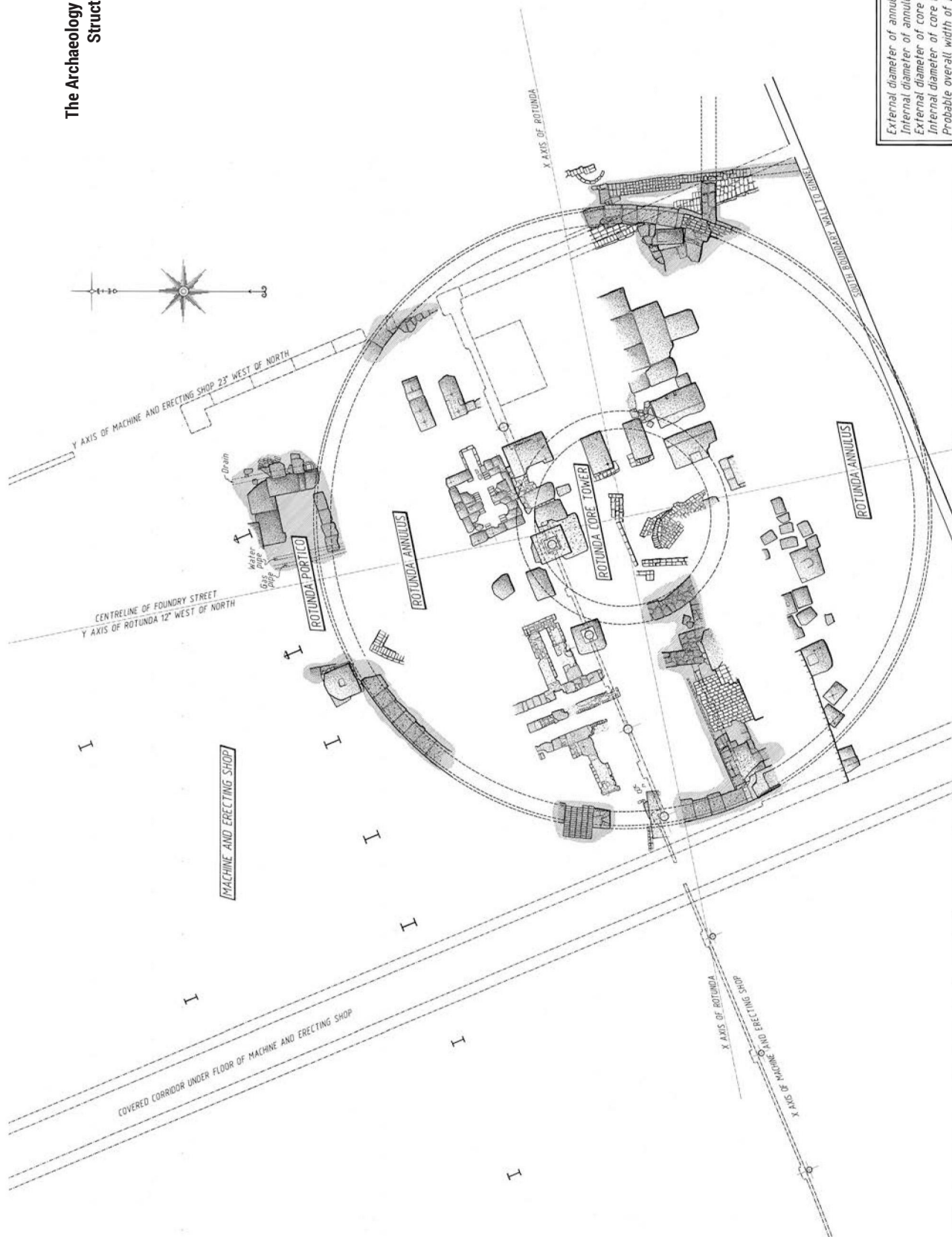
On the 28th of September 1875, the Rotunda, now owned by Messrs. Smith, Beacock and Tannett, was discovered to be on fire which gave rise to several newspaper reports describing the building. One of these reports says that it was four storeys in height and eighty-one feet in diameter. Access between floors was by a *...winding staircase...* The top floor housed patterns and contained a large crane. The building was heated by hot water. At the time of the fire the lower floors were used for light engineering with machinery for manufacturing tools. The fire originated in the



South West Prospect of Leeds.

