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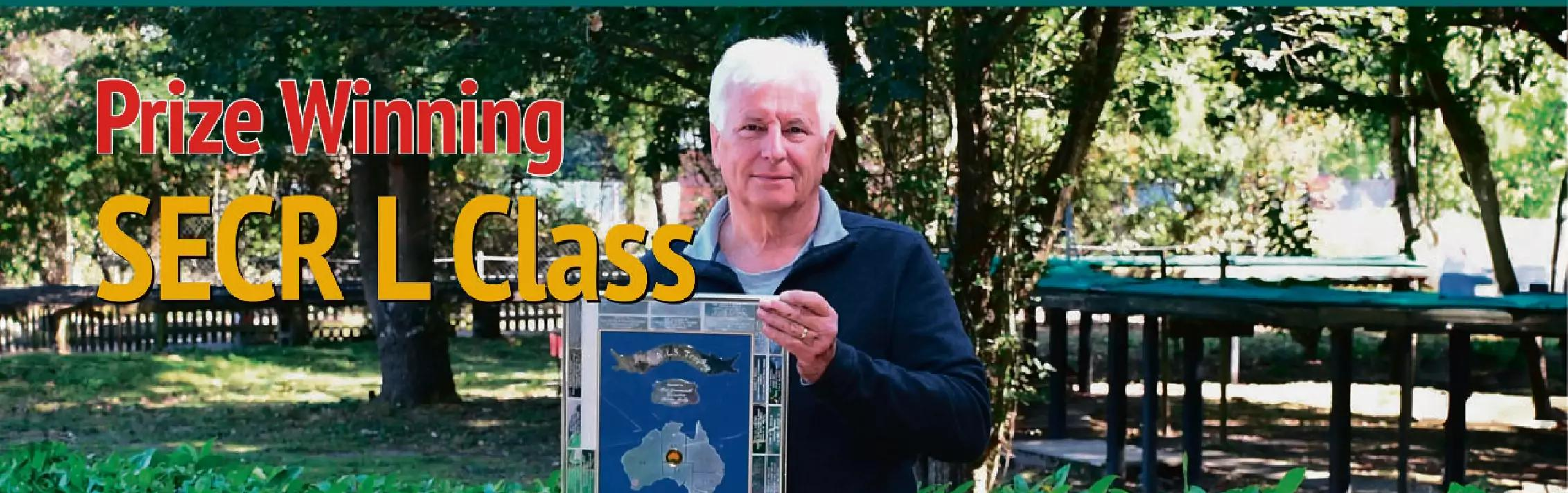
Vol. 233 No. 4754 18– 31 October 2024

# MODEL ENGINEER

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Beam engine inspired clock



Prize Winning SECR L Class

DIGITAL

Brushless DC motor technology

Pre-WW1 motorcycle design

Making a start on a GWR pannier tank

# MODEL ENGINEER

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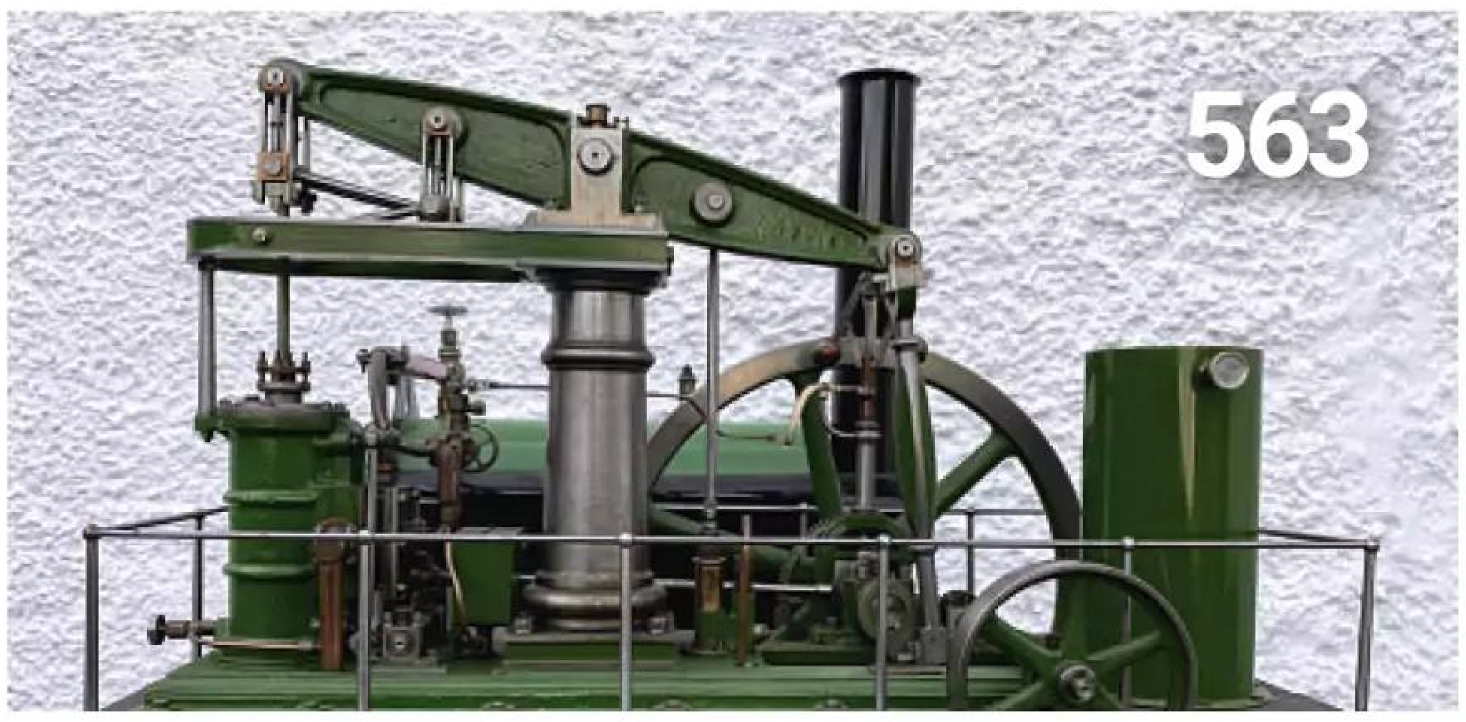



## IN THIS ISSUE


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## ON THE COVER...

*Les Brimson (North London SME) was awarded the Australian Association of Live Steamers Trophy at the recent FMES Rally for his 5 inch gauge SECR L Class 4-4-0 locomotive for workmanship, finish and detail (photo: Mike Chrisp).*

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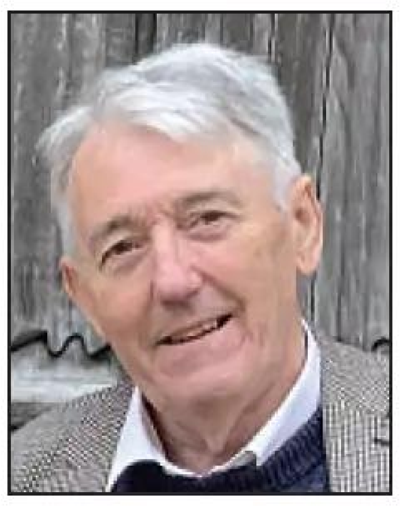
# SMOKE RINGS



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LOWMEX

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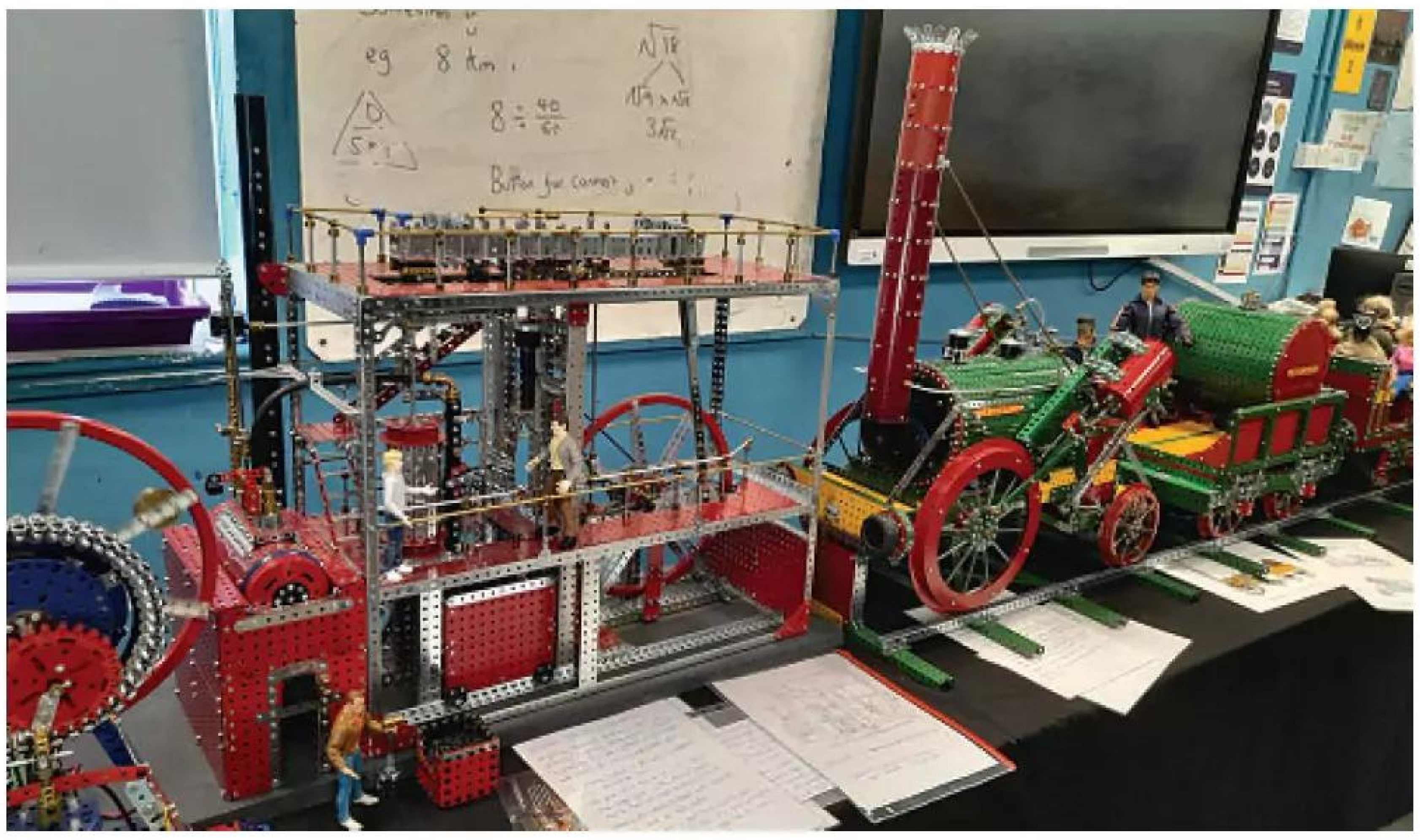
## ST ALBANS

Over the last several years we have unfortunately lost most of our major national model engineering exhibitions.

The last show run by this magazine, for example, was the 2016 show at the Brooklands Museum. Since then we have lost the Alexandra Palace and Harrogate/Doncaster shows, which leaves rather sad gaps in the model engineer's diary. The Midlands show, this week, is currently the only regular national show still on the calendar. Fortunately, a number of clubs run their own shows and some of these are most impressive, matching the scale, even, of the big national shows.

One of these is the Big St Albans Model Show, run by the St Albans & District MES at the Townsend School in St Albans. I was fortunate enough to attend the show a couple of weeks ago and found a very wide range of exhibits there. There was a large display of boats and an impressive collection of Meccano models, including a nine foot long model of the USS *Missouri*, complete with revolving gun turrets. There was a large room dedicated to radio control trucks and many model railway layouts of varying gauges. There were few locomotives or traction engines of the larger scales or gauges but a good collection of gauge 1 and 2½ inch gauge engines and rolling stock. Train rides (free!) were available outside and inside there was a 7¼ inch gauge track laid along a long corridor, providing a 'drive it yourself' experience, which was very popular with the youngsters.


*A fine 3½ inch gauge* Lion*, built by Brian Stringer.*



*Part of the very extensive Meccano display.*

*Mike Joseph's* Zahia*, a battery electric loco on her transport trolley, as featured in* Model Engineer *(M.E.4716, May 5th 2023).*

The show has run a couple of times recently (2020 and 2022) and I hope it will become a regular event (perhaps even annually?). I can certainly recommend a visit.

*USS* Missouri *in Meccano, built by Steve Briancourt.*

## LOWMEX

If you missed the St Albans show, there is still the Lowestoft show ('LOWMEX') to come, with a similarly broad range of models to see. It has been running for several years now and goes from strength to strength. It's an extensive show, rivalling the former national shows. If you live anywhere in or near East Anglia I believe it is a 'must see'. The show will be on the weekend of the 2nd and 3rd of November at the East Coast College, Lowestoft. More details are available at www.lowmex.co.uk

# Brushless DC Motors

**Jon Freeman** explains the benefits of using the latest electric motor technology.

Long ago, Somerset team Julie and Jon joined the local model engineers and started driving their Polly steam locomotive on the miniature railway in a local park, giving rides to the public a few times a month during the summer.

Driving Polly in the park was fun but too much time was spent keeping it clean and in good working order. Maybe an electric locomotive could be a time saver. Critical eyes were cast over visiting electrics, inspiring thoughts about creating something robust and to high standards - a low maintenance design, to be more reliable and more efficient than the norm, using more up to date technology.

This led to thinking of using modern brushless motors, rather than old style carbon brushed DC motors seen in other locomotives. With only two bearings and no other moving parts in contact, brushless motors are inherently more compact, efficient and reliable. They're also quite different, a little like a DC motor turned inside out with some parts thrown away, the magnets on the rotor with the windings closer to the outside on the stator. Often called brushless DC motors, it's more accurate to think of them as permanent magnet synchronous three phase, AC motors, and we'll need some new electronics to make them work at all.

*The Wedge* was the first five inch gauge brushless electric locomotive to emerge from the workshop, nearly a decade ago, the design brief being to produce a locomotive 'not less powerful than the Polly'. **Photograph 1** shows respected steam expert Geoff Stait quite enjoying a test drive at West Huntspill in October 2015. As a regular runner ever since, *The Wedge* has given hundreds of hours and hundreds of miles of trouble free service. With grease packed roller axle bearings, the minimal maintenance regime has been an infrequent look for anything coming loose and a drop of oil to eight plain bronze bearings. Power is from a pair of 50 amp-hour mobility scooter batteries. These remain permanently fitted, with a socket provided on the control panel for a scooter charger. Observing a strict routine of recharging immediately on return from any outing has kept the original batteries in usable condition all this time.

The electronics used in *The Wedge* were designed and assembled to prove the effectiveness of brushless motors and drives and as a platform for further development. As such, cost effectiveness was not a particular consideration and the whole construction cost was a little higher than for similarly powered kits or ready-built locomotives available at the time. The economic case ever since has been constantly moving in favour of brushless designs.

At a recent special event in the park *The Wedge* was on duty for a full seven hours. Although the acrylic body shell does a perfect job at keeping

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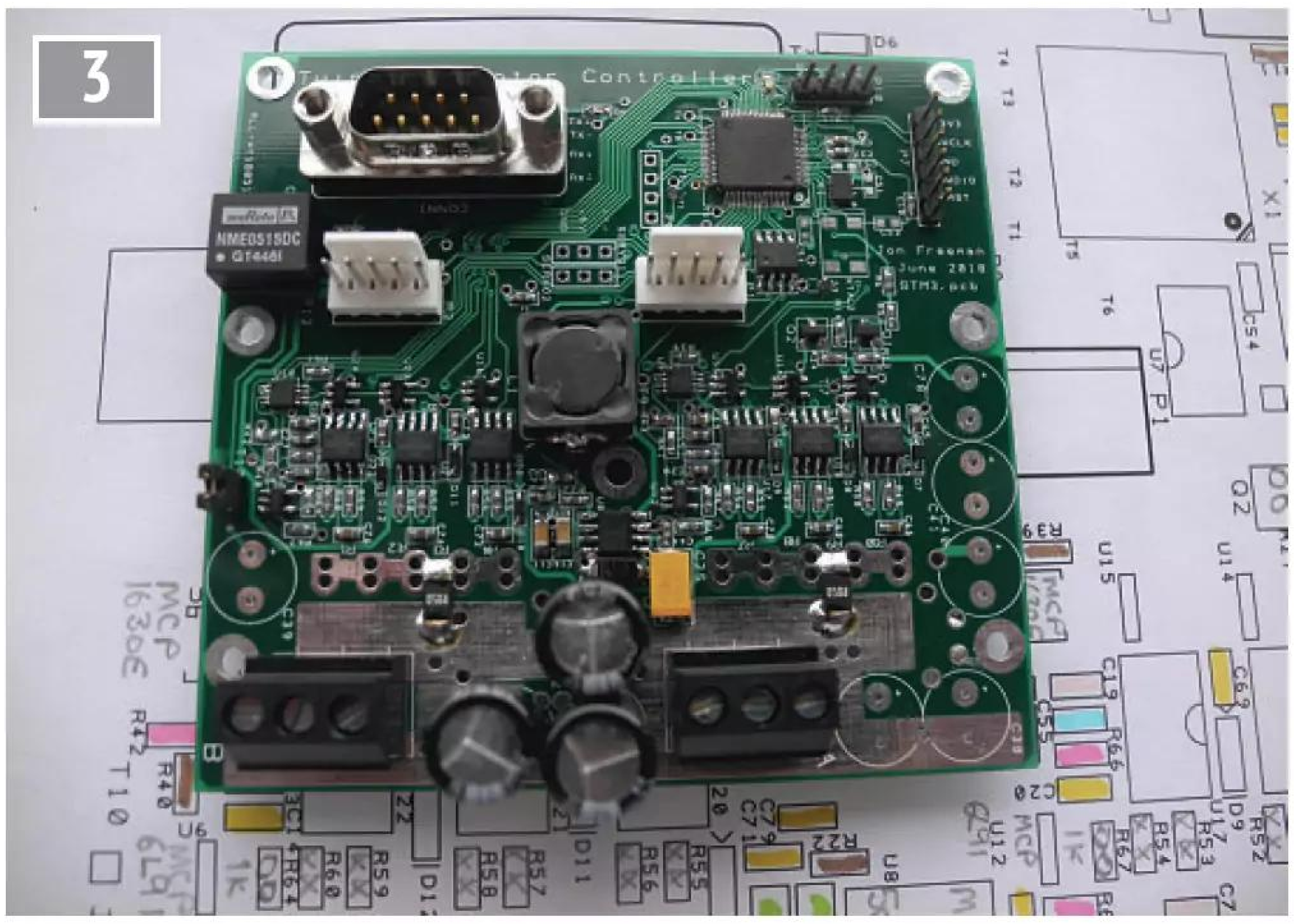
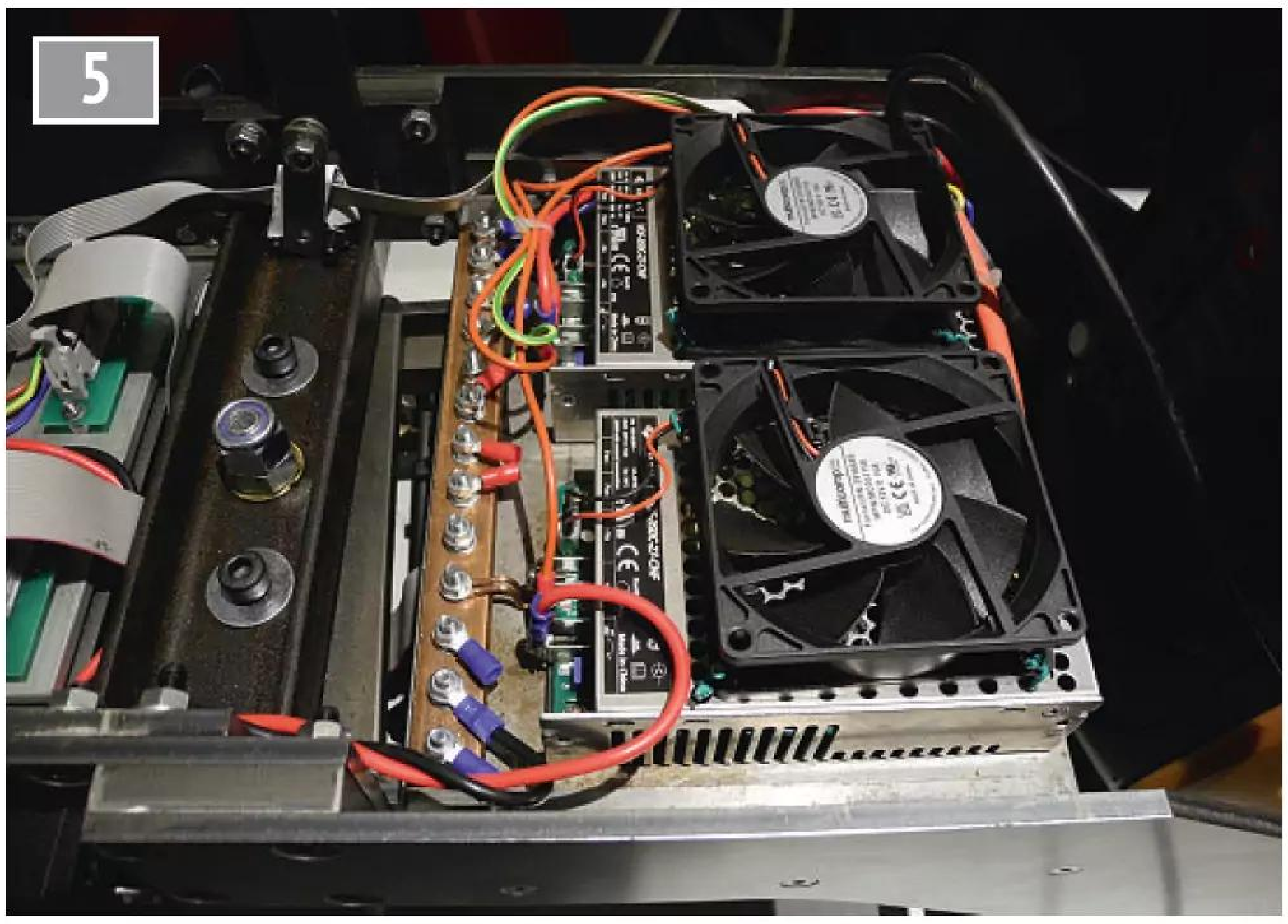
*Geoff Stait driving Wedge at West Huntspill.*

*The Brutalist at Vivary Park Taunton.*



*STM3_EMC dual brushless motor controller.*

*Motors used in* Wedge *and* Brute.



*Baby Deltic power supplies.*

water out from above, wheels on wet rails flick rusty nastiness up inside soaking some of the exposed electronics within. This is a known issue and a few times an old toothbrush has been used removing rusty crud deposits. After a brief rain shower that afternoon, performance had become 'a bit jerky', dirty water having got to where it shouldn't. Lifting the body shell off, and running the next few laps letting the air get in to dry it all soon had it back to normal.

A question often asked - "how long do the batteries last"? We can now honestly answer - "seven hours, or maybe more". Regular public running sessions are normally only three hours and other electrics have often bowed out in less time than this with failing batteries. It is surprising how much more efficient brushless motors can be.

Building upon experience, a second brushless design, *The Brutalist* or *Brute*, followed on two years behind *The Wedge*. This petrol-electric has two sets of bogies to run on five or seven-and-a-quarter-inch gauges. **Photograph 2** shows *The Brute* sporting five inch bogies at Vivary Park, Taunton. The power unit is a 120cc Honda four-stroke engine driving a 2kW brushless motor as a generator. This has proved to be quite sufficient for heavy-duty work on the larger gauge, having performed some public running at Ashton Court Railway, Bristol. New electronic motor drives and controllers were designed with a view to making them available commercially. Each *Brute* bogie is fitted with one STM3EMC dual brushless motor driver controller (**photo 3**). This keeps the wiring tidy and makes for easy bogie removal. Both locomotives are driven by 'touch-screen' and both use the 'six-step' algorithm for motor drive. **Photograph 4** shows the motors used in *The Wedge*, and in both bogie designs of *The Brute*. They are rated at 105, 220 and 660 watt respectively.

Being quite big and heavy, *The Brute* doesn't get too many outings but it has a perfect reliability record to date - start the engine and go.

By design, neither of these locomotives bears any resemblance to any mainline prototype. Too often huddles of gricers have been seen gathering around someone's pride and joy, stroking their chins, mumbling and tutting about how awfully wrong it all is. Thankfully, most of these miserable wretches are so appalled at the sight of *Wedge* and *Brutalist*, they tend to keep well out of the way. Good!

Breaking with tradition, under construction at the moment is a locomotive to externally resemble a 'Baby Deltic'. This is a once-in-a-lifetime attempt at proper modelling, with the aim of building a reliable hard-working, rather than fine-scale showcase locomotive. With no volunteers coming forward to produce a working scale model of a Napier Deltic T9-29 nine cylinder engine, the power source will be a commercial 700 watt petrol inverter-generator powered by a 40cc single-cylinder four-stroke petrol engine. This just about fits, after taking very minor liberties with scale. The 240 volt AC from this is converted down to 27 volt DC using two VOF-350 industrial power supplies from Farnell (**photo 5**). From there on, the 'first fix' electronics uses all the same kit as in *The Brute* with modifications to make the locomotive radio controlled. »

Baby Deltic test run at Bristol.

This is the same as currently used by Tim Coles in his 18100 turbine loco. The Baby Deltic is now fully working, and complete except for the body shell and 3D printed cabs (much more on these in a future article!). The chassis has successfully completed test runs at Bristol (**photo 6**) and Taunton.

Still something of a novelty ten years ago, brushless motors are rapidly sweeping the board, relegating brushed DC motors to 'dinosaur' status throughout industry. Alongside this, the electronics industry has invested in development of many highly integrated, low cost motor drive solutions. A fresh look at this latest technology encourages adoption of simplified, higher performance, lower cost control designs for this latest locomotive.

An important step in the process of designing for reliability is in understanding likely modes of failure and their consequences. Locomotives of these scales may take harsh treatment and we could draw up a list of likely failures: seized axle, shorted or broken wires, slipping drive couplings – and doubtless many others.

With minor variations, all other locomotives seen have been configured as shown in **fig 1**, a number of brushed DC motors wired together to a single power controller. This may work well enough while everything runs sweetly with motors sharing power equally between them but there is little or no resilience to any likely failures. The weakness is that any fault will upset the balance, which has consequences.

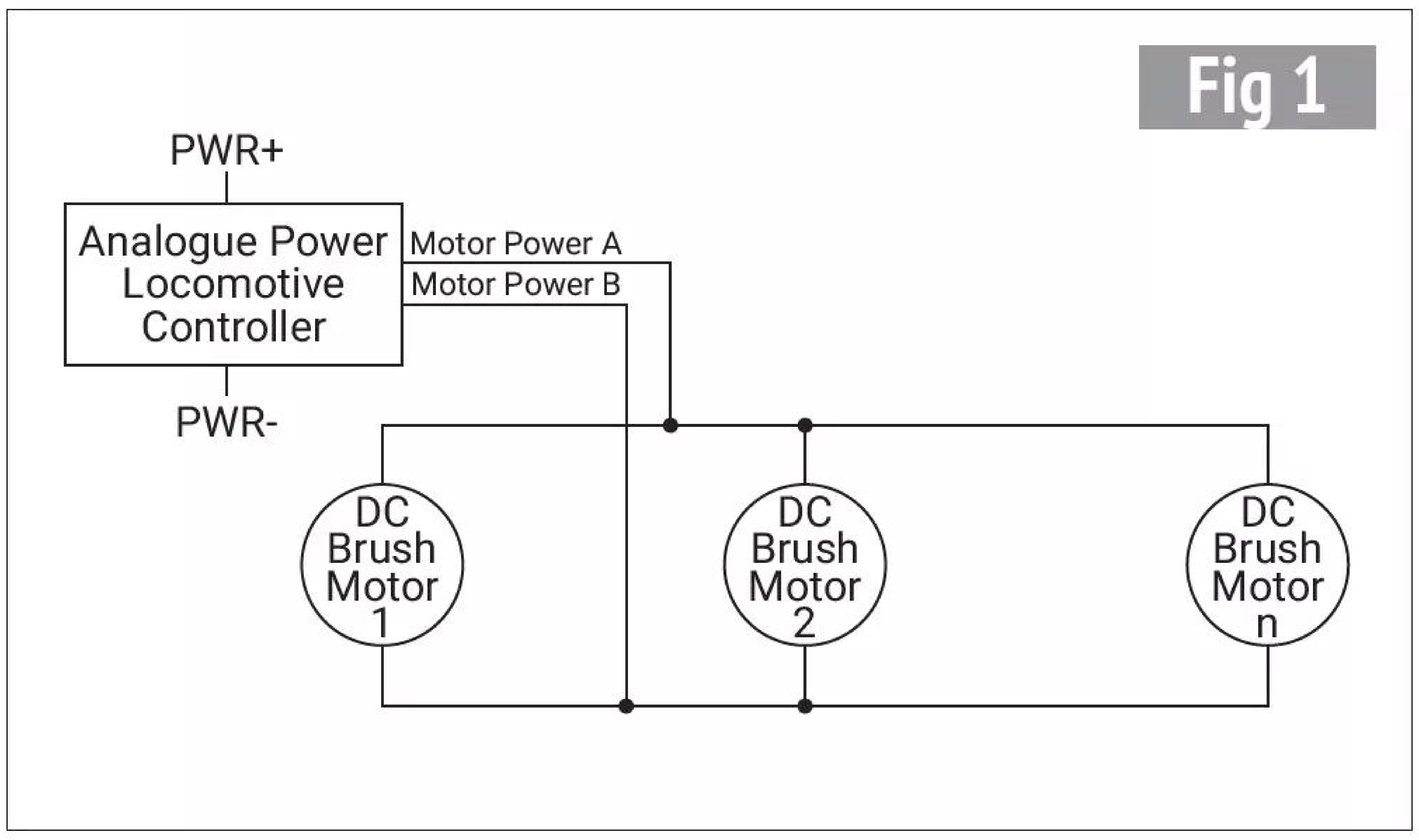
A stalled motor may draw a much higher than rated current leading to damage or burn-out. As another real example, recently on the club track a two motor locomotive was seen trailing plumes of smoke. Somehow one motor had become disconnected, allowing twice rated power to cook and burn the other. Which ever way we look at it, the open loop, single-controller multi-motor model of fig 1 is unreliable by design.

**Figure 2** illustrates the design topology we are moving towards in using brushless motors. Each motor works with its own intelligent motor drive circuit, consisting of six power transistor electronic switches providing motor power and a microcontroller overseeing operations. Any motor problem is managed locally and safely within its own driver, without affecting any other motors or motor drives. All of this with virtually no chance of letting any smoke out. The locomotive controller has been simplified by shifting all the power electronics closer to the motors, while capability has been included for data communications. Modern microcontrollers come with a selection of inbuilt data communication methods and the one chosen for ongoing work will be 'CAN Bus'. The locomotive controller now sends digital commands to the motor drives, which may respond with status information. Any alarm or problem may then be displayed on the locomotive control panel.

On *The Wedge*, for example, the control panel display includes a simple quad bar chart section (**photo 7**). This indicates the measured speeds of each of the four motors. The occasional glance while driving to see them all about the same is sufficient to know that all's well.

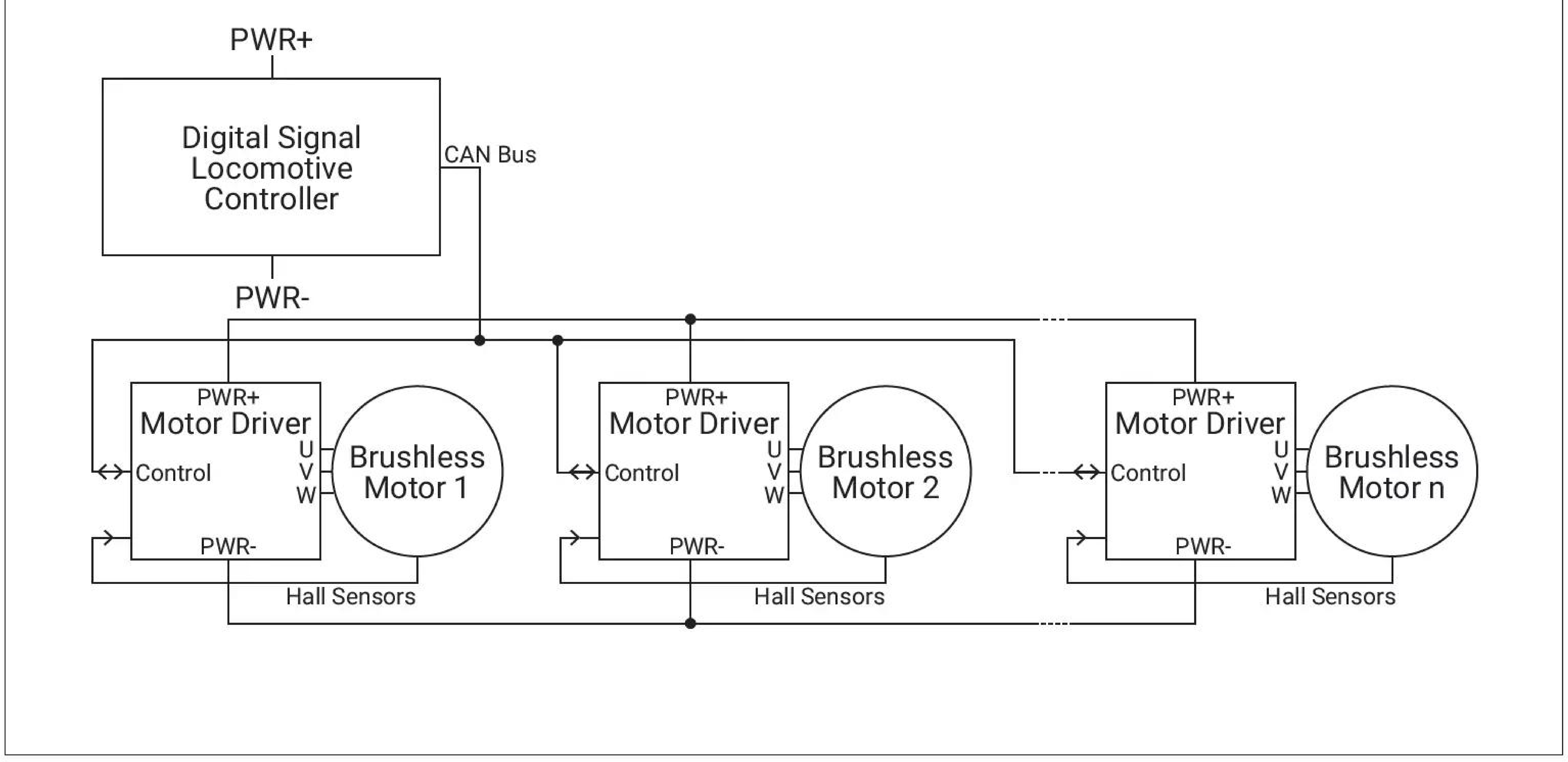
The brushless motors used have eight wires: three heavy wires for the motor power phases and five finer wires to do with three internal Hall effect sensors which provide information to the motor driver about the motor shaft angle at any instant. Not all brushless drives use sensors but they are essential to the 'six-step' algorithm that works very well for our purposes. It can be a little painful routing all these wires within a locomotive but as motor drives get smaller so it becomes easier to mount them on, or at least close to, the motors. This localises and keeps wiring tidy, individual motor drivers then being easily connected together and wired to the locomotive controller.

Back in 2018 the STM3EMC dual brushless motor controller was released. Designed using general purpose electronics of the day, these boards used quite a large number of small components and offered little change out of a hundred pounds per motor. These are used in *The Brute*, and in the




Dinosaur DC motors.

Fig 2




*Safe brushless motor scheme.*

Baby Deltic to start with. Selling in admittedly small numbers, reliability has proved to be good with none ever being returned for any reason. Get out the locomotive, drop it on the track and hit the controls. It all just works without a worry.

The latest advances in electronics provide significant cost and space saving opportunities. For example, measuring only 9mm square, the STSPIN32G4 system on a chip offering from ST Microelectronics comprises a high performance microcontroller, together with other components optimised for motor drivers. Even in small quantities, it costs about the same as a pint down the pub. One of these on a circuit board with six power switching transistors, and a sprinkling of other small components, and we have all the hardware in place. With on board configuration memory, motors will be driven safely within manufacturers' limits, while monitoring performance and responding safely to any abnormal or fault conditions. This motor drive hardware, once proved on the bench, will be built initially into the Baby Deltic and to upgrade *The Wedge* and *The Brute* in due course.

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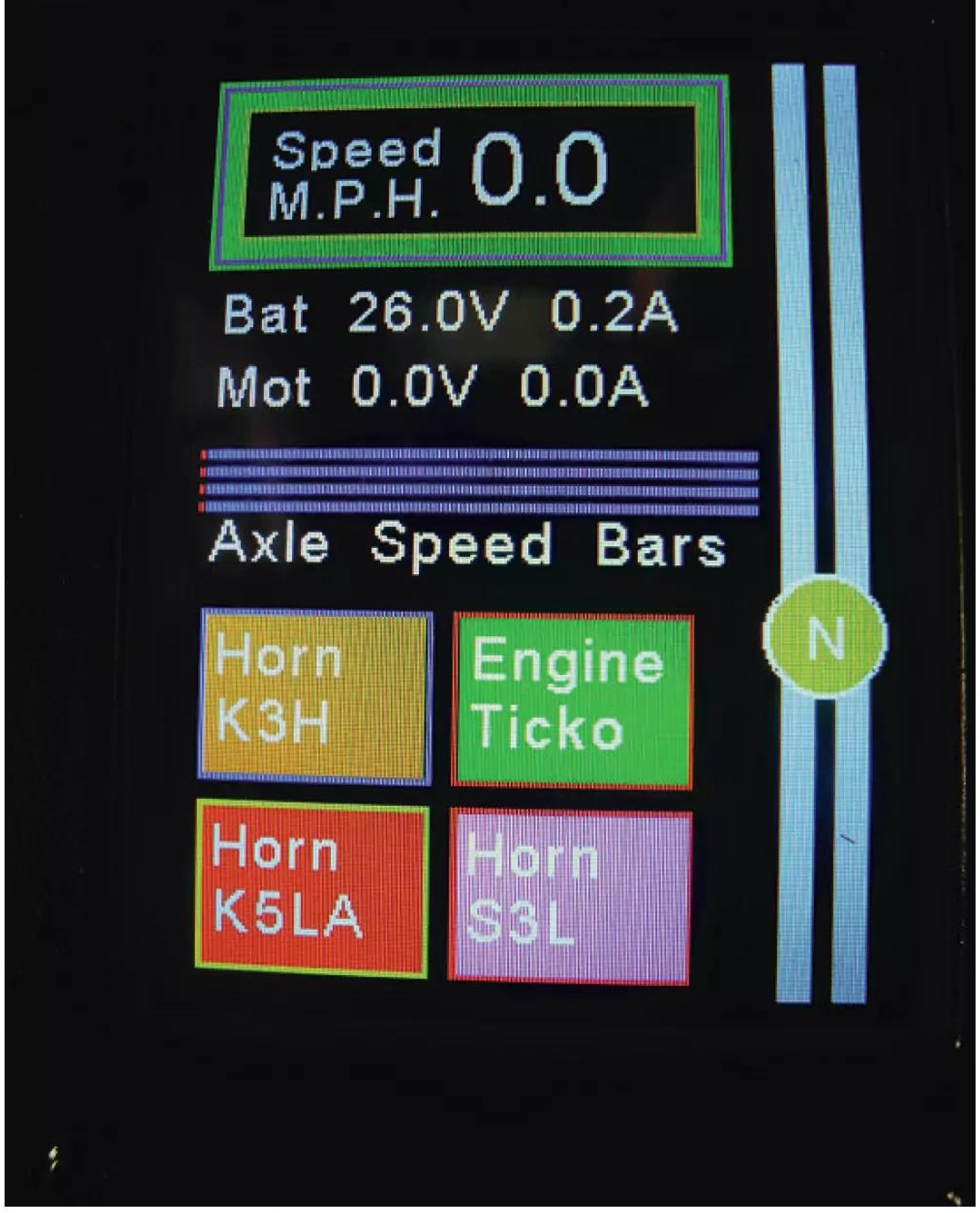



*The Wedge display and touch screen.*

Building electronics using these tiny surface-mount components is no longer a realistic task for the hobbyist. The 9mm square controller chip has 64 connections with a 0.5mm spacing and they're all underneath, where you couldn't get a soldering iron even if you wanted to! Fortunately there's a local company with all the proper kit who can assemble circuit boards for us at a reasonable rate.

Not much works without software these days, motor drivers included, and over time a library of useful motor control and train driving code has been built, incorporating a lot of good feedback from users. This includes the idea of 'driving to limits'. In the motor driver, maximum values for voltage, current and speed are set. This provides total motor protection, from the electrical side at least. A set of variable 'working limits' are used in motor control. These working limits may be individually set to any value from zero to the maximum limit set. This enables a vast choice of control methods, some of which may be useful in traction applications.

For example, with any two of these variable limits set to maximum, the locomotive can be controlled by varying the third between zero and max. This opens the way for new, possibly better or more interesting, ways of driving. For example driving by varying the voltage limit gives a driving experience similar to that of a classic dinosaur DC motor and controller setup. Driving by varying the speed limit is similar requiring even less driver brain activity but arguably more interesting is driving by varying the current, or torque, limit. This gives an altogether different feel giving the driver more of a sense of what's being asked of the locomotive. With torque limit driving, the driver will need to set the control high when pulling away or climbing a gradient and maybe turning it down to zero elsewhere on the track. It would teach the driver something about the track if nothing else.

Work is proceeding towards getting the new motor drive electronics running the 'six-step' algorithm so that new controllers can be almost seamlessly retro-fitted. This leaves scope for future development of software using other algorithms to possibly squeeze a little extra performance and efficiency.

With no space left in the shed, there will be no more locomotives after Baby Deltic 5 9 1 4. This last one's for Julie.