Fig 128

The Archaeology of the Rotunda. Survey by
Structural Perspectives in 2005.



External diameter of annulus 77' 6"
Internal diameter of annulus 74' 00"
External diameter of core tower 26' 10"
Internal diameter of core tower 22' 3"
Probable overall width of portico 26' 6"

Structural Perspectives © 48 Huddersfield Road, Huddersfield, West Yorkshire, HX3 9SZ Tel: 01422 240789 Fax: 01422 248765 Mobile: 0776 864841	Grid Reference	Job Number	Site ROUND FOUNDRY, WATER LANE, HOLBECK, LEEDS.	Drawing Title PARTIAL EXCAVATION OF ROTUNDA.		Excavation by Matrix Archaeology A.O.C. Archaeology	Sheet Sheets	Surveyed Matrix Arch. A.O.C. Arch. Bureau Drawn R. Fitzgerald B.Sc. PhD

pattern store and was finally extinguished at midnight. At first it was thought that the remains could be repaired but more detailed survey showed that total demolition was unavoidable (**fig 128**). The site was subsequently built over by Smith, Beacock and Tannett.

The Rotunda has long been regarded as an enigma. The written accounts contain inconsistencies and fundamental questions have continued to surround both the form of the building and its function. In an attempt to answer at least some of these questions a limited archaeological excavation was undertaken during the re-development in 2003. Unfortunately, the later erecting shop built by Smith Beecroft and Tannett had disturbed some of the below-ground remains of the Rotunda but the surviving fragments did assist in resolving some of the problematic issues.

The most persistent conflict arising from the written accounts is the variation between the estimates of the dimensions of the building. The archaeology proved that it had an external diameter of 77 feet 6 inches with brick outer walls two-and-a-half bricks thick above the stone footings. Watt's estimate of 100 feet diameter is thus seen to be excessive and, by a smaller margin, so is Goodrich's 84 feet. Nesbit is near accurate using 241 feet circumference which would translate as 76 feet 9 inches diameter. The report of the fire gives a hearsay diameter of 81 feet.

Reconciling Goodrich's and Nesbit's descriptions of the plan and external appearance of the building with these results, Goodrich says that the building was internally divided into eight rooms, each with three windows, a total of 96 windows for four floors. Nesbit also cites 96 windows, each 4 feet wide by 6 feet 7 inches high. Taking the archaeologically proven diameter of 77 feet 6 inches and a circumference of 243 feet 6 inches, an equal division

would give bay segments of slightly more than 30 feet and with Nesbit's window width the embayment would be 4 feet window width and 4 feet 6 inches pier width. Unfortunately, Nesbit then adds to his 96 windows of 4 feet width, 14 windows of width 5 feet 4 inches.

That the building had four storeys is attested by the newspaper reports of the fire. The 1806 sketch only shows three but the ground floor is concealed by the sheds which backed onto the boundary wall of the site. Goodrich's statement that there were 3 floors almost certainly referred to a ground floor with three suspended floors above. Accepting that the arrangement was ground floor and three floors above, Nesbit's ground-to-eaves height of 49 feet 6 inches would suggest 12 feet 4 inches per floor but the door height of 14 feet, given by the same author, implies that the ground floor was loftier than the upper floors, as was the case with the fireproof buildings elsewhere on the site.