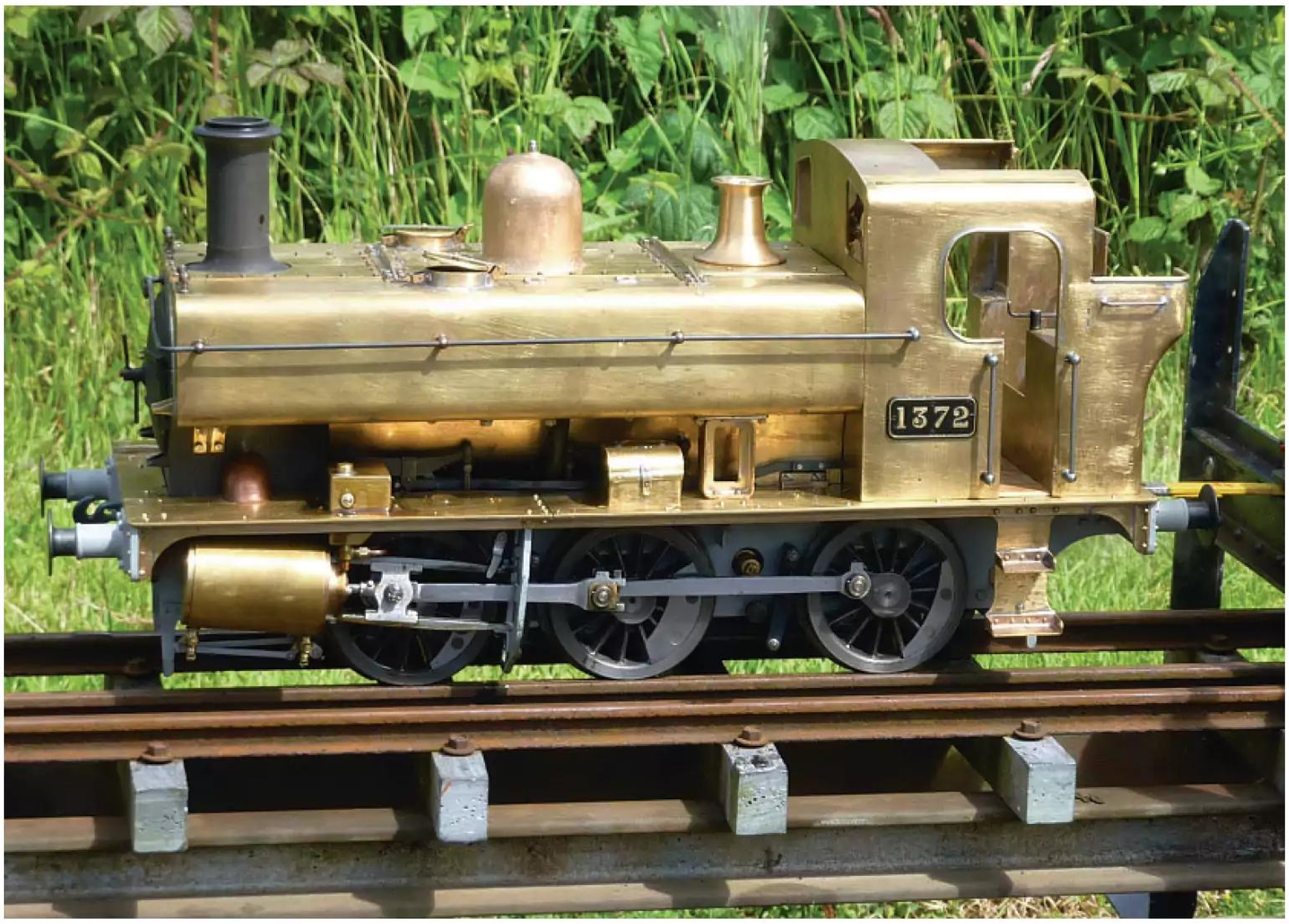
ME

# A GWR Pannier Tank in 3½ Inch Gauge

## PART 3 – MAKING A START

**Gerald Martyn** decides to build a locomotive that he can lift.

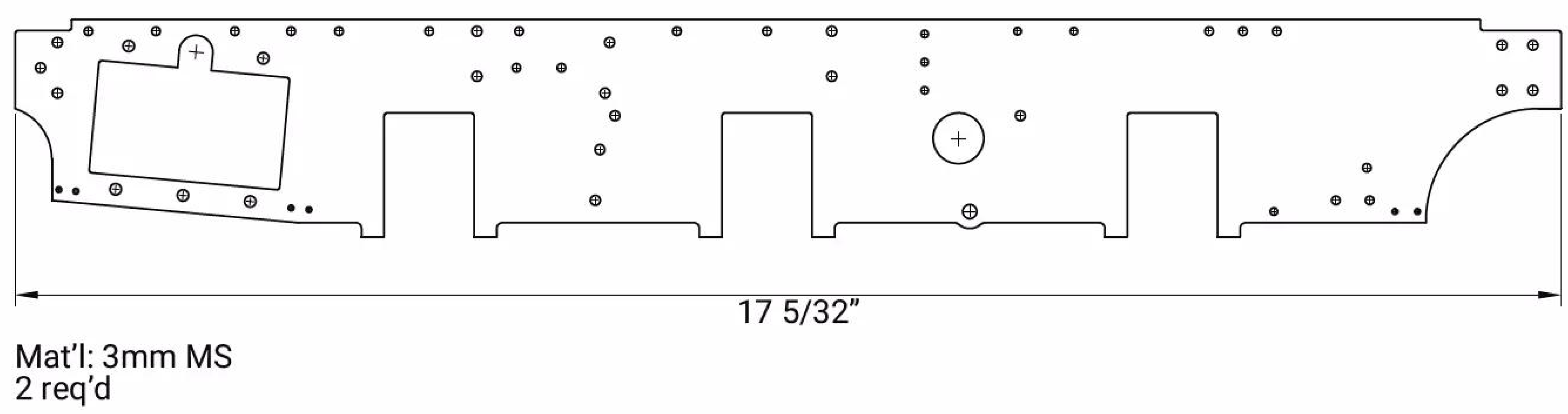
Continued from p.517
M.E.4753 October 4




### Frames

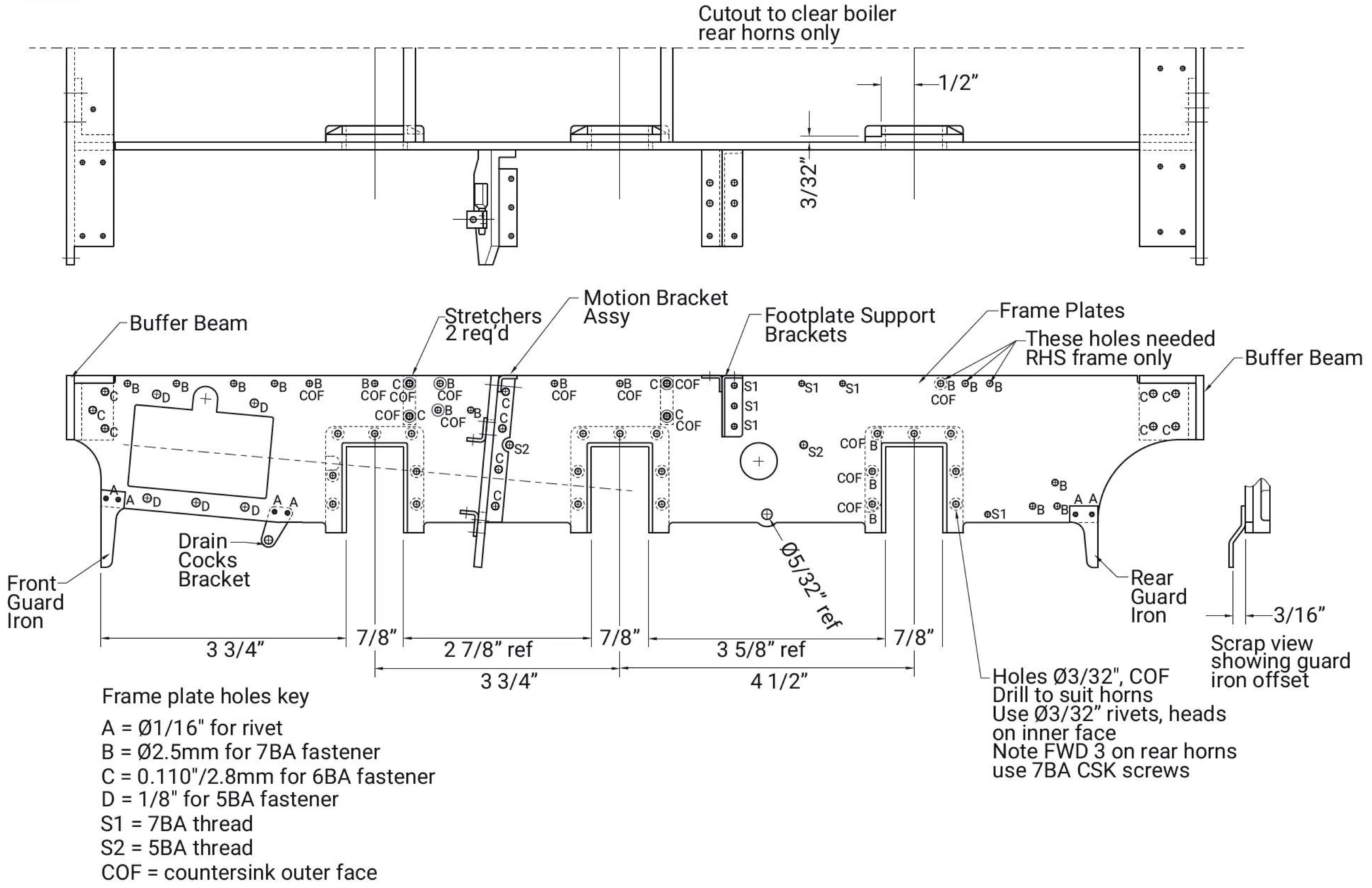
Just to show how little information is needed by the laser, which gets what it needs from the digital shape, **fig 4** shows a visual representation of the main frame plates. I've just given one dimension to help scope the size of the job and even this is not essential. Just think, also, of all the drawing office time saved by not dimensioning every feature on this drawing and how cluttered it would become. The frames need a bit of finishing before fitting and final machining of the horns. The laser cannot cut small holes, so those down to about 0.108 inch (2.75mm, 5BA tapping size) should be there, but for smaller ones the position will be accurately

Fig 4




*Frame drawing for laser cutting.*

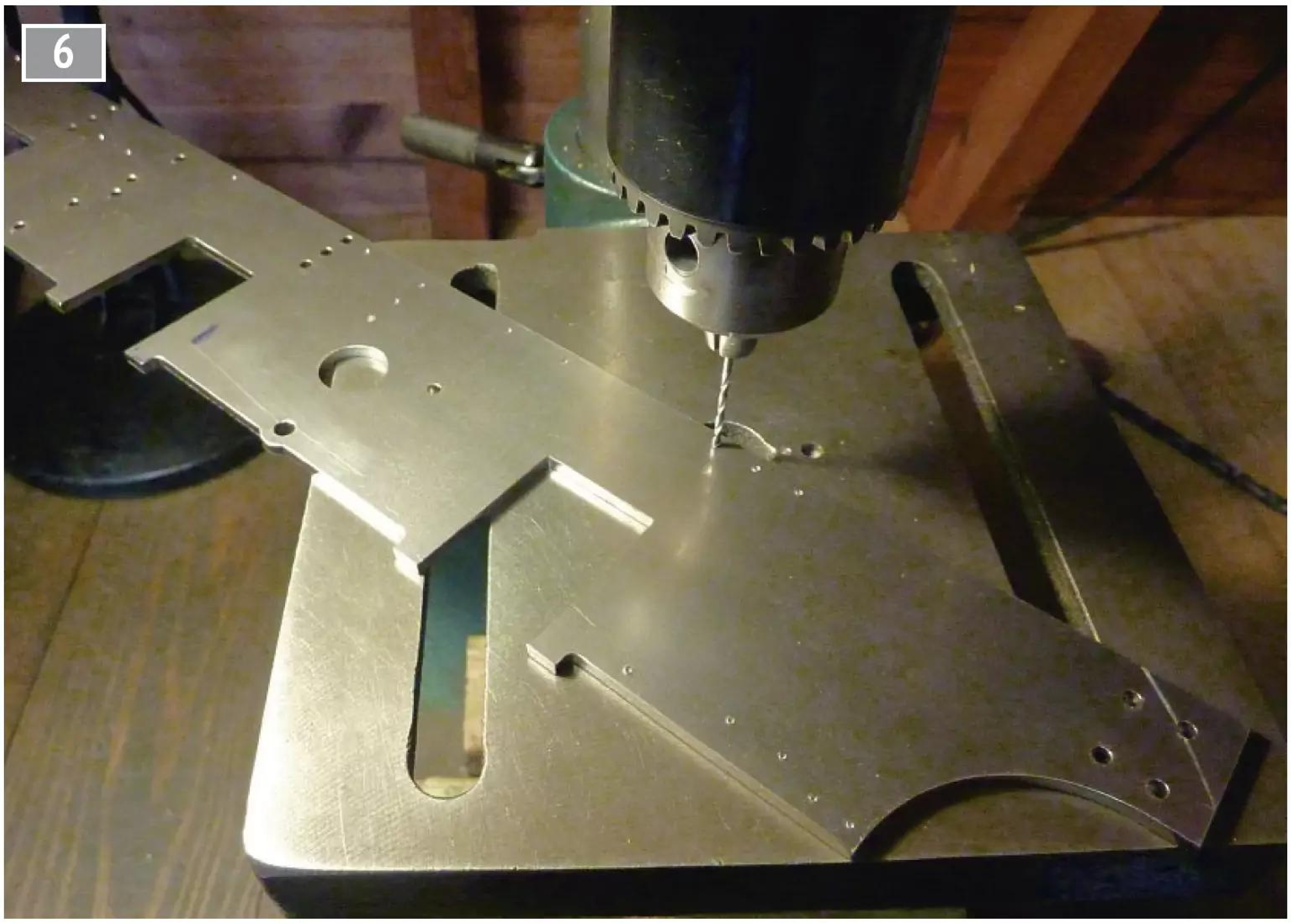
Fig 5




*Drilling details for the frames.*

marked with a small cross. The frames general arrrangement with the side view giving all the drilling and thread tapping information is shown at **fig 5**. Other information is given to aid machining the horns after they have been fitted but for now the task is to drill the holes, tap the threads and cut the countersinks in accordance with the code letters given in the holes key list. Centre punch at the exact centre of all the little crosses on one frame only.

**Photograph 6** shows the first pilot hole of the three for the reverser which are in the right-hand frame only. Pilot hole? It's common practice to start with a small drill which will more certainly pick-up in the centre-pop mark and will also remove the bit in the middle of the hole where a larger drill has no proper cutting edge. (Note: Photo 6 is an illustration and my spare hand is holding the camera; I'd normally hang on to the part




*Pilot drilling frame holes.*

being drilled!) These holes are needed in the right hand frame only. For the other holes bolt the frames together using 6BA bolts and drill through both as a pair. Separate the frames to countersink (try to get these on the right side!) and tap threads. The frames have some skinny

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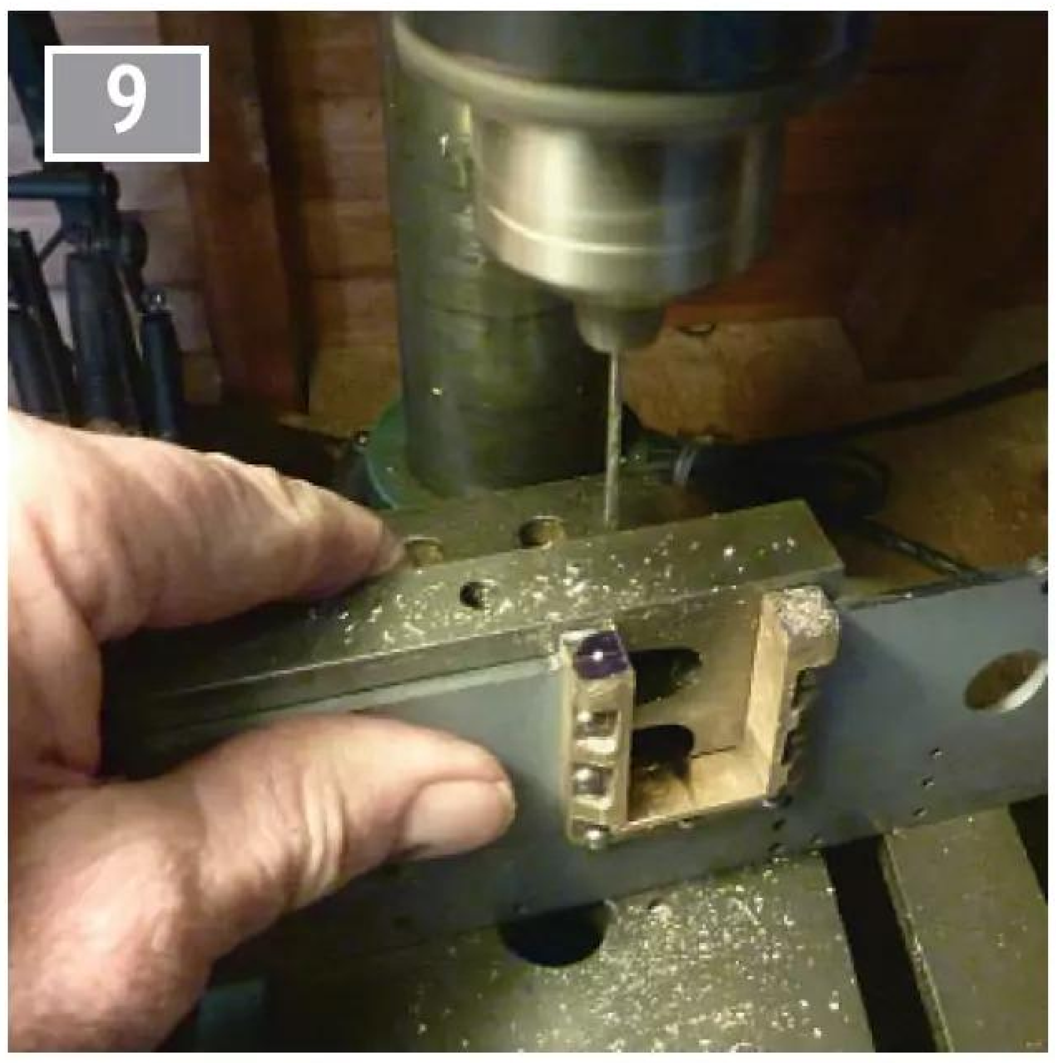
*Filing the horn retaining rivets flush.*


*Milling the horn slots.*




*Drilling the horn toes.*

sections and are a bit delicate until assembled and are easily bent. They may also be a bit curved anyway. Just bend them straight, in either event. When fully assembled they gain lots of strength from the other parts and, later, from the parts that will be bolted to them, particularly the smokebox.

A digression now, about holes and threads. Laser cut holes will generally be 'size' unless reaming is called for, in which case they should be a few thou. under. For threads I always use the recommended tapping sizes, whether drilled or laser cut. This ensures a decent thread without too much chance of breaking a tap. The thread clearance sizes given in data tables are rather arbitrary. To ease assembly they allow for some notional mismatch between the holes on two parts being bolted together, so are oversize and give a rather sloppy fit. I prefer to use close clearance holes and, with the accuracy of laser cutting, the parts will almost always assemble. I also hate to buy special sizes so use what is in a standard drill set whenever possible. So, for (say) 6BA fasteners I find a 7/64 inch drill will just do and have specified diameter 0.110 inch for laser cutting. If parts will not assemble then you can always run a larger drill through and be no worse off than if using a sloppy fit size in the first place. For larger clearance than with the small BA sizes, the tapping drill from two sizes up will generally do quite nicely. Tapping threads in small holes can be a bit worrying but normally if you just back-off half a turn or so, as soon as there is any increased resistance, to break the cutting chips away, all will be well. When taps become worn (more torque, more friction when reversing out) then throw away and replace. I've not had much success with proprietary thread-cutting lubricants in these small sizes but by chance found that Stihl strimmer gearbox grease 'Superlub FS' works reasonably well for most materials, including copper.

On with the story. With all the holes finished then it's time to dress off all the sharp edges and remove the little pips where the laser started and stopped. This is simply good practice. Parts will not assemble properly if there are sharp edges and burrs sticking out. I use a small flat oval needle file but special tools are available. For holes then a finger and thumb twirl with a larger size drill usually works. Do these things on everything but I'll probably not mention them again.

The frames are now ready to have the horns fitted. There are either seven 3/32 inch rivets needed for each, or four rivets and three 7BA screws at the rear axle positions. Hole positions need to be worked out because casting variability precludes precise locations for all. They also need to be countersunk on the outer frame face to give a flush surface but not so deeply that the rivet tails cannot be hammered in to fill the space. It's good practice to put a layer of something between permanently assembled parts and I gave the frame a local spray with primer. Fit a 3/32 inch rivet through from the horn side, clip it off short and hammer the tail to fill the countersink. Repeat! The rear pair of horns have three 7BA countersink screws each, fitted into countersinks in the outside face of the frame. These are as permanent as the rivets so are assembled with Loctite 603* to lock and fill any voids and the tails cut off flush with the horn rebate. A quick cut-off method (no doubt I'll get told off for this) is to use a second-best woodwork chisel, place the cutting edge on the screw at the horn face, and give the chisel a sharp rap with a hammer. To finish off then, file all the countersunk rivet tails and any protruding horn edges back flush to the frame (**photo 7**).

To machine the slots for the axle boxes the frames are bolted back together, outer face to outer face. This is never an easy task and this time I found my long milling cutter had gone AWOL, so adding to the difficulty. In truth, I've never managed to get a good finish by machining with an end mill or slot drill, as they're simply not designed for this sort of job, but a bit of careful filing has always sorted things out and did again this time. It would be far better to use a horizontal mill with a nice big side and face cutter, but I don't have one. First get the slot to the right depth, then attend to the width. **Photograph 8** shows one cutter pass, for interest. I take shallow cuts so as not to risk displacing the horn due to the cutter forces. This can happen in spite of the rivets. On the drawing I've put some reference dimensions which can be measured with a digital caliper (anyone still using a vernier?) to locate the slots. Measure the dimensions to several positions in the slot to find the 'least metal' position and use that as the guide. After all the slots are done, then the best time to carefully take off the high spots is when the axle boxes are fitted.

The 6BA holes in the horn toes (see fig 3 – Part 2, M.E.4753, October 4) come next and **photo 9** shows the drilling operation with the frame held against an angle plate to ensure squareness. Lastly, rivet on the drain-cocks brackets, which should be on the inside faces, and bend and rivet the guard irons, which should be on the outer faces. This took longer than it should because I had some of those infuriating 1/16 inch rivets which are actually made from 16 SWG wire, so of course don't fit in the holes. Hopefully my next purchase will be right. The frames can now be put aside for a while.

*Loctite; another innovative British company now in foreign ownership. I consider that their anaerobic products, like Loctite 603, are still the best available.

●To be continued.

# Unseizing a Beam Engine PART 1

SMEE's **Mitch Barnes** gets to grips with an ME Beam Engine steam plant, which had become seized up at some point in its past.

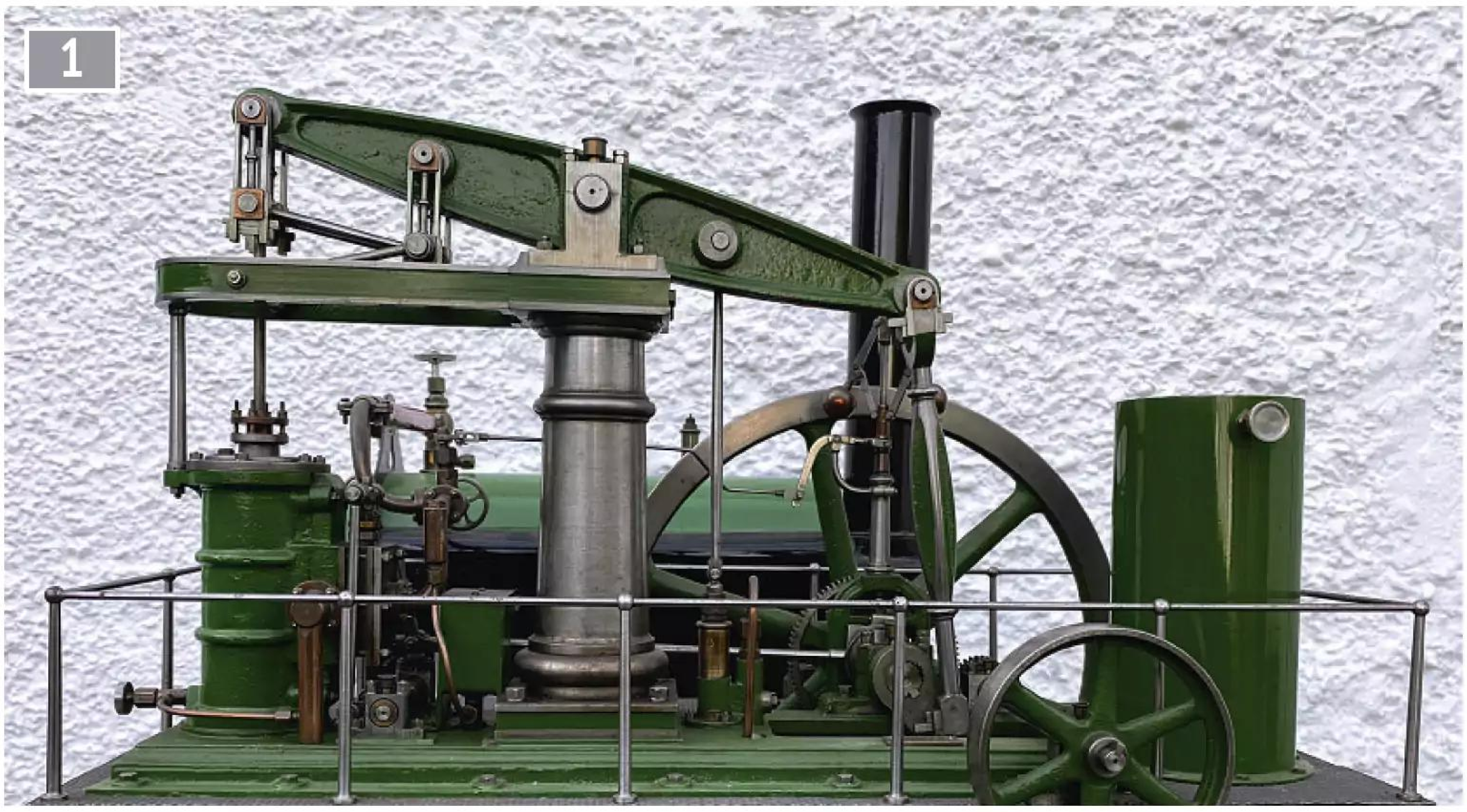
SMEE

**This series is a transcript of a talk given to the Engine Builder's Group at the Society of Model and Experimental Engineers (SMEE) in May 2024.**

## A bit of background

First of all, I'd like to shake the hand of the gentleman who built this steam plant (**photo 1**). It is without doubt one of the finest examples of this popular design that I have ever seen. It was the work of a Mr. L. J. Evans, in 1981, and unlike most model engine builders he was wise enough to put a neatly engraved makers plate onto the bedplate of his creation. If any reader can tell me where he built it and if he is still around, and even to introduce me to him four decades later, I'd be delighted to make his acquaintance. I wonder if he was familiar with full sized stationary engines as this one possesses a mechanical lubricator for the cylinder and a crankpin oiler, something I've rarely seen on a model outside a museum and often present on the real thing. This steam plant would have won awards at SMEE! I've always felt the Model Engineer Beam Engine and its larger sibling, the Major Beam Engine to be handsome beasts and a steam plant built around either one would be a lovely thing to have, so to be able to get this example going again should be a particularly rewarding experience.

The engine with its neatly enclosed Stuart 504 boiler came to me fresh from an auction. The purchaser knew from the auction description that the engine was seized, a problem I have seen before on model steam engines. Often this is the result of having been left with water in the cylinder after a running session but my first encounter with it was when aged 11 or so, and knowing almost nothing about anything driven by steam, I bought with pocket money an old Bowman oscillating pot boiler toy where the piston had been glued into the cylinder with Araldite! Defeated by this but not completely daunted, I soon graduated to Mamods and had quite a few before I left school. My friends and I enjoyed




*A superbly made steam plant, largely of toolroom quality. Who wouldn't want this?*

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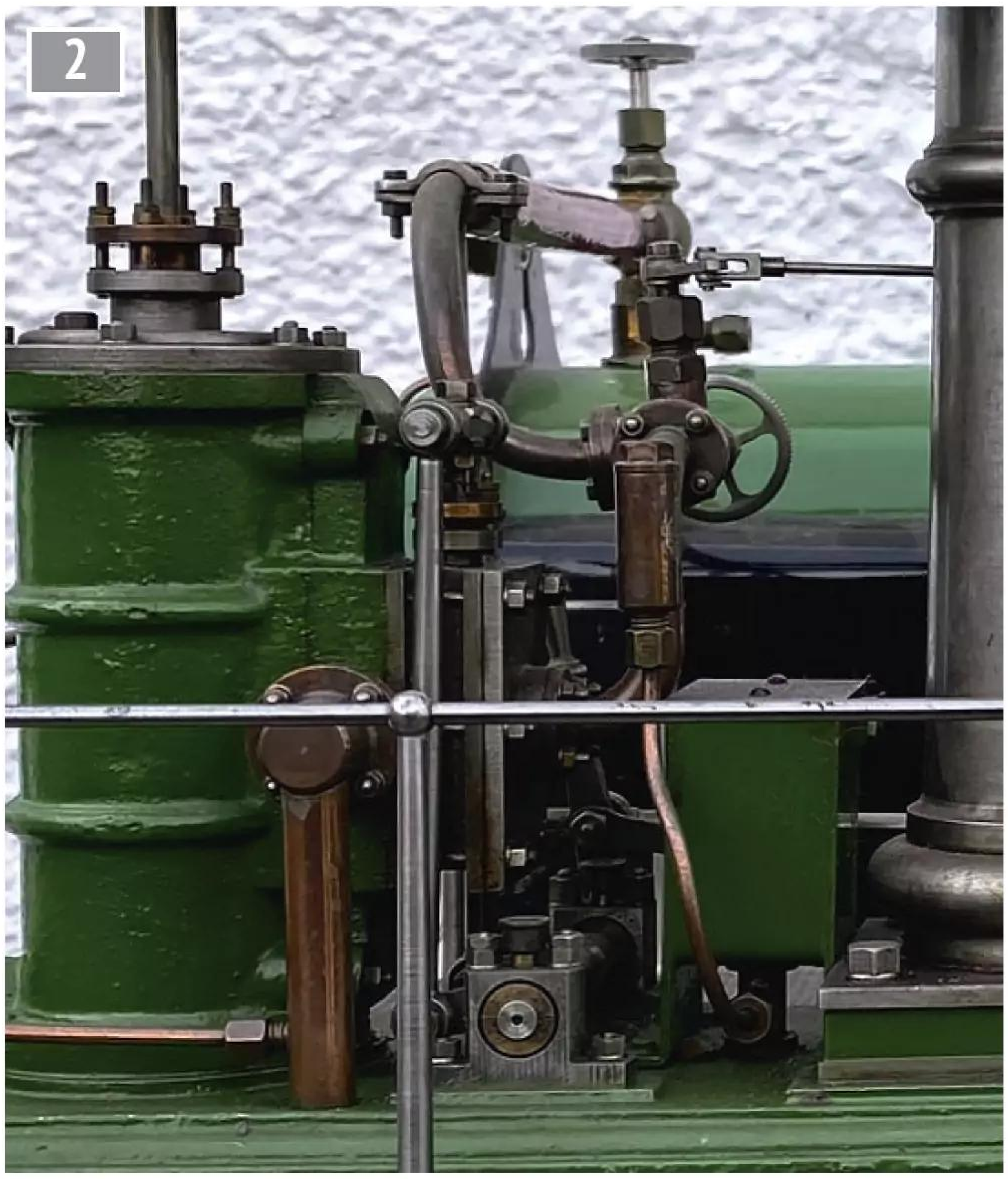
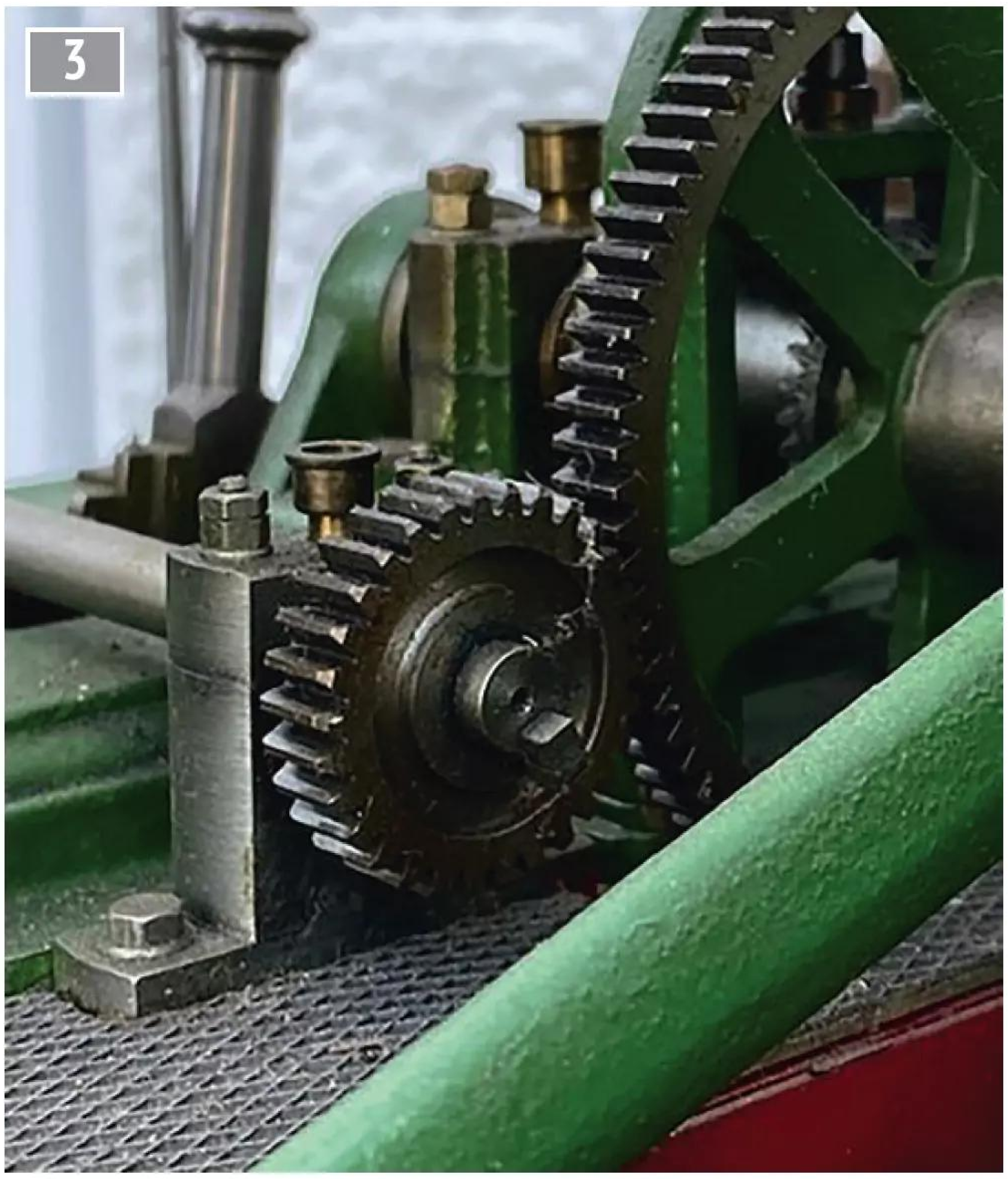


*The engine sports some nice details, all of which have been finely executed.*



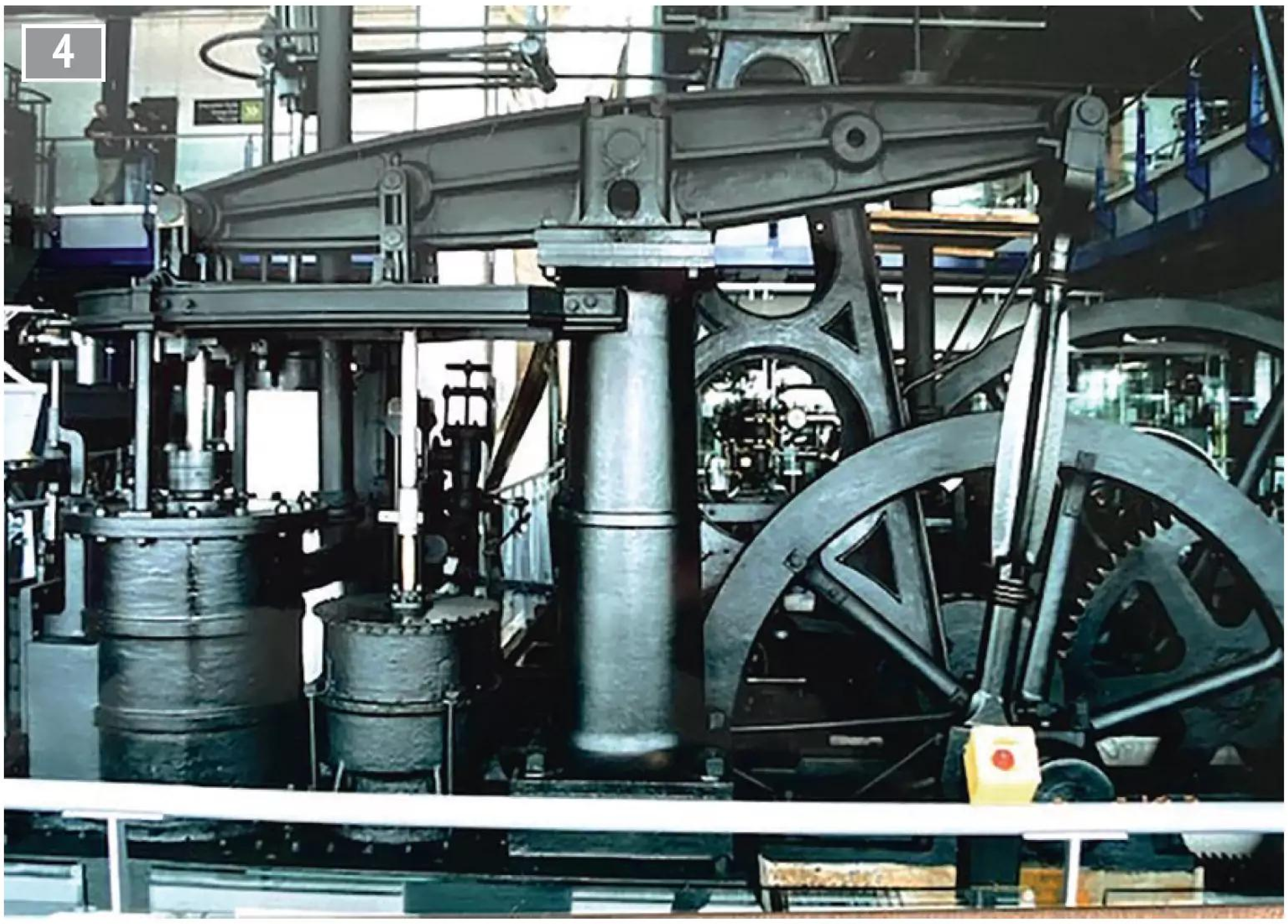
*Even the barely visible pinion wheel has been correctly shaped and keyed in place.*

running our models together and while they went onto other things, for me, the steam bug was instilled in me by those experiences, though a career in retail and then commercial model-making caused it to be latent for almost two decades.

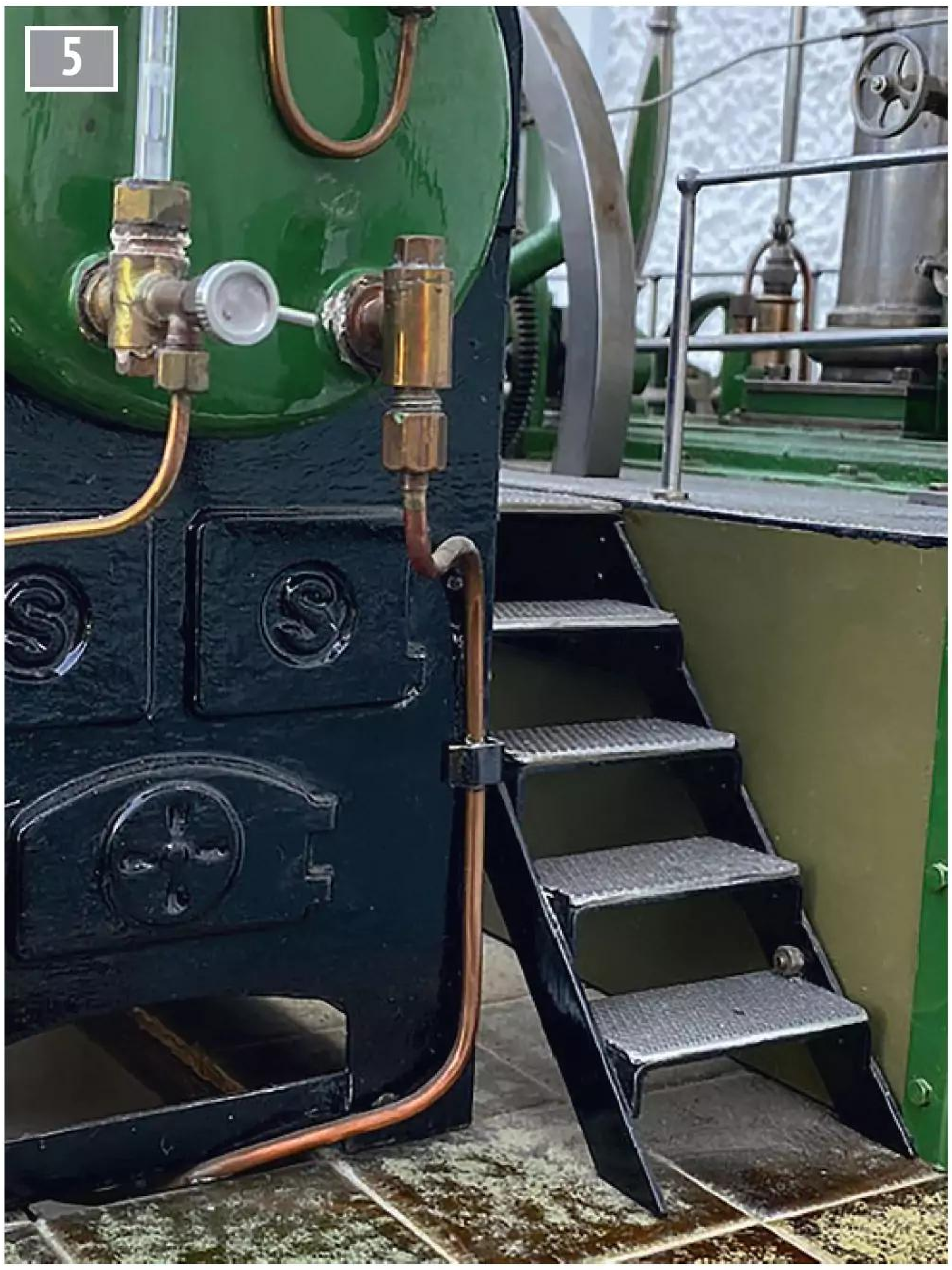
For reference, the Model Engineer Beam Engine is a 1/12 scale model, so an adult person would be just under 6 inches tall standing next to it; its larger but otherwise identical version, the Major, was stated as 1/8 full size by George Gentry back in 1914, so a figurine in scale would be about 9 inches tall. The ME could also credibly pass for a 1/16 model as it's a representation of a small beam engine, even by single column standards. Looking at the height of the railings, I think Mr. Evans assumed this to be the case.

But first let's take a close all round look at the plant and see what it has to offer. The initial impression is that it exhibits excellent attention to detail, a true example of the phrase '… the more you look, the more you see' (**photo 2**). For instance, looking at the pinion shaft with the pulley wheel placed across the crankshaft end of the bedplate; most examples I've seen just have a plain pinion, possibly secured with a grub screw acting on a similarly simple crankshaft drive cog, both with flat blank faces. This one is true to full-size practice, having been radially waisted and is keyed to the shaft in the correct manner (**photo 3**). Similarly the drive wheel on the crankshaft is as clockmakers would say 'crossed out (pierced to create shaped spokes) rather than being a blank featureless disc.

You can hardly see the pinion, sandwiched as it is next to the flywheel, so having that detail on it is an indicator of



*No you are not deceiving yourself here – this is two engines connected together with cast iron gear wheels; The Burman Double Engine, an 1820 engine coupled up to another 20 years younger. In use until 1943, they must have been deafening!*



A nicely made set of steps takes one up to the Beam Engine's cylinder floor.

the care with which the whole steam plant was built.

To be honest, the cross shaft lying over the bedplate is, to me, a visual offence against the Geneva Convention as it's such a lash-up, but this kind of arrangement was not unknown. I have seen such in full size though, notably the 'Burman Double Beam Engine' (now at Birmingham's ThinkTank Museum). This interesting double, painted all-over black, was photographed with difficulty on a dull day in 2003 (**photo 4**); I hope it's still there. The larger A-framed engine behind dates from 1820 and was at some point coupled up using cast iron gear wheels to the smaller single column engine of 1840 - makers unknown. They worked rolling mills at Wychall Mill in Kings Norton, Birmingham until 1943 – a long-lasting lash-up! But last they did, even with the repairs to the smaller engine's spoke/rim joints on its flywheel. With those iron wheels clanking around, working with them must have been deafening! Pardon? At the time of viewing they could be turned over by an electric drive which thankfully, was fairly quiet.

George Gentry's original 1914 articles detailing the construction of what is now known as the Major Beam Engine, of which the ME is a 2/3 scale replica, brought forth some derogatory correspondence about the cross shaft and, given the choice, I'd remove it entirely. On the plus side, it does give the ME or Major Beam Engine a sense of albeit clunky purpose and, along with the governor, is another part of the engine that one can observe twiddling around when the engine is running, I suppose. Such things can appeal to those uninitiated into the Mysteries of Steam and could generate future interest just as those Mamods did for me.

L. J. Evans evidently wanted to give this steam plant an expression of purpose and must have put a lot of thought into this project. Rather than simply a boiler and an engine with perhaps a manually operated boiler feed pump bolted to a board, he put this set-up into context, to represent, within the limitations of space and practicality for running, a representative industrial setting that would give the plant a reason to exist. He may well have taken inspiration from full sized installations. Others in the past have placed their engine and boiler like this but Mr. Evans took it to another level with his attention to detail.

With the boiler placed on the floor, the engine resides alongside, on a prototypical raised floor which also gets around the potential problem of accommodating the flywheel. Access to the engine would be gained by the neatly built steps leading up to the walkway which surrounds the engine. This is nicely executed with chequer-plate flooring and a barrier of finely made railings (**photo 5**).

Whatever his background he was a fine engineer with a good eye for detail and the ability to bring it to fruition; even the railings are superbly executed, each absolutely identical stanchion with entasis on its shaft and the railing itself precisely centred on each one in a perfectly shaped ball.

I confess that I am less enamoured of the water tank at the crankshaft end of the engine but this is another point of interest: this steam plant was evidently meant to entertain and educate while it was running and the water pump, operated from the crankshaft side of the beam constantly circulates water into and out of the tank, adding more interest.

Having a tiny smattering of architectural knowledge, it always grates to me to see the tori (those 'doughnuts', to the uninitiated) at the top and bottom of the column only vaguely rounded in section: this particular engine is among the first I've seen where this job has been carried out correctly, both on the central column and

The column has its two decorative rings – known as tori – turned to near perfection.

the governor column. Having turned one of these columns myself, I can vouch that it's the devil's own job while you are turning the column's shaft. That square plinth at the bottom and the similarly square entablature at the top of it, with those sharp corners, offer the chance of a potentially agonising hazard while whirling around with abandon so close to your fingers and the lathe tool. Form tools can do the job of course but to turn the lower torus with one requires a lathe somewhat more rigid than the average model engineer's Myford unless nearly all the donkey work has been done in shaping, with the form tool taking care of the final contour, due to the pressures of the side loads required. Talking of which, also on this example those two square parts - the plinth and the entablature - have been given a decorative recess along their sides, all of which line up perfectly, those on the entablature marrying with the U-shaped extension to near perfection (**photo 6**).

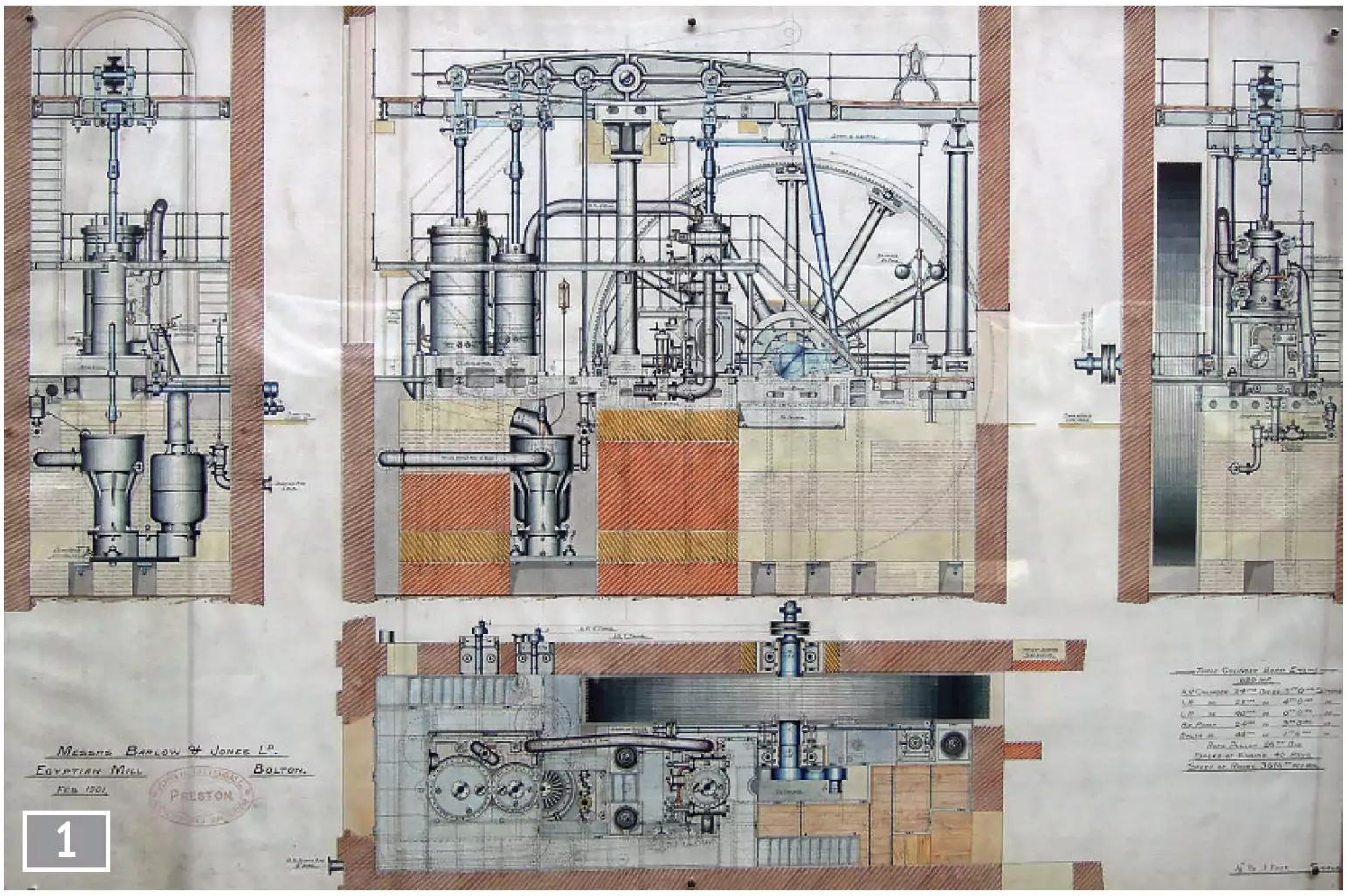
●To be continued.