At the centre of the building there was a brick core tower which was 26 feet 10 inches in external diameter with walls three-header-bricks thick. The internal diameter of 22 feet 3 inches is larger than Goodrich's 18 feet and his dimension for the wall thickness of the tower is one header brick less than that exposed. The function that the internal tower served was not evident from the archaeology but the remains were very disturbed by later machine foundations. It is possible that it contained the spiral stair tower that was to prove so disastrous in constricting the flow of water through the firemen's hoses in 1875. Alternatively, it may have supported the crane which the fire reports indicate was on the top floor, the tower itself possibly forming a hoist shaft. There was nothing to support Watt's statement that an engine stood in the middle of the building and the existence of this circular tower makes such an engine in this location

highly improbable. It should also be noted that the Sun Life Insurance policy warrants that *...there is no steam engine in, adjoining or connecting with either of the above buildings...*

Watt's sketch shows a portico with a pitched gable pediment supported by two columns. The footprint of this portico is shown on all of the large-scale plans from Giles of 1815 onwards. It is axially aligned to give this main door into the building a long perspective when seen from Water Lane looking down Foundry Street. Stone footings for the north eastern corner of this portico were exposed by the excavation but later foundations had destroyed the remains elsewhere. Overall the portico was probably 25 or 26 feet wide with depth of about 5 feet. According to Nesbit, there was a door into the building 12 feet wide and 14 feet high, presumably the portico door. Watt's sketch gives the impression that this architectural feature is attached directly to the drum of the rotunda but the 1806 drawing shows the triangle of the pediment as part of a projecting bay with three storeys of three window bays rising through the full height of the building to a gabled roof surmounted by a belfry. The full-height bay is not shown on the panoramic views but the 1844 Burras painting may show an attached D-shaped external stair tower elsewhere on the circumference of the building which could be a stair or a toilet tower.

The final conundrum that the rotunda gives rise to relates to

the reason why Murray chose to build a round building, a perverse ground plan unless a specific functional motivation existed. There are several apocryphal stories but none will withstand close examination. Watt's view that an engine was to stand in the middle of the building has already been disposed of and with it the possibility that the building was arranged to accommodate radial lines of shafting. (Later sources identify an engine and boiler house in adjacent buildings but this further undermines the argument for the engine being a design feature that was integral to the choice of a round building.) The distinctive plan and architectural embellishment might lend credibility to Watt's supposed use of the Rotunda as a depository and showroom for finished products but as a role this has no endemic quality that would conduce to the circular plan. That engineering work was carried out on the upper floors is testified to by Watt's *...the Upper rooms to be for fitting...* which the 1804 insurance policy supports, giving the function as a *workshop*. When the works was offered for sale in 1844 a plan of the site was prepared which annotates the Rotunda as a *...machine shop...* but the Ordnance Survey large scale plan surveyed in 1847 describes it as a *...fitting up shop*. The plausible explanation for Murray's choice of a round building remains elusive. Reader's views welcome.

● To be continued.

REFERENCES

207. W.Y.A. - Volume ES page 437-8 no.546 31.12.1803 + 1.1.1804. Regd. 8th Feby. 1805
208. Cumbria Archive and Local Studies Centre, Whitehaven, DCU 3/423, reproduced in Murray Thompson op. cit, p. 191. A letterhead of 1798 refers to Murray and Wood's works as *The Leeds Foundry*, for which title there were several other contenders.
209. *A Treatise on Practical Mensuration*, Anthony Nesbit Pub. Nov. 1841 London, pp. 177-8. I am grateful to my colleague Tom Swailes of U.M.I.S.T. for sending me a copy of this quotation.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.



I had an idea. It is often said that a picture is worth a thousand words, so I considered printing two photographs and then taking the rest of the fortnight off. Readers could use the blank space to design their own locomotive, start a scurrilous rumour or commit a felony. However, Editor Martin demurred.

As I have an interest, may I ask all my readers to watch *Putting Up with Parkinson's* - a TV programme by Jeremy Paxman, who is the usual irascible chap that we know and love.

The weekend just gone saw us at Newark Hamfest, the biggest and best of the amateur radio rallies in the country. Without my Luggie, I would have lasted less than an hour, but zooming round the spacious hall and the stalls outside, I was able to stay for four hours. Meanwhile, Debs

went to the Civil War museum in Newark, and commented that it is aimed entirely at children, forgetting that adults should still be catered for.