# A Drop Link Clock

**Neil Carney** pays homage to beam engine designer J.H. Tattersall.

Some time in January 2021, during a telephone conversation with Diane, your Assistant Editor, who is also a member of the Northern Mill Engine Society, I mentioned that a beautiful, watercolour general arrangement drawing of a beam engine, intended for Egyptian Mill, Bolton, had come into the possession of the Bolton Steam Museum and was now gracing the museum wall (**photo 1**). The Museum was, at this time, temporarily closed to the public, of course. I sent Diane a photograph of the drawing and she asked me whether I was thinking of making a model of it. My answer was a definite 'No!' She then asked what it was about this engine that particularly appealed to me and suggested that I could, perhaps, make a model of just a part of it - a part chosen to illustrate the uniqueness of this particular engine.

The engine in the drawing had been designed by

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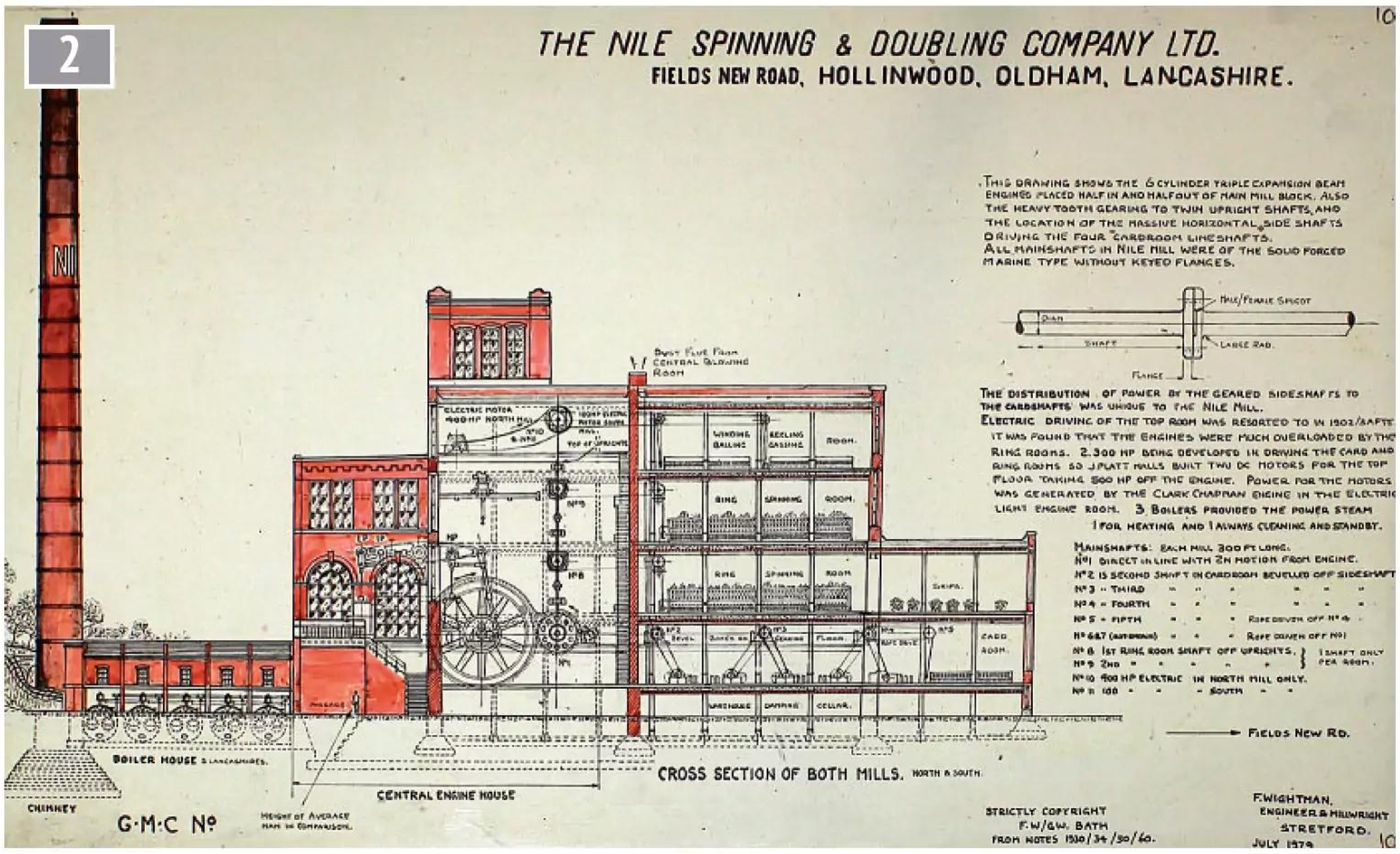
*The watercolour general arrangement of a beam engine, intended for Egyptian Mill, Bolton.*



*The last and largest beam engine ever put into a cotton mill: Nile Mill in Hollinwood, Oldham.*

J. H. Tattersall, a consulting engineer of Preston, who had been responsible for quite a number of beam engines for cotton mills but who was never a builder of engines himself. His designs, however, were rather unusual in that all the parallel motion was rectangular in section with box end bearing housings which gave them a rather cubic appearance - quite outstanding in comparison to others. Tattersall also designed the last and largest beam engine ever put into a cotton mill; that being at Nile Mill in Hollinwood, Oldham (**photo 2**). It was a twin beam engine with three cylinders giving triple expansion on each beam, the H.P. being in the McNaught position, i.e. half way between the beam pivot and the crank, with the L.P. and I.P. in the normal positions. It was set 'half in - half out' of the mill as can be seen on the drawing and the six cylinders gave 2500 N.H.P. It was built by Buckley & Taylor of Oldham in 1899. At the time it was built, Nile Mill was the largest ring spinning mill in the world! I *think* the building still stands.

One of the drop links, which connect the low pressure crosshead to the beam end, was chosen as a suitable component to illustrate this design.

The size of the link was decided by the clock insert which has a 30mm diameter bezel and a body diameter of 27mm (**photo 3**). This called for a box end width of 35mm and, from my photograph - taken by George Watkins and published in his book of *Stationary Steam Engines of Great Britain Vol. 3 (Lancashire Area)* - other dimensions were estimated to keep them all in proportion. The result was a total length of 190mm.

The design requires a reduced section at its centre so this is a separate piece, attached to the box ends by 4mm tongues and grooves, secured with Loctite (**photo 4**). The box ends were made first


*The size of the project - i.e. the link - was decided by the clock insert.*


*The central 'reduced' section.*

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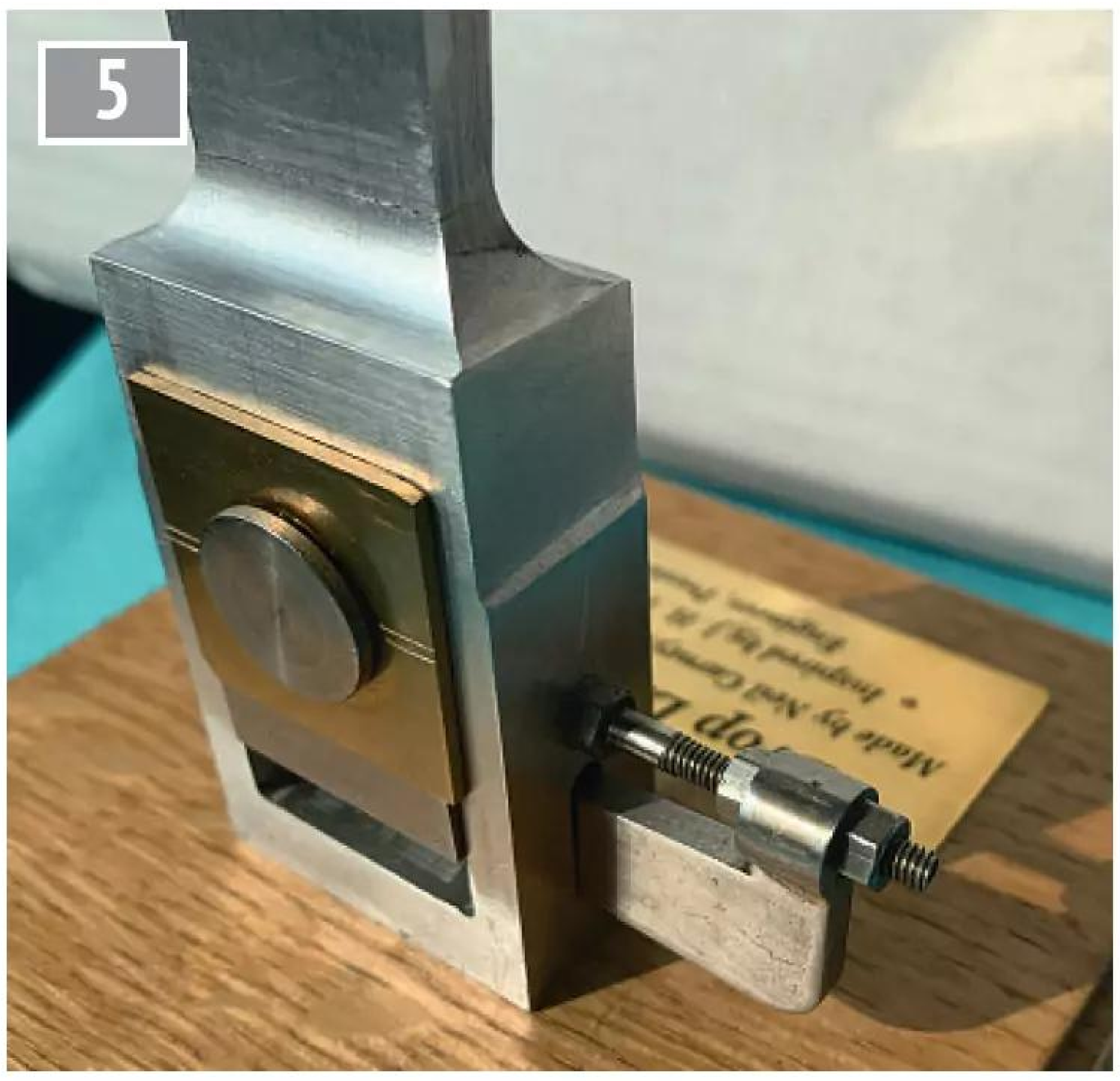
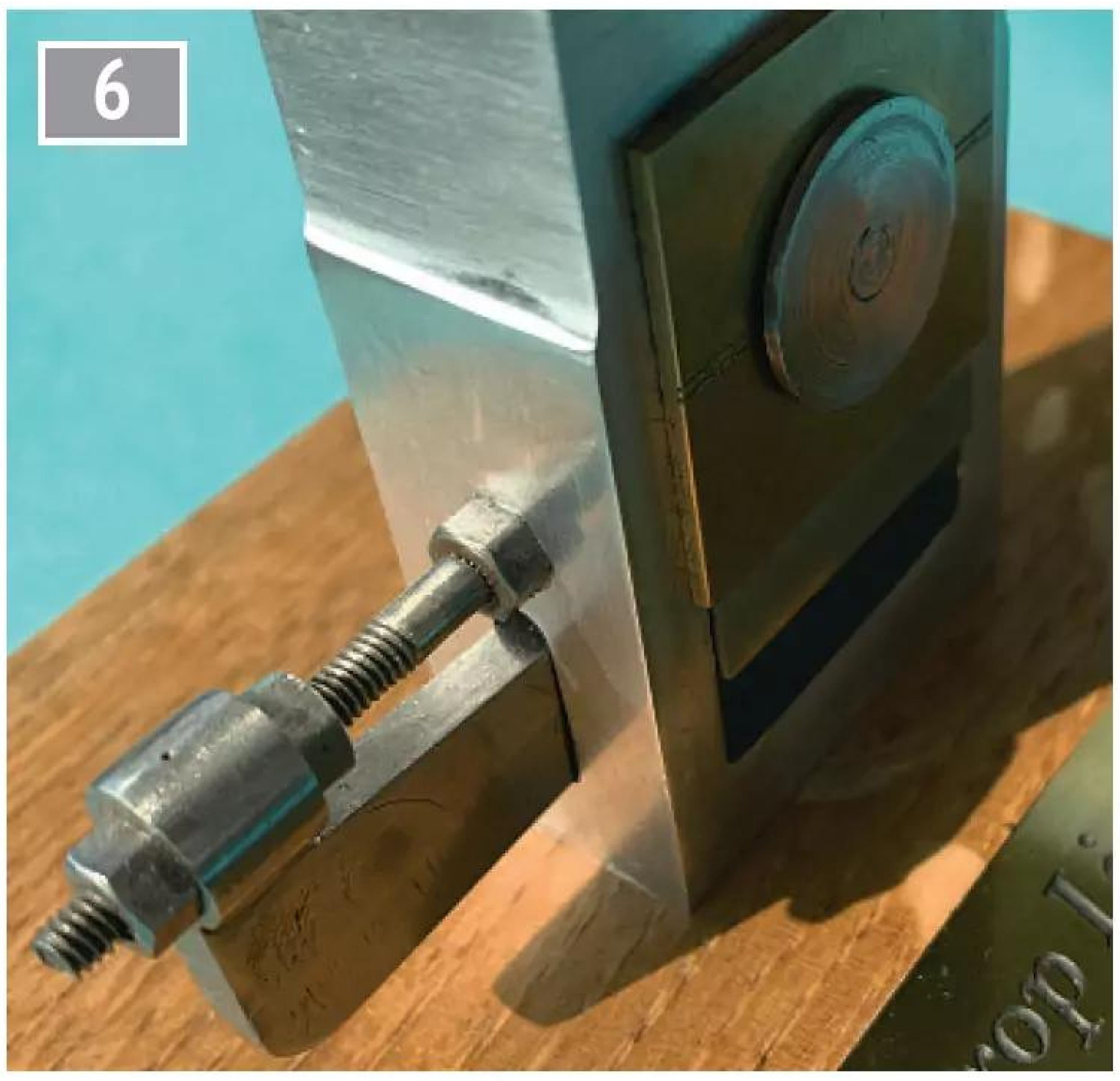
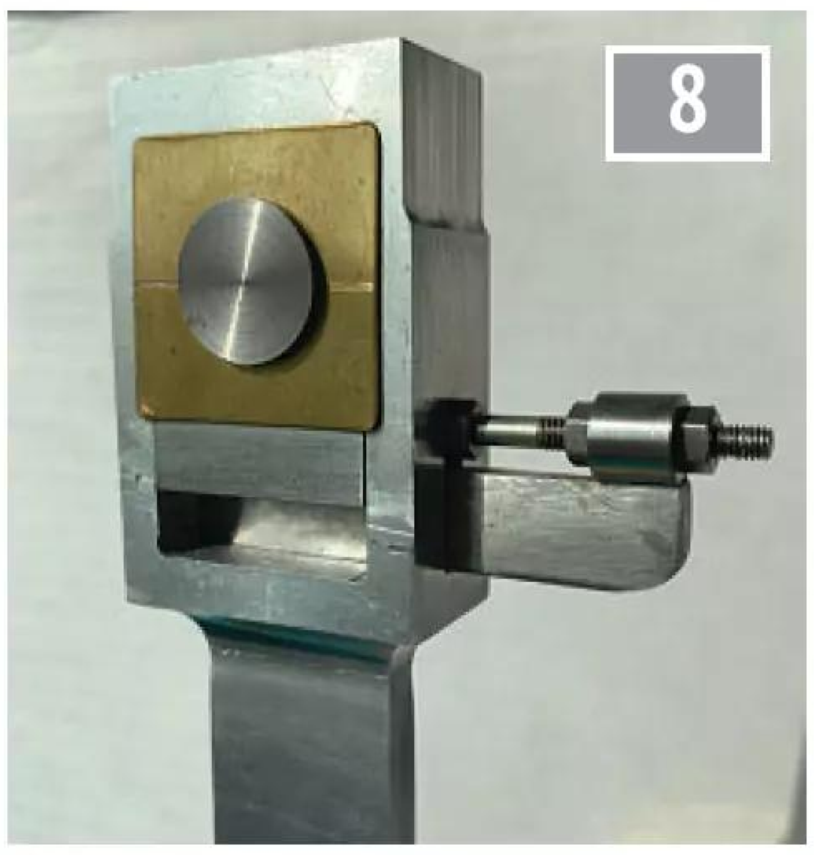


A 12mm diameter end mill formed the attractive 6mm radiuses.



A closer view of the 'bottom end'.

The clock located in its 'housing'.



A view of the back - behind the clock.

A descriptive plaque and an oak base form the finishing touches.

(all in aluminium, by the way) both together. The blending 6mm radius, which makes a beautiful, eye-catching feature of this particular component (**photo 5**), was formed by a 12mm diameter end mill.

Before separating, the combined length was some 130mm and machined down to 35 x 18mm in the four jaw chuck before milling the housing for the 'brasses'. This space was 25mm wide by 42mm long milled out with a ⅜ inch end mill using stops on the milling table slides both ways. The corners were squared off by hand filing. Because the 'brasses' only need to be correct in appearance they are, in fact, 3mm thick sheet brass, 26mm wide, milled down both edges to 25mm for half their thickness to locate in the housing both sides and held in place by the headed steel pins, replicating full size practice, with a reduced diameter inside and screwed together. This is fine for the bottom end (**photo 6**) but the top end had to be designed to take the 27mm diameter clock body (photo 3).

Only a very slight amount of brass is visible at the four corners of the clock bezel (**photo 7**); a square open box was soldered up from 25mm square outside and 3mm wall. It was necessary to have this box fitted into its housing and fixed in place with its retaining gib and cotter arrangement prior to boring the 25mm hole for the clock, which only needed to be a depth of 6mm (the depth of the clock body).

The gib is 4mm thick so slots for this were milled in the box ends and the gib, which is the full width of the box end, 18mm. The taper of the gib and cotter is 4 degrees. The cotter has an eye silver soldered to its outer end to take the 5BA retaining stud which is screwed into the side of the housing and the cotter adjustment is by the two 5BA nuts. Great care had to be taken adjusting the cotter as this has to grip the clock body, after splitting the brass box housing, due to the fact that the 'brasses' would tip slightly as they gripped the clock. The answer was simply a strip of brass equal in thickness to the gap between the brasses and soldered into a slot cut into the dummy steel pin at the back, this pin head matching the one at the lower end (**photo 8**).

This 'top brass' assembly was all fitted in place and wedged with its gib and cotter prior to boring out to 27mm.

The thinkers amongst our readers will realise that 27mm exceeds the 25mm housing space! This was a problem at 'first design' thoughts but it was soon realised that, with the clock body being only 6mm deep, that was as far as the excess bore needed to go and it was covered by the bezel.

Some time was well spent on the finish of the aluminium and it is now satisfactorily mounted on a nice piece of oak with beautifully moulded edges (**photo 9**) - a present from my granddaughter's partner, Ben Roberts, a steam engineer with exceptional woodworking talents!

The brass plate giving details was, of course, made by your Assistant Editor, Diane, who has taken possession of the clock. The wording on the plate is:

*'Drop Link Clock'*
*Made by Neil Carney, Engineer, Bolton.*
*Inspired by J. H. Tattersall, Engineer, Preston.*

ME

# The Development of Motor Cycle Engineering Before WWI PART 3

**Patrick Hendra,** of Eastleigh Young Engineers, takes a look at the design of early motor cycles.

Continued from p.536
M.E.4753 October 4

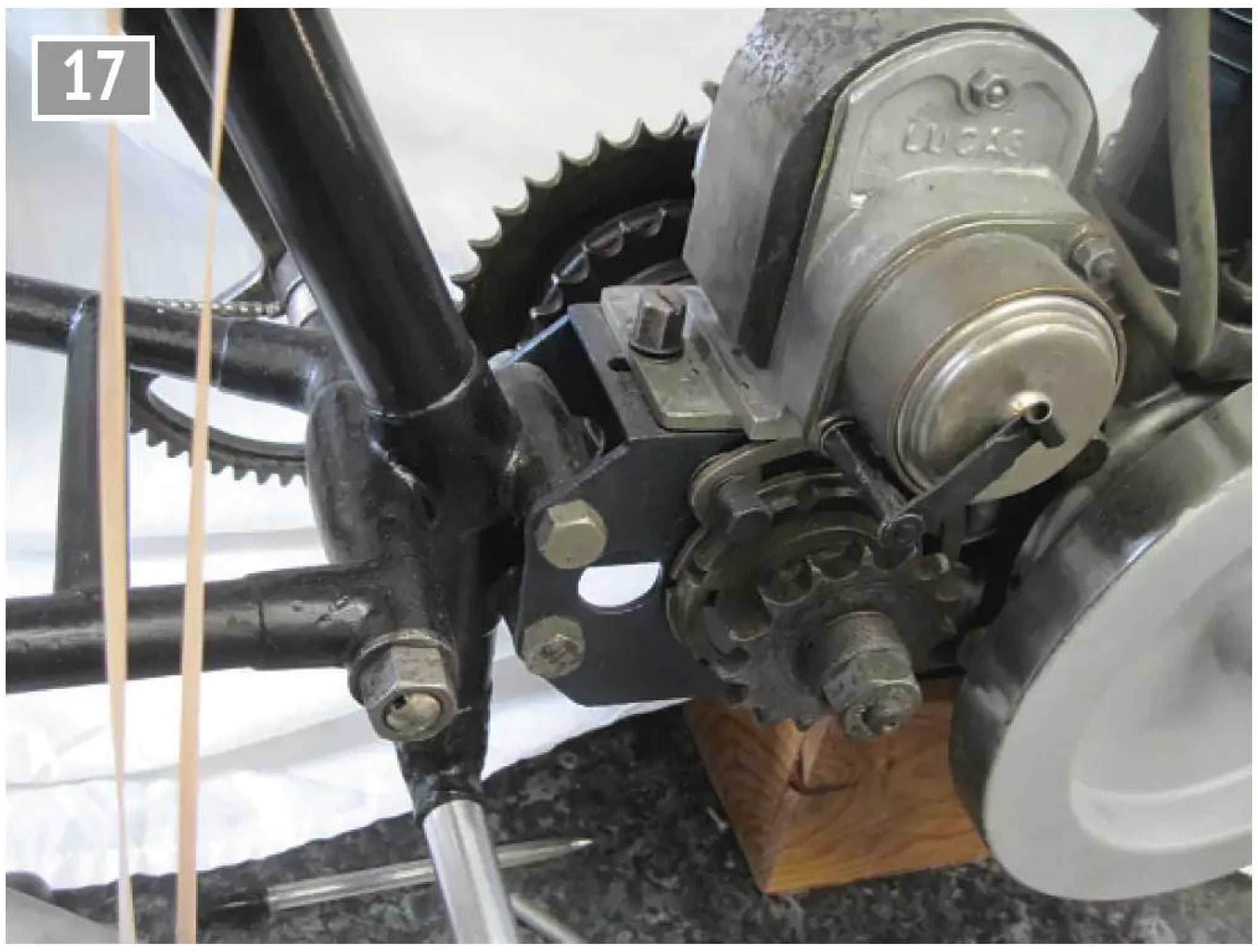
## The cycle parts

The cycle parts are simply a bicycle of 1914 with a sprung front fork but with no pedals.

The run of tubes is broken at the bottom and the crankcases and engine plates complete the frame (**photo 17**). By WW1 this was commonly the case.

There is no attempt to spring the rear wheel - rear suspension crept in in the 1930s and was not universal until 1970. The front 'girder forks' permitted a short range of motion but no damping. Friction damping could be incorporated into girder forks at the rear lower pivot but was not thought to be essential on lightweights. You can see the forks and their mechanism in **photo 18**.

Most readers will realise that telescopic forks are now almost ubiquitous because they permit long travel and excellent comfort but they do have a restriction not shown by girders. Since the two pairs of links in a girder fork are not identical - the lower link is longer than the upper one - the vertical path of the wheel spindle as the girder forks are compressed is designed to move forward whereas telescopic forks invariably require that the wheel spindle moves backwards under depression. This means that bicycles fitted with telescopic forks dive as the front brake is applied. Not a problem in modern cars because the front wheel geometry makes the vertical trajectory of the wheel spindle move




*Engine and engine plates completing the frame.*


*Girder type front forks.*

Cyclists were better sprung!

Flat rim carrying the bead edge tyre.

Front brake of RE Model 201 at the museum.

Rear brake. Rubber 'wedge' in centre of the picture.


Petrol Tank in place on the completed machine.

Footboards were very popular.

vertically or forward under compression. Many motorcycle manufacturers have come up with alternatives to the 'Tele' but no really convincing solution has replaced it, except perhaps by BMW. Their current flat twins use a telescoping girder mechanism which allows long travel and no dive under braking. It should not be thought that this type of suspension was new; Scott used a telescopic/ girder mechanism as early as 1911!

So in the 201 we have a sturdy bike frame fitted with girder front forks.

The rider's spine is sort of protected by a large saddle and two coil springs.

Wandering around the Sammy Miller collection it is obvious that even though motorcycles were lacking in rear suspension, makers and presumably purchasers were not particularly worried about comfort. Simple springs supporting a hard leather covered steel pan seemed to be normal. Pedal cyclists were often better served. There's a battered example of an early bike saddle incorporating a stretched flexible seat supported on a sophisticated spring arrangement in **photo 19**. Very early motorbikes were similarly equipped but seem to have reverted to something unyielding when pedals were no longer provided. Softer, more comfortable saddles incorporating longitudinal extension springs underneath a padded cover appeared rapidly around 1925.

Wheels were unlike modern ones. The rims were of *flat* section with tight beaded edges. The Bead Edge tyres have no metal wires in their edges but do have a thick rubber bead that fits inside the rim (**photo 20**). The construction was cotton, open woven into net penetrated with a mixture of natural rubber and sulphur which was moulded and then heated - the *vulcanisation process*. The uninflated tyres feel floppy to modern hands and are beastly to fit. Since the tyre is retained on the rim entirely by air pressure, they have the nasty habit of coming off the rim if the pressure vanishes. Not a good idea because punctures were frequent. In those pioneering days, the dusty roads concealed vast numbers of nails from horses' hooves. The Americans describe these rims and tyres as 'clinchers'. Pneumatic tyres were routine on bicycles but were very new on cars prior to WWI. Commercial vehicles and cars tended to run on solid rubber tyres because the lack of a deep rim and wired beads meant that the tyres were not really rigid enough to cope with lateral thrusts. Bead edge tyres were replaced by wired rim tyres on cars in the 1920s and motorcycles a little later.

That brings me on to the dreadful brakes - or what passes for brakes. Just as well that these machines are not liable to annual MoT tests!

The front brake is a slightly overgrown form of the brakes I had on my first bicycle. A pair of composite rubber brake blocks is pulled upwards against the almost flat front wheel rim by a stirrup of flat steel. At the rear, a separate rim is spoked into the wheel. This brake rim is of a section close to that of a V-belt pulley wheel but is made of thin pressed steel. A single composite wedge is pressed into the groove and stops the wheel. To make it more effective, the mount is geometrically arranged such that the action is heavily servo assisted. The details are shown in **photos 21** and **22**. These brakes snatched if the machine was pushed backwards. Royal Enfield practice was normal throughout the industry until drum brakes appeared in the mid 1920s.

The front brake is almost valueless and the rear one fragile. A quick estimation is that if the rear brake brings the bike to a halt from 50mph, the brake rim will finish up at well over 200C.

Going down a long slope will be even more dramatic - the brake rim is simply not heavy enough so overheating is inevitable. There must be another way of slowing the machine.

The Royal Enfield two

*Reverse type handlebar levers - end cap removed.*

stroke engine is fitted with a decompressor on its cylinder head. You can see the details in fig 4 (Part 2, M.E. 4753, October 4). The device is very well made and is robust. In effect it is a spring loaded poppet valve controlled by a cable. The exhaust side of the decompressor connects to the silencer through a short tube. The cable is connected to the left hand lever on the handlebars.

In ref 4 (Part 2) 'RE Rider' assures readers that a decompressor or an exhaust valve lifter in four strokers fitted to all Royal Enfield machines is there to stop the engine - nothing more. My view is that for the two stroke engines, the decompressor is intended to be an engine brake. When braking heavily or at the top of a hill, one engages low gear and lifts the decompressor. The engine then operates as an air pump and hence provides a powerful braking effect. If the decompressor vented to atmosphere this would be noisy - not a problem if one intended just to stop the engine. Not so on a hill. The device is therefore connected to the silencer!

**Photograph 23** demonstrates another other unusual feature. The flat shaped petrol tank is mounted on a tube below the crossbar. The tank is made of mild steel sheet and is soft-soldered together. It carries just over a gallon (4.5l.) of ready-mixed petrol and oil. The ratio is debated but was probably 16:1 petrol and engine oil. This doesn't sound like an adequate supply of fuel *but* these machines were very frugal and 100 mpg was quite normal. The equivalent Velocette machine claimed 140

*Coke lever on top - throttle underneath.*

mpg! The first TT races held in 1907 were run using restricted amounts of petrol; *single cylinder machines - 90 mpg; twins - 75 mpg!* I found these figures amazing. Prior to the change from 'flat' to 'saddle' fuel tanks in the mid 1920s riders were quite happy to buy a machine with a range of 100 miles, even though petrol stations had yet to appear. Hmm!

Petrol was available from Oil and Colour Shops where it was stored in 2 gallon tins. Motorcyclists would only want a gallon at a time so the fuel was measured out in large metal jugs - with no *health or safety problems!*

At the rear the machine has a simple stand and an arrangement allowing the rider to lift the combined saddle, rear mudguard, number plate and carrier to swing upwards making it easier to remove the rear wheel. Unfortunately, there is no equivalent stand at the front. Since frequent punctures were all part of the 'fun', removing the front wheel must have been a real chore. Most manufacturers provided stands at both the front and rear.

Perhaps the oddest feature to modern eyes is the use of footboards rather than footrests. Presumably, because the roads were very muddy, footboards and leg shields were thought to be essential for the 'non-sporting' rider. Royal Enfield were not unique in choosing footboards, Douglas and Lewis amongst many others favoured them (**photo 24**).

The mudguards are not original but are close to those fitted to the Model 201 when new. They are heavily valanced at the front - must have

*Acetylene powered headlamp - should be nickel plated.*

been essential because the carburettor faces forward and breathes from just behind the front wheel.

## Control levers

Nearly all manufacturers favoured handlebar levers of the reversed type. To my knowledge only Harley Davidson still offer these (**photo 25**). A feature of these levers is that the cables can be partially concealed inside the handlebar tubing (1 inch diameter rather than the modern size of 7/8 inch) but the pivot end sticks out of the bar and they are hard to adjust to suit the rider's height. The projecting mechanism was covered by a pressed brass cap - many of the machines in museums have lost these.

Today, the clutch lever is on the left and the front brake is operated from the right. The left-hand lever on the RE 201 operates the 'compression release valve'. You will notice two finger levers on the right (**photo 26**). The top one controls the choke ('strangler') slide in the carburettor as one would expect today. The lower, longer one controls the throttle slide. The twist grip was introduced after WW1. Two points: the operation of the throttle control is clumsy, especially when wearing thick gloves *and* the lever, like the choke control, is deliberately stiff i.e. the throttle does not spring shut when the control is released. Today, the twist grip normally snaps shut when it is released. The reason for the stiff throttle control is that the rider has to give hand signals as these machines had no brake lights or indicators. (I was required to give all hand signals when I took my bike and then car Driving Tests in the 1950s so my twist grip did not snap shut when released.)

## Lighting and horn

By 1924/5 electric lighting was becoming widespread but there was no provision for a generator or room for a 6V. battery on the Royal Enfield 201. Acetylene lamps were normal on earlier cars and motorcycles and so the 201 could be supplied with acetylene lights.

The source of acetylene was water dripped onto solid Calcium Carbide:

$CaC_2 + 2H_20 = Ca(OH)_2 + C_2H_2$

This would be done within a two-level sealed tank as part of the brass headlight, as here, or in a separate 'generator' which frequently was clamped to the down-tube behind the engine (**photo 27**). The drip rate was adjustable using a needle valve in the top/water tank. Connection to both the front and rear lamps would be made using rubber tubing.

A problem with these lights was their habit of 'bumping out' (as distinct from 'blowing out'). The headlight is therefore mounted on a lightly sprung miniature version of the girder

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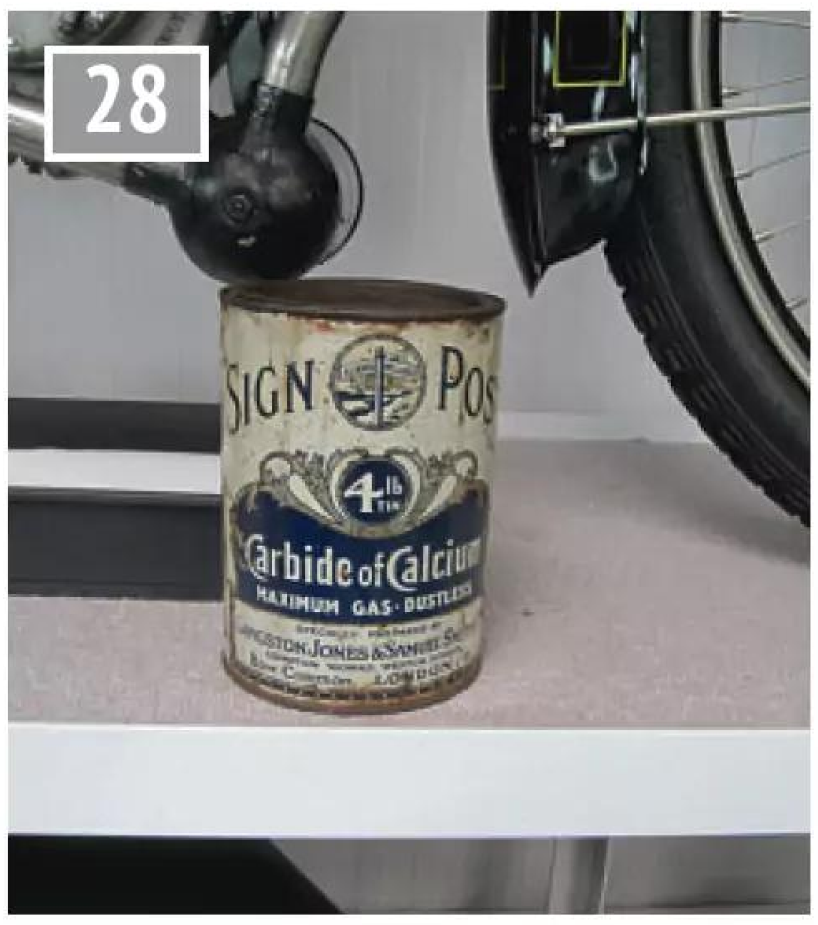



*Calcium carbide came in tins.*

forks - problem solved (see photo 27 again)! Carbide came in large tins (**photo 28**).

## Finally; the toolboxes

All machines of early vintage carried tool boxes, usually made of steel bolted to the rear frame and closed by a leather cover and buckle (**photo 29**). What did they carry? Levers to remove and replace the tyres, tyre repair patches and solutions, plug spanner and open ended spanners, pliers and a screwdriver. They would also carry spare spring links for the


*Tool boxes.*

various chains. A Royal Enfield set of tools supplied in the mid 1920s with their $2^3/_4$ h.p. models is illustrated in **fig 7**.

Tools were essential and could be quite heavy and riders were expected to know how to use them. Personal experience of the 1950s suggests that by then most riders did do roadside repairs and also routine maintenance and even carried out quite serious repairs but that their skills were somewhat limited. Large nuts were frequently removed using a cold chisel and hammer. This brutal technique had been applied to my poor old RE 201. To be fair, workshops were rudimentary pre WW1 - a subject recently aired in *Model Engineer*. To put this in perspective; my house in rural Hampshire, most unusually, had gas from around 1905 but no electricity until WWII. Most villages had no energy source and relied on open fires and paraffin lamps. Fewer than a million households in the UK had electricity before 1914. How could you operate a workshop without light and power?

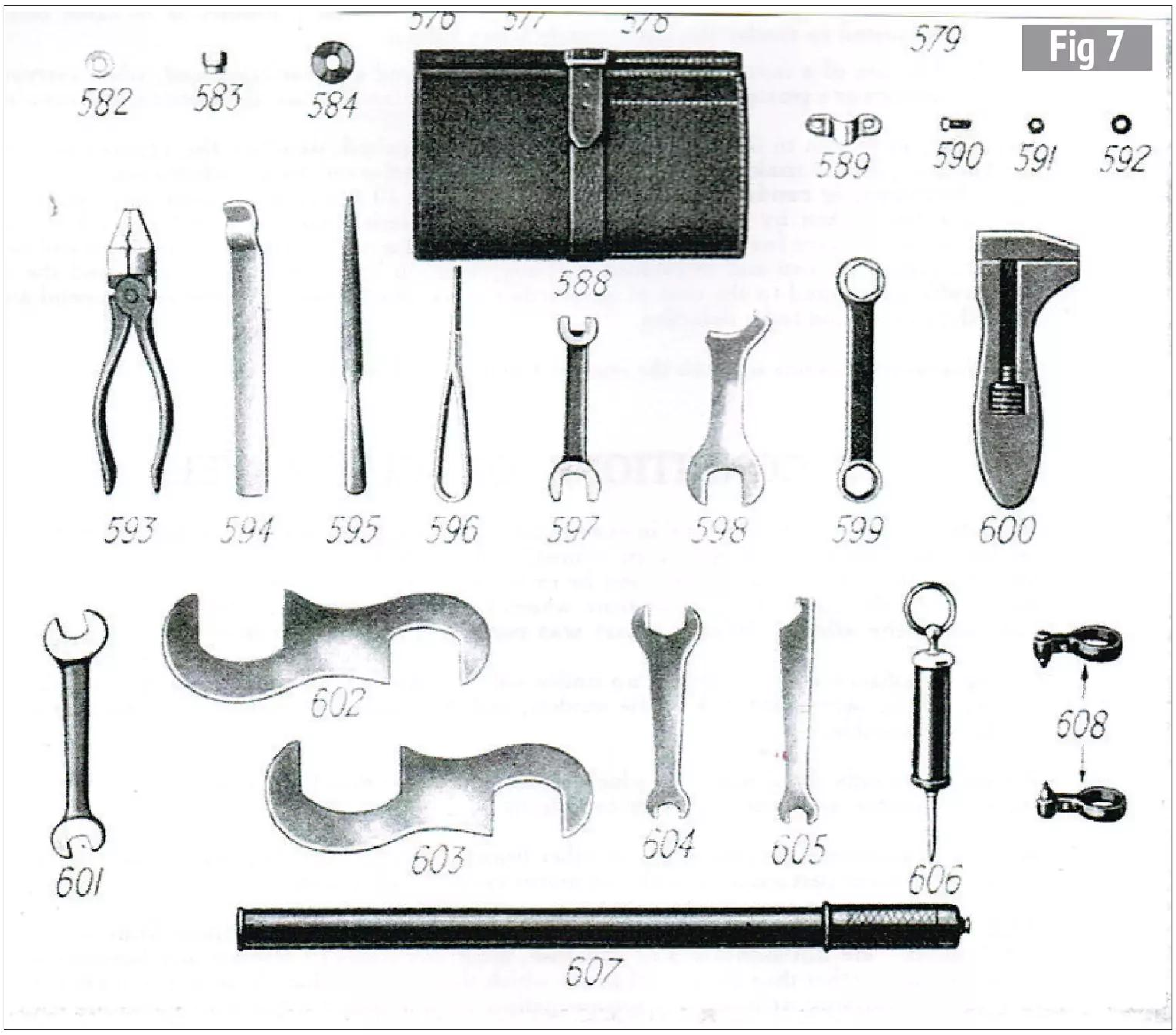
## Conclusion

Things have improved over the last century - a totally trivial comment but there have been more subtle changes that are frequently ignored. After WWI, the troops came home and wanted the 'freedom of the road'. Not for them push-bikes or the horse or walking. Cars were expensive and they had seen motorbikes ridden by dispatch riders and motorbikes were cheaper than cars *but not cheap.* There had been massive inflation during WWI followed, almost immediately, by massive deflation. Have a look at table 2 (Part 2). Note that the price of the machine was very low but rose and fell dramatically. The *real* price remained roughly constant. How did the price compare with that of a car? The ultimate mass-produced car of the period was the Ford Model T and its price in the USA is given in the table. The Royal Enfield does appear to be expensive. How much did the RE 201 cost in today's money? - about £3,500, which was poor value for such a crude machine. And remember, the Model 201 was an economy lightweight machine and lights were extra! A fully equipped four stroke would cost twice as much at about £60 - 80 (= £7,000 in 2024 money) after the War.

To return to the question I asked myself at the start of this piece - motorcycles evolved through tricycles to bicycles with added engines. Cars evolved from tricycles quite differently. Attempts to bridge the gap failed back in the WWI period. It is only now that motor cycle engineers have embraced most, but not all, of the features typical of cars, e.g. 12V electrical systems and hence better lights came in during the 1970s. Adequate silencers and quieter machines evolved in the 1960s, comfortable suspension systems the 1950s, hydraulic brakes, discs and anti-locking systems in the1980s and onwards. The scooter revolution vastly improved weather protection as early as the 1950s but dirty chain drive still persists and automatic gearboxes tend to be confined to the scooters and lightweight machines! Hmm!

Restoring the bike was fun but the detective work required was really fascinating and has resulted in this article.

ME




*Tool box - what was inside?*

### REFERENCES

**Ref 5** Useful source of early details: *100 Years of the Isle of Man TT*, David Wright, Crowood Press 2013.

# The Leufortin Project

PART 8

**Ian Bayliss** presents an internal combustion G-scale locomotive.

Continued from p.539
M.E.4753 October 4

## The redesigned transmission

The main reduction gearbox had not suffered any damage. However, the redesign called for a change of bevel gears from 16T/24T reduction to 16T/32T ratio along with an output gear change from 20 teeth to 30 teeth. Please be aware that this range of reduction bevel gears is generally supplied as matched pairs. Due to an error in supply though, I had two 32T wheels spare. When the replacements came Technobots Ltd. told me to keep these wheels and not return them. A bit of careful measuring and trial with the newly supplied 16T gear showed that the compatibility was acceptable. It remained to be seen how this would work out in the initial trials with a completed locomotive. This change of ratio moved some of the assemblies around. I had hoped that there would be no modifications as such to the main gearbox other than changing the original 16T bevel gear and repositioning the new one on the shaft. At worst it

69

Forward/reverse control lever.

70

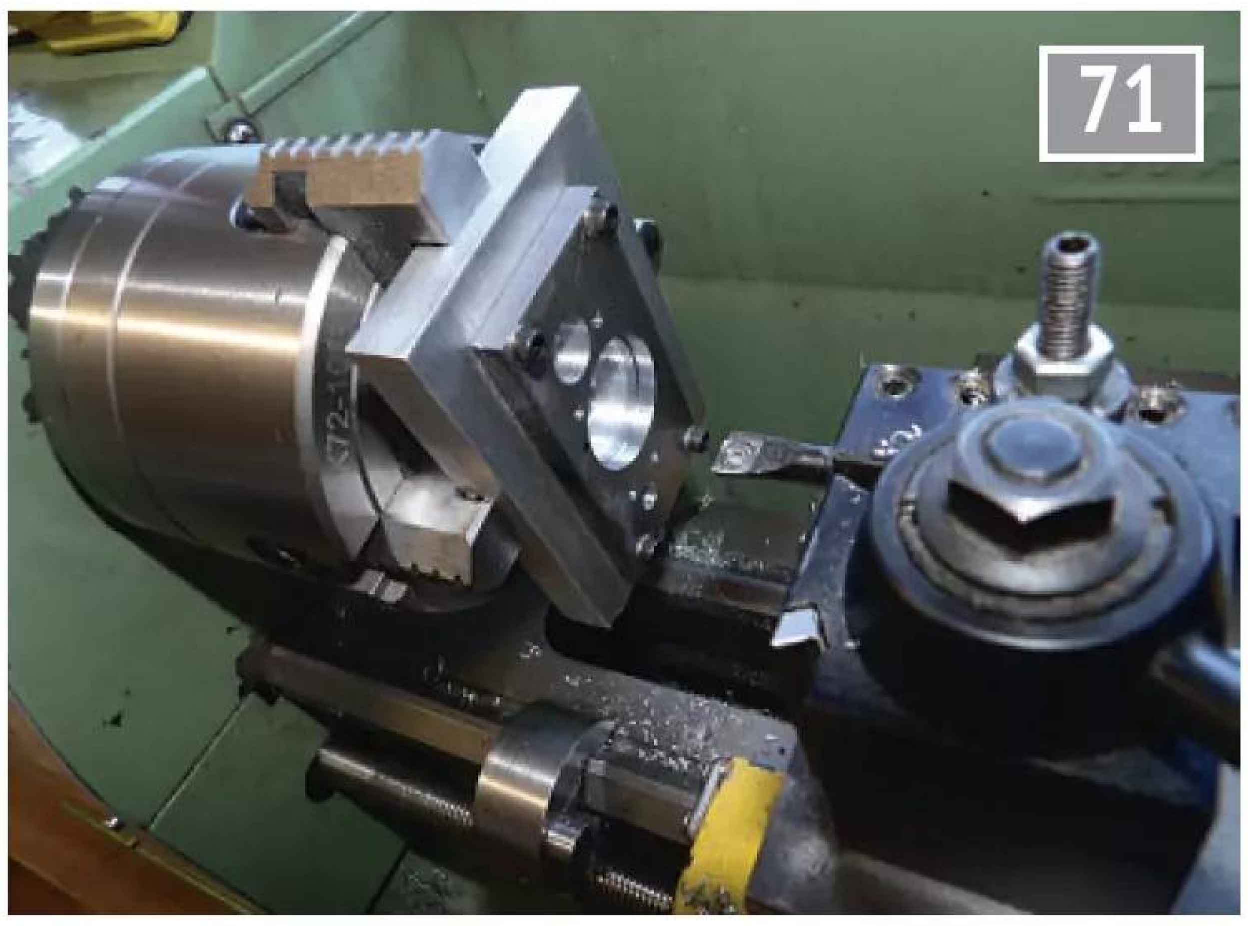
Manufacture of output transfer gear plates started.

was hoped that just machining a little from the output end to clear the spacing boss between the two 32T bevel gears would suffice. Unfortunately the original keyway worked out to be just out of position enough to be directly usable unchanged. It would have been possible to just machine a new keyway further round the shaft. But the decision was to make a whole new shaft. The mounting holes in the gearbox frames were opened up to 3.2mm diameter, hence enabling the use of M3 socket cap screws and Philidas nuts to reduce the risks from the vibrations.