In this issue, a driving position, Not Lego, railcars, a centenary, smoke on the concrete... *Ayesha* (Bless you!) shillet, a hooligan and Not Ozymandias.

The Smokebox, spring, from **Rand Society of Model Engineers**, says that the Chiba-Tetsus (junior enthusiasts) include one Jayden Clarke who was invited to drive Alex Nichol's Simplex on his first day there. After some vicissitudes in assembling locomotive parts, supplies, tools, pipe fittings, etc. in the same location at the same time, he 'assumed the position' and quickly found how inconvenient it was ... for him. This was due to the locomotive being designed for use on a raised track, giving a better driving attitude. This was solved by laying prone on the driving trailer; he could then reach the controls and get a better driver's view at the cost of a stiff neck. Paul Fisher writes on railcars in SA, notably the Austin 7, whose track matched the 3 foot 6 inch Cape Gauge very well.

The **UK Men's Sheds Association** are asking fellow shedders to build a 'Not Lego' man. Not to build? ... Men's Sheds Cymru had created a chamber opera on the theme of loneliness. Swansea City Opera and several notable operatic performers have taken part, together with local opera societies in every town on their recent six day tour. A short video has been released on the subject of Axminster tools, well known to our readers, which company is celebrating 50 years in business in the West Country town.

W. www.ukmsa.org.uk

On Track, October, from **Richmond Hill Live Steamers**, recommends this video on the Bessemer converter <https://www.youtube.com/watch?v=qJ3aTpKMmfQ>
W. www.richmondhilllivesteamers.tripod.com

The Bristol Model Engineer, autumn, from, **Bristol Society of Model and Experimental Engineers**, celebrates Joan Williams' hundredth Birthday. In her day, Joan could handle a steam locomotive as well as anyone, but was not allowed to haul passengers. This was because she was not a member, at a time when females were not admitted to membership. The library has acquired a Hepolite Service Manual, third edition, 1955, published by the company which was based in Bradford (Shipley?). It is lavishly illustrated and highly technical. Alan Church writes on *MV Southampton Castle*. Built in 1965 by Swan Hunter for Union Castle, Alan helped crew this ship in the 1960s and built a model using balsa, ply and card. The shipping line's hulls were painted lavender grey, leading the company to become known as the Lavender Hull Mob. Steve Smith has designed and built a double acting boiler pump for his Simplex. He has made the details available commercially but club members can get them free. Next year, the Society will be hosting IMLEC.

W. www.bristolmodelengineers.co.uk

Ryedale Society of Model Engineers reports that an elderly gentleman who visited the mainline rally appeared to be very knowledgeable about Adam Cro's Black Five. There is a good reason for this; he used to own it and, indeed, built it! His daughter said he had the time of his life and had said that Gilling has a world class railway. On 25 September, Nick decided to hold a barbecue in the steaming bays using coals from his Caledonian 0-6-0T to start it. When the smoke cleared...

W. www.rsme.org.uk

The mini Land-Rover spotted in this area has been seen again. Both Debs and myself are roaming the streets to get photographs. On a similar basis, 18 October marked 100 years of motor buses in Sheffield, illustrated by this picture from Debs (**photo 1**).



Sheffield motor buses centenary. (Photo courtesy of Deborah Theasby.)

Further to this theme, here is a tuk-tuk from the Phillipines, where the design is used for taxis, family transport, goods vehicles, mobile food purveyors etc. This one was at the Sheffield Canal Festival a couple of weeks before (**photo 2**). Other items were (**photo 3**) and how to keep tailgaters away (**photo 4**).

The Cam, Sept, from **Cambridge & District Model Engineering Society**, tells us about Andy Phipps' intention to model an ALCO trench locomotive. These were rather unstable due to the side tanks and derailments were common on the uneven and distorted track. Furthermore, when British manufacturers bought them back after the war, they were often quite battered and had shrapnel damage.

W. www.cambridgemes.co.uk

Durban SME's Workbench, October, has editor, Errol Koch printing a picture of *Ayesha*, which featured in the 'Battle of the Boilers' between the wars in the twentieth century (noted above). When the original was offered for purchase, Errol was one of those who reached into his pocket to help buy it. Two models that were less famous were *Caterpillar*, and *Olga*. The latter design was never published so it languished in obscurity. *Caterpillar* was a 2-12-0 which LBSC admitted was conceived after a splitting headache. Errol also says that his Avonside now steams much better since its chimney's internal decoke, as previously mentioned. *Dolbadarn*, his 5 inch gauge Don Young designed Hunslet locomotive, was quite well built inside and out but the wheels were tight and didn't revolve as freely as one would wish. The problem was traced to an hydraulic lock in the steam passages. When this was cleared, and the sooty crud inside the chimney removed, the smokebox was vacuumed three times before it was clear. It now steams more easily. ('Tubes help you breathe more easily'.) The blame fell on the hydrostatic lubricator, which was over-oiling the cylinders. These devices feed



Tuk-tuk at the canal festival.

oil all the time, even when stationary; QED.

W. www.dsme.co.za

The Big St. Albans Model Show was a huge success, with over 2,000 tickets sold. One customer was so pleased with the catering, she asked if the kitchen staff were professionals! *Newsletter 47* from **St. Albans Model Engineering Society** says that when Mike Ashgrove is on the rota for firing up the 1932, 31 litre, 55 hp Crossley gas engine at Redbournbury Mill, he invites St. A. members to help prep and start it for demonstrations. Chairman, Mike Collins, solved a problem with the torsion bar suspension on his Tiger tank. The problem was that the grub screws used could not cope with the torque load imposed whilst holding a shaft to some other part. The cure was to fit high tensile M4 cap screws with a flattened end. Secretary, Roy Verden showed the deputy mayor round the show. He resented being allocated only 90 minutes in his schedule because he wanted to stay all day! Over a cup of tea, the DM said that his career had been in the Diplomatic Service and it showed him



Sparrowhawk; canals are great for wildlife.



Keep your distance! At Swithens Open Farm in Leeds.

that all the activities for Queen Elizabeth's funeral could not have been organised by any other country. They looked on in disbelief at how everything just smoothly swung into action. Howard Somerville built a Newport exploding clock from Meccano. The original, built for the 1992 Ebbw Vale garden festival, failed in later years and was relegated to a traffic island in Newport. See Wales Online. Guy Keen, on the door, was so busy he had no time for cuppa 'twixt 11.00am and 3.30pm. The Yellow Buses 'have-a-go' train was very popular though some youngsters grasped the 'going all-out' concept easier than throttling back. An endpiece by the editor, also Mike, discusses the Drake equation for estimating the probability of finding intelligent life on other planets. Amending this to estimate the number of visitors to an event publicised in social media, gives 3,000. Using the actual details for the show gives 2,000, which is pretty close, *Nicht war?* (Not an order of magnitude out, for instance.)

W. www.stalbansmes.com

Goodwin Park News, autumn, from **Plymouth Miniature Steam** says that Nick Hill was given a collection of EiM magazines and decided to read the history of PMS from details reported in those pages. Construction of the track took place over a few years from 1985 and thanks to a local contractor who gave 1500 tons of rubble and 300 cubic yards of shillet (type of shale found in SW England, M'Lud). Ti Daley writes, briefly (five pages on a very complex range) on railway bells and whistles and other means of making an 'audible warning of approach', including the note sequences, on single or two tone horns. (One driver on the Aire Valley line from Leeds regularly used the first four notes of *On Ilkley Moor bah't 'at*). The USA had a more detailed list owing to fewer telephonic connections and the various independent railroads. I am reminded of The Goons' recording

of *Whistle your Cares Away*. <https://www.youtube.com/watch?v=rxDAiuXKRYs>. Tony Fleming writes *A Blower for my Puffer*, in verse...

W. www.plymouthminiaturesteam.co.uk

Roger Backhouse of **York Model Engineering Society** writes on my previous comments about Lannies, or Landy's. He suggests that 'Lannies' was the military term, and 'Landys' was used by others. He discovered this one in Switzerland at pocket money prices (photo 5) – see also www.lannyclark.com which proves nothing either way...