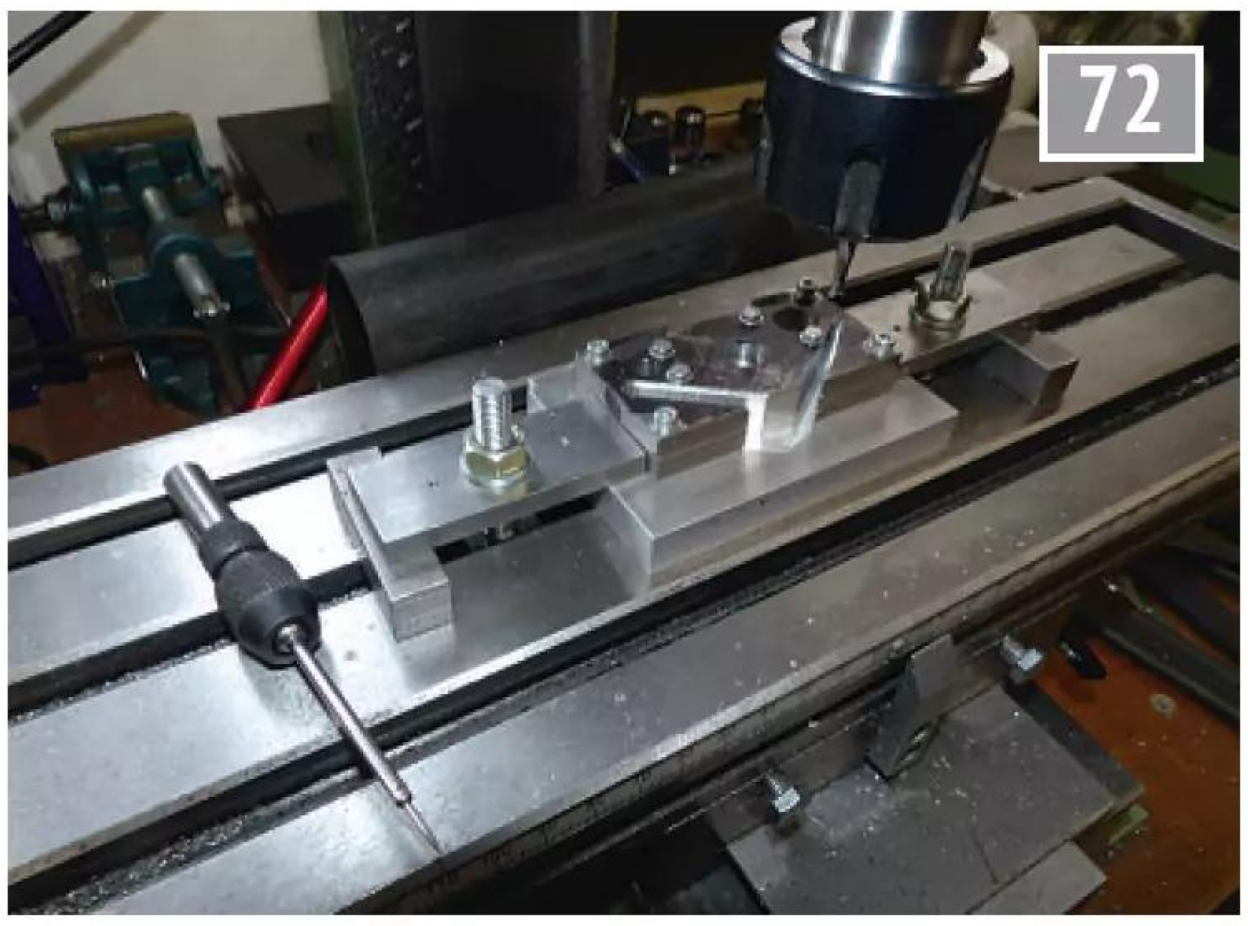
A whole new assembly for the transmission output shaft had to be built to the new design along with the sliding multi-pin dog coupling. This was designed to ensure that the pins are always engaged and the bevel wheels only move in synchronisation along the output shaft so only one can be in mesh with the main box output pinion at any time. The control is by spring loaded lever which has little of the forces of the system passing through it (**photo 69**).

This sub assembly included a pair of deceptively simple flat plates. They turned out to be anything but simple and three pairs were made or partly made before an acceptable pair was achieved. They were made by mounting a pair of oversized blanks on a sacrificial piece of aluminium alloy plate (**photos 70**, **71**, **72** and **73**). The final sub assembly became a little more complex than originally envisaged, probably because of my need to over engineer because of previous experience (**photo 74**). There was relief when this group of parts actually fitted together without any major modifications.

There remained at this point just one remaining suspect area (**photo 75**). This issue involved the meshing and alignment of the transmission chain with the first gear of the jackshaft, whilst the yokes still clear the wheel. This becomes the point where all the tolerance imbalances come to fruition. Fortunately there was very little modification to be done, in fact it came down to just 0.35mm, this being the difference between 6mm material thickness and the ¼ inch thick material that had been supplied. This had not been accounted for in one of the spacer lengths and the meshing had worked as designed. **Photographs 76** and **77** show the dry run before the painting was undertaken.



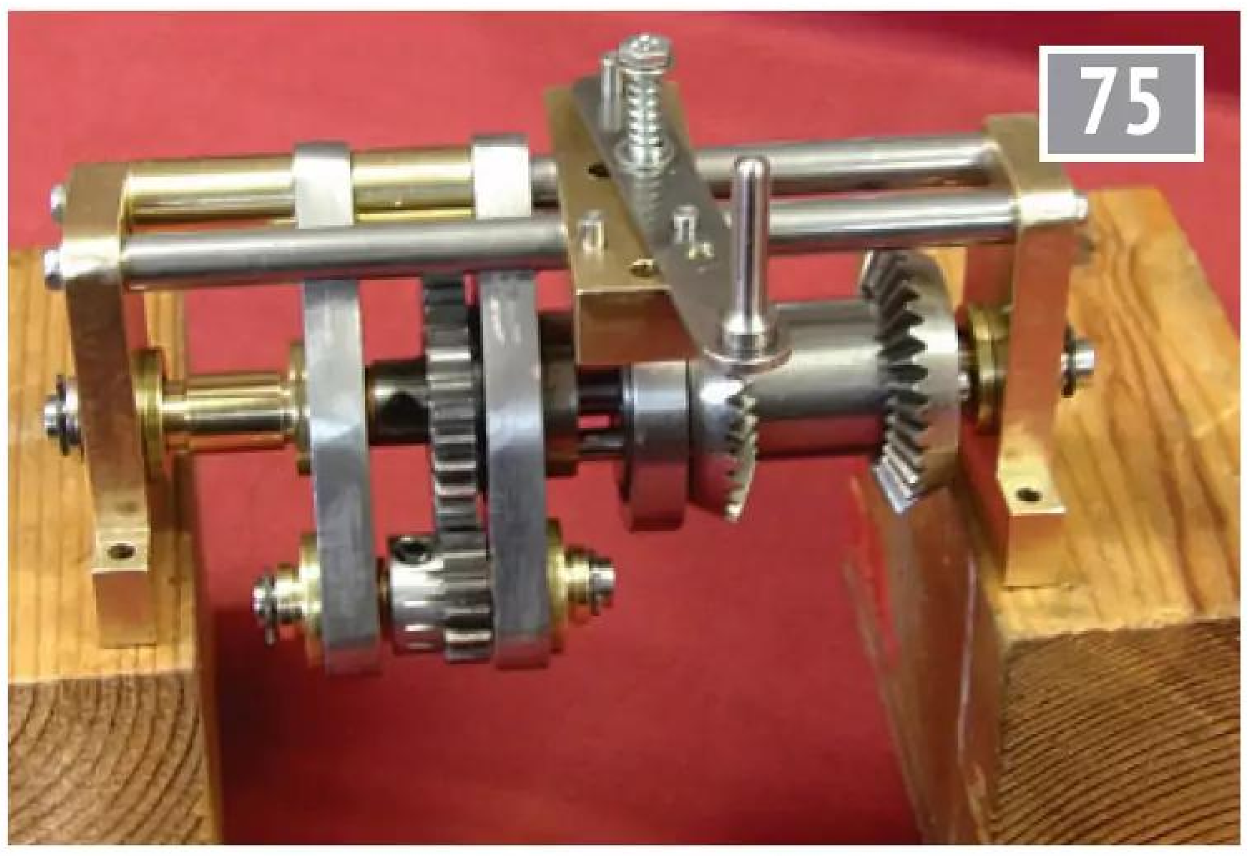
*Boring bearing housing in one of the cheek plates. Bearing carries the static portion of the 3-pin dog coupling.*



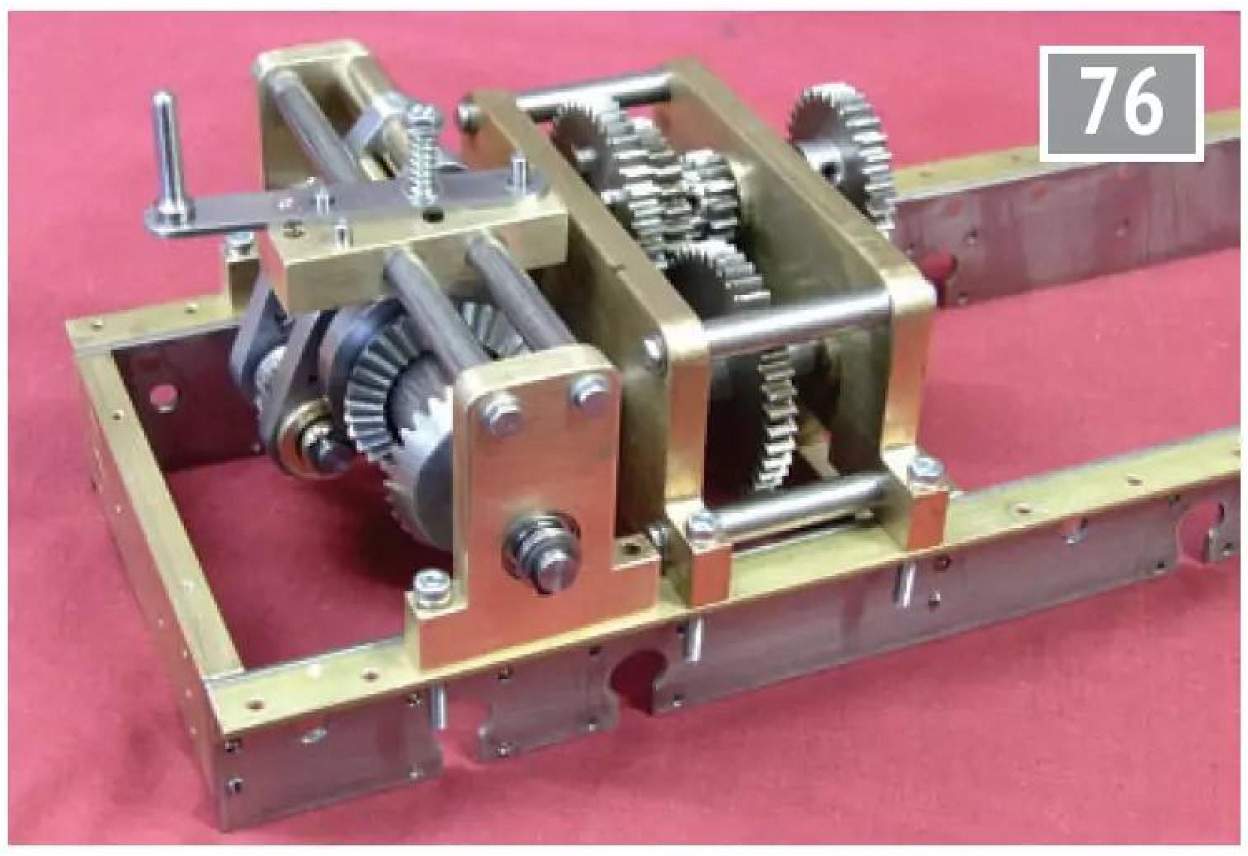
*Cutting away outer profile of cheek plates on the mill to reduce hacksaw and hand filing work.*

*Finally a pair of finished cheek plates.*

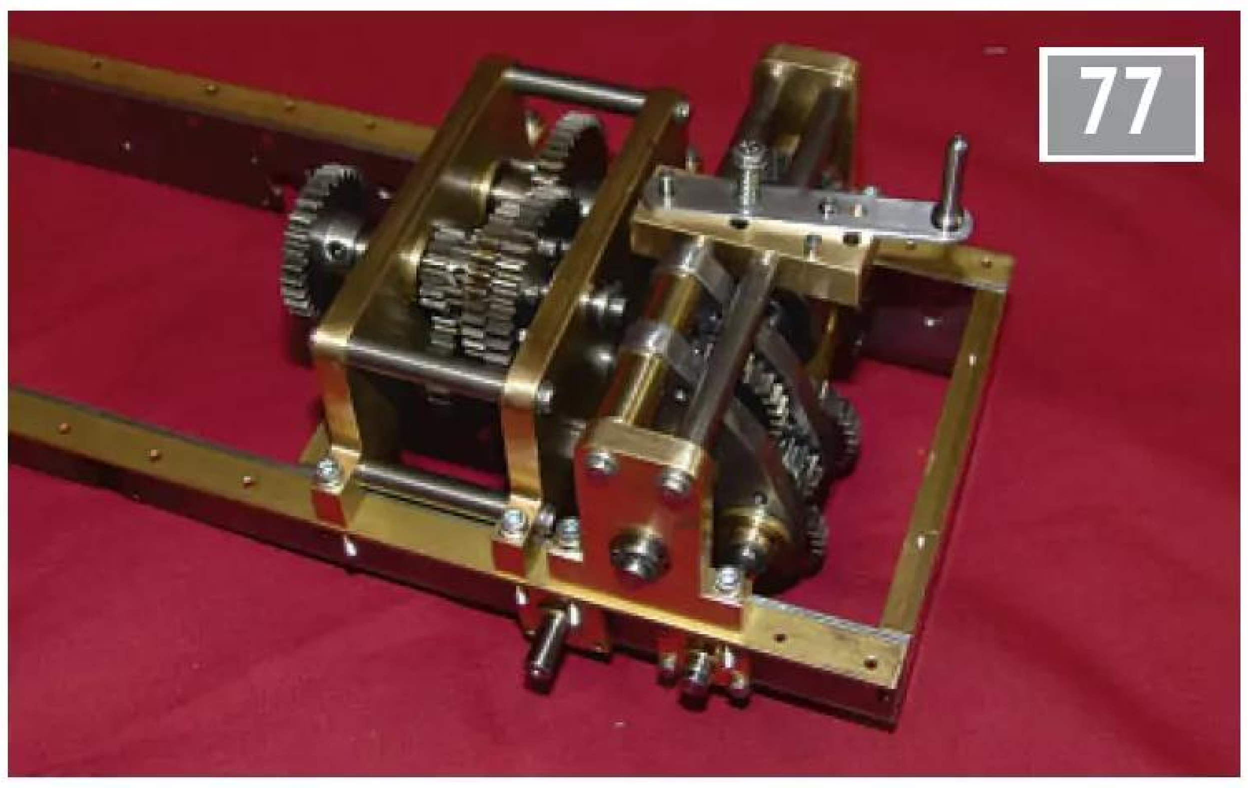
*Array of parts for output of transmission and forward/ reverse gear change. Hoped for a simple sub-assembly...*



*All those parts put together, ready for installation as a sub assembly.*



*Right hand side view of the trial run with chassis and main gearbox.*

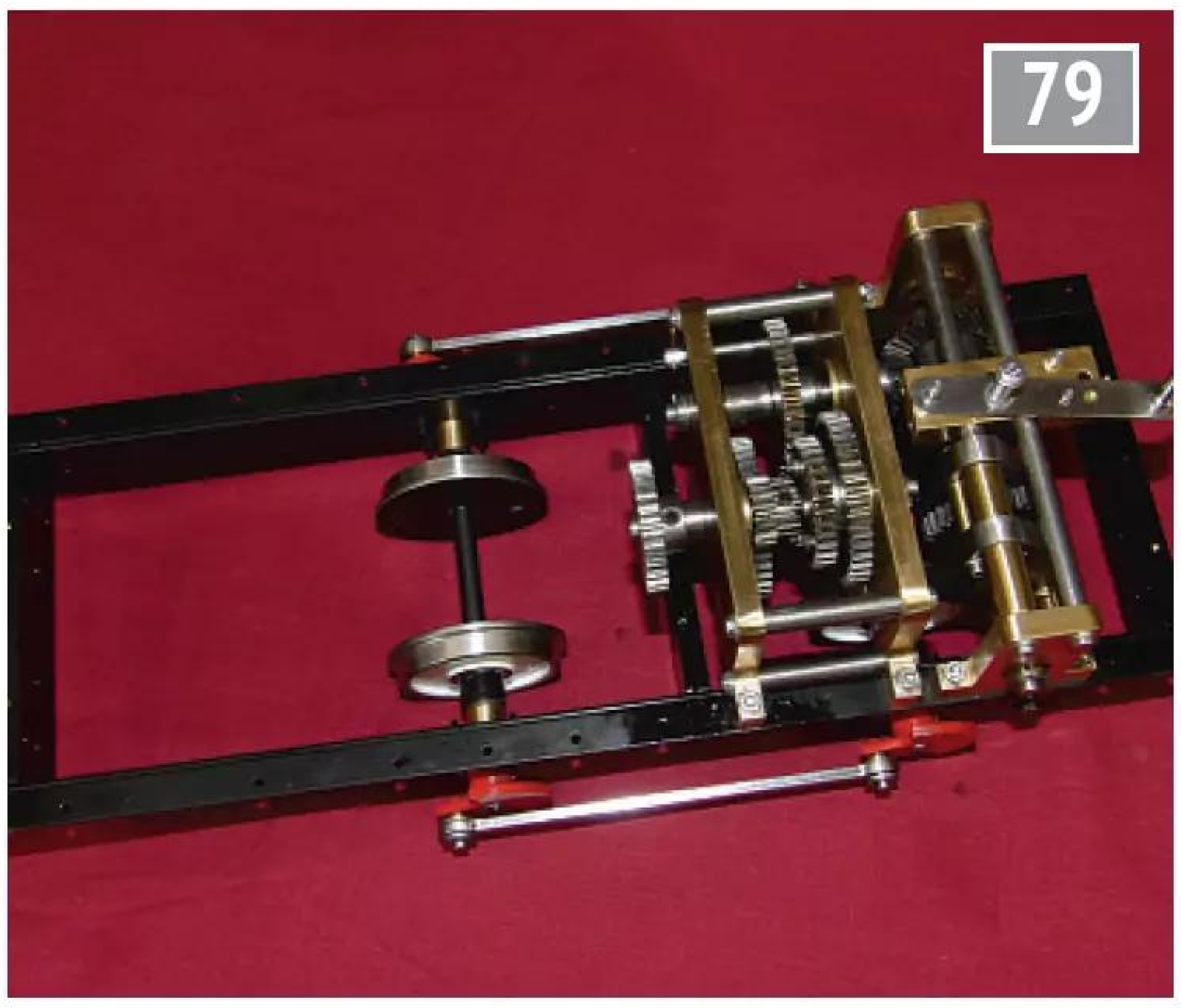


*Left hand side view of the trial run.*

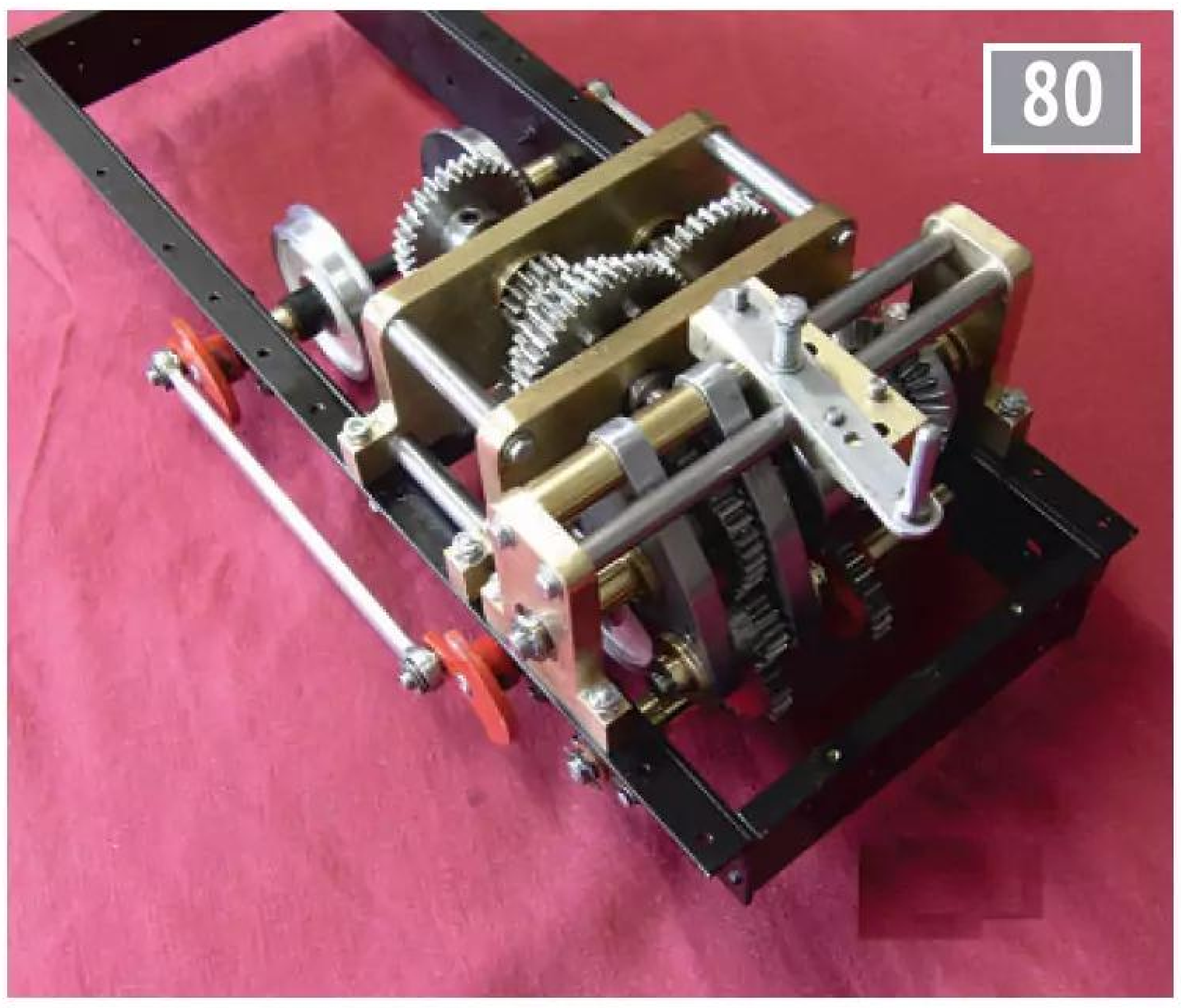
*Painted and on its own legs again. Relief?*

## The painting and finishing job

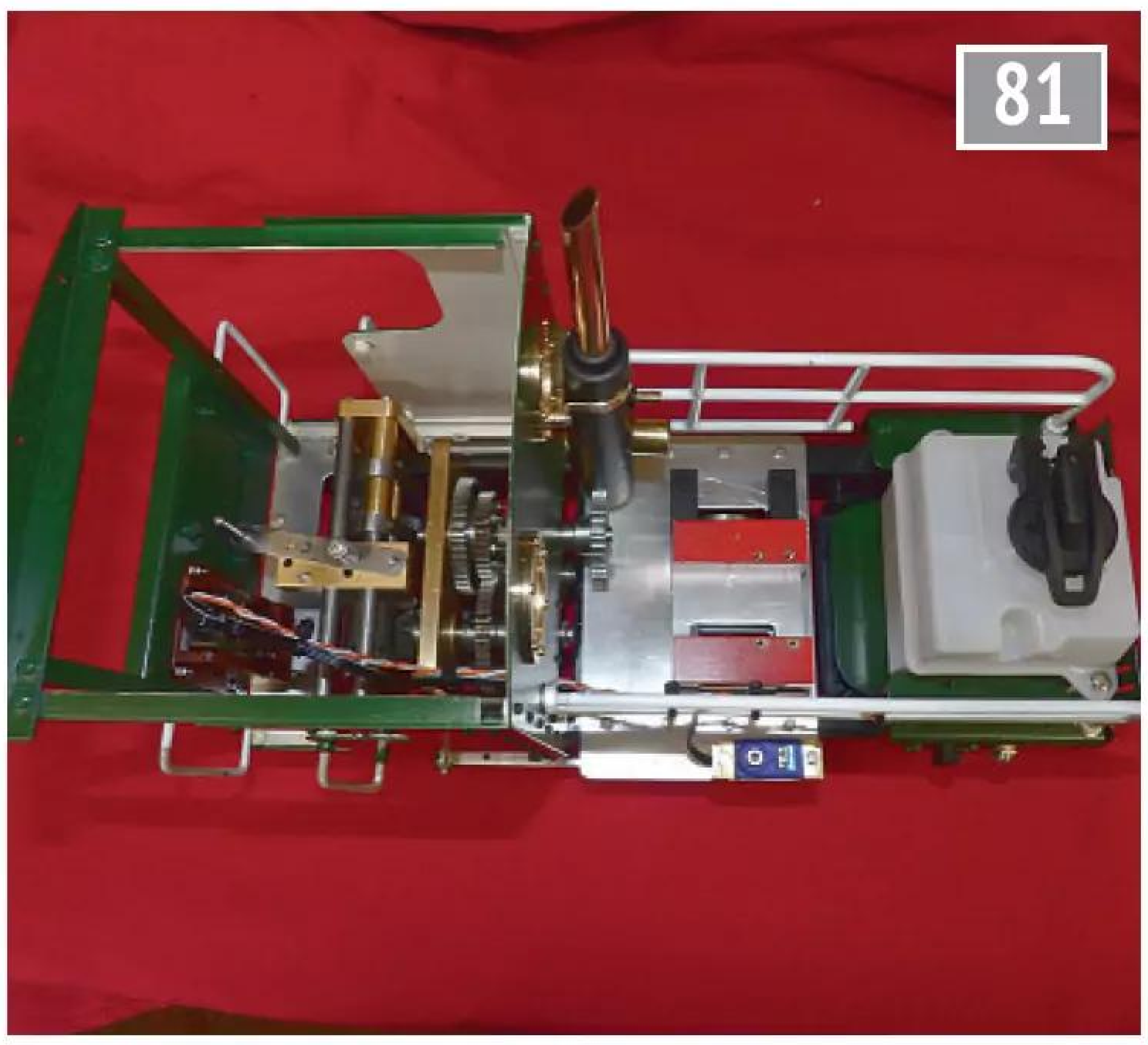
This is a task not to be relished. **Photograph 78** shows the start of the assembly after painting. At least the locomotive is standing on its own legs again. »



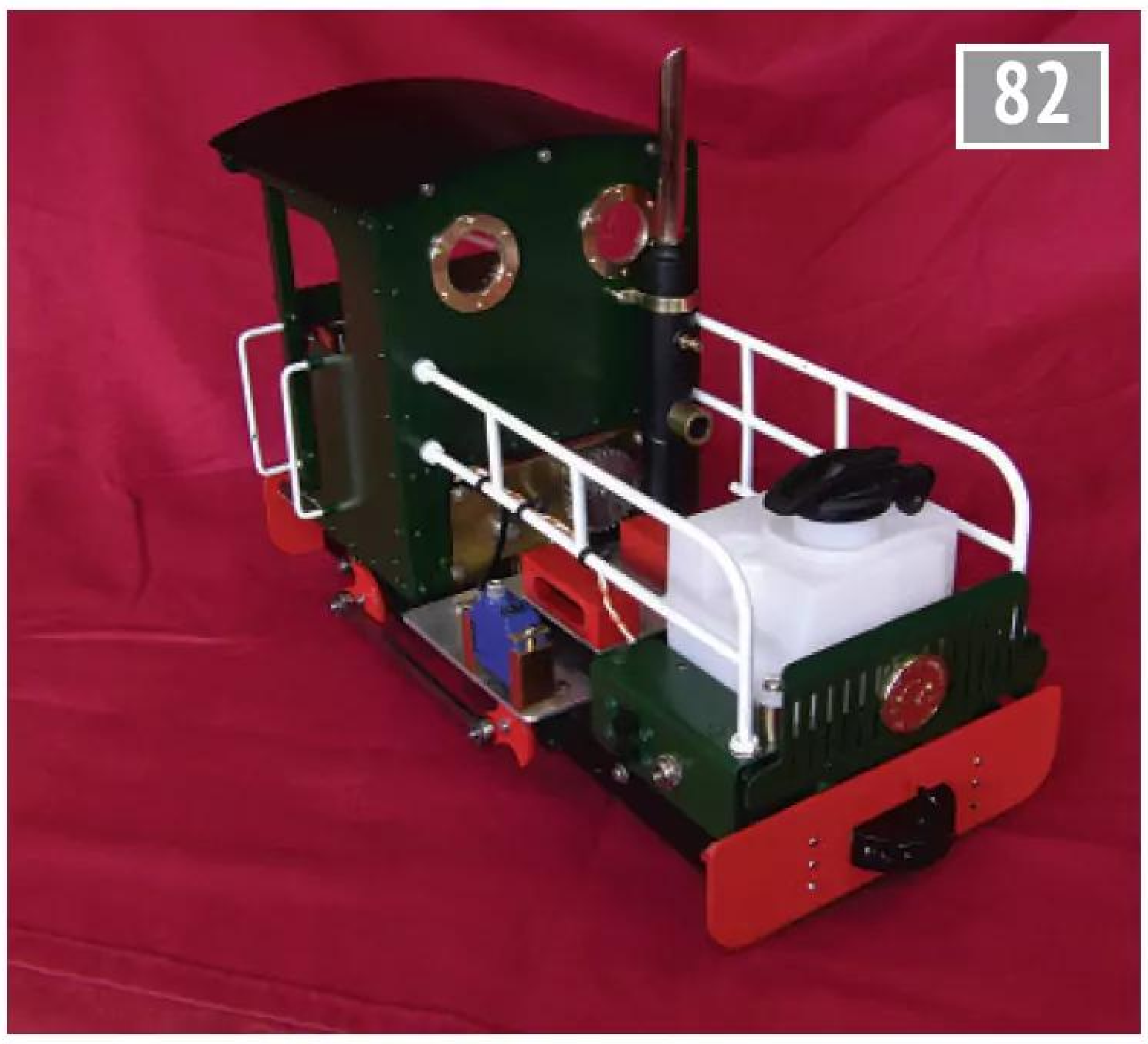
*Transmission finally installed, with Philidas locking nuts.*



*A closer view of the transmission detail.*



*Ready for engine to be installed.*



*General view of all in place awaiting motive power.*

The next stage was a full clean up and installation of the transmission, checking all again as the sub assemblies went into place. It did all go back together as the dry run assembly had paid dividends (**photos 79** and **80**).

The existing cab had suffered little or no damage and was salvaged as-is for the second iteration rebuild, with the exception of the addition of a couple of 2.2mm holes to pick up the new mounting holes in the new footplate.

Some additional cutaways were added to the grille to try and make it a little easier to fit.

It is published wisdom particularly from the model aero world that, with nitro fuel about, all should finally be sprayed with hot fuel proofer. This is not an easy task deciding which parts should be treated such, considering that all was not really an option. However both in discussion and publication, it has been suggested that automotive acrylic paints are fairly good at resisting nitro fuel. Often the argument is used about hot exhausts but the really aggressive materials should have been burnt off in the engine before the exhaust system is reached if the tuning is somewhere close. Only a small percentage will be exhausted. Even my local model shop does not stock hot fuel proofer and their customers spray glassfibre and vacuum formed bodies and parts with acrylics and no proofer. Industrial narrow gauge is pretty scruffy anyway so the easy route was decided upon. For now.

Colour scheme is nothing special and within ethos: satin black frame, British Racing Green axle boxes, red drag beams, flycranks and exposed gears away from main box, British Racing Green grille, outside cab and fuel tank mounts, cream cab interior, satin black roof. Pick out some internal items in enamel and heat resisting black exhaust system (we will see?). Paying due reverence to Health and Safety, handrails are picked out in white as are wheel centre recesses.

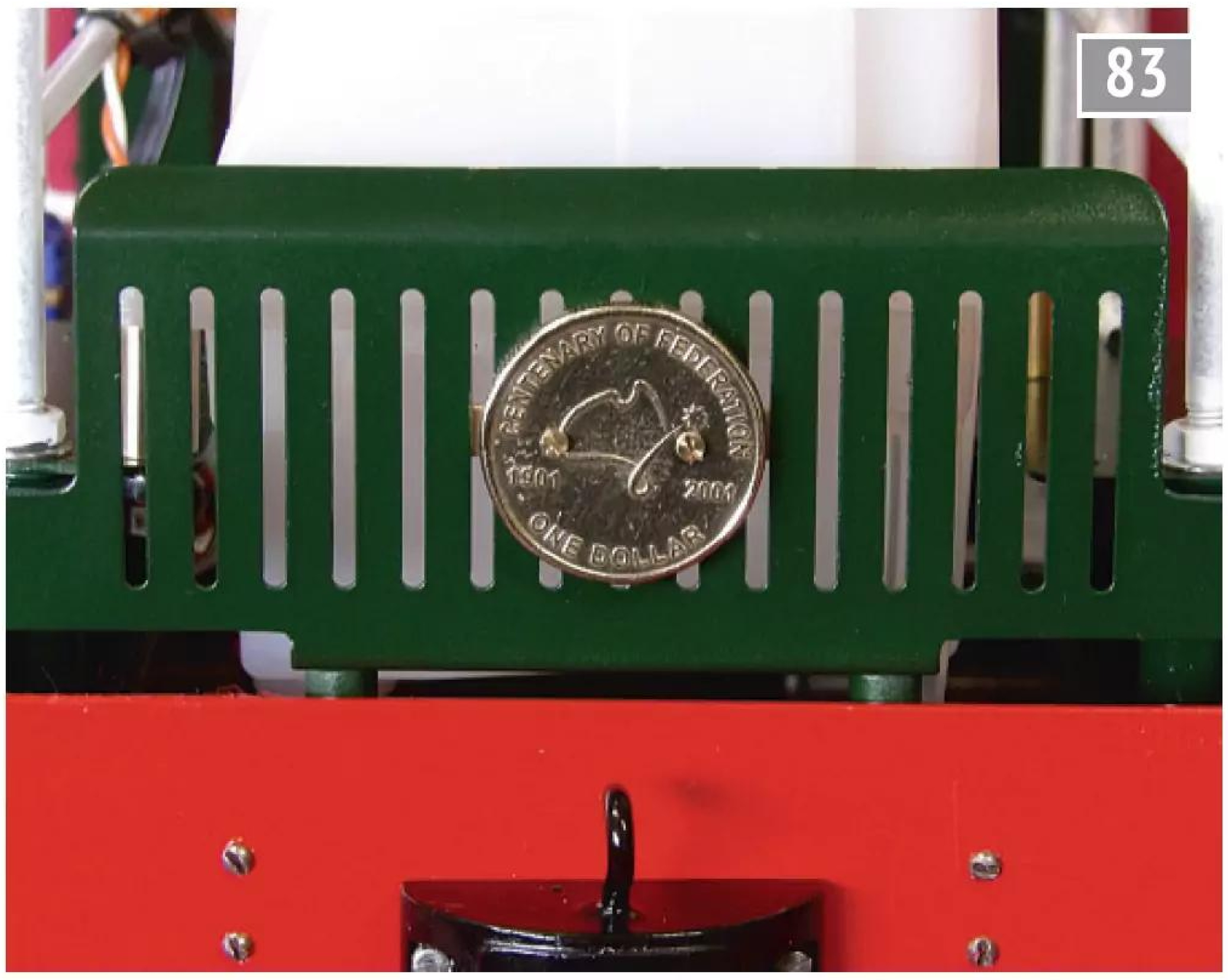
This was all done with ‘rattle cans’. Preparation is degrease, mask, thin etch primer, two coats acrylic automotive primer and top coats as needed in automotive acrylic. I have not been impressed with the latest can of etch primer, particularly on the brass components. Furthermore, automotive rattle can paints from a well known retailer no longer have those touch-up vials to match the cans, that have a brush with them. I tried spraying a quantity into a container then brushing in the inevitable assembly damages and bolt heads etc. It was not successful and I resorted to mixing some Humbrol enamel as close to colour as I could get to touch in. I will be looking at other paint systems and airbrushing again for the next model(s).

The locomotive was now complete and the time had come to refit the engine (**photos 81** and **82**).

Decisions over the radiator badge had to made. As this is Leufortin Number 1 and there are connections with our Antipodean cousins, an Australian one dollar coin seemed appropriate. Number 2 will have a UK two pence piece suitably polished up affixed in the same way (**photo 83**).

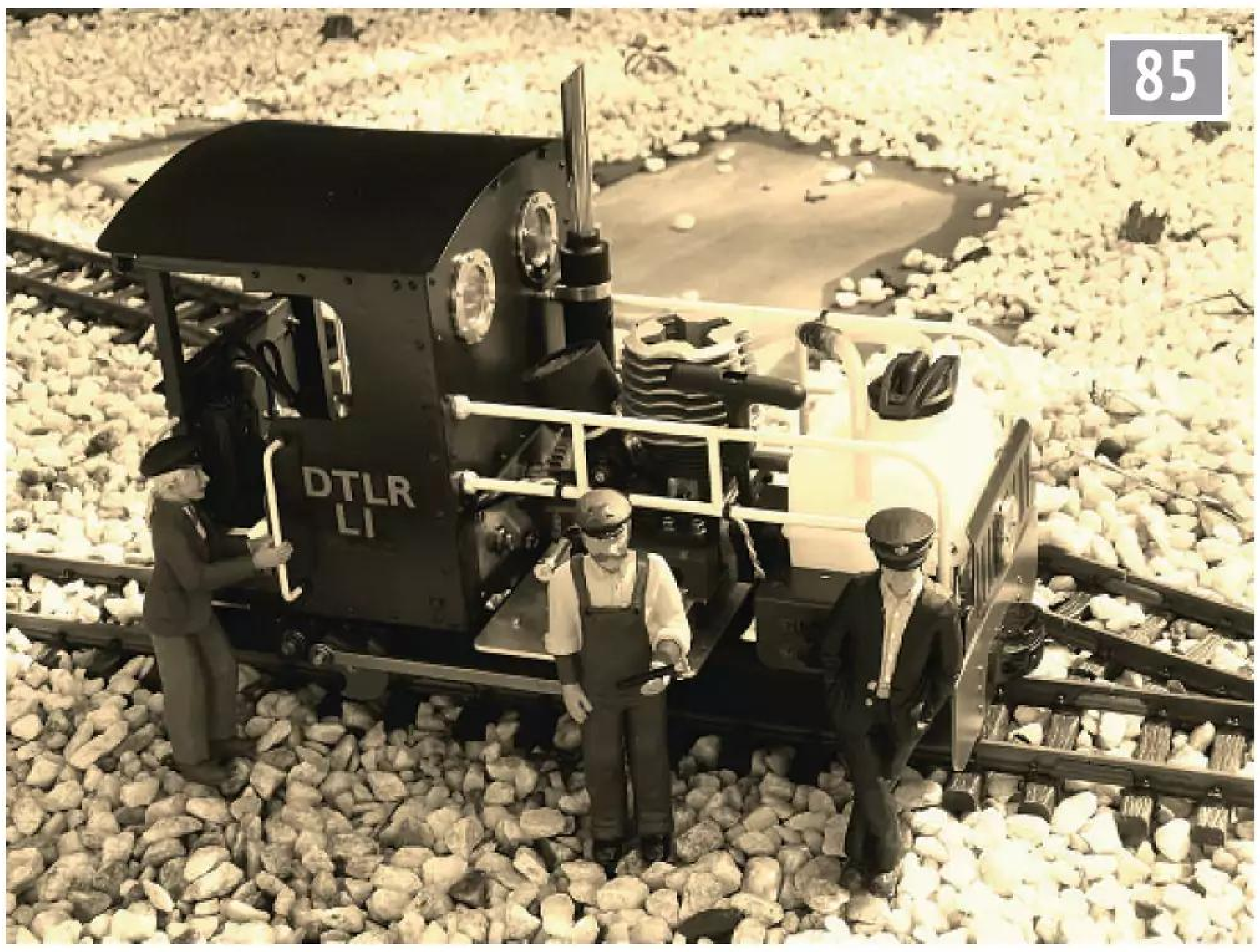
Now it was time to set up the test bed for a final session of engine tuning, getting reliable starting and reliable smooth running. Not so! As previously described (out of chronological order) the engine would not start. I raised the test bed fuel tank to reduce the lift required to supply the carburettor at the correct rate. Still little success. I reset all the variables again and finally it started. Control and running were still nebulous - rapid overheating and very high revolutions - symptoms of very lean settings for fuel – and stalling on throttle opening. The final straw came when the engine seized. It is worthwhile investing in a specialist thermometer for glow plug engines.

I stripped the whole engine down as far as it could go in the seized condition. The crank was freed up a little, just about allowing one half a revolution. I picked out all the swarf from the crank case and found the missing fractured pieces of the big end bearing. The big end hole in the connecting rod was by now about twice the size it should be. I had a second new engine of exactly the same model but was reluctant to even try it. So back to research and computer. There is so much material available on the internet and instruction manuals galore that are available for model cars that use this engine. None actually give you the information that you really need. Even the stated ‘factory settings’ for the jets are incorrect, particularly the low speed needle. This setting gives an extremely lean mixture leading to the over revving of the engine, lack of control and




*Grille close-up sporting an old Australian one dollar coin as this is Leufortin No.1.*


*Well this is it. All pristine, checked and ready to try out (albeit reluctantly after the historical experiences!).*




*In the best traditions of the heyday of Narrow Gauge, the posed sepia as out-shopped photograph.*

over heating. Full marks to the guys at the model shop when shown what had happened but an expensive lesson had been learned by the tyro that I am in nitro engines. One of the senior guys took the new engine that I had purchased in replacement and checked the jet settings for me. Whilst the high speed needle was pretty close, the low speed needle was way out and I would have set it way out again to the published data. The screw head has to be flush with the throttle operating collar rim which takes it some two full turns richer than specified for the engines I have and should be kept this way until the engine is broken in at least.

The time had come to face putting it all up on the test bed again. The settings were very rich but at least it started after several attempts and ran long enough to start 'tuning in' with very small incremental changes to the low speed needle until the throttle actually worked and an even idle achieved slow enough to allow the centrifugal clutch to disengage. The engine still runs too cold so there is more to achieve but has finally become part of the enjoyment in learning new skills after all the frustrations.

There were lessons to be learned which have proved hard on my pocket. I had firmly believed that modern glow engines would be more reliable and easier to handle than my experiences with the recalcitrant 'diesels' of over 50 years ago. It was unwise to have taken this simplistic stance. Modern nitro glow plug engines are highly developed, very high performance machines and their apparent simplicity is deceiving. A brand new engine was wrecked and had to be replaced.

My own attitude, calming after the initial horror, to all of this was that it was just another hurdle to be overcome on this long twisting trail. Research of a wide range of published information is key but don't treat it as THE word on the subject. Talk to experienced users and take on board all they have to say. Err on the safe side, adapt the knowledge to the project in hand and keep going. Then, when the job is complete and chugging around the garden with the sun shining through a haze of 'aromatic' blue smoke, the satisfaction of having solved the issues will be even greater.

**Photograph 84** shows the now finished locomotive ready for its initial bench trials on a wooden cradle, preventing its escape, and then track trials.

## Do I know if it will work?

*No! Not a clue! It will be fun finding out.*

As a closing touch to my little efforts of fun, frustration and overcoming my own ineptitude, I thought that in the finest traditions of narrow gauge in its heyday there should be an 'outshopped' posed sepia picture of the locomotive in its glory before the hardships of narrow gauge working life take their toll (**photo 85**).

Please note the inclusivity of the DTLR with female footplate crew. Our solitary brake van is also the domain of our female guard. Woe betide him who sneaks a cup of tea, crisps and a sausage roll uninvited.

I hope that my trials and tribulations have helped and amused someone along the way as it has helped me tread that troubled path travelled by so many others and provided in the end such satisfaction.

Finally Gremil (christened by my wife), my resident workshop gremlin, sends his greetings to all those other resident workshop gremlins out there in the wider world. I plan to live long enough to discover what he is building with all the tools and bits and pieces which hit the workshop floor that he spirits away.

Now for number two. There are things I will change on the second locomotive - for another day. In the meantime railway infrastructure work beckons as the weather hopefully improves.

**ME**

# FMES Rally 2024

**Mike Chrisp** reports from this year's rally, held at the Nottingham SMEE.

The Federation of Model Engineering Societies (formerly Southern Federation of Model Engineering Societies) promotes an annual Autumn Rally at various venues around the UK which this year was hosted by Nottingham SMEE. Nottingham SMEE shares a site with the Nottingham Transport Heritage Centre at Ruddington. Very well appointed with a fine clubhouse and well equipped workshop and machine shop, the Nottingham SMEE site features a dual gauge 3½ and 5 inch gauge raised alloy track some 2270ft long and a 7¼ inch ground level railway recently extended to about 3168ft. Fully signalled, the tracks are equipped with all appropriate facilities. Garden gauges are catered for with a 240ft gauge 1 track and a 16mm narrow gauge track currently under construction.

With their popular venue enjoying a convenient location and excellent facilities, members of Nottingham SMEE were splendid hosts for the 2024 event that thankfully enjoyed good weather. A catering team consisting mainly of ladies associated with the society provided a hundred buffet lunches for visitors and NSMEE members acting as stewards and track marshals of whom there were plenty. Following the day's main proceedings bacon and sausages were barbequed and served in cobs.

The FMES Rally is an opportunity for model engineers, their families and friends to spend time together pursuing their chosen activity in good company. For some years now, participants with working steam locomotives in gauges from 2½ to 7¼ inch inclusive built to accurately represent any Commonwealth prototype automatically compete for the Australian Association of Live Steamers Trophy. Under similar rules at their Easter Convention, AALS members compete for the Federation of Model Engineering Societies Trophy. To provide a more generally accessible award, the


*Shirley Cannon (North London SME) enjoyed her run at the controls of her battery-electric 5 inch gauge Metropolitan locomotive* Sir Christopher Wren, *some laps with husband George as passenger.*

Paul Godin (North London SME) tackles the back straight with Bongo, his fine 5 inch gauge LNER B1 4-6-0 in much admired black livery.

Seen here at the regulator of his 3½ gauge Gresley A1 Pacific (4-6-2) locomotive originally built in 1934, Andy Nash (Romney Marsh MES) was presented with an engraved glass tankard in recognition of his having travelled the furthest to participate in the rally, a round trip of c. 410 miles.

Andrew Lane (North London SME) with his sturdy 0-6-0 locomotive to the Butch design.

This handsome Kerr Stuart 0-4-2 locomotive Hampton by Alain Foote (Rugby MES) was one of two visiting 7¼ inch gauge engines to run on the ground level railway during the rally.

George Winsall (Rugby MES) with his 3½ inch gauge Hunslet 0-4-0T Lilla built to Don Young's drawings.

Frances Mayall (Bracknell Railway Society) enjoyed plenty of laps of the raised track with her 3½ inch gauge 0-4-0ST to the attractive Conway design.

Federation recently introduced a new trophy for competition at the Autumn Rally for any example of model engineering participating in the event. Both trophies are awarded at the discretion of independent panels of Judges.

Sixteen clubs and societies were represented at this year's Rally including Banbury DMES, Bracknell RS, Brent House Railway, Brighouse & Halifax ME, Cheltenham SME, Harlington LS, Maidstone MES, North London SME, North West Leicester SME, Nottingham SMEE, Romney Marsh MES, Rugby MES, South Cheshire MES, Spenborough MEE, Tyneside SMEE and Wakefield SMEE. Maybe not a record, but certainly an excellent turnout.

Thirty-three visitors attended with models including two 7¼ inch gauge locomotives, nineteen 5 inch gauge steam locomotives, five 5 inch gauge battery-electric locomotives, four 3½ inch gauge locomotives, two traction engines and a lifeboat on a trailer towed by a battery-electric powered lorry. It is no exaggeration to say that stewards and marshals were kept very busy managing the day's arrangements.

Following a thoroughly enjoyable day's activities, FMES chairman Bob Polley expressed the Federation's appreciation of our hosts' considerable time and effort involved in preparing for the Rally and making it run so smoothly. He then presented the awards to the successful participants. Les Brimson from North London

»

Wayne Robertshawe (Wakefield SMEE) wth his 5 inch gauge 0-4-2ST locomotive to the popular Sweet Pea design.

David Ackerman (Harlington Locomotive Society) about to set off from the station with his 5 inch gauge GWR Prairie 2-6-2T locomotive.

Les Brimson (North London SME) poses at the station while awaiting a clear road ahead.

Steve Bennett (Nottingham SMEE) was awarded the FMES Trophy for his AEC Matador truck based on a battery-electric mobility scooter, and detailed model of a Clyde Class lifeboat (photo: Chris Harrison NSMEE).

Bob Polley (chairman FMES) presented Les Brimson (North London SME) with the AALS Trophy for the workmanship, finish and detail of his 5 inch gauge SECR L Class 4-4-0 locomotive (photo: Chris Harrison NSMEE).

SME won the AALS Trophy for his 5 inch gauge SECR L Class 4-4-0 locomotive, Steve Bennett from Nottingham SMEE won the FMES Trophy for his AEC Matador truck and RNLI Clyde Class lifeboat and Andy Nash from Romney Marsh MES was awarded a glass tankard engraved with the NSMEE logo for travelling the furthest distance to participate in the event to run his 3½ inch gauge Gresley A1 Pacific *Spitfire*, a return journey of some 410 miles. Much to Bob Polley's embarrassment Tony Knowles presented him with an engraved glass tankard to celebrate an imminent birthday and another to NSMEE member Nick Harrison who had driven overnight from Italy to be present at the Rally.

Les Brimson's 5 inch gauge SECR L Class 4-4-0 locomotive gained the AALS Trophy for fine workmanship, excellent finish and good detail including a steam reverser which he admitted had given him some headaches on the way to getting it to work as it should. Built over some 47 years with reference to works drawings and as many photographs as he could find, Les explained how the valve gear is correct to prototype and set up according to Don Ashton's principles. The locomotive is fitted with a scale steam operated reverser situated on the right-hand running board augmented by a larger unit beneath the footplate which operates in parallel with the scale reverser. Both operate simultaneously from correct controls in the cab with cutoff indication by quadrant plate and pointer, also in the cab. The boiler is to LBSC's *Maid of Kent* design with a more representative backhead. Platework is scaled from works drawings and livery is according to an illustrated print of No. 771 in a 1914 edition of the RCTS magazine.

Steve Bennett's AEC Matador truck and RNLI Clyde Class lifeboat were awarded the FMES Trophy for workmanship and detail. The AEC Matador truck was built around a battery-electric disability scooter and the lifeboat is unusual in that it represents a cruising lifeboat designed with accommodation for the crew on board rather than the more usual arrangement for it to be launched for a rescue mission.

Andy Nash gave an interesting account of his 3½ inch gauge Gresley A1 Pacific (4-6-2) locomotive. Built to Clarkson's drawings in 1934 as a Gresley locomotive by G.W. Smith it was later modified to resemble a Greenly locomotive more suited to RHDR motive power. Rebuilt in 2013 and subsequently subject to major overhaul in 2022, Andy wished to publicly express his thanks to all who have helped bring *Spitfire* to its present excellent condition.

Regrettably, all good things come to an end. The locomotives were cleaned and loaded into owners' vehicles, farewells were exchanged, promises repeated to 'keep in touch' and visitors set off on their homeward journeys. With repeated thanks to our hosts, it was generally agreed that this year's FMES Rally was one of the best we've had for a long time. For me, it was also a great opportunity to catch up with long established friends and make new ones.

ME

# Kinematics PART 3

**Rhys Owen** presents a readers' guide to the laws of motion.

Continued from p.510
M.E.4753 October 4

## An algebraic digression

Now for another digression. Earlier we saw that:

$(a + b)^2 = a^2 + 2ab + b^2$

By the same method we can show that:

$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

Likewise:

$(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + \dots$

There is a pattern here - the expression is always of this form:

$(a + b)^n = a^n + na^{(n-1)}b + \dots + b^n$

Note the second term on the right-hand side!

Back to the plot – literally!

So far we have looked at graphs in which velocity is plotted against time. However, we can also plot displacement against time. Suppose we have a body travelling at a varying speed, where the displacement varies as the square of the time, as shown for the first few values in table 4.

If we plotted a graph of displacement against time, this would look like **fig 4**.

Note that in this case the axes are not to the same scale as otherwise the figure would be even taller and thinner.

In fact, we could describe the above relationship between displacement *s* and time *t* by the following expression:

$s = t^2$

In the graph above the blue curve consists of those points $(t, s)$ whose co-ordinates are of the form $(t, t^2)$ because they satisfy the above equation. So, because displacement is equal to the square of time, we can in this case substitute $t^2$ for *s*. We can in fact say that s is a function of time.

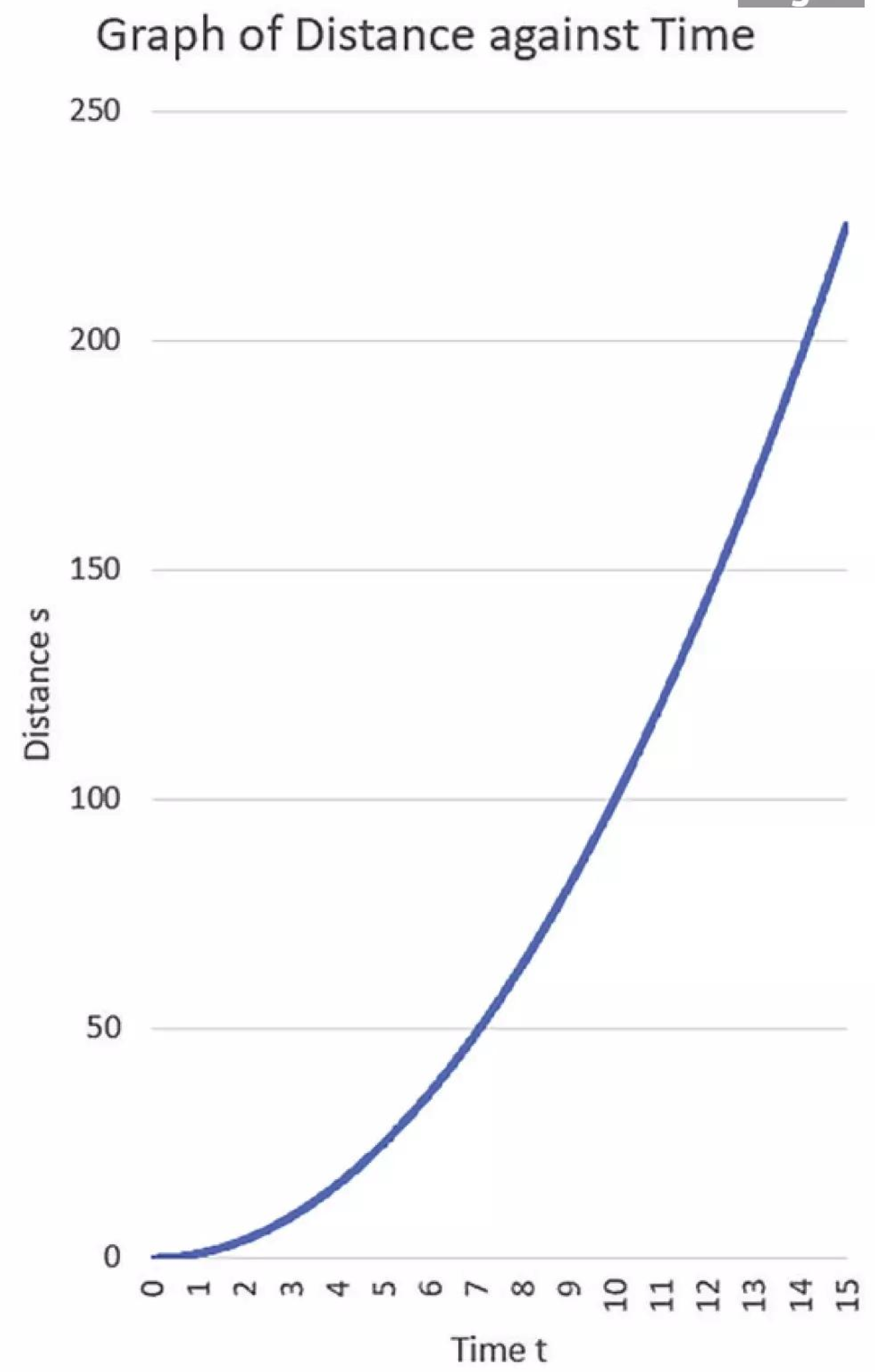
The word function is basically a fancy way of saying 'mathematical recipe'. In this case the only 'ingredient' is time and the 'cooking instructions' are simply to multiply time by itself, that is, to square it.

Since velocity is the rate of change of displacement with respect to time it is clear from the steepening slope of the blue line that the velocity is increasing as time increases. How can this be evaluated at a particular time? For example, what is the velocity of the body when 10 seconds have elapsed? That is, if $t = 10$ what is *v*? This velocity can in fact be found as we shall now demonstrate.

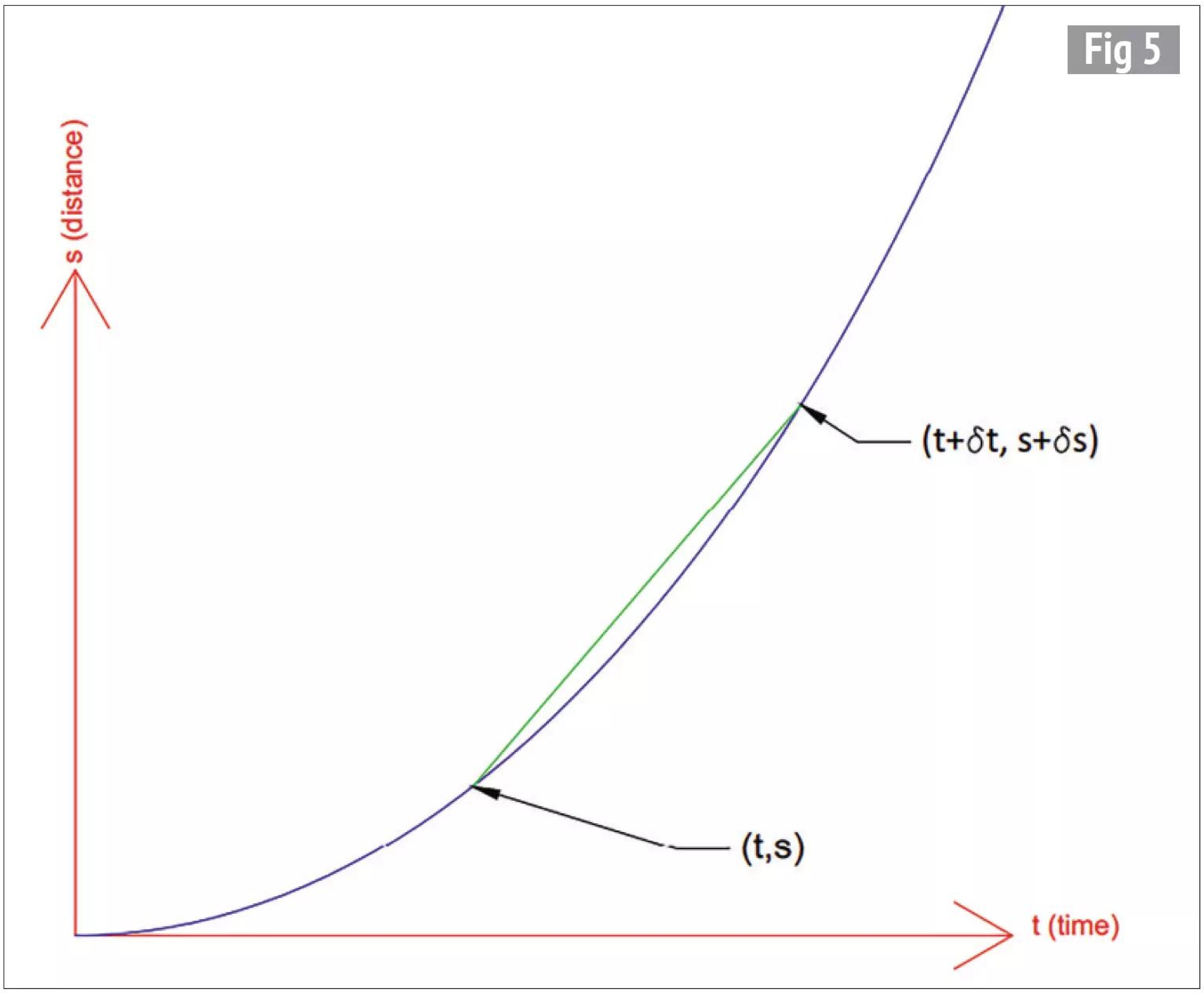
In **fig 5** we can see a general point $(t, s)$ on the curve described by the function $s = t^2$. We can get an approximate value of the velocity at time *t* if we increase the time by a small amount $\delta t$ to get a new point $(t + \delta t, s + \delta s)$ that also lies on the curve described by $s = t^2$.

Please note that here $\delta t$ does not mean '$\delta$ (delta) multiplied by $t$' but simply means 'a small increment of $t$'. Likewise, $\delta s$ means a small increment of *s*, in this case the increment that corresponds to the increment $\delta t$. We can say:

Fig 4




*Graph of distance vs t squared.*




*Establishing approximate velocity.*

$$\text{velocity at time } t \approx \frac{\delta s}{\delta t}$$

The sign '≈' means 'approximately equal to'.

But we can do better than this! Since both $(t, s)$ and $(t+ \delta t, s+ \delta s)$ are on the curve described by $s=t^2$, we can rewrite both points as follows:

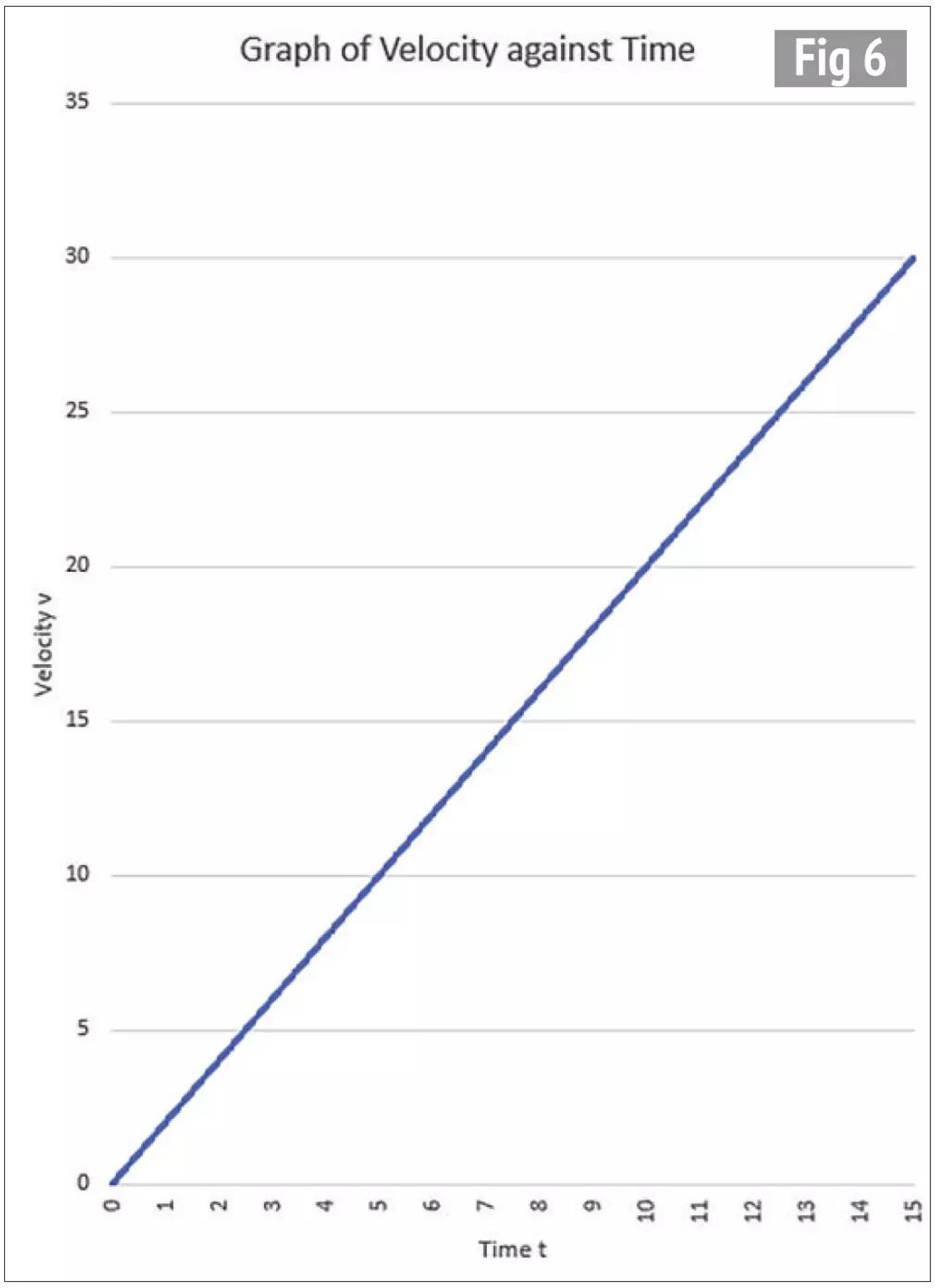
$$(t, s) = (t, t^2)$$

$$(t+ \delta t, s + \delta s) = (t+ \delta t, (t, \delta t)^2)$$

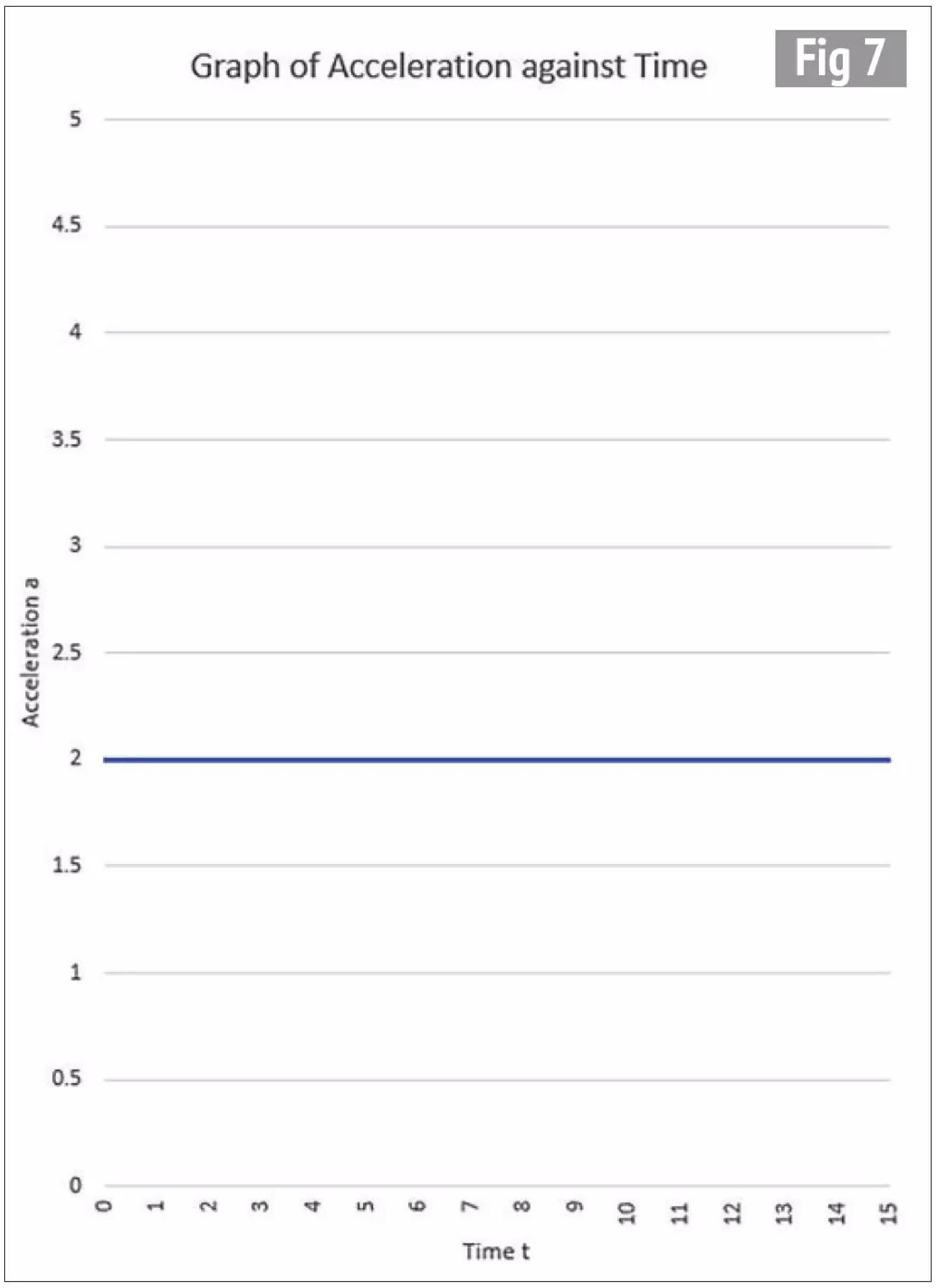
We can see that the increase in time $t$ from $t$ to $t+ \delta t$ (this increase is, of course, $\delta t$) has given rise to the increase $\delta s$ which we can now describe in terms of the variable $t$ using the following steps:

$$\delta s = (s + \delta s) - s$$
$$\delta s = (t + \delta t)^2 - t^2$$
$$\delta s = t^2 + 2t\delta t + (\delta t)^2 - t^2$$
$$\delta s = 2t\delta t + (\delta t)^2$$

Dividing both sides by $\delta t$ we get:




*Graph of velocity against time.*




*Graph of acceleration against time.*

$$\frac{\delta s}{\delta t} = \frac{2t\delta t + (\delta t)^2}{\delta t}$$

As you may recollect from our false proof that 2 equals 1, dividing by zero is meaningless so we can't let δt equal zero. Nevertheless, we are interested in the velocity at time *t* and clearly the smaller the value of *δt* the closer the green line in the above diagram approximates to the gradient of the curve $s = t^2$ at the point *t*. So, we can say that:

As *δt* tends to zero,

$$\frac{\delta s}{\delta t} = \frac{2t\delta t + (\delta t)^2}{\delta t} \text{ tends to } 2t$$

Or, if you prefer, the limit is that value to which we can get as close as we wish to by choosing smaller and smaller values of *δt* that are greater than zero.

The limit value in this case is written as follows:

$$\frac{ds}{dt} = 2t$$

In words:

The limit value *ds/dt* is the derivative of *s* with respect to *t*.

The derivative of *s* with respect to *t* is the rate of change of *s* with respect to *t*.

Since velocity is the rate of change of displacement with respect to time, at any given time *t* the velocity of the body *at that instant* is thus given by the function *v = 2t*.

The question posed earlier was 'What is the velocity of the body when 10 seconds have elapsed?'.

To answer this we simply put t = 10 seconds into the equation *v = 2t*, so:

$$v = 2 \times 10 = 20ms^{-1}$$

We can plot the above velocity function on a graph (**fig 6**).

By inspection we can see that the slope of this graph is constant. In fact, the velocity is steadily increasing at 2 metres per second per second. In other words:

$$v = 2t \Rightarrow \frac{dv}{dt} = 2$$

The above is also the second derivative of s with respect to t and we can see the following relationship:

$$\frac{d^2s}{dt^2} = \frac{dv}{dt} = a$$

Plotting acceleration against time we get **fig 7**.

We could, if we wished, differentiate again to get the third derivative of displacement with respect to time but since the second derivative, acceleration, is constant, the result would be zero at all values of *t*.

Here are a few rules:

$$\frac{d(x^n)}{dx} = nx^{(n-1)}$$

Where *k* is a constant then:

$$\frac{d(kx^n)}{dx} = k\frac{d(x^n)}{dx} = knx^{(n-1)}$$

Note that $x^1 = x$ and $x^0 = 1$ so that:

$$\frac{d(kx)}{dx} = k$$

And:

$$\frac{d(k)}{dx} = 0$$

We can see these rules in action if we look at the second equation of motion under constant acceleration:

$$s = ut + \frac{1}{2}at^2$$

Applying the above rules:

$$\frac{ds}{dt} = \frac{d(ut)}{dt} + \frac{d\left(\frac{1}{2}at^2\right)}{dt}$$

$$= u + \left(\frac{1}{2}a \times 2t\right)$$

$$= u + at$$

Which, because velocity is the rate of change of displacement with respect to time, is our old friend:

$$v = u + at$$

Both *u* and *a* are constants so, when we differentiate again:

$$\frac{d^2s}{dt^2} = \frac{dv}{dt}$$

$$= \frac{d(u)}{dt} + \frac{d(at)}{dt}$$

$$= 0 + a$$

$$= a$$

Which is no surprise!

## Continuity and differentiability

To obtain the derivative of a function at a given point the function must be well-behaved in that it must be continuous (essentially, there must be no gaps in the curve) and differentiable (that is, there must be no sharp corners at a point that make it impossible to determine what the derivative is at that point). There are formal definitions for both continuity and differentiability but we shall not pursue these matters here.

## Maxima, minima and points of inflexion

At the maximum value of a function the derivative (i.e. the slope of the curve at that point) is zero as the function has ceased to increase.

At a minimum, the derivative is also zero as the function has ceased to decrease.

A point of inflection is a bit like a landing on a stairway, that is, a level bit before you resume climbing or descending. The function $y = x^3 + 2$ has a point of inflexion at (0, 2) as shown in **fig 8** (the curve was created in Excel and the vertical axis is offset to the left).

While maxima, minima and points of inflexion can often be determined by inspection, in other cases it is not so easy. The example below shows how these can be found by differentiation.

First, we differentiate the above function:

$$\frac{dy}{dx} = \frac{d(x^3 + 2)}{dx}$$

$$= \frac{d(x^3)}{dx} + \frac{d(2)}{dx}$$

$$= 3x^2 + 0$$

$$= 3x^2$$

To find out what value of x will give a zero gradient we set this to zero as follows:

$$\frac{dy}{dx} = 0 \Rightarrow 3x^2 = 0 \Rightarrow x = 0$$

So we know that the slope of the curve is zero when x = 0.

We now set x = 0 into our original equation $y = x^3 + 2$ and find that when x = 0 then y = 2.

So, zero slope occurs at the point (0, 2).

If we had no graph of the function, we could verify that it was a point of inflexion by evaluating values close to the point of zero slope to see how the function behaves.

We find that when x = -0.1 then y = 1.999 and when x = 0.1 then y = 2.001 so that we can see that the function is increasing both before and after the point where the slope is zero. Thus the point (0, 2) is a point of inflexion and neither a maximum nor a minimum.

## Example 4

What is the largest rectangular area that can be enclosed by 100 metres of fencing?

By symmetry we can deduce that two adjacent sides of the rectangle will together use up 50 metres of fencing.

So, if the length of one of these sides is x metres, then the length of the other will be (50 – x) metres.

So, the area of the rectangle will be x multiplied by (50 – x):

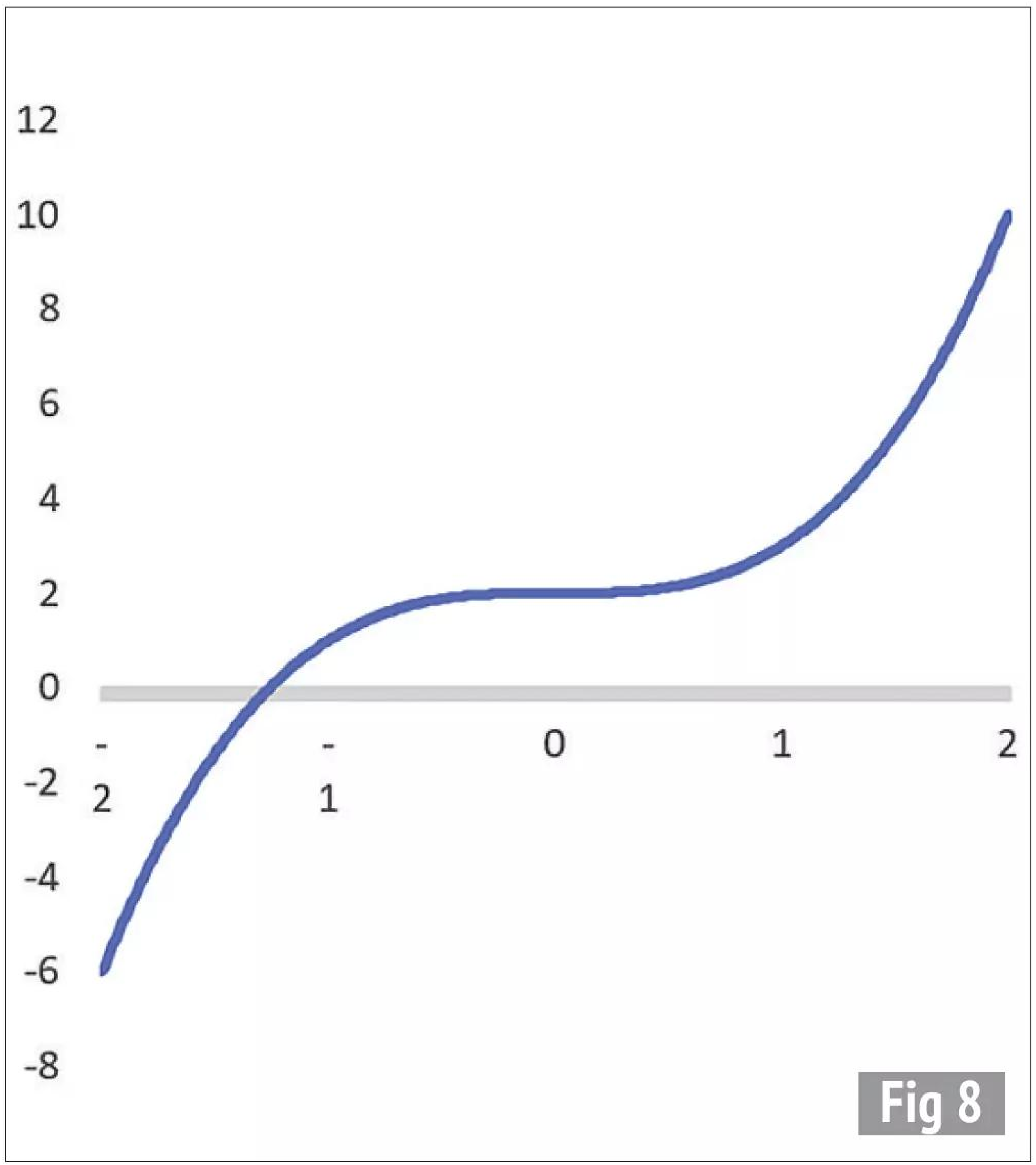
$$A = x(50 - x)$$
$$= 50x - x^2$$

We now differentiate A with respect to x:

$$\frac{dA}{dx} = \frac{d(50x)}{dx} - \frac{d(x^2)}{dx}$$

$$= 50 - 2x$$

As noted earlier, at a maximum, at a minimum or a




*Point of inflection.*

**Table 4**

| Time t | Displacement s |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | 4 |
| 3 | 9 |
| 4 | 16 |

*Displacement vs time.*

point of inflexion, the derivative is zero, so:

$$\frac{dA}{dx} = 0 \Rightarrow 50 - 2x = 0 \Rightarrow x = 25$$

If one side is 25 metres long then the other side (50 - x) must also be 25 metres long giving a total area of 625 square metres.

Is this a maximum, a minimum or a point of inflection?

If we let x = 24 then the other side will be 26 giving an area of 624 (< 625) square metres.

If we let x = 26 then the other side will be 24, also giving an area of 624 (< 625) square metres.

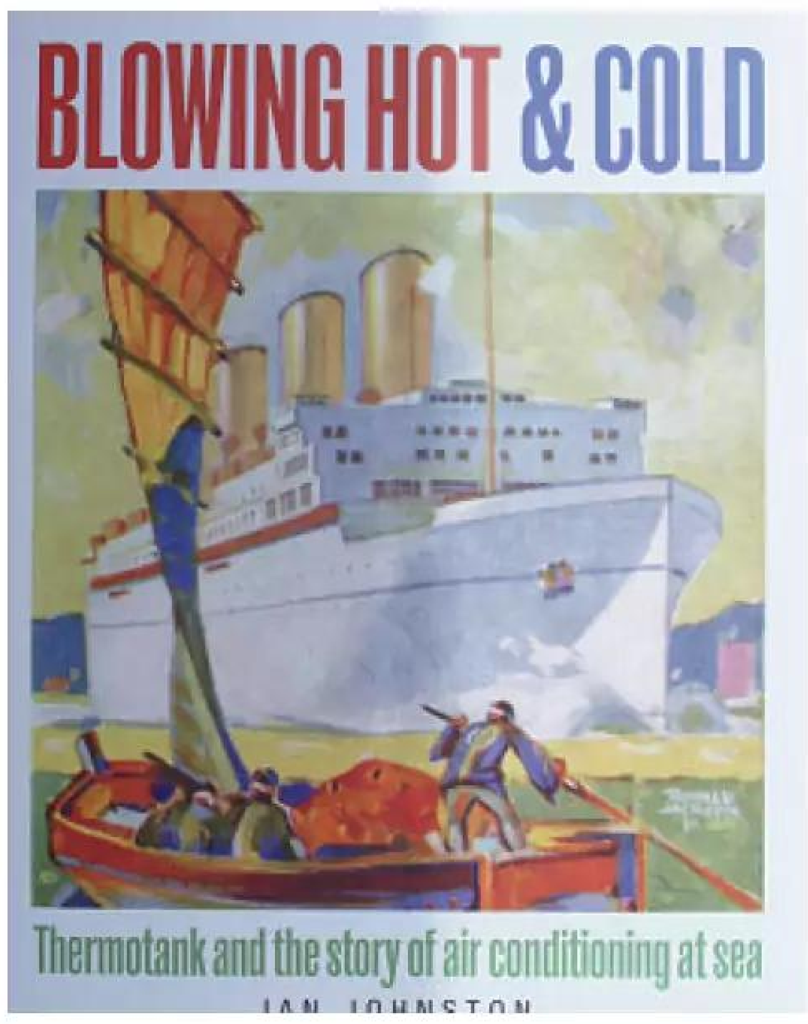
So, an area of 625 square metres is the maximum rectangular area that can be enclosed by 100 metres of fencing.

●To be continued.

# Book Review

## **Blowing Hot and Cold:** Thermotank and the story of air conditioning at sea

Ian Johnson




Published by Seaforth, 2024
ISBN 978-1-0361-0769-7
144pp, hardback, £19.99

Something completely different! Heating, ventilation and refrigeration engineering have contributed enomously to human comfort and enjoyment but receive little attention from authors.

As steamships increased in size problems of ventilating and heating passenger and crew spaces increased. With more passenger ships using tropical routes cooling became more important.

*Thermotank* was an early air conditionaing system for ships, though the term 'air conditioning' wasn't coined untill years later. Electrical engineer Alexander Stewart thought of the idea working as a ship's engineer and then for the shipbuilders Thomson and Co. (later John Brown and Co.) at Clydebank. The Clyde then had over forty shipbuilding firms with a large share of the growing market for ocean liners which often travelled to tropical climes as well as facing the adverse weather of the North Atlantic.

Yet the first *Thermotank,* as Alexander called his invention, was tried on a Russian warship. Air drawn in circulated around steam heated pipes to warm air or round cold water (or brine) filled pipes to cool Fans blew air via trunking to compartments on a ship. Alexander patented the invention in 1898 and set up his own company to market *Thermotank* in 1901.

At first the company commissioned others to manufacture the units but later built units themselves in their own works at Govan. Units were widely used and both *Lusitania* and *Mauretania* built in 1907 were so equipped with the units around their funnels. Royal Navy ships used them too.

One innovation in the 1920s was the 'Punkah Louvre' an adjustable ball and socket vent outlet. These were used in ships, aircraft, offices and even the Cabinet War Rooms. Under Alexander's son Ian *Thermotank* expanded with works and offices in the UK and abroad. In the head office product development included a wind tunnel along with hot and cold rooms to test systems.

Sadly the demise of much Clyde shipbuilding affected *Thermotank*. It was taken over and became APC Hall. The Govan premises are no more. However, Ian Stewart led efforts to modernise working practices at the failing Fairfield shipyard but that ended with the Government sponsored creation of Upper Clyde Shipbuilders.

A worthwhile and readable book on an unusual engineering subject.

*Roger Backhouse*

# A Tandem Compound Mill Engine

PART 5

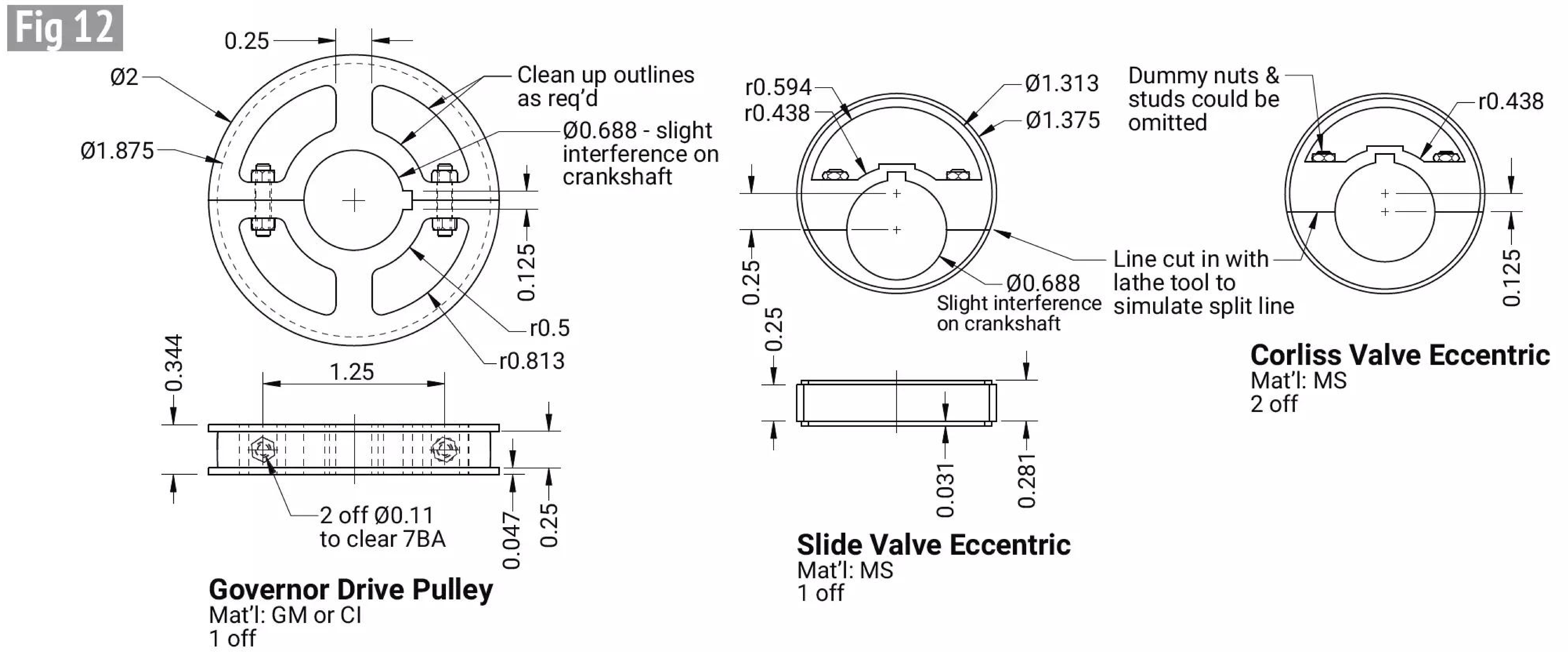
**David Thomas** builds Arnold Throp's model of a Corliss mill engine.

Continued from p.531
M.E.4753 October 4

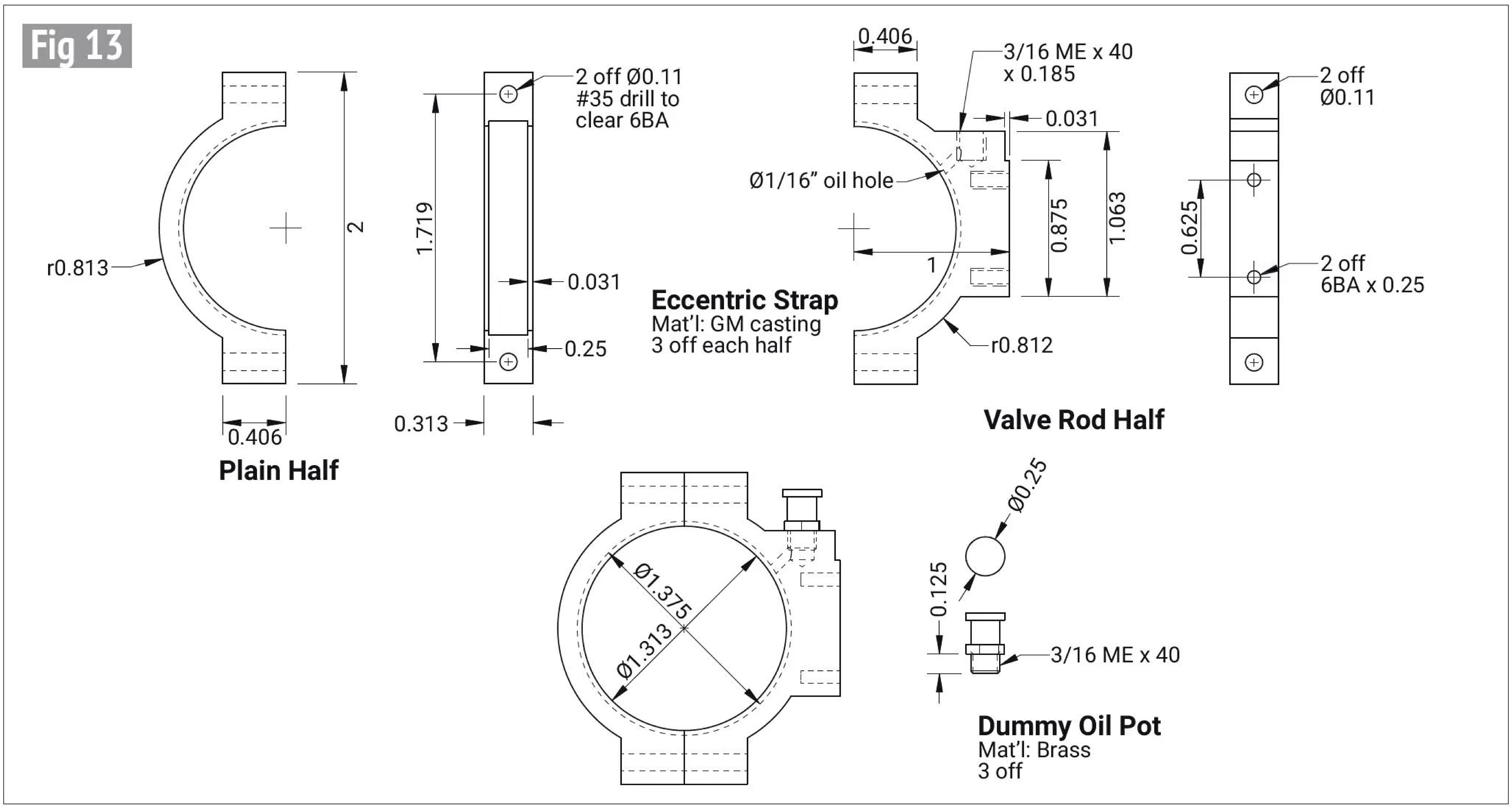
In addition to the flywheel and crank there are four other parts that attach directly to the crankshaft: the three eccentrics and the governor drive pulley (**fig 12**). In this part of the series, I'll describe making these parts plus the eccentric straps (**fig 13**).

The governor drive pulley was supplied as a gun metal casting which had a fairly rough finish; it was certainly going to need a lot of smoothing or, as I chose to do, machining all over. There was a shallow groove cast in on one side that I took on trust to be across a diameter, so I used this to set the casting up for slitting into halves (**photo 51**). A simple error meant that the slitting saw wasn't set to cut quite all the way through which actually came in handy as the cut finished and prevented the top half from flying off. A piece of string or fishing line to support the top bit would have been a better idea. After soft soldering the halves back together (**photo 52**) it was clear that the groove hadn't been quite across a diameter, so you need to check this. Like most of the castings in the set the machining allowances were small and setting up needed to be carefully done, something I learned as I went along. The pulley was set up in the four-jaw chuck, bored to fit the crankshaft, and faced on one side (**photo 53**). A stub of mild steel was turned to make a mounting mandrel for the pulley (**photo 54**) which was attached to it with CA glue then the second face, and the belt groove, machined. With the pulley still attached, the mandrel was fixed on the rotary table and the curved slots milled out (**photo 55**). Working out the angles and radii for (in

Fig 12




*Eccentrics and governor drive pulley drawing.*



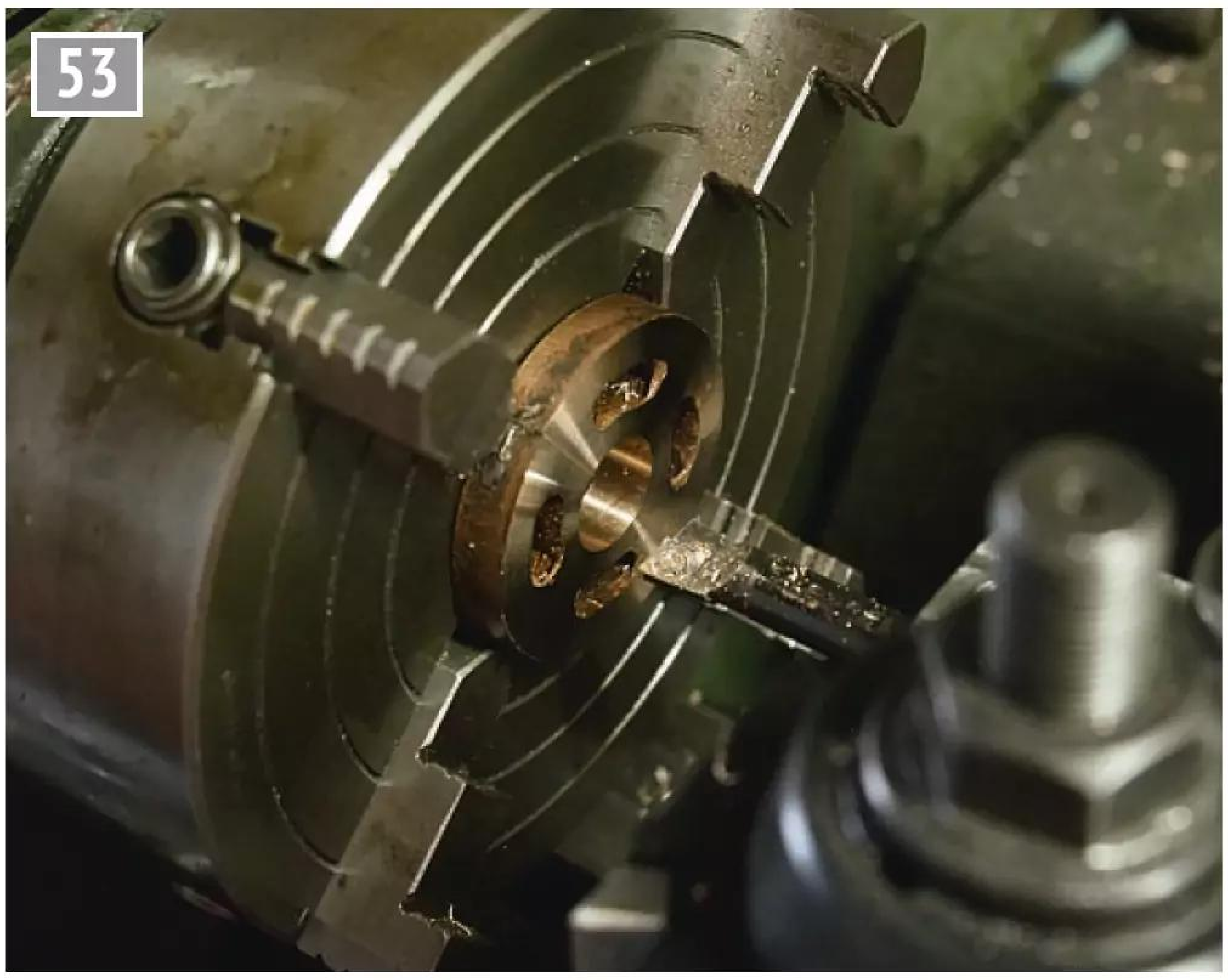

*Eccentric strap drawing.*

this case) a 4mm end mill was almost certainly more trouble than it was worth; using files would have achieved much the same outcome. With the pulley halves heated and separated they were very carefully aligned and gripped in a vice on the mill to drill the stud holes and machine in the keyway (**photo 56**). With machining of the halves complete the cross-arms thickness can be checked and the 7BA studs made to length.