W. www.yorkmodelengineers.co.uk

Welling & District Model Engineering Society Newsletter Oct-Nov, remembers Graham Fisher, who led an interesting life, in particular the visit of QEII to his headmaster friend's school, delivering newspapers (one to Stirling Moss), being late for work as a locomotive fireman and being caught speeding and subsequently hauled up before the beak, who called him a hooligan. Then, delivering beer around the district and feeding the dray horses pear drops. Later, he developed interests in photography, astronomy, golf and cars. In 2017, he had a flight in a Spitfire, whereupon the next club meeting saw everyone sporting 'Flying Officer Kite' moustaches (the full 'handlebars'). 'Colonel' John North was another of Eltham's distinguished residents. Working his way up the business ladder, he became very rich and known as the Nitrate King (as in Railway King, Andrew Carnegie; Railway King, George Hudson and the Diamond King, Cecil Rhodes) for his involvement in the fertiliser trade from Chile, Bolivia etc. Thinking of his antecedents in Leeds, he bought Kirkstall Abbey when it was threatened with demolition and presented it to the city. Alan Picot completed his model steam boat, thanks to lockdown, but found taking all the



It's Landy time! (Picture courtesy of Roger Backhouse.)

accoutrements - batteries, tools, water, oil, radio, etc. - was rather cumbersome. The boat itself weighed 4kg, and was a strain to launch so he devised a suitable trolley. Bob Underwood writes on John Melling who invented a means of helping single wheeler steam locomotives when starting a heavy train. Small extra cylinders drove the wheels by friction rollers, ensuring that whatever the wheel diameter the same peripheral speed was achieved. This never caught on. A joke about Ozymandias, who spent all his wealth fighting the Hittites (later, later - Geoff) reminded me of a saying told by my maternal grandmother: 'Nebuchadnezzar, King of the Jews, wiped his behind on the *Keighley News*'. The Paris Exposition of 1889 was serviced by trains powered by local company, Decauville, who developed the locomotives into the trench railways of WWI. They were named after locations where Decauville had sent their products so they had *Hanoi* and *Dumbarton*...

W. www.wdmes.co.uk

Maritzburg Matters, October, from **Pietermaritzburg Model Engineering Society** contains a piece about rail terminology,

starting with the 'frog'; comparing the rail crossing fitting to the hoof of an ungulate quadruped. (Having hooves M'Lud.) Interestingly, dolphins are ungulates but I must refer you elsewhere for details, as this is straying rather far from my brief. (Yeah, I know it doesn't normally stop me but that's the way the management (me) wants it and that's the way it's gonna be!) I referred above to the Battle of the Boilers between LBSC and Wenman Bassett-Lowke at the 1924 MEX. That 'Battle' has rumbled on ever since, but it may be significant that LBSC was the only model locomotive designer to be admitted to the Institute of Locomotive Engineers. He also designed more locomotives than any of the 'full-size' members.

W. www.pmes.co.za

And finally, from RHLS, "Did you ever walk into a room and forget why you were there?" "Yes, that's why I'm no longer a locomotive fireman".