All three of the eccentric strap castings were well enough made that they only needed a small amount of filing to allow them to be held by the bore on a three-jaw chuck (**photo 57**). One outer face was cleaned up then the strap turned and brought to thickness. Once again there wasn’t much machining allowance so, assuming that castings are the same sizes, only remove the bare minimum necessary from the first face. With the three castings held together, all the flat external surfaces were milled (**photos 58** and **59**).


*Separating the pulley casting halves.*

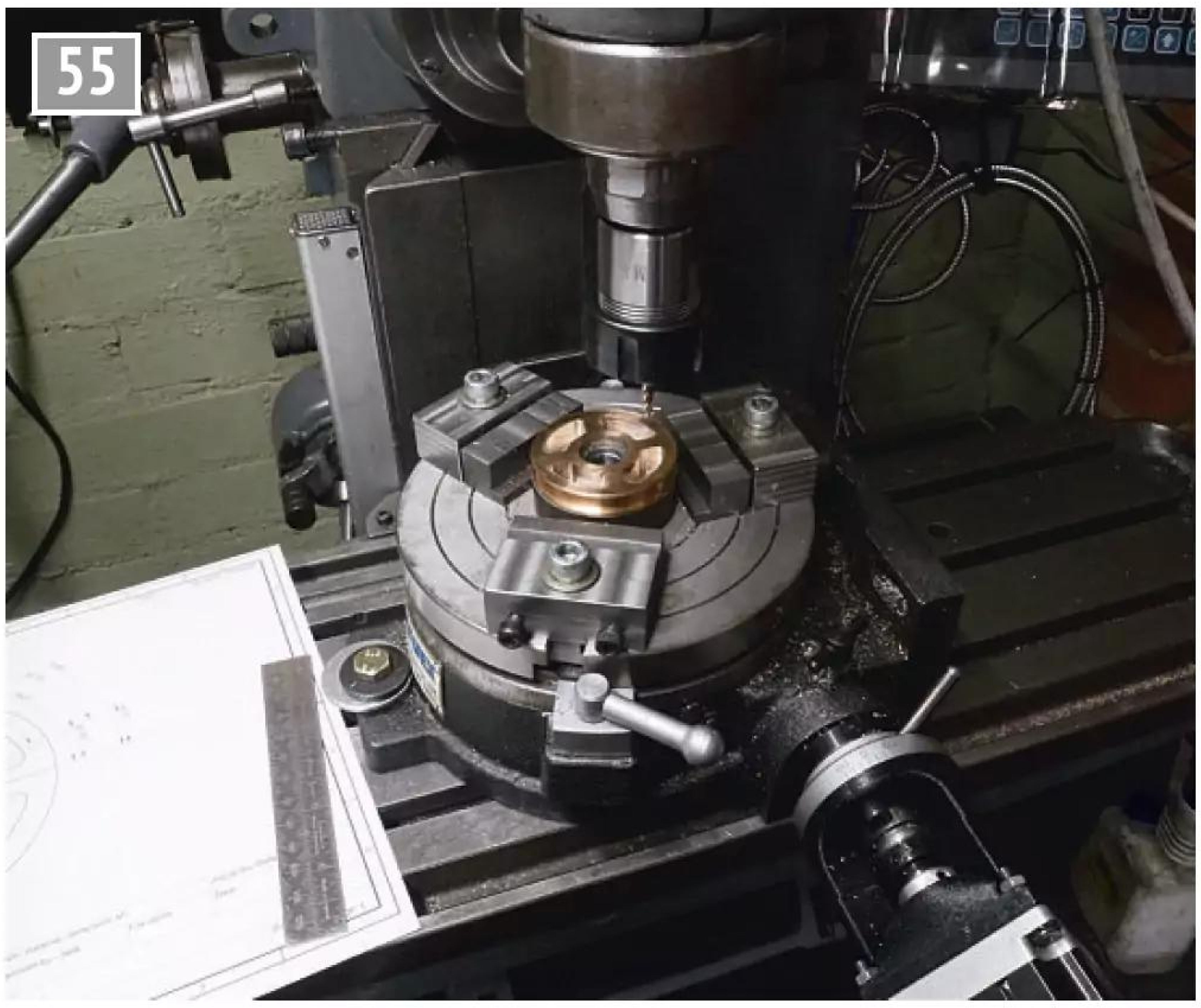

*Pulley re-assembled with soft solder.*




*Boring and facing the first side of the pulley.*

54

*The pulley glued to a steel mandrel with CA glue in order to machine the other face and the belt groove.*



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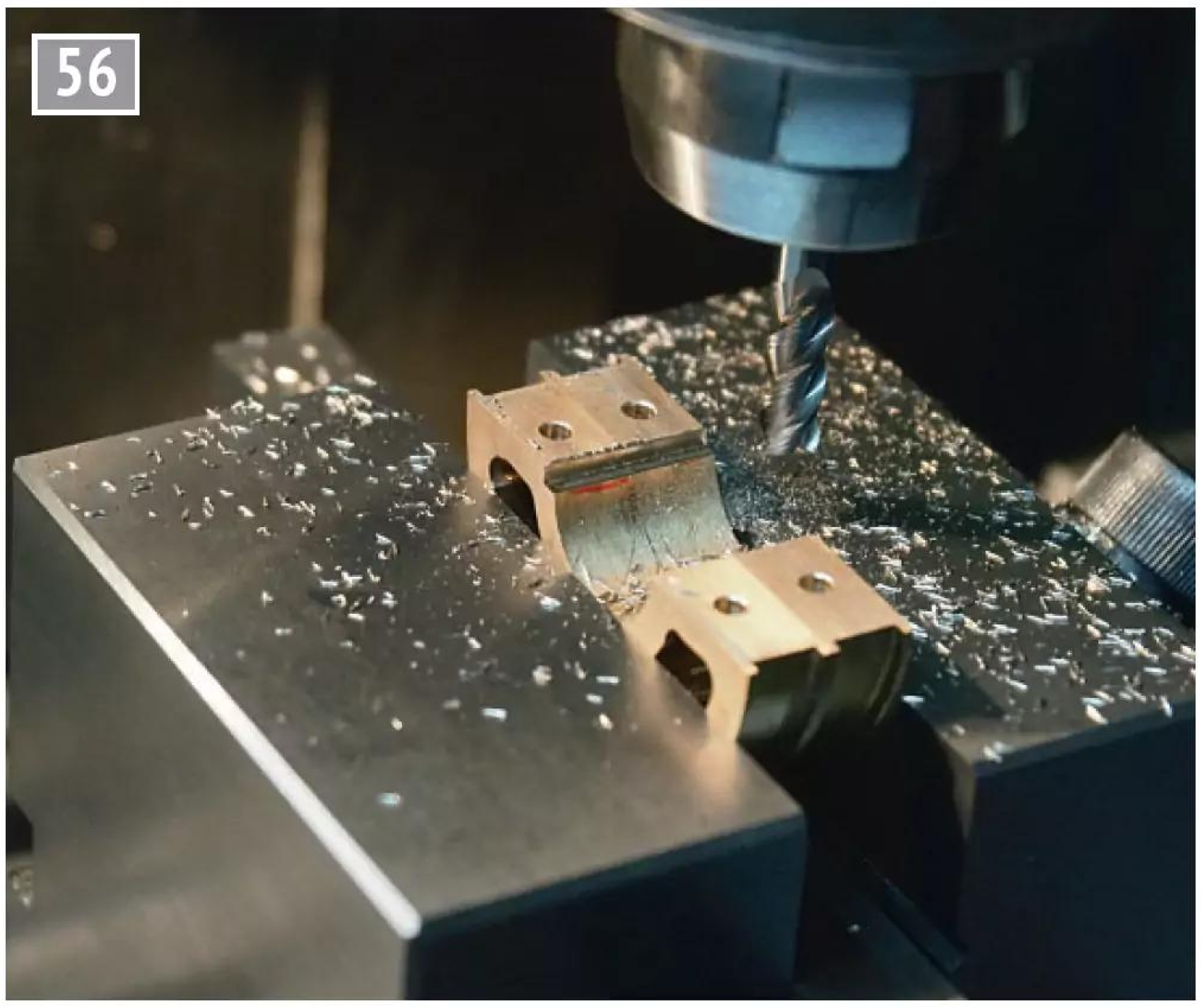
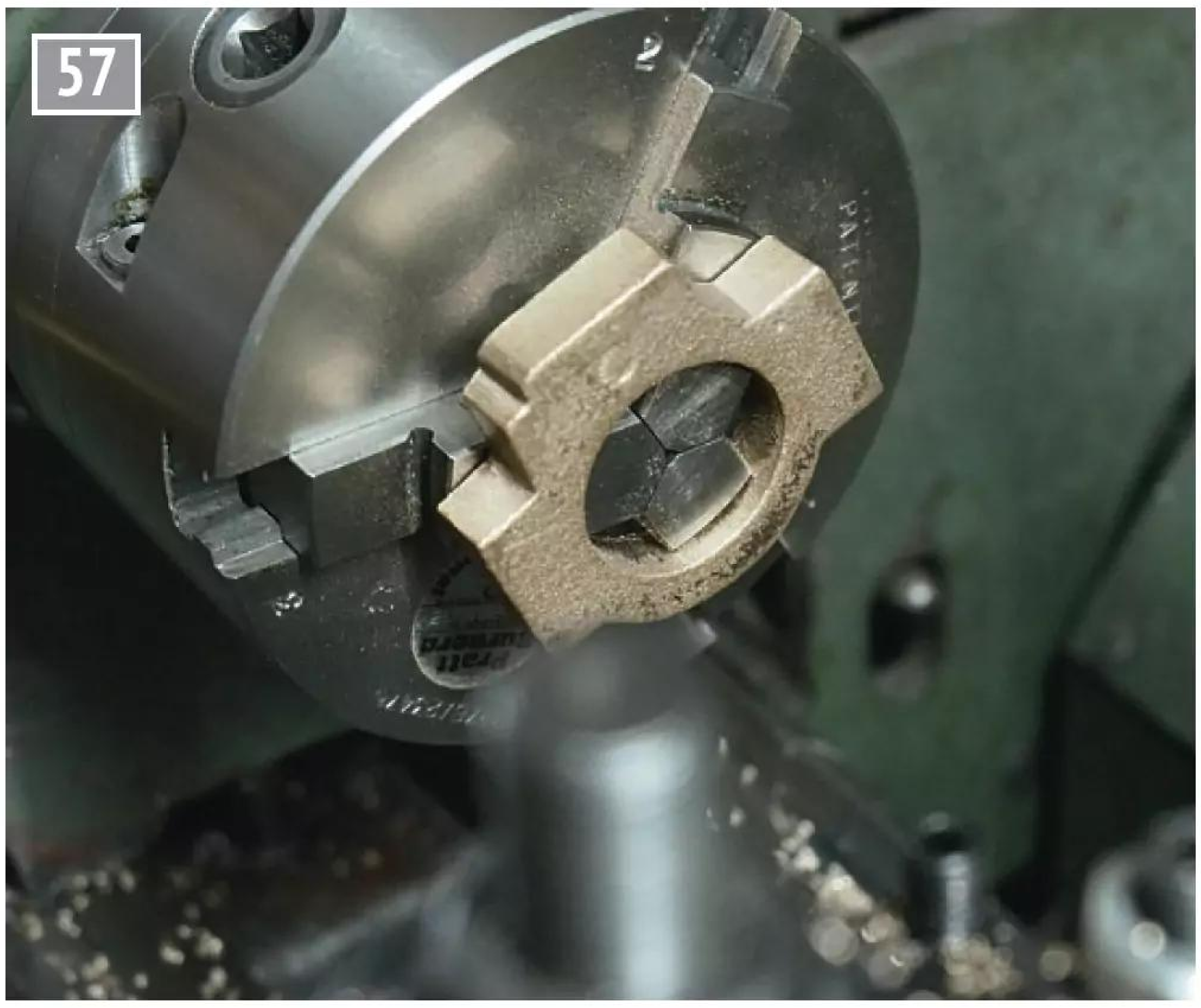
*The pulley, still glued to the mandrel, mounted on a rotary table to clean up the crossing holes.*



56

*Set-up for machining the keyway in the pulley and drilling the stud holes.*



57

*Eccentric strap casting; first set-up for facing.*

58

*After facing both sides of all three castings they were machined as a group.*

59

*More work on the outer surfaces of the eccentric strap castings.*

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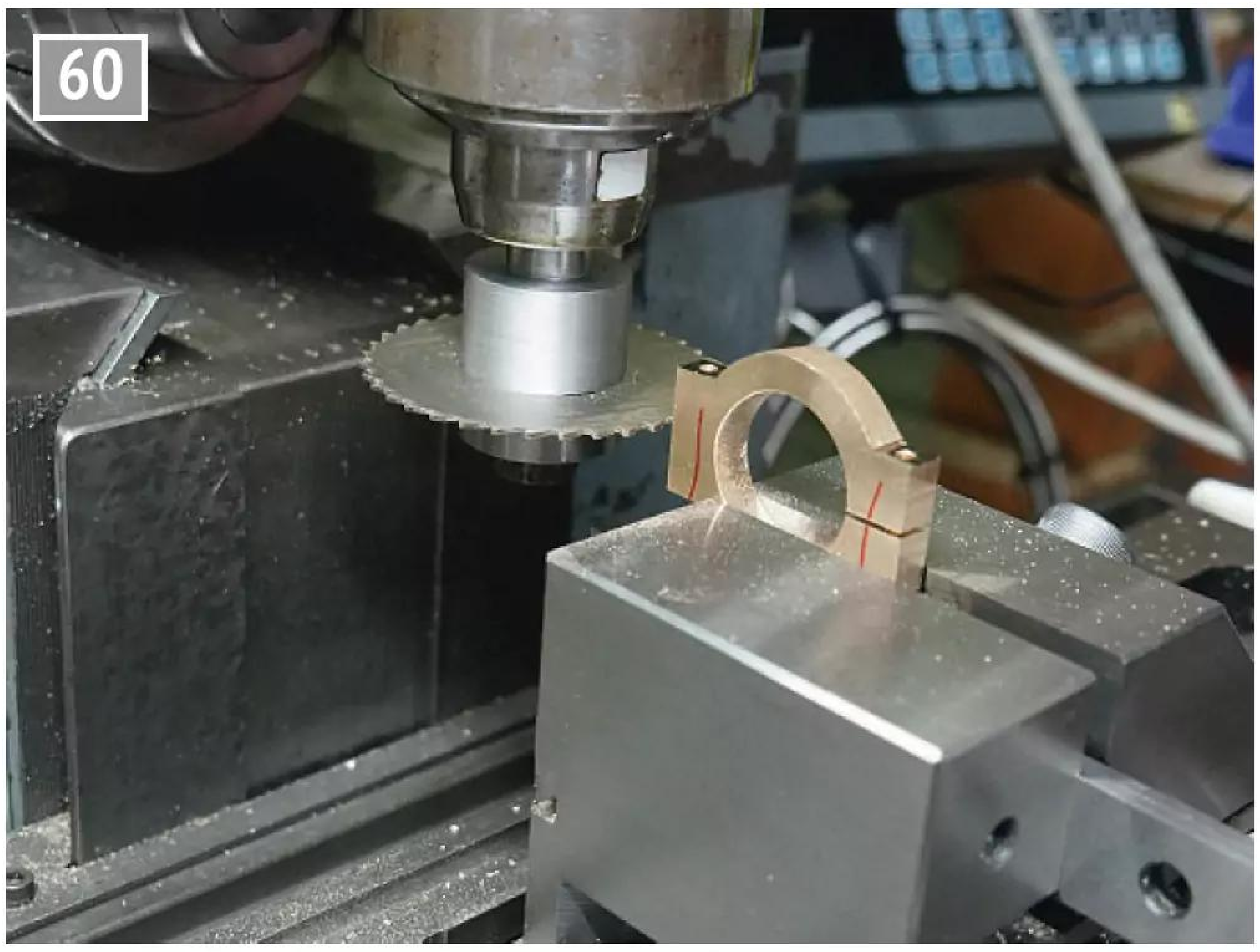
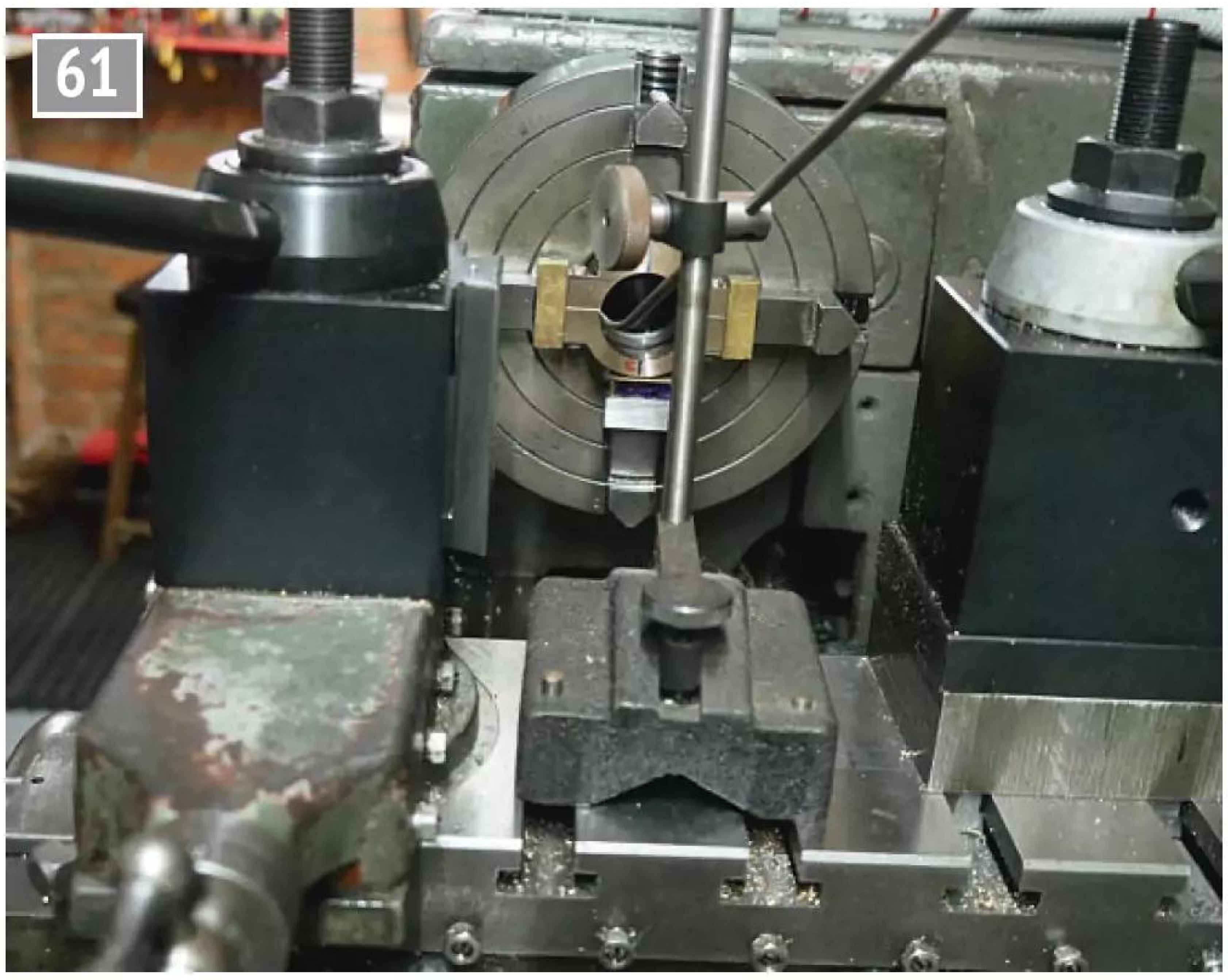
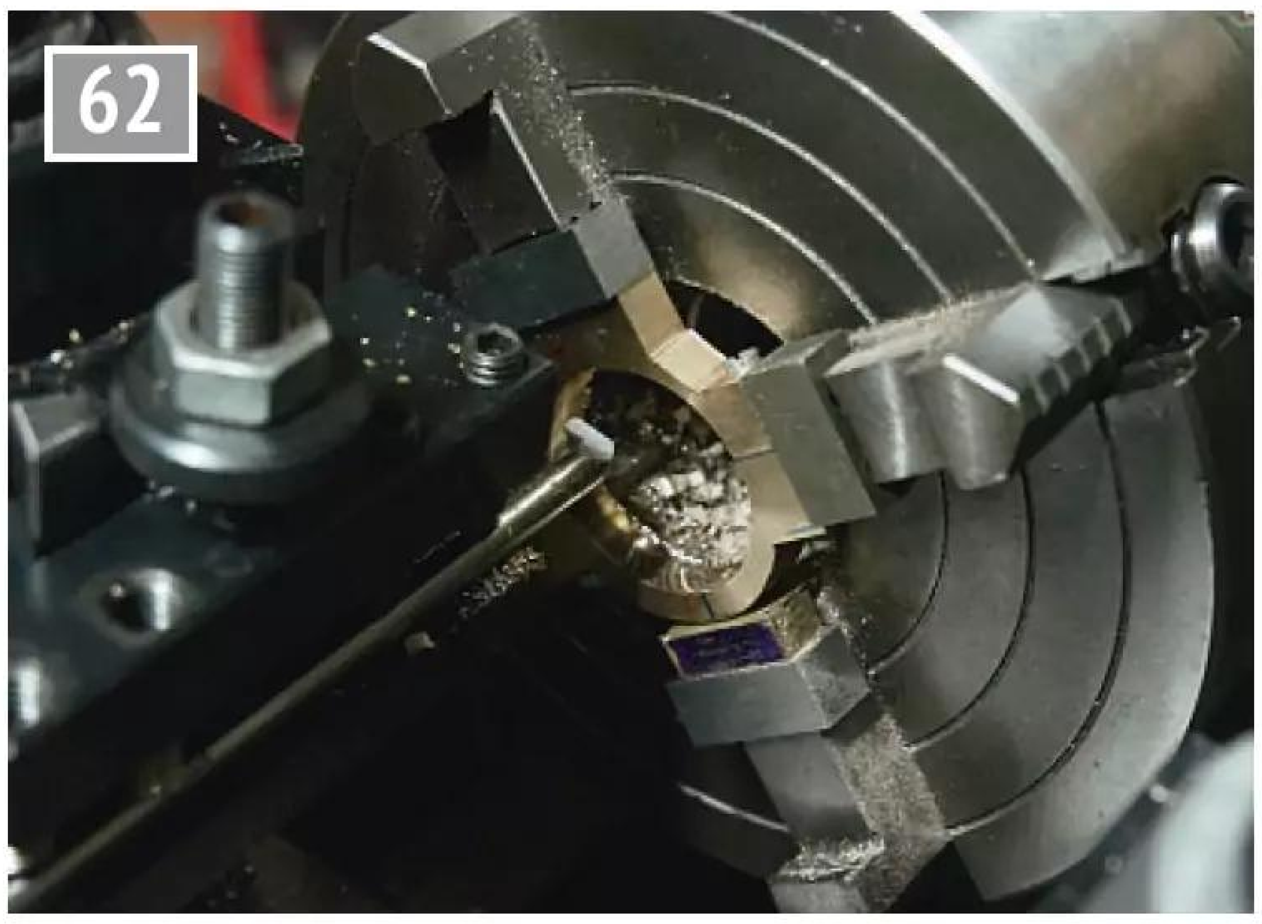



*Parting the straps, the pen marks are to ensure that the bits remain in pairs and match up the correct way around.*

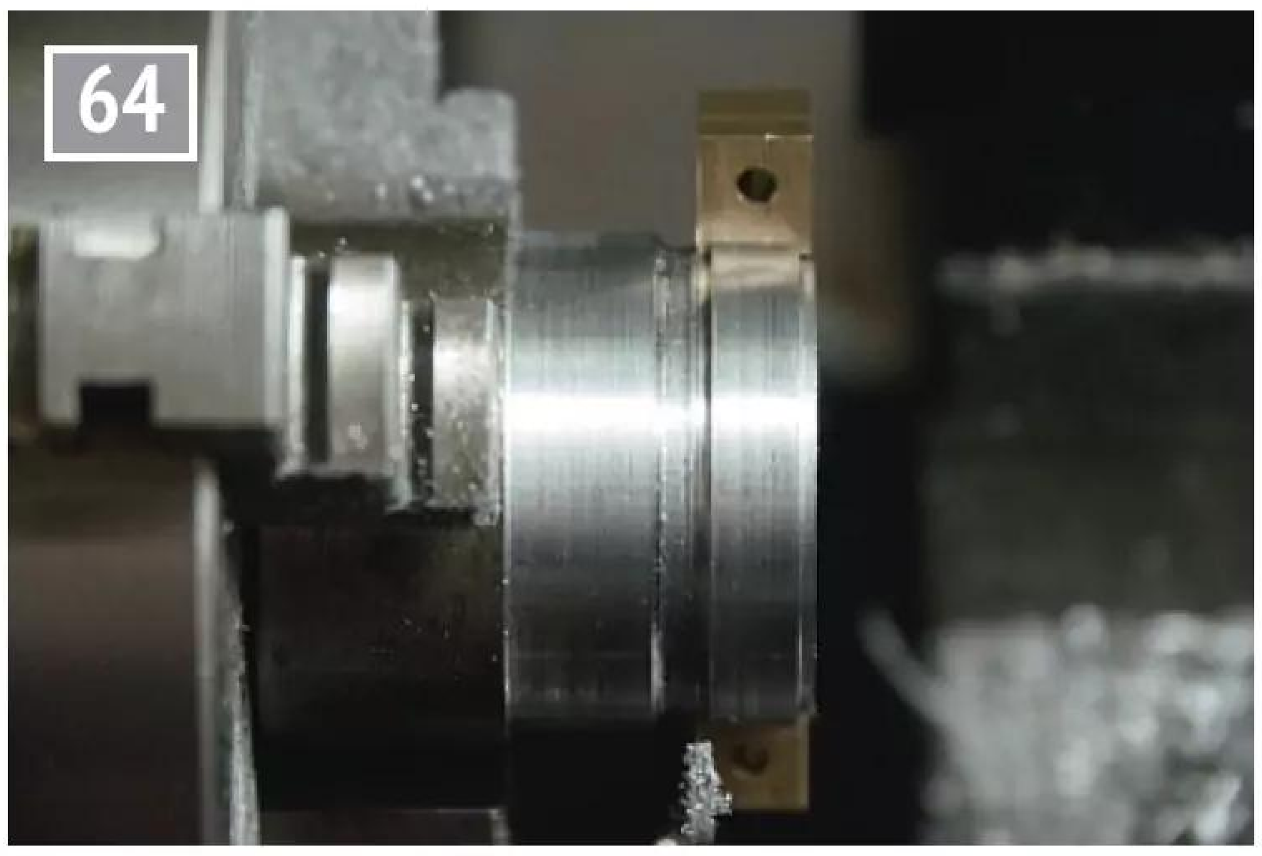



*Setting up the straps to cut the internal grooves to locate them on the eccentrics.*

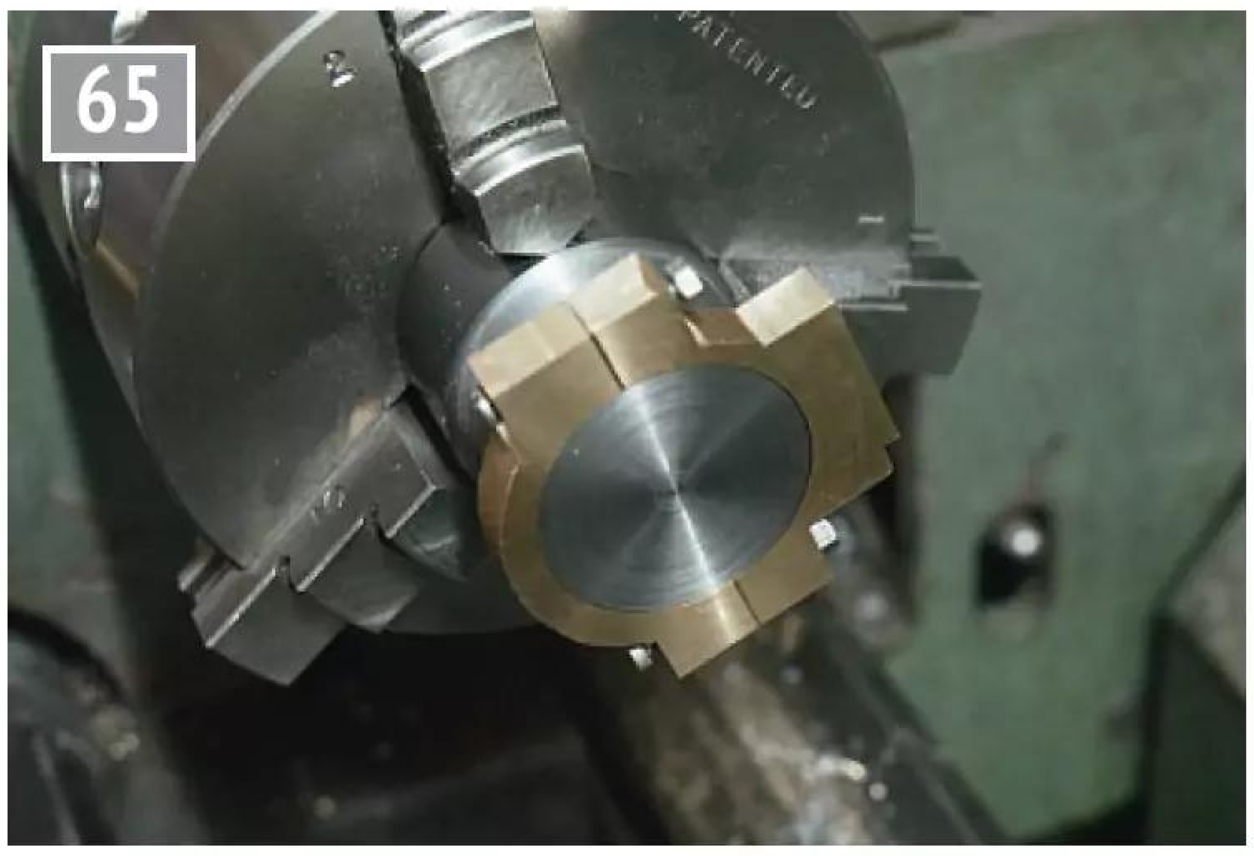



*Turning in the locating grooves. Located axially by using the saddle stop.*


*3D printed dummy eccentrics used to help work out how to make these parts.*

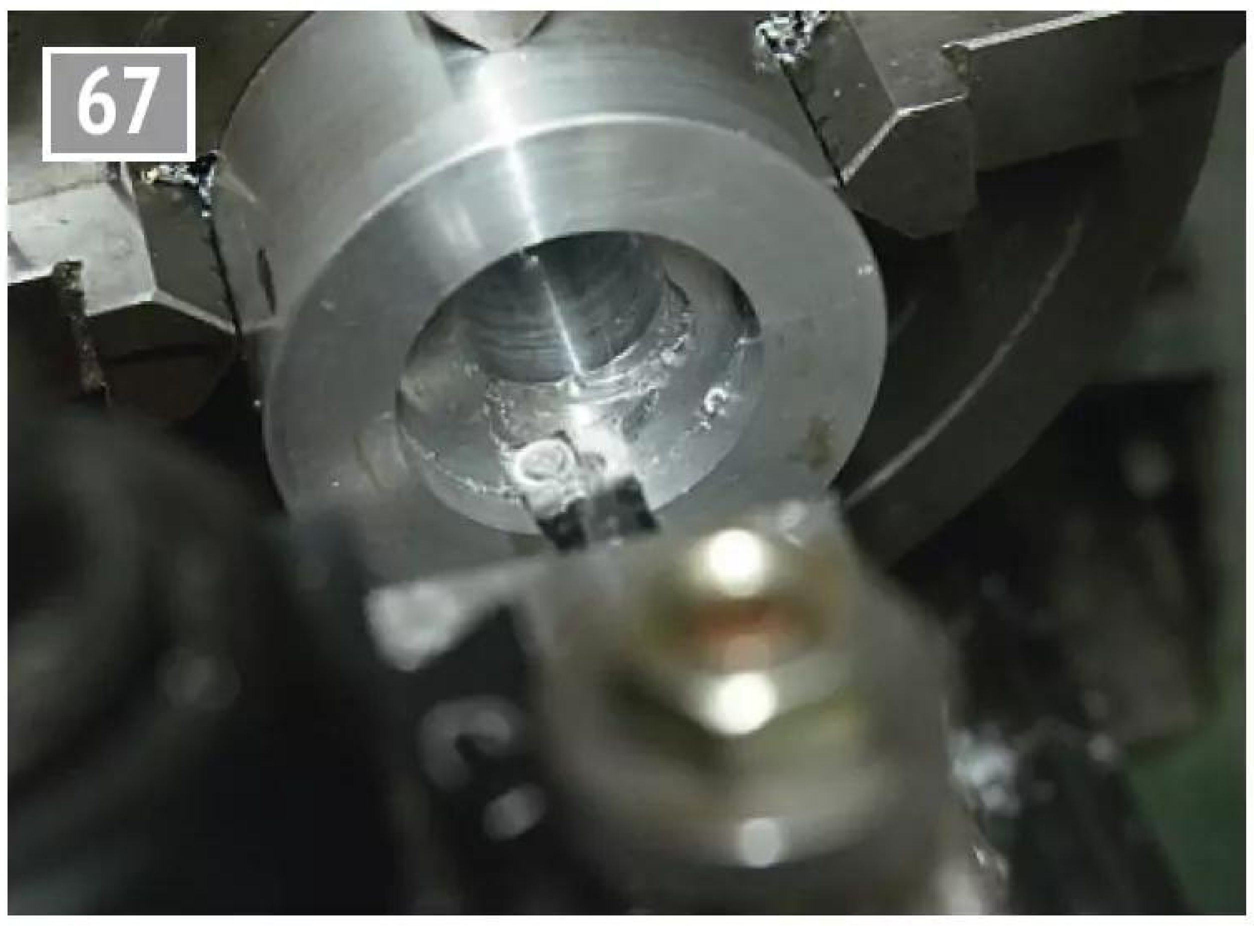



*The eccentrics were turned using the straps as a gauge.*




*The first eccentric completed and ready to part off.*

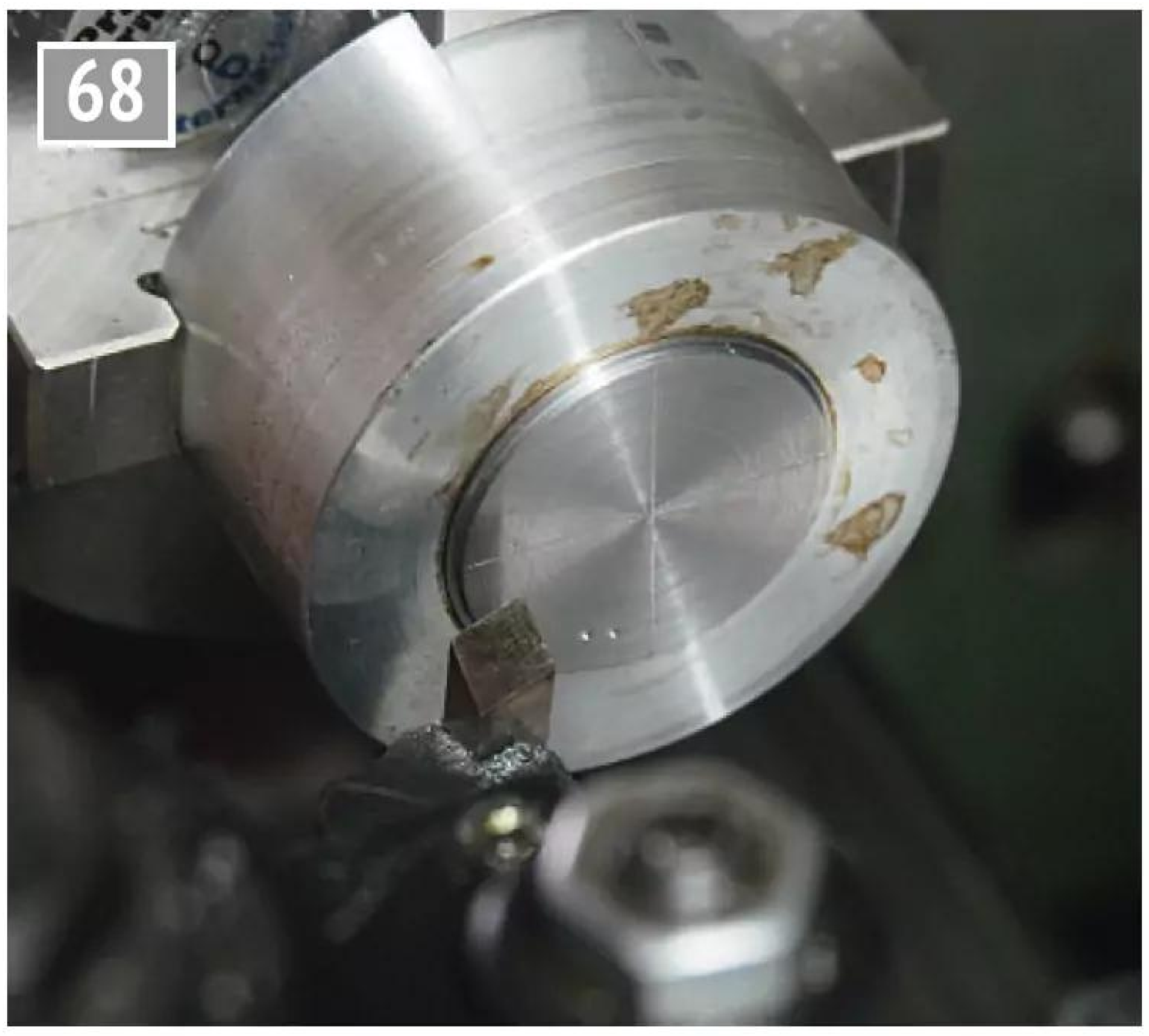

*Soft jaws were used in the three-jaw chuck to face the other side of each eccentric.*




*An aluminium pot chuck was recycled to hold the eccentric for boring and cutting the keyways.*

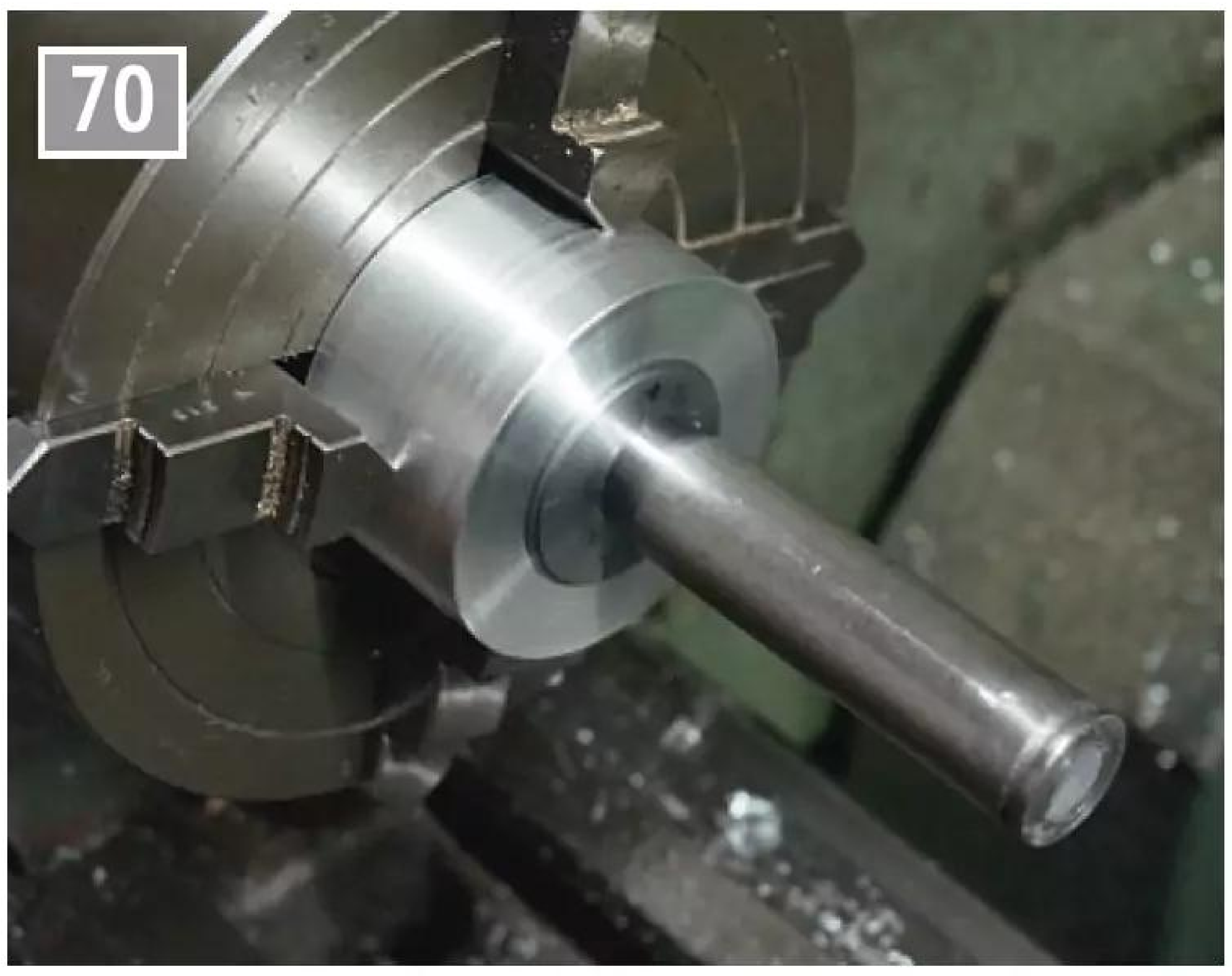
With the stud holes drilled and identifying and locating marks made, the straps were split (**photo 60**) then put together with screws and set up in the four-jaw chuck (**photo 61**). Looking closely at photo 61 I can see that the bore has already been machined and I must have forgotten to take a picture when the bore was still rough and had to dummy it up later. The scriber point was set to lathe centre height and used as a reference whilst spinning and adjusting the chuck. In **photo 62** a small boring bar is being used to turn in the groove that will locate the strap on the eccentric. Machining the groove at this stage means that the straps can be used as gauges for the outside of the eccentrics, doing things the other way round would be more difficult.

As originally drawn the eccentrics pose a problem as it looks difficult, bordering on impossible, to tighten the nuts on the studs that hold the halves together. So that I could try this in practice I 3D printed pairs of parts for one eccentric for the Corliss valves and for the slide valve (**photo 63**). Working with these I convinced myself that while it was just possible to assemble the slide vale eccentric (on the right of photo 63), tightening the nuts adequately would require a very special spanner. The nuts for the Corliss valve eccentrics were very difficult

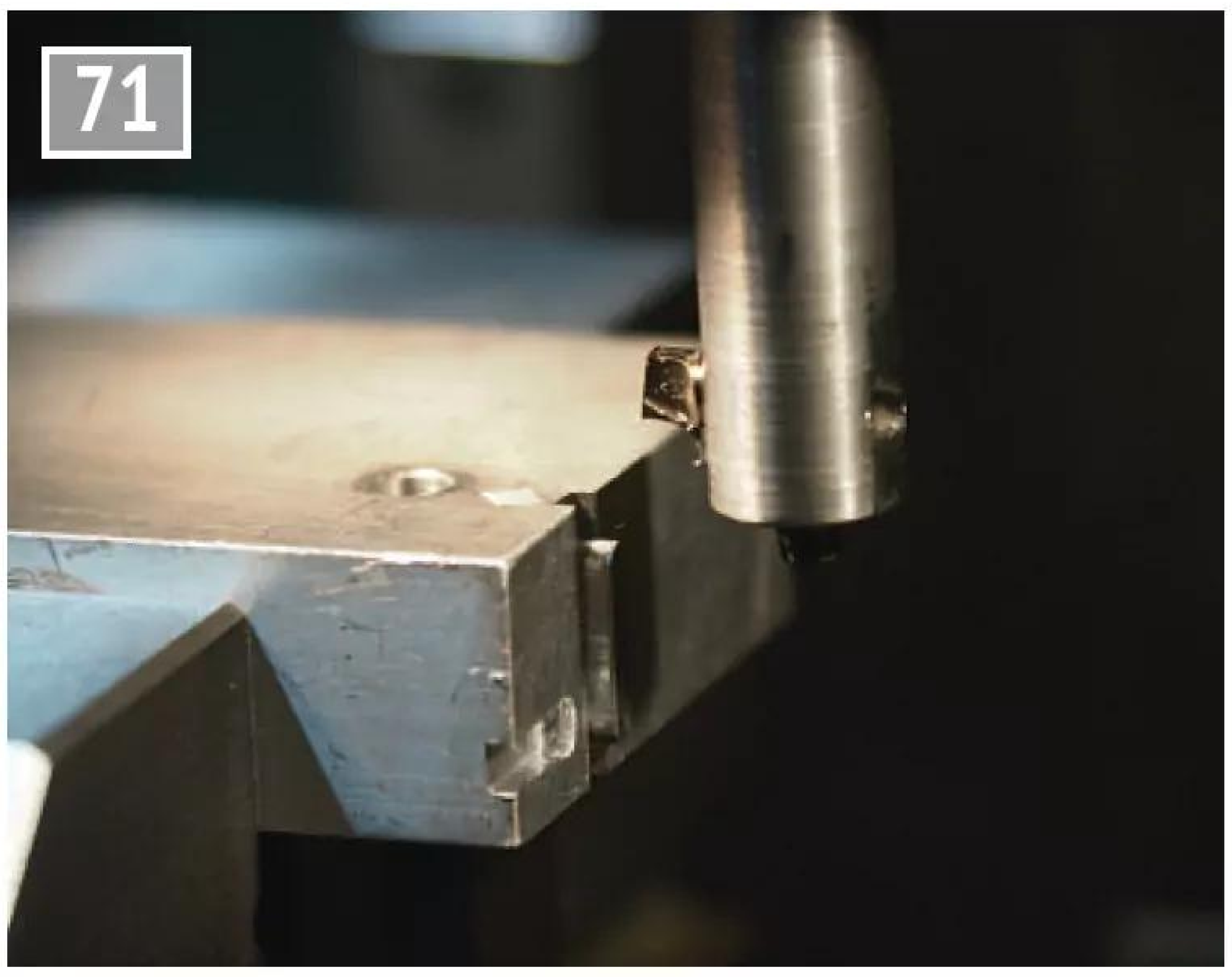


Centre lines were scribed with a lathe tool ...

... and the centre for the bore marked out then the pot chuck set up in the four-jaw.



The plug gauge had been made when the crankshaft was turned.



Testing the slotting tool used for the keyways. The key is being retained solely by friction.

CA glue wasn't strong enough to hold the eccentrics for slotting - two M6 screws were.

The slotting only takes a few minutes.

Once again, care in grinding the slotting tool paid off.

The marking out lines were polished out and the dummy joint line scribed in. The 'nuts and studs' are glued in dummies.

to place and looked to be impossible to tighten at all. You could try using dummy studs and nuts and relying on the straps to hold the eccentrics together but that isn't really satisfactory and I chose to make the eccentrics solid, scratch in lines to represent the division and glue on dummy nuts and studs. When the parts are assembled on the crankshaft the lines, studs and nuts aren't easy to see so you could also choose to omit them completely.

The eccentrics were formed on the end of a stub of mild steel using the straps as gauges to achieve a close sliding fit (**photos 64** and **65**). After parting off I tried two methods for finishing the second side, first with soft jaws in a three-jaw chuck (**photo 66**) and secondly by making a pot chuck (**photo 67**) and gluing the parts in with CA glue. With hindsight I might as well have gone straight for the pot chuck as that is what is needed later to hold the bits for slotting the keyways. Further marking out was done in the chuck using a lathe tool with the tip at centre height (**photos 68** and **69**); note the pop marks for orientation and identification. The bores for the crankshaft were aligned to centre pops, drilled then finish bored to the plug gauge made earlier (**photo 70**). A slotting tool had to be made for cutting the keyways and I tried this out on the end of a scrap of aluminium plate (**photo 71**) and managed a good fit. The pot chuck needed two M6 tapped holes to make sure the eccentrics stayed where they needed to be (**photo 72**) and the keyways slotted out using the mill (**photos 73** and **74**). When fitted to the crankshaft the eccentrics were able to slide a little, so I went for belt-and-braces and drilled and tapped for grub screws (**photo 75**). After the parts were properly assembled there really wasn't any tendency for axial movement so these screws may well be unnecessary.

●To be continued.

# A BR Standard Class 4 Tender Engine

PART 5

**Doug Hewson** describes a 5 inch gauge version of the BR Standard 2-6-0 tender engine.

Continued from p.499
M.E.4753 October 4

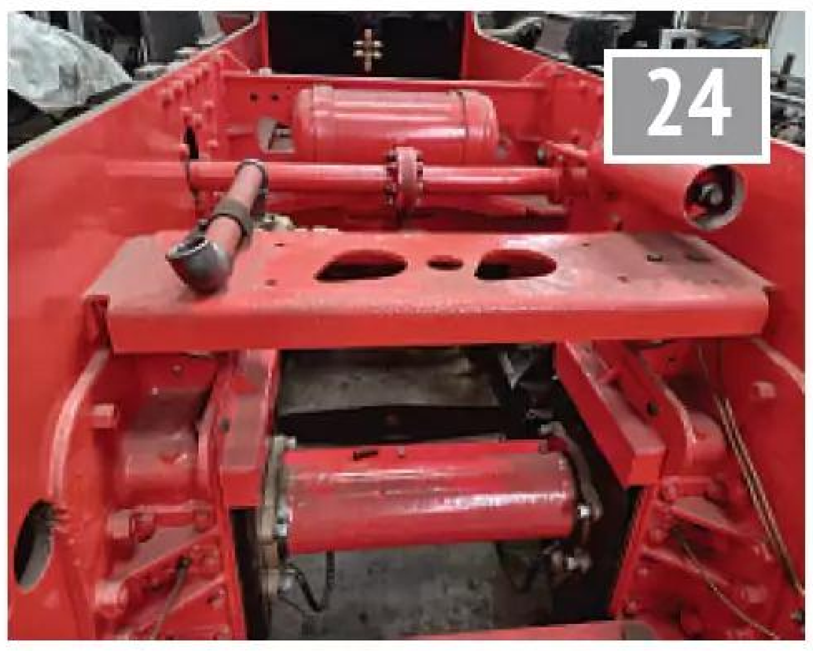
Now that we have finished with the weighshaft brackets we can get on with the drag box. The people in charge of 76077 decided it needed a new one, so Andrew very kindly sent me some appropriate photographs of the very thing. I took some photos of it while it was still in place but that must have been at least fifteen years ago, so we are having a fresh start on this. **Photograph 22** is one of the photos which I took, and which shows one of the boiler mounting pads. You must appreciate that I had a job finding the frames, let alone trying to take any photographs of the stretchers. Anyway, you will see that **photo 23** does show a little more of the drag box.

If you wish to get started on frame stretcher no. 2, which is shown in **fig 11**, you will see that there is a small recess around the edge, just enough to fit a ¼ inch fillet weld both inside the side plates and outside. Underneath the stretcher is the arrangement for the pony truck pivot. This of course fits in the lower part of the frames. With the other drawings (**figs 12** to **15**), I don't think that there is much more that I can say. If you have a look at **photo 24** you will see stretcher no. 3 has the flange underneath it and there are several other things you need to know. The first thing is the return spring housed in a tube which has a bracket from the frame plate and a small arm to it off the weighshaft. On the left side inside of the frame plate there is also part of the vacuum system and it is also worth noting the five bolts there which secure the left hand weighshaft bearing. It is also worth noting the two little plates fixed to the bracket above the frame plate to make sure that it is in the correct place and note the round headed bolts which I referred to in the previous issue. I would not be surprised if these are fitted bolts. Note also the four bolts for the right hand bracket. Beyond that, there is also the vacuum reservoir.

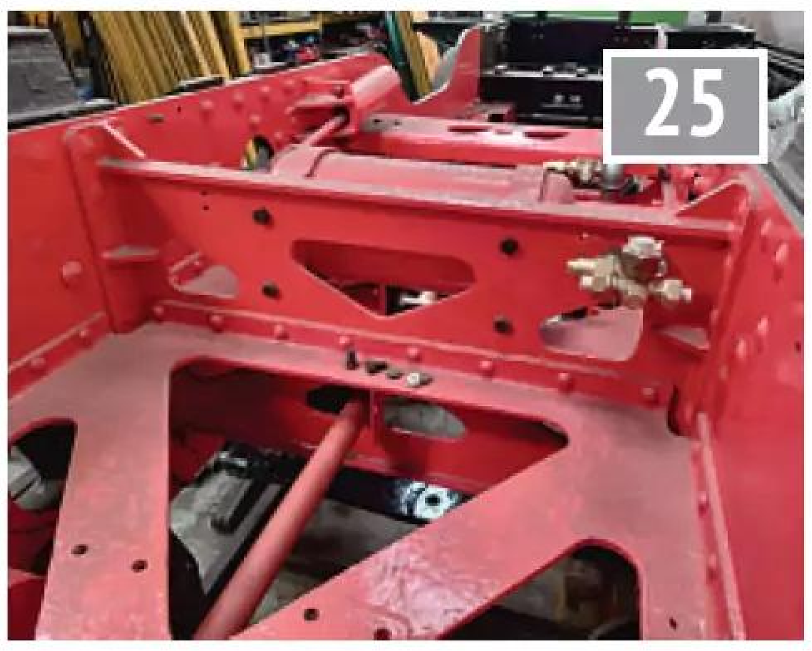
We will now have a look at **photo 25**. Here we see stretcher no. 5, which is partly obscured by stretcher no. 6, which is amongst the drawings supplied (**figs 15** to **18**). In the immediate foreground are the four holes which fix the front sand box in place. In stretcher no. 6 there are four bolts with black painted heads which are for the straps which hold the vacuum reservoir in place (**photo 26**). **Photograph 27**


*One of the boiler mounting pads on the drag box.*

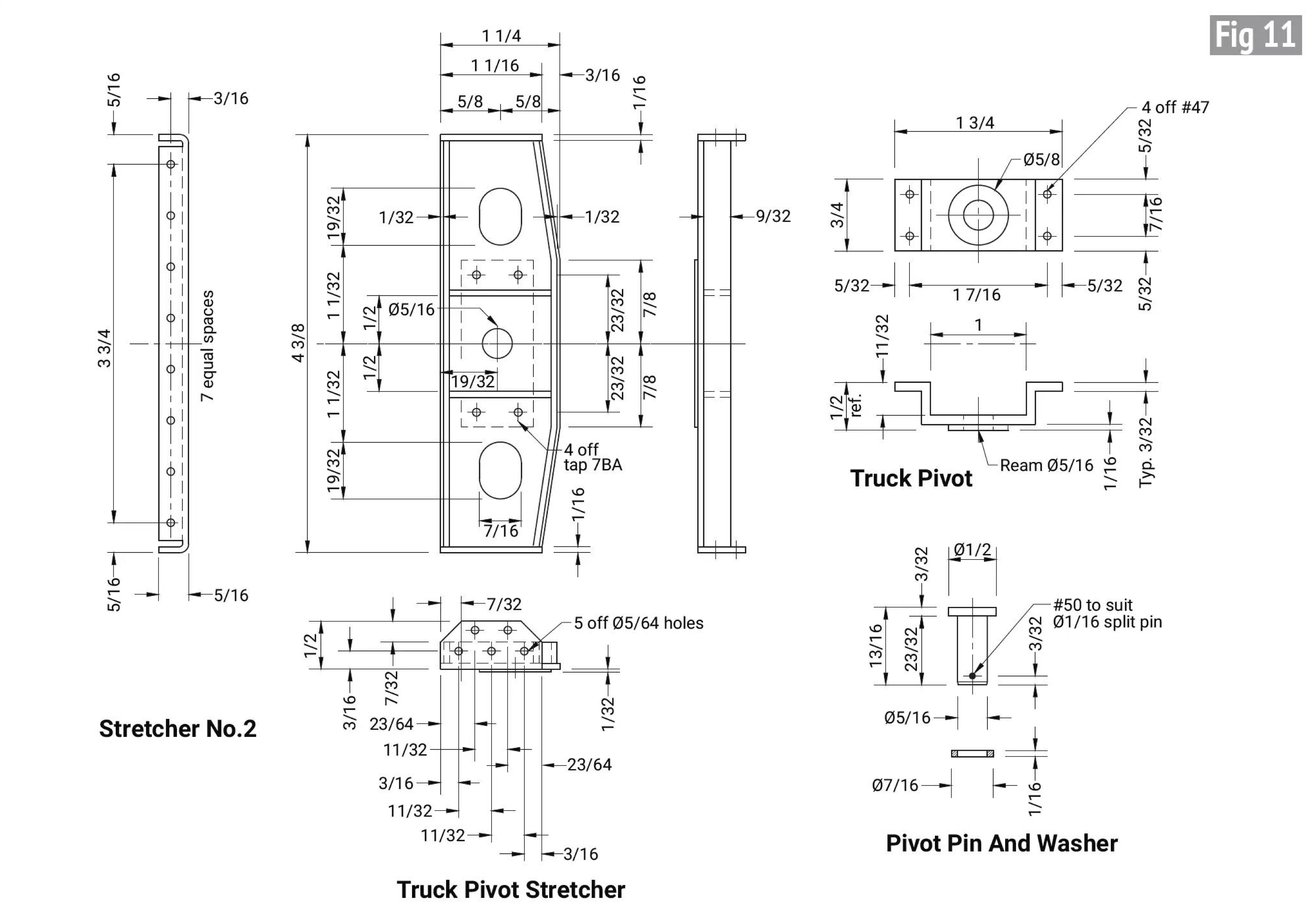

*The drag box.*




*Stretcher no. 3 (photo: Toddington Standard Loco Ltd.).*



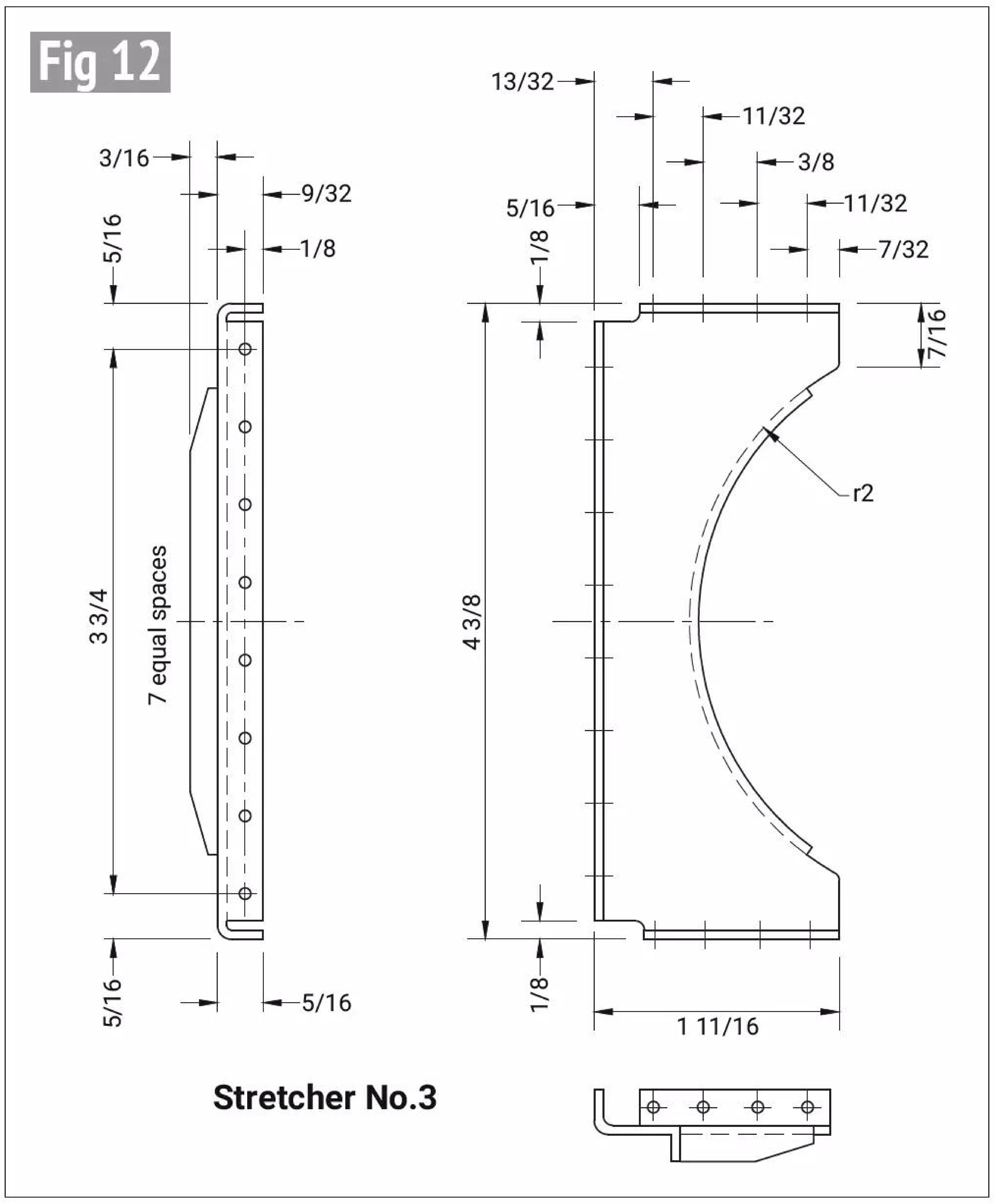

*Stretcher no. 5 (photo: Toddington Standard Loco Ltd.).*



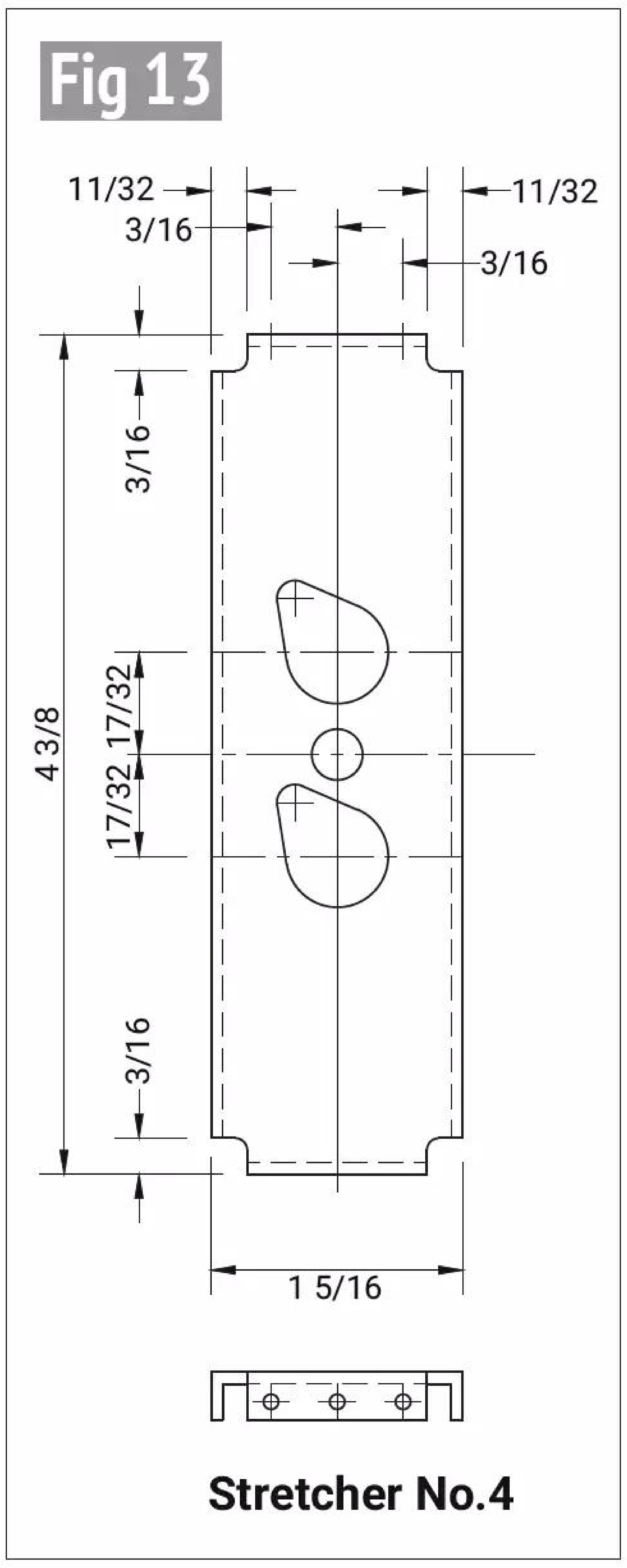

Stretcher no. 2.


The vacuum reservoir (photo: Toddington Standard Loco Ltd.).

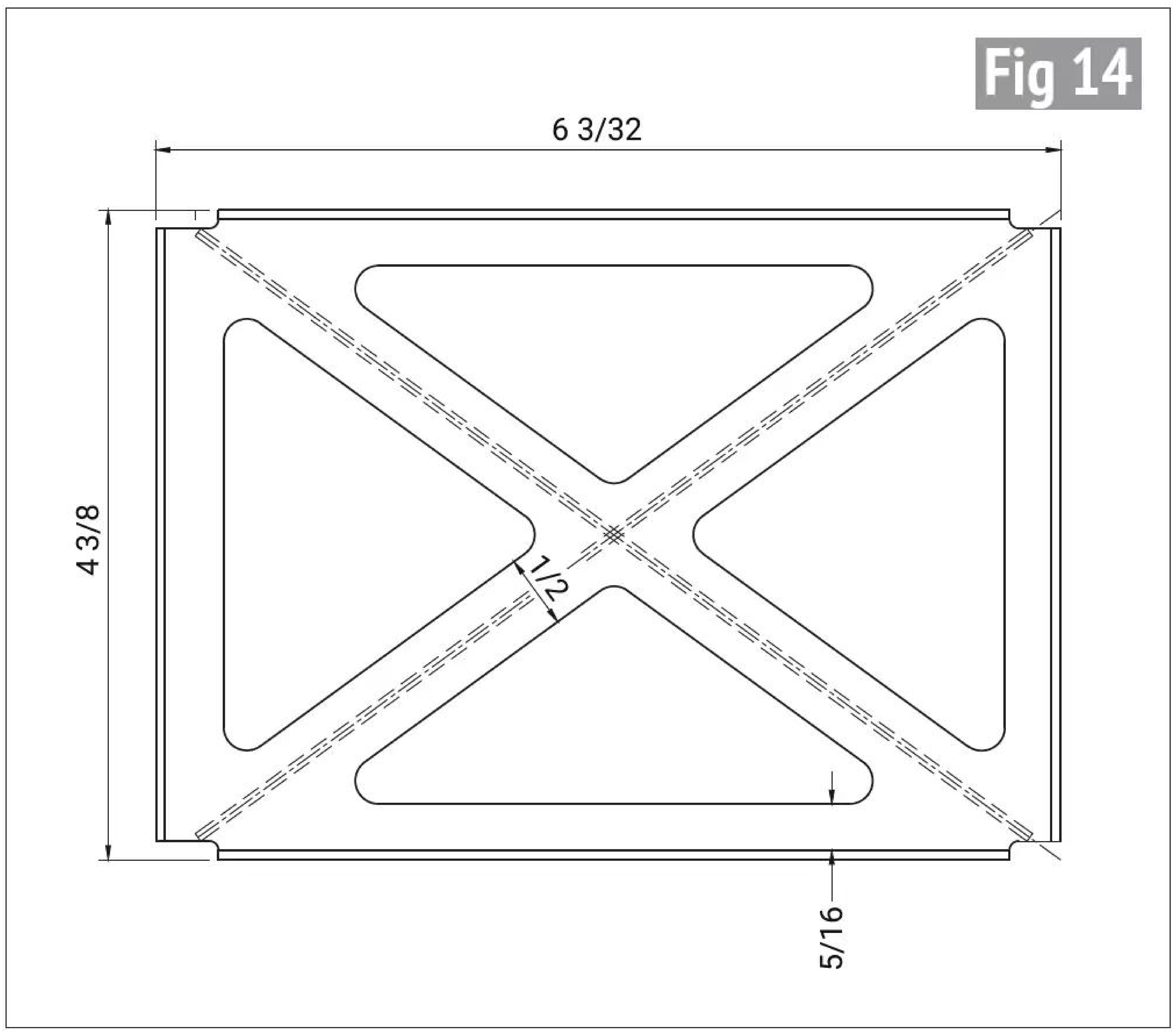

The rear horns (photo: Toddington Standard Loco Ltd.).



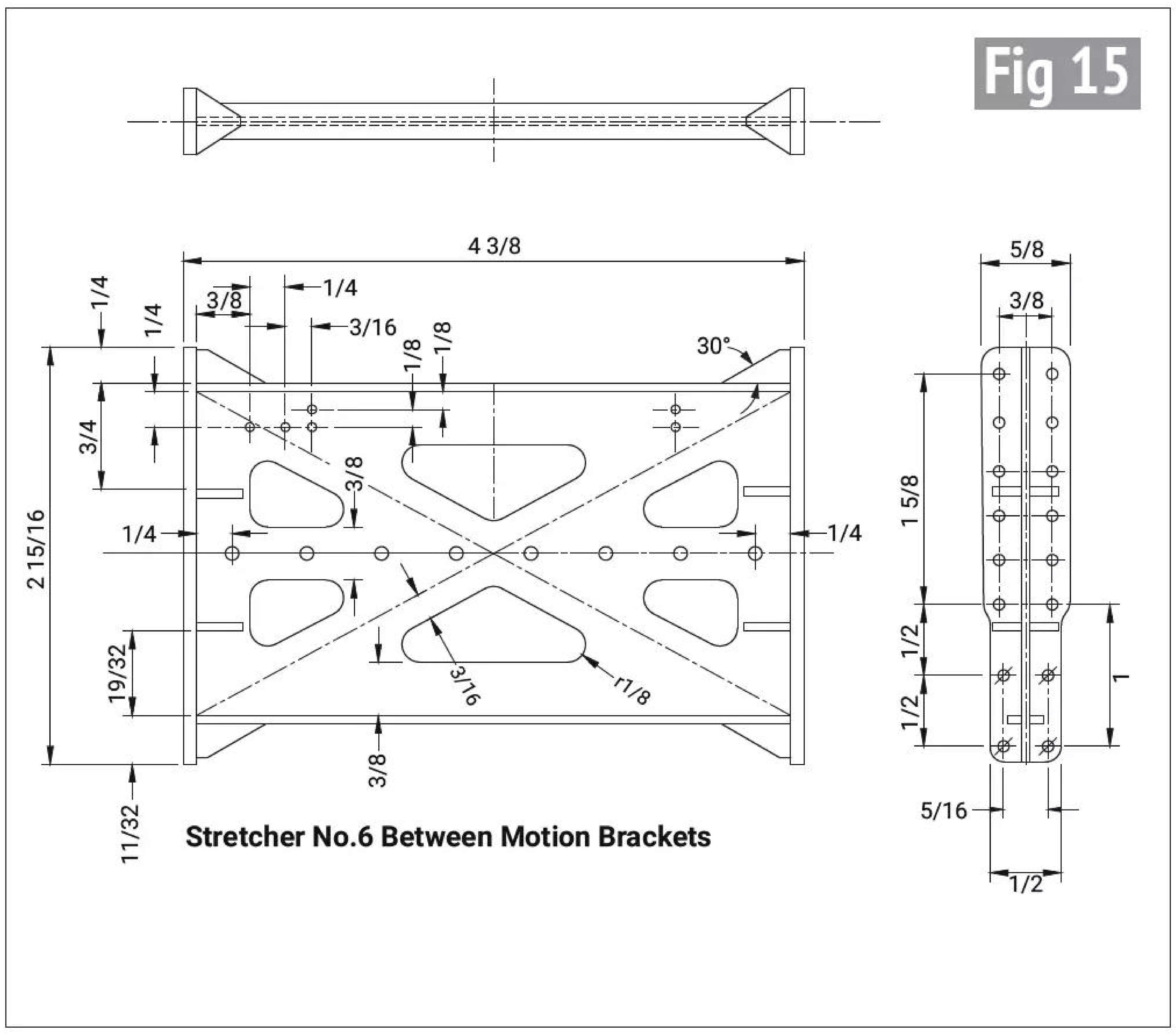

Stretcher no. 3.



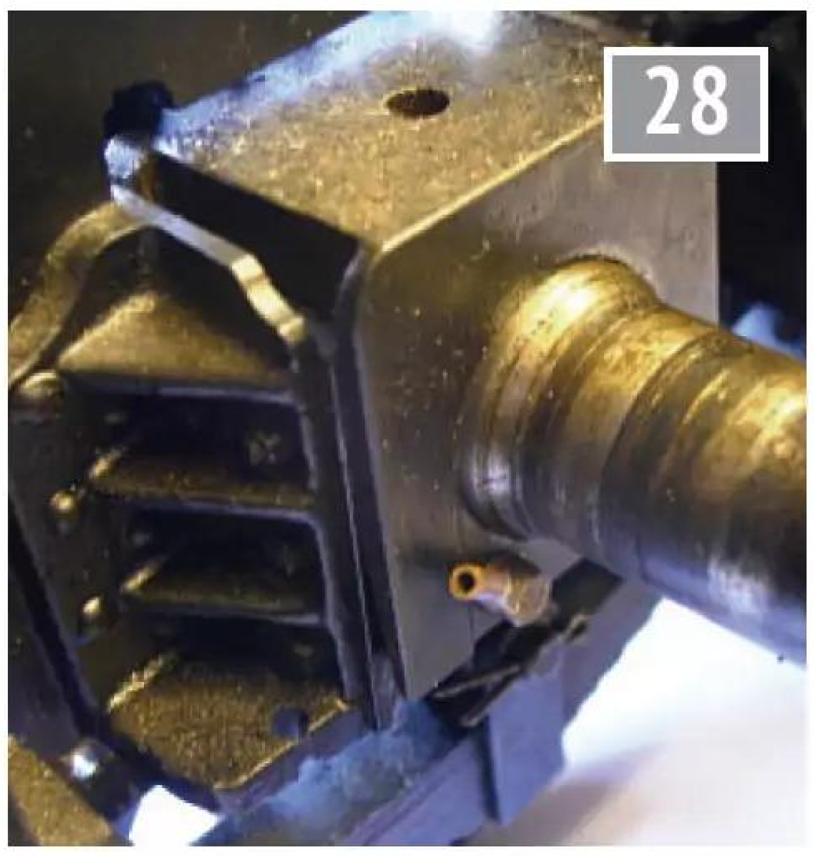

Stretcher no. 4.




*Stretcher no. 5.*




*Stretcher no. 6.*

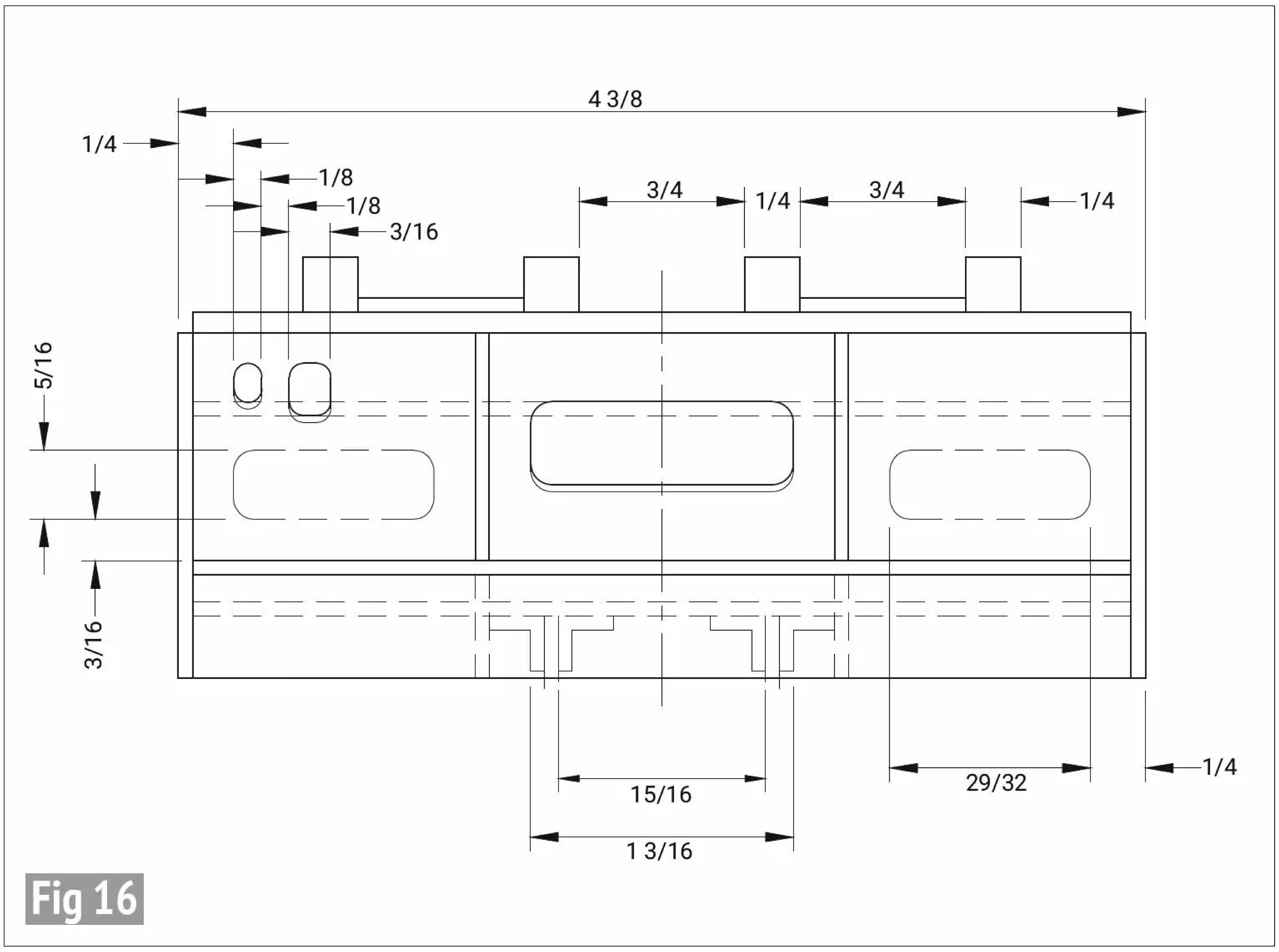



*Rear horns on the author's 4MT, showing the oil connection.*

is one that I thought that you might like as it is the horn blocks which can be riveted in place. The pair shown are the rear horns which come in pairs as they need to miss the boiler. I would guess that the cutout in the cover plate is also there to miss the boiler. Note that there is a brass fitting on the right hand side which I am sure will be for an oil feed but we may not ever see it again, so I am going to be a little presumptuous here and use it for the lubrication on our engine. This will come much later in the proceedings. Whilst on the subject I have included **photo 28** which shows the axle box on my 4MT which has that very oil box connection! Isn't science amazing! I have run a pipe to the underkeep on the axle box. It is one of the things which will come later on when we get to the general description of the lubrication system.

We can now get on to what I intended to do in the first place and that was to show you the new drag box for 76077 (**figs 16** to **19**). I am indebted to Andrew Meredith for supplying me with these two **photos 29** and **30**. Now just before we leave this session, I just want to describe a little gadget which I admit that I missed off my 4MT as it could not be seen.

It is a return spring for the

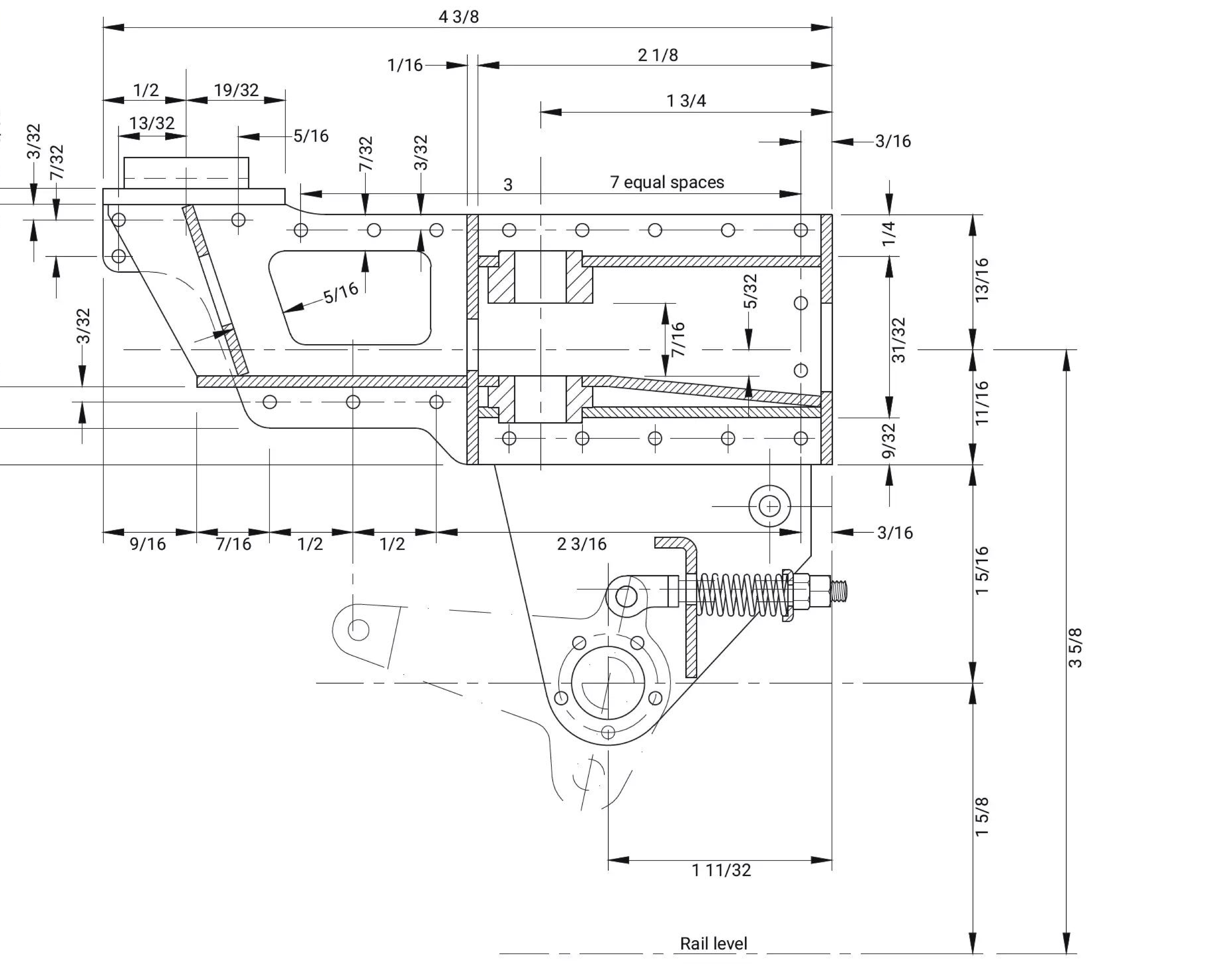



*Drag box – front view.*



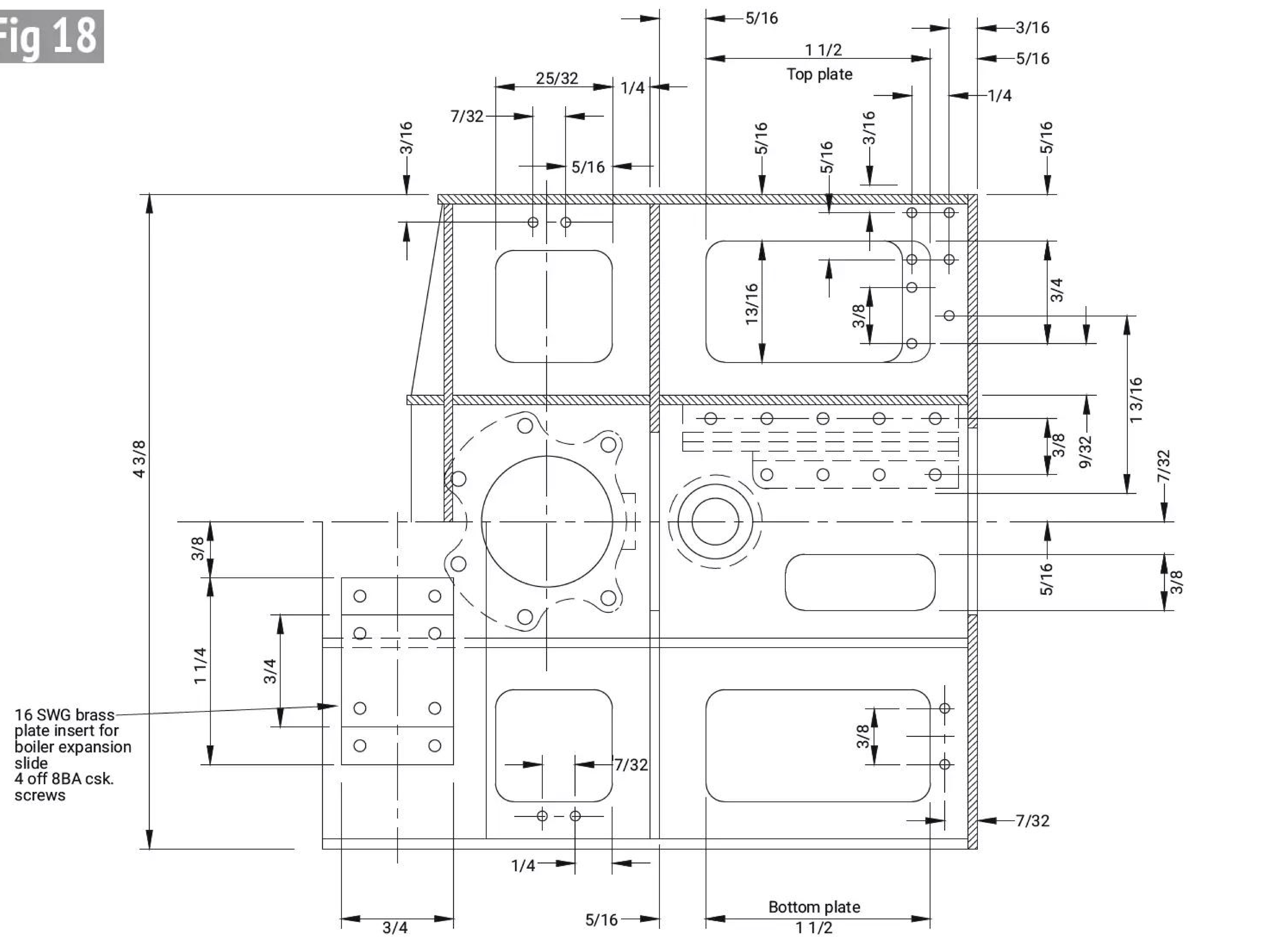
*New drag box for 76077 (photos: Toddington Standard Loco Ltd.).*

Fig 17




*Drag box – side view.*

Fig 18




*Drag box – plan view.*

weighshaft, which is sort of visible on the 2-6-0. It is shown on photos 24 and 26 and I think it will be easy to make and build. You will have to try the spring in there such that it should have some effect on restoring the valve gear to its mid gear position or into reverse. You may have to alter the spring once your engine has been run in as it should free up a little. Note the fork joint on the spring shaft with the offset joint with the pin to the small arm on the weighshaft.

●To be continued.

# SMEE News
# The Selby Coalfield

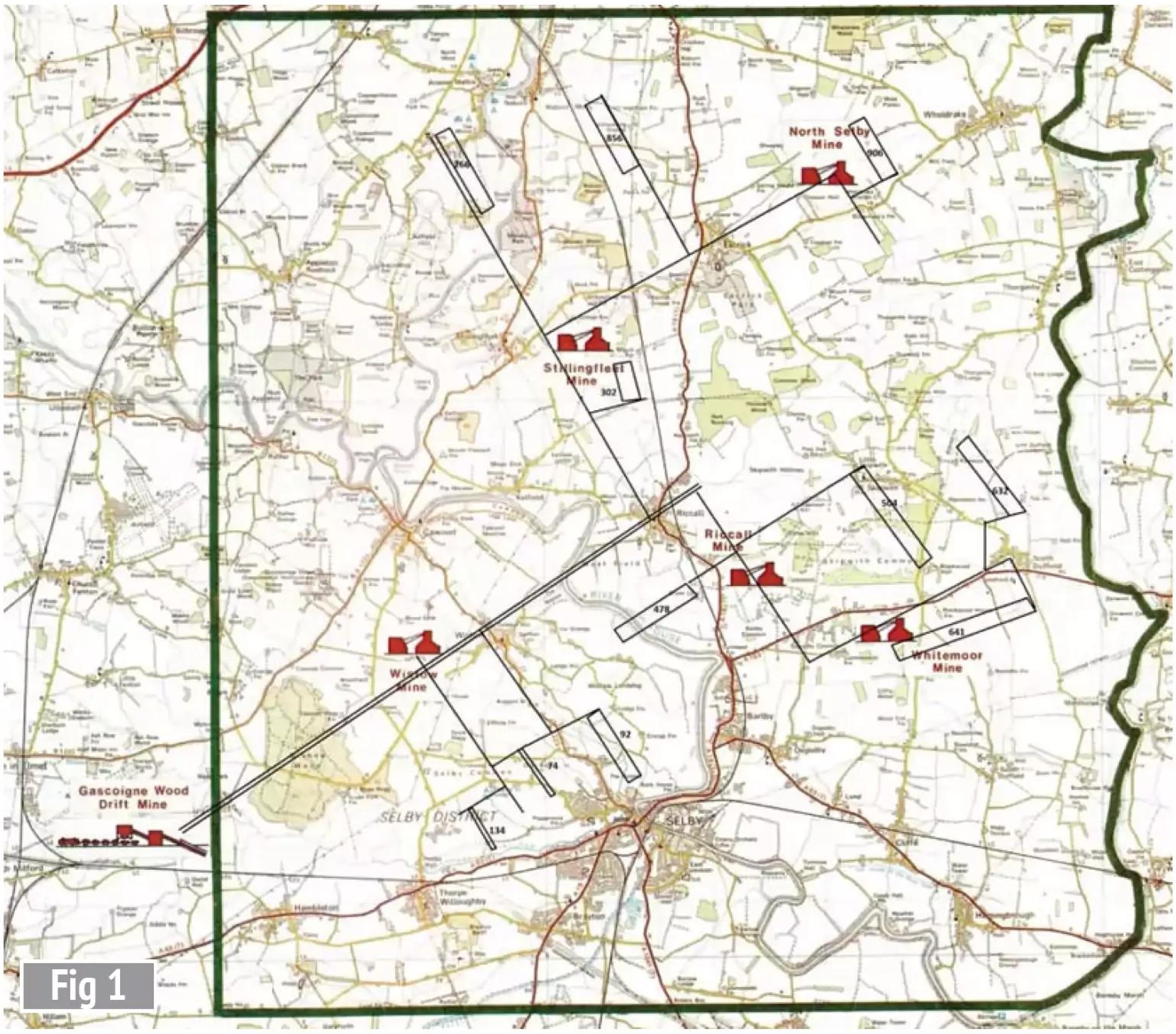
**Martin Kyte** has the latest from the Society of Model and Experimental Engineers.

SMEE

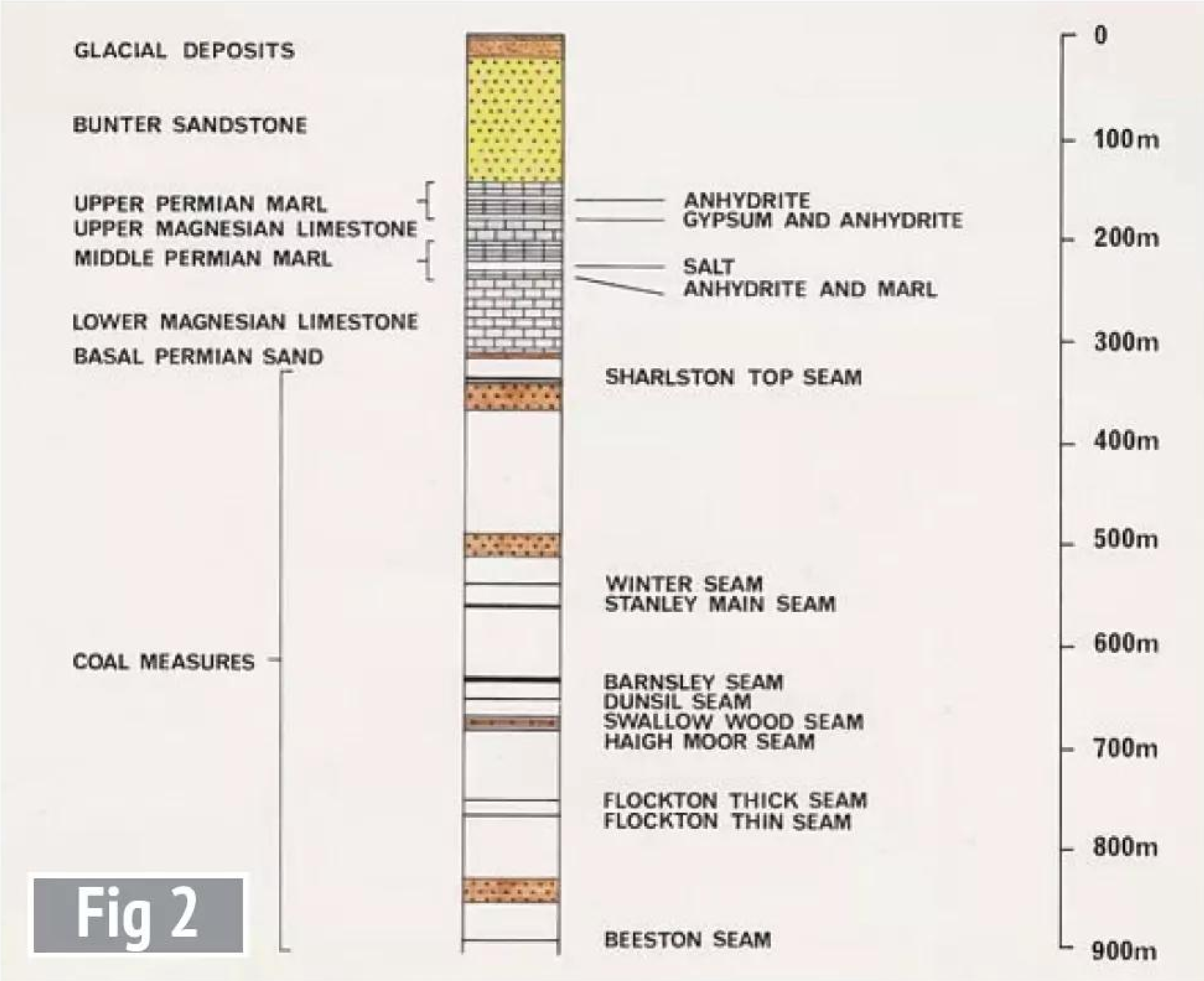
Those of you, who like me, were unconnected with coal mining and at the time were rather more concerned with building their own nascent careers to follow very closely the fortunes of that once important industry, could be forgiven for thinking that the miners' strike of 1984-1985 marked the end of coal mining in Britain. Without intending any political comment - and these pages are not the place for such - I cannot but acknowledge the enormous impact that dispute had on the individuals and families on both sides and on the social and industrial landscape of the country and whose effects still echo today. So perhaps like me, to hear a description of a major development of an entirely new coal field in the last two decades of the twentieth century will come as something of a revelation.