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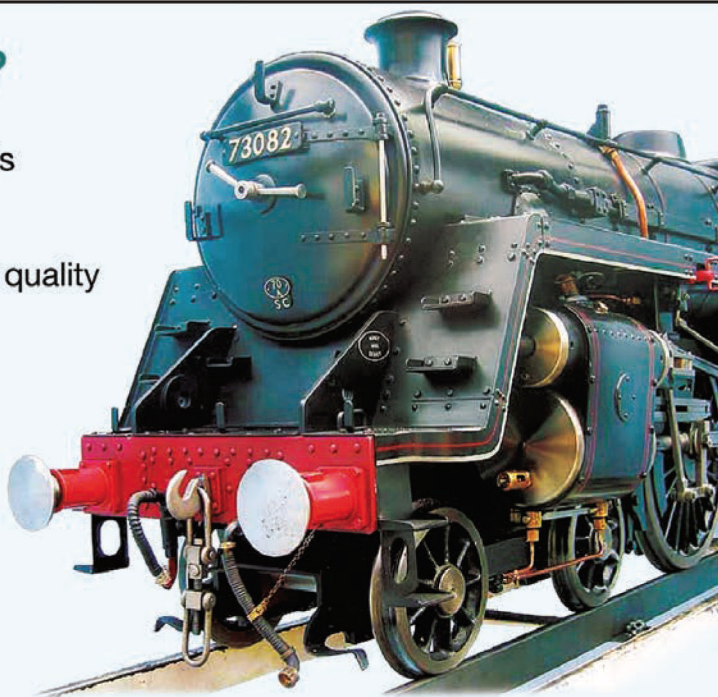
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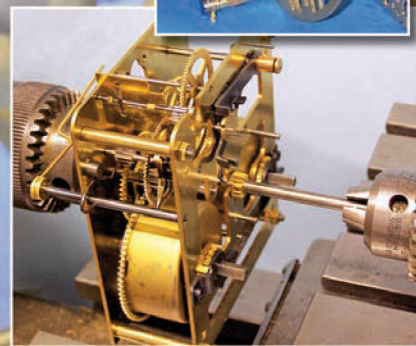
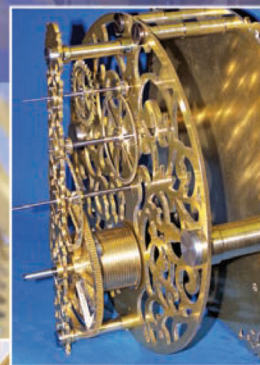
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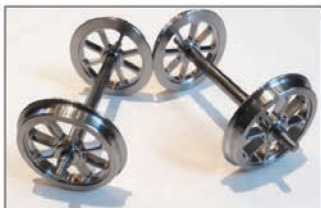
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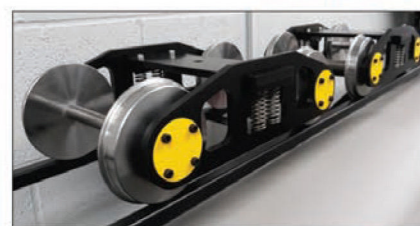
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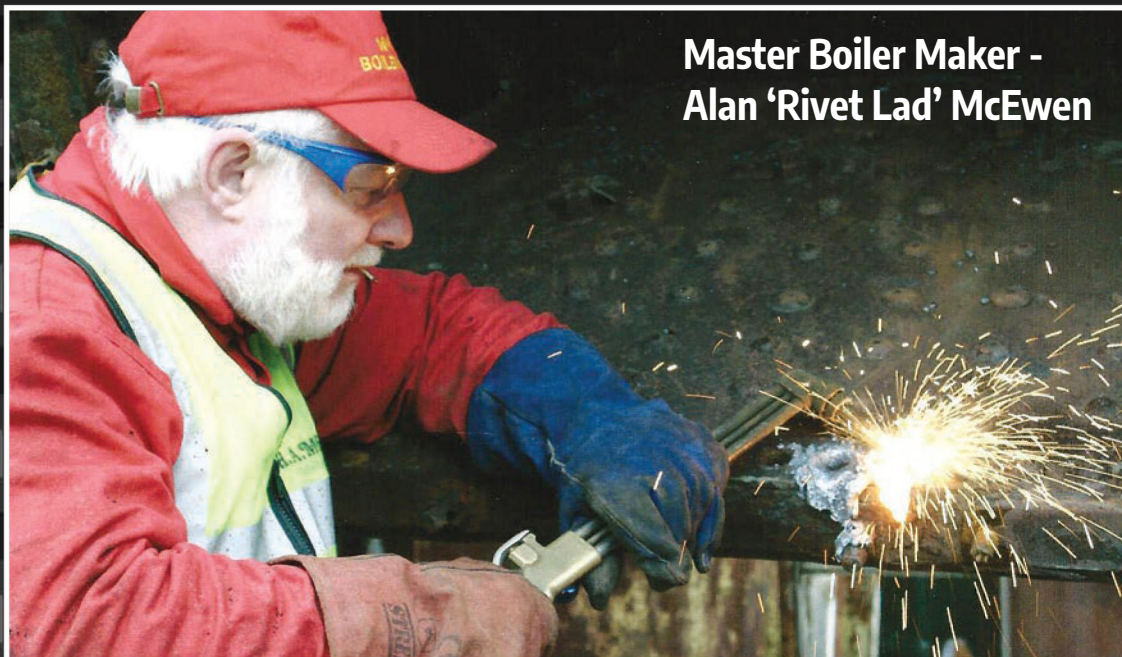
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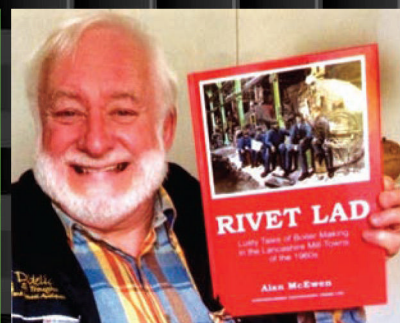
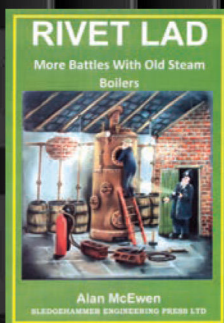