However that's precisely the tale that Neil Rowley, mining engineer, unfolded for us at our SMEE monthly speaker meeting in September and which I shall briefly relate.

In the 1970 with the price of oil increasing a Plan for Coal was formulated to exploit Britain's coal reserves in a modern world. One development that came from this was Selby. Geographically (**fig 1**), the Selby Coalfield was located in an area south of




*The Selby coalfield.*



Section of strata.

Four synchronised winches support the 5 deck sinking stage.

Power and telephone cable drums at the pithead and the normal winding engine.

The shaft lining is 1m thick sulphate resisting concrete. Neil Rowley is standing on the top of the sinking stage.

the York bypass, west of the Derwent and Selby in the south, extending approximately 10 miles west to form an area of 100 square miles. Geological surveys (boreholes) had shown an extension of the Barnsley seam which had been long exploited to the west of the area. An ambitious plan was drawn up to exploit the field of an estimated 200 million tonnes taking only the 2m thick Barnsley seam of high quality steam coal and which, with the three largest power stations in the UK at Drax, Eggborough and Ferrybridge at hand, was deemed to be very economically sound.

As the area was largely rural farmed land the plan was to extract all the coal via underground conveyor systems, bringing the coal to the surface at a new drift mine to the west.

Gascoigne Wood was built next to the Leeds to Hull railway as two tunnels at 1 in 4 for 800 m before levelling out. Personnel and materials were supplied to the Selby complex by five satellite mines across the field, connected by underground tunnels. This allowed for minimised environmental impact and with the railhead at Gascoigne Wood allowed all coal to be transported directly to the power stations. The underground extent of the mine was huge with the distance from the North Selby mine to Gascoigne Wood a full 20km. The working parts of the mine roadways, underground bunkers etc. with the exception of the faces was built 80m below the Barnsley seam. The East Coast Main line ran through the middle of the field and at a maximum design subsidence of 0.99m for the project the line had to be rerouted to the west at the expense of the Coal Board at a cost of 60 million pounds.

However with a target output of 10 million tonnes/year and a 25 year life money was available.

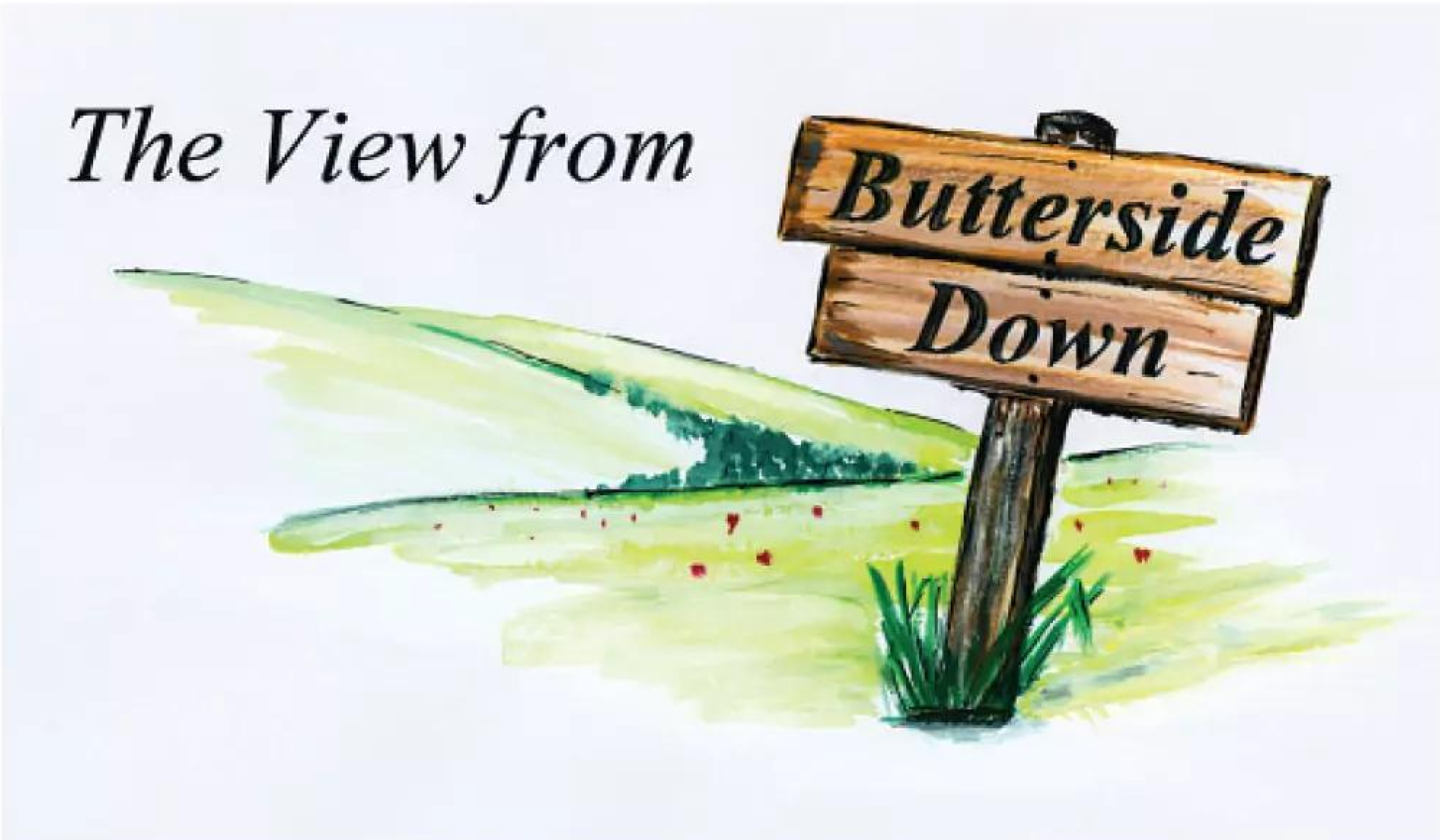
**Figure 2** shows the strata at the shallowest mine and you can see that the Barnsley seam is 600m deep at this point as it slopes down towards the west. Shaft sinking was problematic through the wet Bunter Sandstone and the very wet Basal Permian Sands. Freezing techniques were employed to control the water at these layers until the concrete shaft liner made a permanent seal. **Photograph 1** shows the temporary shaft sinking headgear and **photo 2** the inside of the winding house at Wistow. **Photograph 3** shows Neil in the sinking cage at the Permian Sand level and you can see a ring of pressure relief pipes around the shaft to extract some of the water. These were subsequently entombed by the shaft lining concrete. Looking at photo 3 you can imagine how much trust has to be placed in winding equipment, both mechanical and human. In 1983, once the construction phase was complete at Gascoigne Wood and the nearest satellite mine Wistow, Selby began cutting coal.

ME

# Part 22: The Wonders of Technology - Part 1
## The Model Engineer's Role

**Steve Goodbody** takes a random walk through model engineering.

Continued from p.504
M.E.4753 October 4



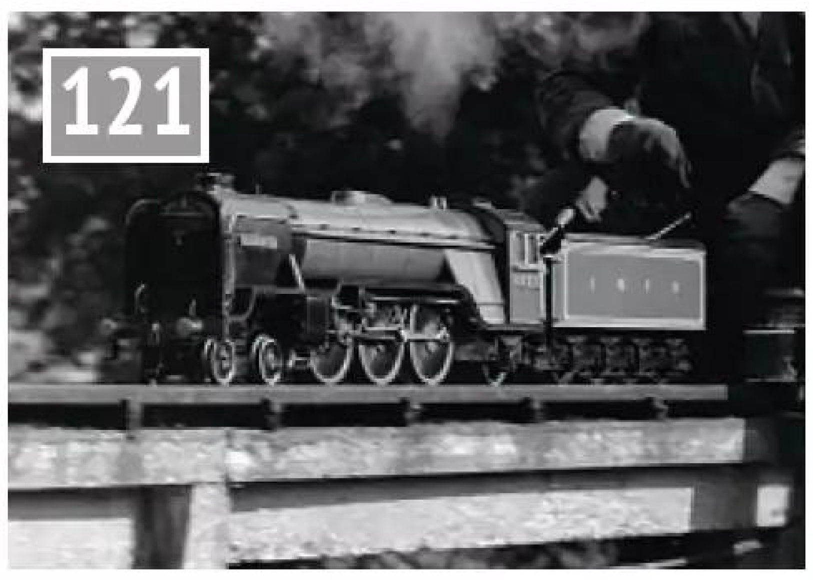

Goodness gracious me, how time flies! It seems barely a few weeks since I penned the previous episode, yet February is nearly over and fully five months have passed since last I sat before this keyboard to type a metaphorical hello.

Now, before you accuse me of idleness, let me assure you that I have been anything but; the intervening time has been spent busily building walls, running wires and laying floors, partly for Jenny's new office in my vacated workshop and partly because the project inevitably expanded to encompass much of the rest of the basement. However, I am presently awaiting the arrival of our friendly building inspector who, having checked my work for code compliance and safety, will hopefully give me the thumbs-up to finish the job. Therefore, having reached a temporary stopping point, I've popped my head meerkat-like above ground, taken a breath of fresh air and decided to treat myself to a quick Butterside Down article. Please accept my apologies, for I realise you are getting the short end of the stick.

120

*On Sheppey Island, Tich ably demonstrates the power of combining a handful of coal with a pint or so of boiling water.*

121



*Hielan Lassie gracefully laps the Thames Ditton circuit, twenty-two years after her sole prototype was cut up for scrap.*

### A mixture of feelings

I don't know about you, but I have a rather schizophrenic attitude towards technology. Some of it I love - the ability to receive BBC Radio four in America over the Internet being one pedestrian example; some of it I'm glad of - the jaw-dropping advances in medical diagnostic imaging techniques being notable and some of it I absolutely hate, which includes almost anything to do with the ironically and (in my opinion) often inaccurately named *social media* curse.

To expand further, let me state for the record that I am not opposed to technology's progression where truly beneficial, but *beneficial* is an unusually problematic judgement to make: difficult to quantify even in hindsight and often dependent on the eye of the beholder. And while I can do nothing about technology's inexorable march even if I were so opposed, you know me well enough to realise that I have a somewhat pragmatic personal viewpoint, believe that *good enough* is often a far healthier goal than the siren-song *perfect*, and enjoy the mental and tactile challenges inherent in older and more manual techniques, notably when building things in the workshop. Put another way, I personally do not think that newer is always better, am not an early adopter of anything and will happily let others risk the dangers of the cutting edge. Best of luck to 'em, that's my view.

Of course, even the best, most pervasive and most useful technology can be a bane if used incorrectly, a point proven in droves by expectant parents Miles and Alyssa (not their real names, I hasten to add) one memorable night in 2005.

### Aisle twelve for midwifery

Miles is, without doubt, one of the cleverest and most technology-savvy people I know, and over the years his abilities have led to a stratospheric career culminating thus far as Chief Technology Officer for a very well-known global financial firm. He is, it is fair to say, a strong advocate for technology's value, and believes sincerely that its continued infiltration into our lives will yield yet greater societal benefit. I do not fully subscribe to this view as you know, but he's a nice chap and it's only fair to hear him out.

You may imagine, therefore, that when Miles, myself and our little group of friends gather in the *Cow and Calculator's* busy bar and settle down for a pleasant evening's chit-chat, our different outlooks, fuelled by an excellent selection of home-brewed tipples and ignited by my devilish nature, sometimes lead to energetic debate of technology's relative merits and shortcomings. Of course, in a fair fight, Miles' superior knowledge, experience and (dare I say) intellect would provide unassailable advantage to his arguments, but on this particular subject I always have the last word. Here's how it goes.

"So, tell me…", I begin innocently after Miles has expounded technology's benefits for a while, "isn't there a danger we may become over-reliant on our electronic aids and suffer adverse consequences as a result?".

Miles, sensing trouble, takes a long swig of beer and remains quiet.

"In fact," (I continue, after a pause to allow the others to tune into the thread) "I often wonder, for example, how people would manage if their 'phones and GPS systems suddenly stopped working or gave erroneous results. Could they still find their way around without them? What do you think, Miles? Hmmm?".

Miles studiously ignores me, so I turn to Harry who knows what's coming.

"Harry - I'm painting the basement walls tomorrow and need some primer. Please remind me: is that in the Labour and Delivery department or the Neonatal Intensive Care Unit?"

Harry feigns deep thought before replying. "No, I think you need Pediatrics for primer, but you could go to the Emergency Room and I'm sure they'll point you in the right direction".

"Good idea - thanks Harry," I reply sweetly.

At this point, Miles shakes his head, mutters something unprintable under his breath, and heads to the bathroom.

As Miles departs, Harry and I smirk at each other, for we both recall the time when, nineteen years prior and awoken by his heavily pregnant wife entering labour with their first child, our technology-savvy friend had diligently selected their destination from the alphabetic menu in his new car's navigation system and set off for the hospital, barely a fifteen-minute journey through the early morning backstreets of New Jersey. And I really do pity him when, twenty minutes later, in between her increasingly painful contractions, Allysa opened her eyes, saw the hospital passing her window and disappearing rearwards at seventy miles an hour, wondered what on earth they were doing on the freeway, and gently enquired, at the top of her lungs and peppered with a dazzling array of expletives to garner his attention, where the hell he thought he was going.

I suspect I know what word Miles uttered next, when, emerging from his brain-fog, he realised that, rather than selecting *Hospital* from his car's navigation menu, he had mistakenly chosen an adjacent option from the destination list and had been blindly following the system's concise instructions since leaving home. Yes indeed, I very much doubt that Miles will ever live down the time he selected *Home Depot* as the appropriate venue for their eldest child's birthplace, but fortunately his secret is safe with me.

## Bits and pieces

In this day and age, when presented with the word 'technology', it's likely that our thoughts immediately turn to the electronic world of bits, bytes and apps which now pervade our lives yet which very few people (perhaps no-one?) fully understand. In doing so, we usually forget that a far broader spectrum is covered by the term, which is a shame, for the word 'technology' fundamentally means 'the practical application of knowledge' and that, let's face it, encapsulates the entirety of engineering of every kind: including model engineering.

Of course, this also means that we, as model engineers, are technologists too, and the result of our creative endeavours is itself a form of technology. Furthermore, in my opinion, our tangible miniature creations represent a type of technology with an unusually potent benefit.

To explain, let's consider the primary difference between our models and their original brethren: their size. Unlike the prototypes upon which they are based, which are often too large for we humans to view or comprehend at any scale beyond the piece-by-piece of, say, the driving wheel beside which we are standing in a museum, our scaled-down creations represent a form of technology which can be readily examined in its entirety, or by its component systems, or indeed piece-by-piece if a particular detail catches our eye. And that's important, because it means that our models represent a *complementary technology* with respect to their full-size prototypes, because the viewer, finally able to see the big picture (so to speak) when looking at one of our models, is placed in a far better position to appreciate the original machine in its entirety, and the working of its sub-systems, and the function of its individual pieces.

Going one step further however, and using steam railway locomotives to illustrate the point, while it's hard to beat the sensory appeal and majesty of a full-size engine thundering along the main line, I would argue that a model engineer's creation, in operation at a public park, is often a far more engaging spectacle than a full-size engine, especially to a youngster, particularly if the original is sitting inanimately in a museum and supported only by a few dreary facts and figures printed on an aging display board. Indeed, in the presence of one of our miniature engines - hot and sizzling and ready to go - a young visitor might be encouraged to wonder at the energy stored in a handful of coal which, when released by the fire and transferred to a small amount of boiling water, enables our little creations to lug their overscale loads speedily around the track (**photo 120**). What a wonderful demonstration of science and technology!

Furthermore, and of equal significance, our home-brewed technological creations, especially those based upon an extinct or terminally inoperable original, are of real historical importance; they represent the closest the world will come to seeing the original in operation ever again (**photo 121**). Food for thought, isn't it?

So, please don't be shy when you operate your model in public, go ahead and explain it to those around you for I'll bet they'll be interested, and your technological presentation will likely beat anything they might encounter at a museum. That, in my opinion, is the model engineer's technological role.

## Postscript to Part 1

You may have noticed that the pictures supporting this episode, taken by the author in the first few years of the 1980's on his trusty Zenith camera, are devoid of colour and of markedly lesser quality than is typical for today's magazine. While I apologise for this, in my defence let me explain that I have selected them for four reasons: (a) because they nicely illustrate a point, (b) because I personally like them(!), (c) because I think their seeming antiquity helps convey the historical value of our models, and (d) because one of our readers may recognise the people or models depicted. If the latter is true, please drop a quick note to the editor for it would be nice to give credit where credit's due.

●To be continued.

# A New Clubhouse at Cheltenham SME

**Graham Gardner** looks back over the Cheltenham club's project to build their first proper clubhouse.

Cheltenham SME

The society has been in existence since 1938 and now has over 80 members. After so many years it was decided by the members that it was about time they had a clubhouse. This would also save the cost of hiring a room nearby for meetings. The society has been on the present site in Hatherly Lane since the 1960s when it was then owed by the Dowty engineering empire. Over the years it has been developed to cater for all areas of model engineering and has members from a wide area. The society also now owns the site.

The building is a timber section type and came all the way from Holland. Member Bill Kaighin was the main lead for the project with members helping as well on Tuesdays, Wednesdays and Sunday mornings. It was a fairly expensive undertaking but all the money for the building was raised by the members.

No concrete base was needed for the building as it is built on a frame supported by ground screws that was levelled first before the building went on top. The clubhouse has been positioned so that members have a good view across the ground including the boating lake and the garden railway, which has recently had an extension added, helping to gain many new members.

The remaining jobs are to finish the kitchen and during the


Unloading the new clubhouse.


Putting in the first ground screw.


*The frame under construction.*


*The new building rises from the ground.*


*Putting in the floor.*


*The roof goes on.*

winter to get a mini digger to dig a trench across the ground so that the services can be laid into the building. The kitchen can then be used by members and will also be used on public running days and the birthday parties that the society is asked to host during the year.

The official opening of the clubhouse was carried out by Martin Evans from *Model Engineer* on Sunday September 15th at 12 o'clock. Many members and their families were present and this was followed by a BBQ. This together with the raised and ground level tracks running, plus the garden railway, the club traction engine and boats made for a pleasant afternoon.

Hopefully the photographs will provide a good overview of the construction and the opening - we were also lucky that it did not rain to spoil the event! For more information on the society and membership please visit the website www.cheltsme.org.uk or call in at Hatherley Lane GL51 6PN on a Tuesday, Wednesday, or Sunday morning where you will be made most welcome.

ME


*The editor of* Model Engineer *wields the scissors.*


*The team celebrates a good job, well done.*

# Club Diary 17 October 2024 – 27 December 2024

## October

**17-20 Midlands Model Engineering Exhibition**
Warwickshire Events Centre, See www.meridienneexhibitions.co.uk

**18 Rochdale SMEE**
Annual General Meeting. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

**20 Guildford MES**
Open day, 14:00-17:00. See www.gmes.org.uk

**24 Sutton MEC**
Afternoon run from 13:00. Contact: Paul Harding, 0208 254 9749

**26 Cardiff MES**
Steam up and family day at Heath Park, Cardiff. Contact : secretary@cardiffmes.co.uk

**27 Westland and Yeovil MES**
Track running day 11 :00. Contact : Michael Callaghan, 01935 473003

**31 Guildford MES**
Open day, 10:00-13:00. See www.gmes.org.uk

## November

**1 Rochdale SMEE**
Talk – 'Re-building the Ellenroad Beam Engine'. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

**2/3 Halesworth and District MES**
LOWMEX 2024, East Coast College, Lowestoft. See www.lowmex.co.uk

**6 Bradford MES**
Meeting: Autumn Auction 19:30, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999. Note: Only Members may bid on lots.

**7 Cardiff MES**
Talk : 'Temperance Town', Richard Britton. Contact : secretary@cardiffmes.co.uk

**16 Cardiff MES**
Steam up and family day at Heath Park, Cardiff. Contact : secretary@cardiffmes.co.uk

**17 Rochdale SMEE**
General Meeting. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

**21 Cardiff MES**
Members' projects. Contact : secretary@cardiffmes.co.uk

**23 Westland and Yeovil MES**
Track running day 11 :00. Contact : Michael Callaghan, 01935 473003

## December

**1 Guildford MES**
Small Model Steam Engine Group, 14:00-17:00. See www.gmes.org.uk

**4 Bradford MES**
Meeting: 'Film Night', 19:30, St James' Church, Baildon, BD17 6HH. Contact: Russ Coppin, 07815 048999.

**5 Cardiff MES**
Talk : 'Old Pictures of Cardiff', David Green. Contact : secretary@cardiffmes.co.uk

**6 Rochdale SMEE**
Talk – 'Railway to Bacup'. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

**8 Guildford MES**
Open day, 11:00-15:00. See www.gmes.org.uk

**27 Bradford MES**
Meeting: Mince Pie Steam Up, 12.30 pm until frost-bite sets in, Northcliff. Contact: Russ Coppin, 07815 048999.

# NEXT ISSUE

### LED Lights
Doug Pitney uses light emitting diodes to create a realistic model of a Baldwin kerosene locomotive headlamp.

### Aylesbury
John Arrowsmith takes a trip to Quainton Road, once the terminus of the Metropolitan Railway, to visit the Vale of Aylesbury model engineers' extensive track.

### Steam Plant
Ian Beilby builds a steam plant based on an electric boiler and vertical marine engine from Cheddar Model Steam.

### Vintage Trains
Henk-Jan de Ruiter investigates the early history of model trains.

### BR Standard 2
Doug Hewson details the motion brackets on the BR Standard Class 2 Mogul locomotive.

*Content may be subject to change.*

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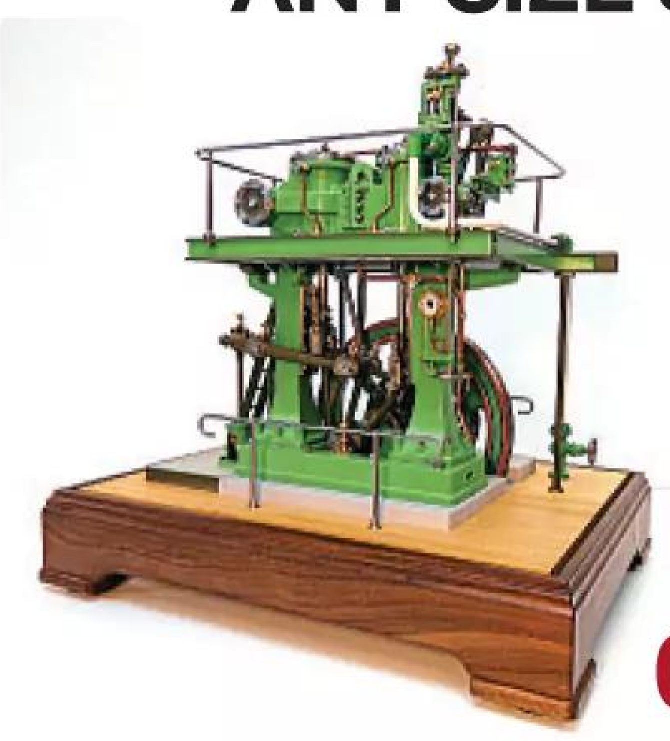

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# CLUB NEWS

**Geoff Theasby** reports on the latest news from the clubs.

An interesting snippet heard on the radio one night concerned a mixing of Artificial Intelligence and speech synthesis. This impinges on an idea I had many years ago, whilst editor of Northern Heights Amateur Radio Society Newsletter, *NHARS News*. I suggested we may equip our radio relay system (repeater) with the voices of film stars, politicians, the hangman or a robot by changing a few components. At the time, computers weighed tons, lived in an air-conditioned room, with high security, physical or digital in the access. This is alive with possibilities, not least by appearing to have the speaking party saying something derogatory, risking a court appearance. I tried *Voiceai* but it is not available for Linux. However, *Elevenlabs* is free and works with Linux.

In this issue: more tea, Captain?, the Swiss Guards (nothing to do with the Pope), the leaning trams of Scarborough and care and feeding of 'The Shed'.

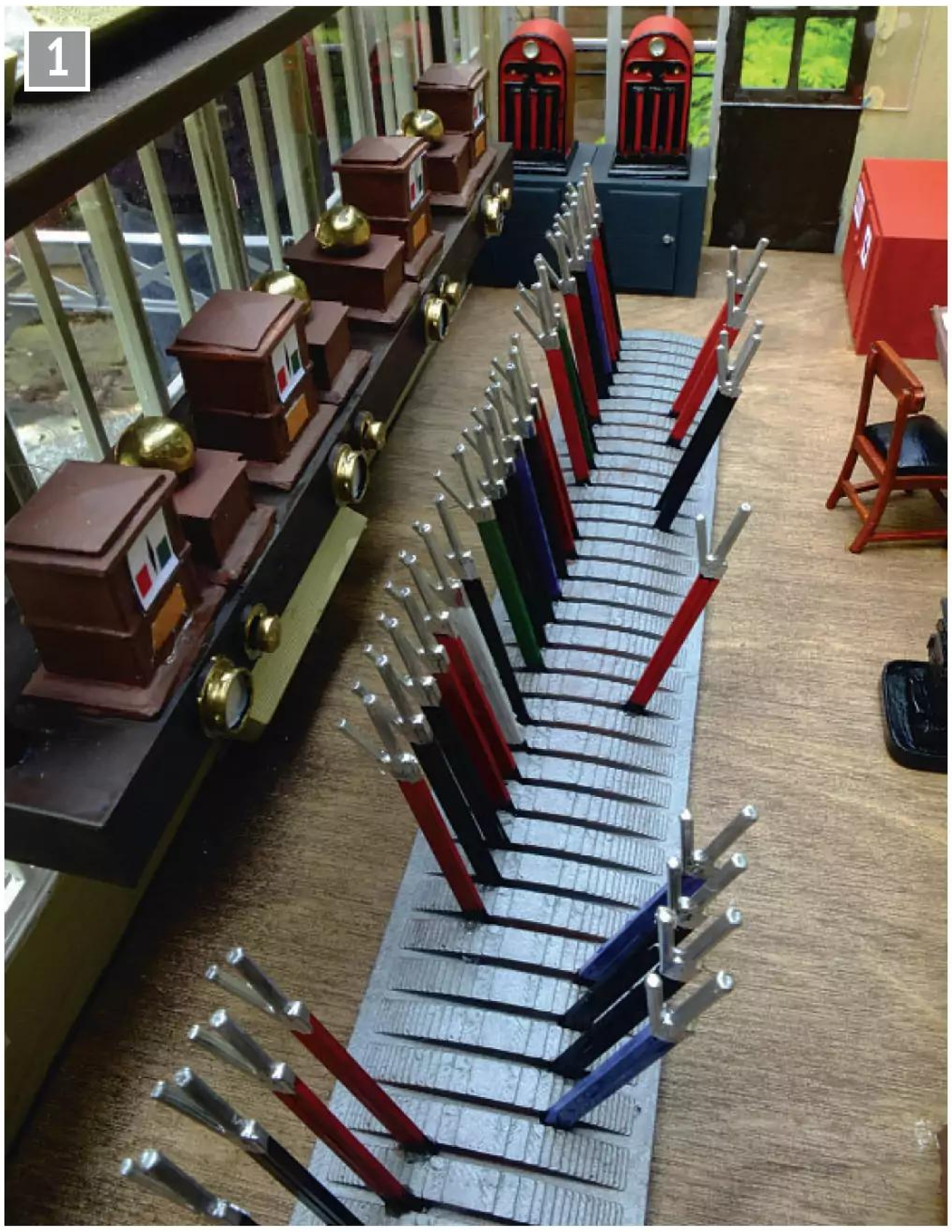

*This is not a steam train (1), Graves Park, family gathering.*

The *Gauge 3 Newsletter* arrives, with a fine shot of a signal box interior on the front page. It is in fact John Candy's model LNWR 'box', constructed with the assistance of a 3D printer (**photo 1**). Mike Williams built a wagon from new supplier Scottish Wagon Works. Ian Turner contemplates incorporating a computer into his layout, Jim Clement is building a 'Crab' and David White extends his military train.

**W.** www.gauge3.org.uk

During a family visit to Graves Park in Sheffield, by the Theasbim, I saw an erroneous illustration, to wit, this sign in the playground. Puffs of smoke, etc. - a steam train! There haven't been such trains on the National System for nearly 60 years (**photo 2**)! But then I saw this (**photo 3**). Is this misrepresentation? Then, however, when crossing a railway line, the warning sign also features a steam train.

**Grimsby and Cleethorpes MES** August *The Blower* had to be rescued from the e-Bin, where my computer had consigned it, regarding it as 'spam'. This happened once before but I thought it was a one-off. Please Mr. Editor, could you and your cohorts attend to this? It has a picture of a steam kettle on the front. Windermere kettle? A number of members drove to Sheffield SMEE on their open day. They say the club track is only a few minutes' drive from the city centre. (Well, more like 30 minutes, but no matter - Geoff) A number of well chosen photographs of the garden railway enhance the piece. In 'Build a V-Twin', Chris Cruickshank discusses a club project for the winter. It was designed by Julius van der Waal, a Dutch engineer now living in New Zealand. Plans




*Gauge 3 LNWR signal box (picture courtesy of Mark Thatcher).*


*This is not a steam train (2), as photo 2.*

are on the members' section of the club website. Greg Marsden has been *en vacances*, and didn't quite succeed in having a tram-free holiday. (Debs and I went to a 'Tex-Mex' restaurant in Nottingham recently and, even before we found a table, I spotted pics of the New Orleans trams on several walls... Geoff) Greg did find the Swiss Vapaeur Parc, mind you. In an area of land amounting to four hectares, the track fills the area and has spectacular civil engineering. A notable feature, or absence of one, is that there are no guards on the trains, the Swiss public apparently not needing them. A mystery photo shows a cabless 2-6-2 locomotive. It looks strangely naked in revealing itself *déshabillé*. Anyway, no prizes as the committee finds such expenditure frivolous and no doubt sordid and unbefitting a gentleman.
**W.** www.gcmes.co.uk

In *Shoulder to Shoulder*, from the **UK Mens Sheds Association**, August, Si Poole writes on what Mens Sheds do, from teaching specific skills, to providing a place where they can meet friends, discuss health problems and promote well being. Si Poole talks about a man who lost his family house and job through an addiction to alcohol. He came to Colwyn Bay MS whilst living in a hostel but never brought his disability to the Shed. Then he disappeared, no one knew where he was, until last year he was back, having relapsed. The stress of the job had made him ill and he confessed that the Shed helped him cope with life.
**W.** menssheds.org.uk

STOP PRESS: 'Shed of the year' made it to the pages of the Daily Telegraph on 4th September.

*OVLESME*, from **Ottawa Valley Live Steam & Model Engineers,** posts detailed information on how to negotiate Highway 174 as the rails for the Rapid Transit System are laid. This is not a great deal of use to any one outside Canada but included as to why there are few reports on this Society.

The **Stamford MES** newsletter begins with editor Joe Dobson hoping that the future will be happy and profitable, come Hell, High Water or Kamala Harris (?). Joe has been finishing off Frank Austin's 'King' locomotive using 10BA screws. That some fell on the floor was inevitable. What was not inevitable was that they couldn't be found again. I have just the tool for this process - a button magnet on an extending rod, a redundant transistor radio aerial, mayhap. Wrap the business end with a cut from the material of a plastic bag, then, to clean it, turn the plastic sheet inside out, holding the detritus within, and consign it to the bin.

*MEEA Newsletter*, August, reports progress on Mike Jack's Class Three locomotive, i.e. fitting a dummy ejector. The highly detailed reverser was also shown. This must be very well made and should have no backlash. Ken Pointon refers to an aged member who was building a ME beam engine. He is 90 and all parts are now made, so he is looking for another project to keep him busy. One idea stemmed from an item in an old issue of *Model Engineer*, mentioning an earlier (1951) piece about making components for a Tuxford engine dating from the time of the Great Exhibition. Graham Bell reports that he was given a number of planes, by Murray, made from both steel and wood. Ken Pointon said that the old apprentices had to make their own planes given a cuboid piece of wood and a piece of steel. Graham also refurbished a vertical boiler dating from the 1930's-style steam toys. The sight glass mounting holes were damaged and the fitment was no longer available. A price from a UK supplier was £123, deemed too expensive. He obtained a length of glass tubing and made the ends himself. The meths burner was missing , so he concocted one from 6mm cotton piping cord found in a wool shop. On reassembly, various shortcomings were encountered, making this job much more time-consuming than expected. The cylinder is double acting,with a simple, reversing slide valve. Before and after photographs are very contrasty and brightly coloured - a complete transformation.

**Bradford Model Engineers Society**, *Monthly Bulletin*, August, saw president Adrian Shuttleworth's daughter married, with the reception at his golf club, He discovered, whilst talking to the Club captain, that there is a disused miniature railway only metres away from their track and clearly visible on Google maps. This may warrant further investigation. The Code Word puzzle, set in the July issue, received the grand total of three entries, only one of which was right. The successful entrant was John Nicholson. John Stoton, late of our friends at Worthing Model Engineers, writes on drilling small holes. He says that the pin chucks one finds often have a run-out of more than the taper pin diameter and finds difficulty in locating the drill accurately in the mill, since one is working sight unseen, the chuck facing downwards, the jaws tightened and checked with a dental mirror. How to sharpen them? Why do you think they are sold in packets of 10 or 20? Many of us 'know' that plastic lemonade bottles can be subjected to a fair amount of pressure before giving up. An anonymous article (NOT the editor) considered which may be the most dangerous, a boiler with 5 bar or the bottle with 8 bar. He includes the calculations which prove it is the boiler. Flash steam has over 22 times the volume of the stored energy of the compressed air in the bottle. The maximum pressure in the bottle reached perhaps 170 psi and the boiler was designed for 7 or 8 times that. Not just pressure, though. When steam 'flashes' upon sudden release of the pressure, the whole of the water content turns to steam (flashes) immediately. This is what gives it such destructive power. The compressed air in the bottle just expands relatively slowly until equilibrium is reached.
**W.** www.bradfordmes.uk

This is a ¾ scale mill engine in a power plant, based on a Stuart No. 1 Made by Gerry Mason and photographed at Papplewick (**photo 4**).

*PEEMS*, from **Pickering Experimental Engineering & Model Society** has Brian Mulvana writing on the Scarborough trams. These were introduced in 1904 and disappeared quickly in 1931. Trams began in the 1860s and by 1890 there was a wide push for new systems. Edmonsons (who are still trading) built a power station to operate the trams, being one of the first to operate steam turbines, and ran the service. The article goes into great detail about the history, the engineering and the power. It also says that the top decks of the trams were

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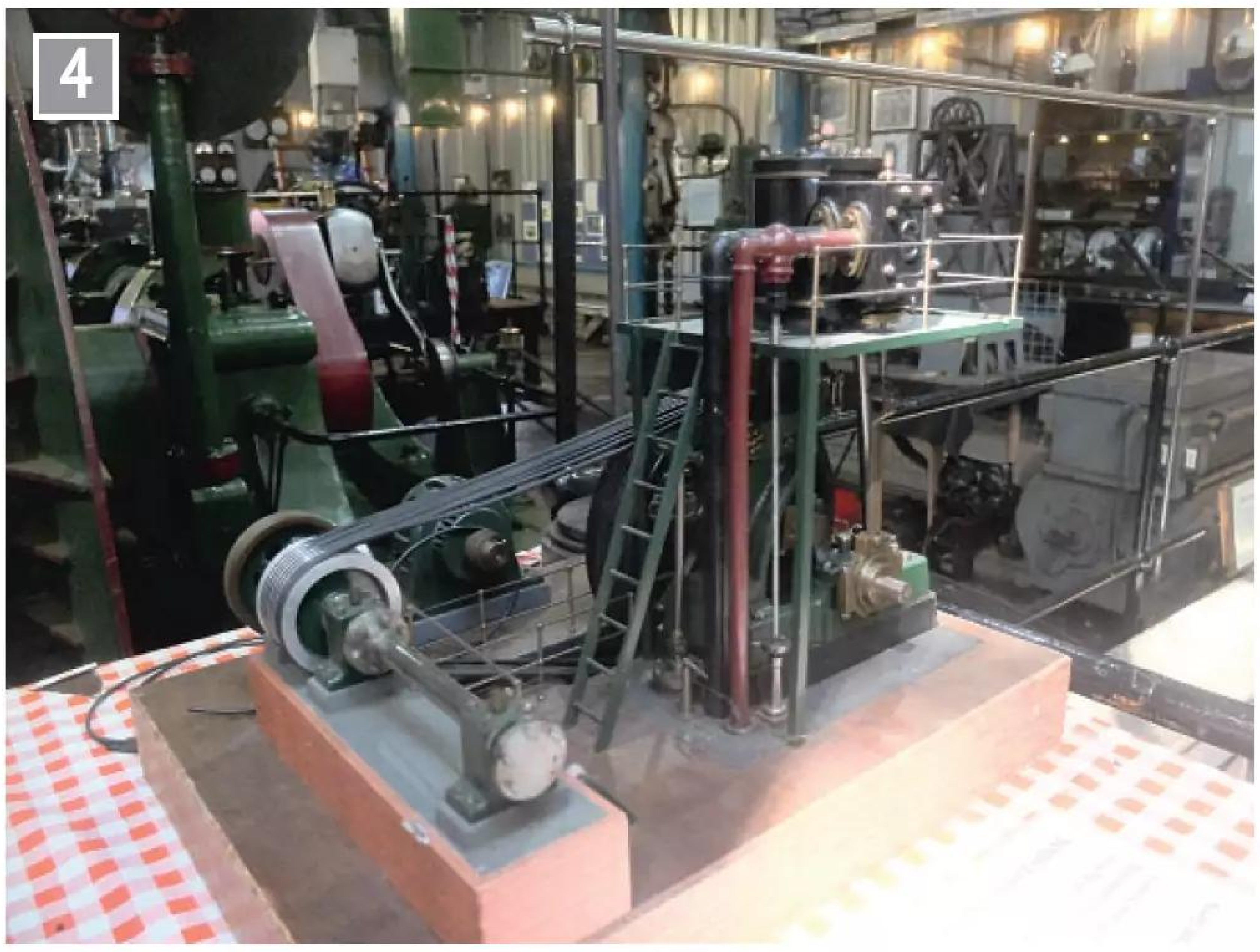



¾ scale mill engine based on Stuart No. 1, Papplewick.

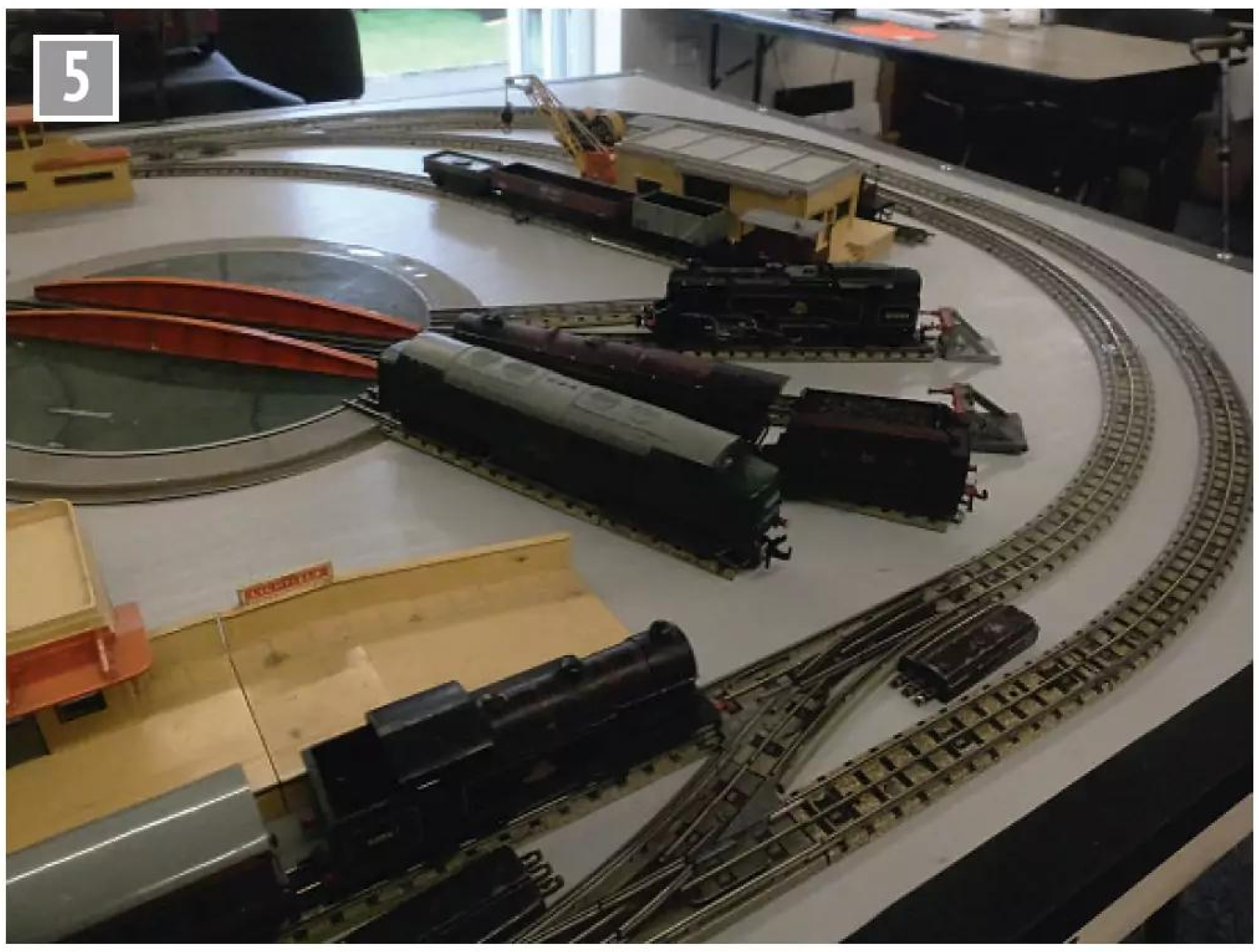
never covered in. This was because the wind off the sea could push a tram over, if it met a solid facade. The opening day tram was driven from the depot by the Mayoress. This was unusual as drivers were expected to be men. Madame Mayor is the only woman ever to have officially driven a Scarborough tram. The system was never profitable, as the 1870 Tramways Act was so written as to prevent a tramway being a going concern. They had to maintain the road between the rails plus 18 inches either side. They were also charged with repairing the road surface when damaged by other vehicles. Finally, a clause allowed the tramways company to be bought out by the council, often only for scrap value, after 7 years. A tram accident in 1925 was reported on British Pathe - here is a 50 second bit of film showing the aftermath: www.youtube.com/watch?v=fPM-vg-7oMw

**W.** www.peems.co.uk

**North London SME**'s *The News Sheet*, September, is a packed newsletter (44 pages) and begins at the very beginning, a very good place to start, with a front page picture of young Nathan bringing his train out of the tunnel on the garden railway. Jacob, another young member, has achieved six consecutive laps of the club track, in a locomotive belonging to Tom Loxford. Those who know the engine will realise that this was not an easy task. A photograph shows Nigel enjoying an outing, courtesy of the Cornish beach coal. It looked great and and gave off that great smell. (The engine, I hasten to add.) In John's Narrow Gauge column, he photographed his steam plant on the garden railway track, commemorating the demise of Mamod. The day before had been their last Open Day. Perhaps, as with the Lynton and Barnstaple closure, publicity (and money) will miraculously appear – 'Perchance it is not dead, only sleepeth'. John raised a few eyebrows as he appeared to be taking a little trolley around the track, on a lead. He cleared the air by saying he was testing the track for possible defects resulting in derailments. That's his story, and he's sticking to it! Geoff, meanwhile, notes that his arms are a darker shade lately, possibly a sun tan, and he does wash regularly… 'Bookworm' notes a difference in the way that domestic discussions begin and conclude. **He** looks longingly at pictures of locomotives at speed, and **she** begins plotting a route around an area, noting the wool shops or stately homes on the way. He wrote at length on this matter, as I am slowly nodding in agreement. He also notes how they used to plan their new life together, choosing wallpaper, furniture and so on. And the shed… Oh! The shed! It began as a 6x4 hut and expanded every time they moved house, gradually acquiring a pillar drill, then a lathe. Of course, there were bumps in the road to true love. There was that misunderstanding with the life model at art classes and then the vicar and the spilt tea. Member Eddie Castellan has written a book on the Battle of the Boilers. This is an update of Brian Hollingsworth's book, of coal-fired locomotives as against the contemporary tendency to use meths as fuel. It details the life and times of 'LBSC' (Curly Lawrence), who championed the cause of multiflue boilers in 1920s. The argument went on for several years, Curly having made a model to his requirements showing that he was right. However this led to a long period of ill-feeling 'twixt himself and Henry Greenly. Roy deviates a little from building boats, and considers 'manning' them (no women on fishing boats, just in case readers were having a sharp intake of breath) using or rejecting figures of differing scales, and explaining why.

**W.** www.nlsme.co.uk

This compact 'table-top railway' looks good at Sheffield SMEE Open Day in July (**photo 5**).




Hornby 3-rail compact layout, Sheffield & District SMEE Open Day, July.

At a meeting of a local community group it was suggested that we hold a series of events to raise funds and provide some light relief. Amongst the activities were art classes, face painting, poetry readings etc. Yet again, no mention of woodworking, toy making, card games, science classes, electronics. WHY? Why are there no funds for these activities?

And finally - roses are red, violets are blue, depending on their relative velocity to you.

ME

## CONTACT

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