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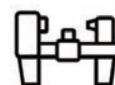
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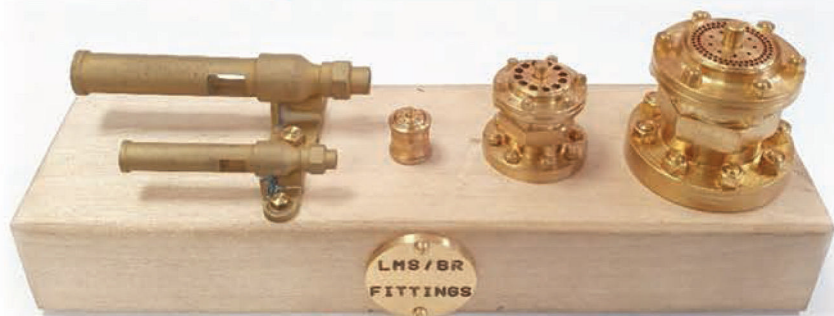
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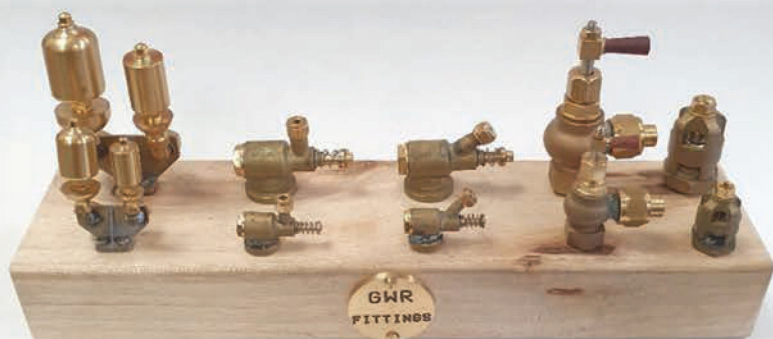


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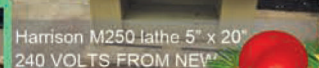
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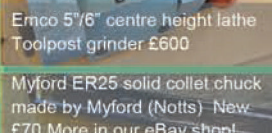
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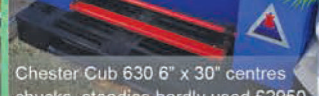
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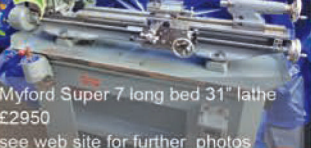
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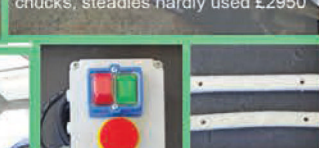
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